EAST RIVER WATERFRONT ESPLANADE AND PIERS- INBOARD RESOURCES NORTH OF BROOKLYN BRIDGE PHASE 1A ARCHAEOLOGICAL ASSESSMENT

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I. INTRODUCTION

The Lower Manhattan Development Corp. (LMDC) is the lead agency for the development of the proposed East River Waterfront Esplanade and Piers Project. The East River Waterfront Esplanade and Piers project is intended to revitalize the East River waterfront by improving a two-mile-long, City-owned public open space connecting the Whitehall Ferry Terminal and Peter Minuit Plaza to the south with East River Park to the north. The existing esplanade would be enhanced, some new sections of esplanade would be created, and several piers would be renovated and redeveloped. For the purposes of this study, the Project Site or Area of Potential Effect (APE) runs along present South and Marginal Streets roughly from Whitehall Street adjacent to Battery Park, north and east to Jackson Street, along the East River shoreline of the Borough of Manhattan. The APE has been broken down into ten segments corresponding to discrete project elements, and the rough boundaries of the segments are described below:

1. Whitehall Street to the south side of Broad Street
2. Broad Street to Vietnam Veterans Plaza, on South and Marginal Streets
3. Broad Street through Old Slip, on Marginal Street and Outboard of Bulkhead
4. Old Slip to the North Side of Pier 15 between Fletcher and John Streets
5. Pier 15 and Adjacent Channels
6. Marginal Street between Beekman Street and Peck Slip, Pier 18, New Market Building, and the Proposed Marina
7. North of Pier 15 (between Fletcher and John Streets) to Montgomery Street
8. Pier 35
9. Part of Pier 36, between Montgomery Street and Gouverneur Slip West
10. Pier 42

A more detailed depiction of the APE is found on Figures 1-4, which use the current Sanborn insurance atlas as the base map. According to current plans, projected subsurface disturbance in the APE will generally be no greater than five feet below the current surface, with certain exceptions. The roadway area north of the Battery Maritime Building (BMB) to the Vietnam Veterans Plaza would require more substantial excavation to move the entrance to the Battery Park Underpass approximately 350 feet to the northeast, as well as for the potential relocation of a sewer outfall. The proposed pavilions to be constructed beneath the elevated FDR Drive would typically be constructed on concrete slab footings to a depth of not more than three feet, including utilities. Specific outboard locations—those on the river side of the existing bulkhead—such as Piers 15, 35, and 42, for example, would be affected by pile driving and/or dredging.

Due to the length of the project corridor, as well as the multi-phased components of the proposed improvements, a Programmatic Agreement (PA) is being established between LMDC, the Advisory Council on Historic Preservation, and the New York State Historic Preservation Office (SHPO). The PA outlines the appropriate procedures for assessing the archaeological sensitivity of the APE. As described in the Final Environmental Impact Statement (FEIS), LMDC and the City will cooperate in the preparation of a Phase 1A study that will examine the potential for archaeological resources to be present in the Archaeological APE. The Phase 1A study will consider the entire Archaeological APE, with the exception of two areas that would experience

minimal disturbance (less than two feet in depth) for the Esplanade Project. These two areas are: the esplanade area that is outside the pavilions, and South Street north of the Brooklyn Bridge. The Phase 1A study will be submitted to LPC and SHPO for review and approval. It is anticipated that the following phased approach to the required Documentary Study will conform to the PA so that the project can move forward and, at the same time, treat potential resources appropriately. Such studies may or may not indicate that further work, in the form of testing and/or monitoring during construction, will be required.

Historical Perspectives, Inc. has completed this Phase 1A study in compliance with the PA. The following documentary study of the proposed APE: 1) identifies categories of potential archaeological resources in the APE; 2) examines the construction history of the project site in order to determine the probability that any potential archaeological resources have survived post-depositional disturbances and remain in situ; and 3) determines whether additional study or testing regarding potentially-surviving archaeological resources is necessary.

This report, the third Phase 1A task, covers the inboard portion of the APE that is north (technically east) of the Brooklyn Bridge (the majority of Segment 7) (Figures 3, 4). Separate Phase 1As cover the sections of the APE outboard of the bulkhead wall (Figures 1, 2, 4) and the portion of the APE that is south (technically west) of the Brooklyn Bridge (Figures 1, 2).

Methodology

To build a picture of environment, land use, and disturbance to the APE through time, various public and private offices and institutions were contacted and collections researched. This includes not only published and unpublished archaeological and historical literature, but also newspaper articles, pamphlets, correspondence, maps, soil boring logs, photographs, and drawings. These contacts and their offices and institutions are given below.

Contacts

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Brian Cook, Topographic Bureau, Manhattan Borough President's Office
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Meghan A. Douris, Assistant General Counsel, New York City Department of Design and Construction (DDC)
Simon Gelin, New York City Department of Environmental Protection (DEP)
Jeffrey Katz, Section Chief, New York City Department of Design and Construction
Joshua Kraus, Project Manager, Lower Manhattan Borough Commissioner's Office, New York City Department of Transportation (NYCDOT)
Bill Lemke, URS
Matthew Monahan, Assistant Commissioner, Public Affairs, New York City Department of Design and Construction
Daniel Pagano, Archaeologist, New York City Landmarks Preservation Commission
Rob Pirani, Director of Environmental Programs, Regional Plan Association

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Suchi Sanagavarapu, New York City Department of Transportation
Vincent Soriano, Chief, BW&SO Mapping/Records, New York City Department of Environmental Protection
Rajen Udeshi, Principal Engineer, Outside Projects, CPM
Deborah Waters, Collections Information, Museum of the City of New York

Repositories
City Hall Library
Manhattan Community Board 1
Manhattan Borough President's Office, Topographic Division
Municipal Archives, Photographs–Department of Docks and Department of Ports and Trade; Manhattan Borough Presidents' Collection; New York City Mayors' Collection
New York City Department of City Planning
New-York Historical Society
New York Public Library (Humanities and Social Sciences Library)
New York Public Library (Science, Industry, and Business Library)

Online Resources
3dparks.wr.usgs.gov/nyc/index.html—"Geology of the New York Region," USGS
historicals.ncd.noaa.gov/historicals/histmap.asp—Office of the Coast Survey, Historical map and chart collection
rs6.loc.gov/ammem/browse—Library of Congress-American Memory
www.davidrumsey.com—David Rumsey Historical Map Collection
www.cooper.edu—"History Group EID101-D"
www.greenway.org—"East Coast Greenway-New York"
www.nycgovparks.org—"FDR Drive"
www.nycroads.com—"Franklin D. Roosevelt (East River) Drive
www.nylcv.org—"New York Waterfront Blueprint: Manhattan"
www.nottingham.ac.uk—"The 3Cities Project: JB Axelrod Essay"
www.oasisnyc.net/oasismap.htm—New York City Oasis (aerial photographs)

II. TOPOGRAPHY, PALEO-ENVIRONMENT, AND EXISTING CONDITIONS

A knowledge of Manhattan's geological history is essential for understanding the development and land-use history of both the project site and New York City. The island lies within the Hudson Valley region and is considered to be part of the New England Upland Physiographic Province (Schuberth 1968:10). The underlying geology is made up of "gneiss and mica schist with heavy, intercalated beds of coarse grained, dolomitic marble and thinner layers of serpentine" (Scharf 1886:6-7). The land surface in the metropolitan area was carved, scraped, and eroded by advancing and retreating glaciers during three known glacial periods. Before the final glacial retreat from the New York City area at the close of the Pleistocene (ca. 12,500 Before Present [BP]), melting ice formed a number of lakes in the valleys of the East, Hudson, and Hackensack Rivers, dammed by ice and glacially deposited moraines. Much of Manhattan Island, including the APE, was submerged beneath glacial Lake Flushing (USGS 2003).

When Lake Flushing drained as erosion ate through the moraine dams—probably through one or more massive flood events by 12,000 BP—Manhattan Island and the present channel of the East River, including the APE, were exposed as dry land. The release of meltwater during this same glacial retreat, however, also resulted in the rise of sea levels from about 400 feet below current levels 12,500 years ago, to about 10 feet below current levels between 4,000 and 2,600 years ago (Raber et al. 1984:10), flooding the APE. In short, the APE was exposed as dry land in ca. 12,000 BP, and then reflooded by ca. 2,600 BP as sea levels rose. For much of this period, the APE was not a shoreline location, and the channel of the East River was several miles distant.

Present Manhattan Island is marked by low hills and is surrounded by estuaries and tidal straits. These bodies of water, part of an embayed section of the Coastal Plain, are the remains of the channels of the Hudson, East, and Harlem Rivers, inundated by rising sea levels. Historical development has altered many of the topographic features which once characterized precontact Manhattan, and the current East River shoreline bears little resemblance to its condition during the early 17th century, when European colonization commenced. An examination of the Viele "Water Map," which charts the original shoreline of Manhattan, shows the APE submerged beneath the waters of the East River, lying between approximately 54 feet (Segment 7 between Frankfort Street and Catharine Slip) and 550 feet offshore (Segments 4 and 7 from Wall Street to Fulton Street) from the pre-fill/pre-bulkheading shoreline (Viele 1865) (Figure 5).

Intentional bulkheading and filling begun during the 17th century extended the shoreline to approximately its present location by the early 20th century (Sanborn 1928). According to the mid-19th century profiles of South Street, one covering Whitehall to Moore Streets (Smith 1846 – now part of Segment 1 of the APE) and the other between Roosevelt and Catharine Streets (Profile ca. 1851 – now part of Segment 7 of the APE), the then-existing street surface was between 2.1 and 8 feet above the high water mark. According to the current United States Geological Service (USGS) topographic map, the tidal rise from mean low to mean high water in Upper New York Bay is 4.5 feet (USGS 1981), indicating that modern, human-deposited fill extends at least 6.6 feet or more below 19th-century street levels.

Furthermore, regrading and the continuous paving and resurfacing of South and Marginal Streets in the APE raised the surface of the project site an additional number of feet by the 1950s. During the construction of the South Street Viaduct in 1952, the 1836 cobblestone street surface was encountered on South Street at Clinton Street (APE Segment 7), within 4 feet of the modern street level (*New York Times* 1952:25; Borough 1954).

III. PRECONTACT PERIOD

The precontact period on Manhattan Island and in the surrounding area can be divided into three time periods, based on the precontact population's adaptations to changing environmental conditions. These periods are generally known as the Paleo-Indian (ca. 12,000 to ca. 10,000 BP), the Archaic (ca. 10,000 to ca. 2,700 BP), and the Woodland (ca. 2,700 to ca. 500 BP). These precontact periods are followed by the proto-historic and historical European Contact period, (beginning ca. 500 BP), which is distinguished from the precontact by the first Native American interactions with European trade goods, traders, trappers, fishermen, explorers, and settlers.

Although the earliest evidence of humans in the New York City area appears during the Paleo-Indian period, approximately 12,500 years ago, and human occupation has continued into the present, there is no existing evidence of direct precontact occupation or exploitation of the APE. This is understandable, since before landfilling, the APE was under water for approximately the last 2,600 years. As noted in the previous section, however, with the melting of the glacier at the end of the Wisconsin age and the draining of Lake Flushing, the APE would have been dry land available for exploitation by humans during the period from approximately 12,500 BP, when sea levels were 400 feet below current levels, until sometime between 4,000 and 2,600 BP, when glacial meltwater brought sea levels to 10 feet below current levels (Raber et al. 1984:10), flooding the APE. This time period corresponds roughly to the Paleo-Indian and Archaic culture periods.

The potential presence of submerged precontact sites far out on the continental shelf has been hypothesized for decades, and studies of near shore submerged sites were being published by the early 1960s (Emery and Edwards 1966). Unfortunately, the time, difficulty, and expense required to locate these sites, much less recover data, have resulted in the investigation of few submerged sites in this region. Ironically, our knowledge of precontact "coastal" adaptations, both in the New York City area and in other parts of the United States, is not generally based on sites that were coastal when they were formed, since the contemporary coast was many miles distant (Lewis 2000:528; Merwin, et al. 2003:46). Based only on terrestrial archaeology, we have an incomplete view of Archaic coastal adaptation, since few sites that were actually coastal have been investigated. Submerged archaeological sites from these periods would be extremely valuable because of the expected preservation of organic materials such as wood, plant fibers, and leather, which would survive in an underwater environment (Merwin et al. 2003:42, 51-52).

A review of available underwater archaeological literature regarding submerged site formation and the potential survival of submerged remains has proven somewhat inconclusive. There is no doubt that submerged archaeological sites do survive to a certain extent, and that certain data are preserved. This has been noted by archaeologists at submerged and partially-submerged sites around the world, including England, Denmark, Greece, Israel, South Africa, and Australia (Wilkinson and Murphy 1986; Stewart 1999:572-574; Merwin et al. 2003), as well as along the Gulf Coast of the United States (King 1981; Lewis 2000).

There is general agreement that rapid inundation increases the potential for a site's survival and integrity. Archaeologist George Bass noted in 1980 that gradual submergence "allows time for waves and currents to tear the site apart," while rapid submergence with a subsequent sediment

cover "protects both the artifacts themselves and their spatial patterning from destruction by water and marine organisms. Archaeologist David J. Stewart observed that the "pounding surf, [and] alternate periods of dryness and wetness" expected under conditions of slow inundation "can damage or destroy material, [and] even if artifacts are preserved, spatial context will be destroyed" (Stewart 1999:565).

Research along the Mississippi Gulf Coast conducted by Archaeologist R. Barry Lewis suggests that the submergence of low gradient and low energy (i.e., minimal wave and current action) shorelines, somewhat similar to those formerly in the APE, would have "tended to submerge rather than rework archaeological deposits." On the other hand, he also concludes that storm surges and storm tides are probably the most destructive agents on the Atlantic and Gulf Coasts (Lewis 2000:531, 536).

Based on data from a number of sites in the Eastern Mediterranean, Stewart agrees with Lewis' conclusions that archaeological sites on steep slopes tend to suffer more from inundation, since steep slopes become submerged more gradually than shallow ones,[1] and thus are exposed to direct tidal action for a longer period of time. Also, he observes that on steeply-sloping sites, artifacts erode out of their positions more easily and move farther downslope – away from their original positions. This migration is also affected by artifact size, shape, and weight. Israeli archaeologists have investigated a number of submerged coastal sites which exhibit some disturbance, but some artifacts are preserved in situ. One site, Athlit-Yam, a pre-pottery Neolithic (PPN) village (occupied ca. 8,100 to ca. 7,500 BP), was found 300 to 400 m (984 to 1,312 feet) offshore in 8 to 12 m (26.2 to 39.4 feet) of water, on a shallow slope of approximately 2° to 3°. Numerous stone structures, hearths, at least one well, and a wealth of artifacts, including organic remains, were recovered. Spatial patterning was preserved to the extent that activity areas (lithics work area, animal butchering area, etc.) could be identified. It is not clear, however, whether spatial patterning *within* the activity areas was preserved (Stewart 1999:572, 583-584).

Of course, Paleo-Indian and Archaic period sites in the New York City region are somewhat less substantial than PPN villages. New York Harbor, the drowned estuary of the Hudson River, has long been hypothesized as an attractive place for precontact human activity, based in particular on the resources of the surrounding land, the number of precontact archaeological sites found on its present banks, and the small number of known sites dating to between 10,000 and 6,000 BP. The largest cache of stone artifacts from a precontact submerged site (more than 200), was recovered in 1994-1995 by beachcomber Helene Corcione, who combed through sand that had been dredged for a beach replenishment project and deposited on the Central New Jersey shore. The sand and the artifacts, which included 24 Archaic period points, some of which dated to the Early Archaic, came from a modern "borrow" area 3 km (1.86 miles) east of Sandy Hook. The artifacts were believed to have been in the upper 2 m (6.6 feet) of the sand stratum, buried beneath river sediment and muck. A survey of the area around the borrow location was conducted by the Stony Brook University Department of Anthropology in July/August 2003, and found water depths in the vicinity ranging from 14 to 20 m (45.9 to 65.6 feet) (Merwin et al. 2003:46-47).

[1]Lewis' examples refer to slopes of 14° (steep) versus 2-3° (shallow).

Sea level curves constructed for New York Harbor by Paolo Pirazzoli in his 1991 *World Atlas of Holocene Sea Level Changes* indicate that offshore archaeological sites dating to 10,000 BP will be in water depths no greater than approximately 26 m (85.3 feet) below mean low water, and those from 6,000 BP will not be deeper than 14 m (45.9 feet) (cited in Merwin et al. 2003:46-47). These figures correspond roughly to the water depths from which Corcione's artifact cache originally dredged.

Several studies have hypothesized potential survival of submerged precontact and historical resources in and around New York harbor. In 2004, the Cross Harbor Freight Movement DEIS assessed the precontact potential in a location quite similar to that of the APE—in and adjacent to the 65th Street Yard in the Bay Ridge section of Brooklyn—an area of drowned land, partially under water, and partially filled and developed with piers and bulkheading. The report concluded that:

> the channels along the Brooklyn waterfront have been subject to repeated dredging and maintenance during the 19th and 20th centuries, and construction of the piers and bulkheads along the waterfront also frequently involved dredging and deposition of large quantities of landfill. Due to the expected extent of disturbance associated with these actions, it is unlikely that any undisturbed prehistoric archaeological resources are present under the bulkheads or immediate off-shore areas of 65th Street Yard (NYCEDC 2004:7-14, 7-15, 7-16)

On a site north of the harbor, an attempt was made in 2002 to locate potential submerged precontact and historical resources prior to a dredging program planned for the upper Hudson River. This involved the collection of a series of 967 sediment cores. The preliminary analysis by the archaeologists reviewing the cores found that 122 of the cores contained historical archaeological deposits. No precontact period artifacts were recovered in any of the 967 Hudson River cores reviewed (URS 2003).

Potential Precontact Archaeological Resource Types

Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected beneath river-deposited stratum, which are generally identified in soil borings as "mud" or "river mud," or "silt," but could also contain sand and clay. Mud and clay are expected as the predominant deposits in relatively still water, such as is found between piers and in slips. Sandy strata beneath the mud and clay would represent river deposits found in flowing river channels, i.e., predating pier construction. Beneath these deposits, a sandy, glacial till stratum would be expected, representing the former land surface of ca. 12,500 to 2,600 BP. This would be glacial till left behind by the Wisconsin glaciation. If this former land surface is undisturbed by river currents, tidal action, and historical dredging and construction, it would be expected in this stratum. The preinundation land surface would be buried more deeply the closer a location is to the present river channel. Soil boring logs show deposits of river mud in many parts of the APE, but this mud stratum varies in thickness and in depth depending on location and historical dredging.

Physical evidence of dredging or current/tidal activity that may have destroyed or severely impacted strata with precontact archaeological potential would include thin or missing glacial till strata, such as locations where fill or river mud sits directly atop rock or hard pan.

In Lower Manhattan, there have been no documented archaeological investigations of the preinundation land surface. The nearest contender is the 7 Hanover Square Site (south side of Old Slip, between Water and Pearl Streets, 2 blocks west of the APE), at which a layer of red sand was encountered beneath later river deposits. This was originally identified as the intertidal zone of Manhattan's early-17th-century beach. Examination and testing of the red sand under the direction of Steven Selwyn, Ph.D., however, concluded that it was not a "'beach' horizon" deposit, but sand redeposited *underwater* by river or stream currents. Furthermore, the red sand did not come from the most recent Wisconsin ice sheet of ca. 12,500 BP, the sands from which would have been of a yellowish cast, but represented the deposits of an earlier glaciation from ca. 40,000 BP (Rothschild and Pickman 1990:Appendix C).

A second consideration in determining precontact archaeological potential is an assessment of a location's attractiveness to precontact hunter foragers. The normal criteria for evaluation include a dry, sheltered, well-drained location, near a fresh water source, and near an area rich in game and useful plant resources. Given the extreme changes which have occurred to the environment since the period between 12,500 and 2,600 BP, it is nearly impossible to reconstruct the ancient environment of the APE. It is worthwhile to note that for most of this time period, the channel of the East River was as much as several miles distant from the APE, until rising sea levels flooded the estuary and eventually inundated the APE.

IV. HISTORICAL PERIOD

Historical Period Overview

Before being superseded by the Hudson River during the mid-19th century, the East River was the main port of entry into New York City. Its advantages included a gently sloping shoreline sheltered from strong winds, and a channel with an average depth of 50 feet, deep enough for 17th- to 18th-century ocean-going ships (Gratacap 1909:112). As ships gradually got larger during the 19th century, commerce shifted to the Hudson, until the vast majority of Manhattan's shipbourne trade entered the City via the Hudson River by the 20th century.

The importance of the East River shoreline is reflected by the placement of the New Amsterdam settlement there in the 1600s. Ships moored in the deep water off shore, and would be unloaded into smaller boats which would ferry the cargo to shore. The first wooden dock was built in 1647 at what is now Pearl and Broad Streets, and the shoreline was ordered stabilized with wooden sheetpile seawalls during the 1650s (Bone 1997:92-93).

The East River was the center of activity, and continued as such after the British conquest in 1664, and following the American Revolution. As trade and other ship-related industries expanded, and ships became larger, there was an ever greater need for facilities and storage space. As a result, piers, warehouses, and other facilities were constructed along the shoreline, and in order to keep pace with other ports, they were continuously expanded and modernized (Buttenwieser 1999:11-13). They also became more permanent, as the construction techniques of the 1600s and early 1700s—piles, plank platforms, timber sheet piling, and stone embankments—gave way to solid-based cribworks. The calm waters of the new basins and slips created by the new docks accumulated silt and debris, requiring the institution of regular dredging (Bone 1997:94-97).

Waterfront development also included the expansion of the Island of Manhattan into the East River. With the Dongan Charter of 1686, the City of New York received title to, among other things, all lands and water bodies on Manhattan extending to the low-water mark, and allowing the City to "fill, make up, lay out, use and build on" lands then under water. The city began selling water lots to private citizens, provided that the new owner fill and build the street and wharf along the low-water line. The Dongan Charter effectively extended Manhattan 200 feet into the East River, and the Montgomerie Charter of 1730 extended City boundaries from Whitehall to Corlears Hook, another 400 feet beyond the old low water mark. As commerce recovered from the British Occupation during the Revolution, the Outer Streets and Wharves Act of 1789 provided for the creation of South Street beyond the 1730 400-foot line. The Act also provided for greater regulation by the City of new development, including surveying straight streets (South Street) to facilitate commerce, and allowing the City to take action to fill in gaps at the private owners' expense, if necessary (Buttenwieser 1999:28-29, 39-40).

A comparison of maps from this period, namely a 1793 map by Goerck and Van Sheecburgh (South Street Seaport Museum Library) and the Taylor-Roberts Plan of 1797 (Cohen and Augustyn 1997:94-95) illustrates this problem, showing the jagged East River shoreline with crooked, irregular Front Street interrupted by numerous slips and watery areas between piers.

The 1797 map does show the earliest section of the new South Street, however, extending a grand total of three city blocks, from Whitehall Street to Broad Street, and Broad Street to Coenties Slip. North of Coenties Slip, the location of the future South Street is punctuated by numerous wharves jutting out into the East River as far north as Beekman Street.

The opening of the Erie Canal in 1825 provided further impetus to New York's commercial and physical expansion. By 1828, the Goodrich Map shows South Street open from Whitehall Street north to Roosevelt Street, broken only by Coenties Slip, Old Slip, Coffee House Slip (Wall Street), Burling Slip, and Peck Slip. After a seven-block break of East River wharves, South Street is again shown on the map, from Rutgers Street east to present Jackson Street, but this appears to be a projection, with the existing shoreline drawn in to the landward side of South Street (Cohen and Augustyn 1997:115).

By 1849, with the exception of Coenties Slip, South Street ran uninterrupted from Whitehall to Jackson Street (then Jackson Slip). The shoreline was punctuated with piers, beginning with Pier 2 at the foot of Whitehall Street, and ending with Pier 57 at Jackson Slip. Although generally straight along the landward side, South Street's mid-19th century pier and river edge was still jagged. Although a 70-foot street width was mandated, the width varied from a low of 61 feet to as much as 108 feet wide, although it was generally between 61 and 80 feet wide. This additional area is labelled "Marginal Street" in many 20th-century atlases. "Marginal bulkhead platforms were often constructed to permit vehicle and pedestrian traffic access to the bulkhead line;" in other words, these additional filled areas facilitated the functioning of the piers and wharves, and sometimes also hosted structures (Alvord 1849; Sanborn 1975; Historical Perspectives 1987:30).

Department of Docks—East River Bulkhead

Subsequent filling and construction activities during the 19th and early 20th centuries gradually expanded South Street (including unlabelled "Marginal Street" areas) to its approximate boundaries at present. The proposed width was originally 200 feet, but this was modified to a projected 150 feet to provide an additional 50 feet for piers in the somewhat narrow East River (*New York Times* 1895). In spite of this, the modern street is generally 120 to 125 feet in width (Bromley 1921). The major innovation was the construction of the East and Hudson River bulkheads and associated structural systems begun in 1871 by the New York City Department of Docks. This initiative was partly in response to the run-down and squalid waterfront conditions that existed at the time, and New Yorkers' growing sense of, and pride in, their city as a center of world commerce. Design of the bulkhead was originally the responsibility of Civil War General George B. McClellan. The masonry-faced bulkheads and modern piers were to be the most up-to-date port facilities in existence, and were intentionally monumental to symbolize New York's international importance (Graham 1873; Bone 1997:99,102).

According to research conducted by AKRF, Inc. utilizing the archives of the South Street Seaport Museum, Department of Docks annual reports, and a structural conditions survey completed in 1989 by TAMS on behalf of the New York State Department of Transportation (NYSDOT), the bulkhead within the APE was generally completed by ca. 1890. The section between Piers 35 to 42 (east of Rutgers Street through Montgomery Street), however, was not constructed until ca. 1910. The documentary record is somewhat incomplete. In some cases, dates of original construction are suggested by recorded dates of bulkhead damage and repair.

The bulkhead north of the Brooklyn Bridge to Market Street, for example, was rebuilt in 1890 after being washed out by heavy tides.

Cartographic research indicates that the construction of new piers and the filling and expansion of Marginal Street behind the new bulkheads did not take place as soon as the new bulkheads were built, but were completed as late as the first decade of the 20th century. The 1891 Bromley real estate atlas does not record an expanded Marginal Street, and the piers are essentially the same as depicted in the 1885 Robinson atlas (Robinson 1885). More detailed maps from the collection of the South Street Seaport Museum Library (SSS 1903a; 1903b; 1907; 1911), showing bulkhead and pier facilities from 1903 to 1911, show an unwidened Marginal Street in the early 20th century.

For example, at Old Slip, the 1903 South Street Seaport Museum Library map (SSS 1903a – Figure 6) records a crib bulkhead ("CRIB B'H'D") at the foot of the filled-in slip, varying between 75 and 90 feet east of the landward side of South Street. Former Piers 11 and 13 are drawn in north and south of the slip. The bulkhead line is noted at 125 feet east of the landward side of South Street. Lest it be assumed that the 1903 map is simply out of date, two years later the 1905 Sanborn records a similar scenario, but with updated attributes. (Figure 7) There the "new" bulkhead line and proposed new piers are delineated with a dashed line, but former Pier 11 is still apparently functioning. Former Pier 12 remains as a stub, having been truncated to the new bulkhead line in preparation for the construction of new Pier 10.

The 1906 annual report of the Department of Docks notes expenditures for the construction of bulkhead walls and paving "new marginal street[s]" in all sections of the APE from Broad Street to Jackson Street. In the Old Slip section, from the upper part of Coenties Slip to just north of Wall Street (including the location discussed in the preceding paragraph), bulkhead expenditure was substantial ($248,596.07), especially in proportion to the total moneys ($371,875.54) already spent on the bulkhead there (Docks 1906:175-176), and the large volume of work corresponds to the projected bulkhead lines shown there in the 1905 Sanborn atlas (Sanborn 1905).

In other areas, such as the Broad Street to Coenties Slip section, where bulkhead wall and new pier construction had been authorized in December 1899 (Docks 1899:115, Map n.p.), the funds spent on the bulkhead wall in 1906 ($31,381.71) were a small part of the total expenditure on the bulkhead ($205,538.16), and suggest minor construction or even repairs. This is also apparent on the 1905 Sanborn Atlas, which shows no ongoing or projected construction in this area (Sanborn 1905).

As the maps also show (e.g., Sanborn 1905), even with completion of the new bulkhead, both old and new piers existed side by side. Old piers continued to earn revenue (Docks 1906:81) while the "old work" was gradually removed and new piers built (Docks 1899:82; 1906:175-181; 1914:172-175).

In summary, the monumental task of constructing new port facilities for the island of Manhattan did not end with the completion of the bulkhead wall. Filling and pier and street construction continued for many years after sections of the bulkhead were finished.

East River Drive

Despite the major improvement to the East River facilities, commerce still shifted to the better-endowed Hudson River. The East River piers became obsolete, and the adjoining area quickly declined to slum-like conditions. As its importance in shipping and related trades declined, the East River shoreline entered a new phase of existence, as the site of a new arterial highway—East River Drive—planned to relieve ever-increasing traffic congestion that followed the advent of the automobile. Under the direction of engineer Walter Binger, the Commissioner of Borough Works, and with the support of Borough President Stanley Isaacs, the grand opening of the Montgomery Street to Grand Street section of the East River Drive (now the FDR Drive), (adjacent to Segments 7, 9, and 10), took place on May 17, 1940 (Isaacs 1940: Box 5, Opening Ceremonies Program).

In a 1940 letter to Mayor LaGuardia, Borough President Isaacs noted, "There will still be required at some future date, the construction of an elevated express highway from Montgomery Street to South Ferry. I believe this will be needed when the Brooklyn-Battery tunnel is opened four years [1944] from now" (Isaacs 1940: Box 5, Letter 9/11/1940). With the interruption of World War II, construction of the planned elevated South Street Viaduct linking the FDR Drive with the Brooklyn Battery Tunnel and the West Side Highway had to wait until June 1951, when construction work began on the support foundations (*New York Times* 10/13/1951:14), under the direction of the contractor, the Fehlhaber Corporation of New York. The viaduct was designed to accommodate express traffic, while attempting to keep the number of supporting columns to a minimum so that local traffic on South and Marginal Streets would not be interfered with. The highway was completed in 1954, and opened on May 28 (Borough 1954).

By 1979, the steel and concrete structure had begun to deteriorate. In June of that year, a "small part" of the highway collapsed, "showering a parking lot with chunks of cement." This resulted in the banning of buses and trucks from the viaduct, and an engineering study "of the whole viaduct area" was initiated (*New York Times* 1979). Corrosion of the highway's supports was attributed to salt from de-icing operations (Bird 1980), and work began in 1980 on a new concrete deck, replacement of some structural supports, new drainage, and new lighting (*New York Times* 1980). The rebuilding was carried out by NYSDOT (www.nycroads.com/roads/fdr).

Potential Historical Archaeological Resource Types

Riverbottom Remains
These resources include discarded and lost cargo, and discarded material from shoreline activities. Prior to filling, the APE was part of the original harbor of Nieuw Amsterdam/New York, and potential for resources from this category would be expected within the strata of accumulated river muds, silts, and sands. For example, at 64 Pearl Street (between Broad Street and Coenties Slip, 3 blocks north of the APE), Archaeologists Rothschild and Pickman noted substantial numbers of late 17th-century artifacts in the stratum believed to have been the 17th-century East River bottom adjacent to an existing dock, and interpreted these as ship and shore discards and losses (Pickman and Rothschild 1981).

The nature of discarded remains is somewhat problematic, however, since they generally cannot be linked to any specific episode, person, household or business. Artifacts might be purposely dumped, or accidentally lost from either ship or shore activities, from businesses and households adjacent to the underwater location, or dumped clandestinely, and/or with collected refuse from other locations.

This is not to say that under certain circumstances the data provided by riverbottom remains cannot be valuable as a dating tool or for other avenues of research. In his archaeological study of excavated Cruger's Wharf (Old Slip and Water Street, 2 blocks west of the APE), Archaeologist Paul Huey noted a red sand stratum more than 25 feet below modern street level, which was identified as the original river bottom, and two strata of river bottom deposits representing the period between ca. 1650 and the construction of the wharf in ca. 1740. Huey not only used the artifacts to date the strata, but he was able to interpret the pieces of ships rigging, numerous whole bottles, ceramic vessels, shoes, and other complete objects as items lost or discarded overboard during normal shipping activities. From this data he attempted to reconstruct the changing trading patterns of New Amsterdam/New York during the 17th and 18th centuries (Huey 1984).

Sunken Vessels
Sunken vessels are perhaps the most complex and sensational of the artifact classes that have been recovered in the landfilled areas of Manhattan. Sometimes decrepit vessels simply sank at their moorings, or in another case, ships even caught fire and burned (Historic Sites Research 1977:45). A systematic examination of the New York City Common Council minutes from 1675 to 1776 and 1784 to 1831[2] (MCC 1905, 1917) provides references to approximately 28[3] "Hulks" or sunken vessels in slips and docks. In each case, the Common Council took action to have the hulk removed. Only two cases are mentioned prior to the Revolution, when the Dockmaster was ordered to "Remove several Boats & Wrecks that have lien Sometime as Nusances in several of the Slips and Dock of this City" in 1729, and in 1769, when Lambert Losie and others were paid £7 5s to remove a wreck from "Elises Slip" (MCC 1905:III 477, VII 157). In comparison to the approximately 24 hulks recorded between 1784 and 1831, the paucity of references dating to the

[2]The intervening period represents the British occupation of the city, 1776-1783.
[3]In one case, more than one hulk is noted but not the exact number (MCC 1905:III 477; 1917: I 152, 170). In other cases, based on the date and location, it is unclear whether the same vessel is being referenced (e.g., MCC 1917:I 223, 230-231).

century before the American Revolution naturally reflects a smaller volume of trade. The increase in hulk removal during the 1780s, with five removals during 1784 and 1785 alone (MCC 1917:I 6, 27, 52, 80, 152, 170)—more than in the entire century before 1776—also documents the decrepit state of the Manhattan waterfront after the British occupation ended in 1783 (Bone 1997:96; Buttenwieser 1999:38).

The necessity for rebuilding war-ravaged and neglected harbor facilities, and the need to revive the city's trade after the seven-year occupation, were probably the original motivating factors behind the Common Council's more proactive role in slip and wharf maintenance, beginning in the 1784 with an order to the aldermen to investigate the presence of "Old Hulks and other Incumbrances" in the slips in their wards (MCC 1917:I 60-61). In December 1805, the involvement of the Council with and its scrutiny of these issues was underlined by the creation of the Standing Committee on Wharves, Piers and Slips (MCC 1917: IV 106-107), whose three aldermen recommended action to the full Council (Ibid.:VII 645-646).

Two general courses of action were taken by the Common Council when a hulk was blocking the channel of a slip or wharf. The Council either ordered the owner of the vessel to remove it (MCC 1917: I 52), or directed a municipal employee or official to have the hulk removed and to bill the owner (Ibid.:VI 171, VII 601). In cases in which the owner could not be found, the Council ordered the work done at Council expense (Ibid.:VII 264). The title of the official varied, depending on the circumstances. The "Corporation Wharfinger" was ordered to take charge in the case of Whitehall Slip in 1790 (MCC 1917: I 612), in 1799 and 1818 hulk removal was referred to the Street Commissioner (MCC 1917:II 543, IX 739), and in 1810 and 1812 the "Superintendent of Repairs" (MCC 1917:VI 171, VII 264, 601).

Council action regarding hulks often began with complaints from "Sundry Inhabitants" (MCC 1917:I 52, VII 601), ships' captains (Ibid.:XVI 607), underscoring the fact that the offence was a very public one, affecting not only City revenue, but private revenue as well. Private wharves and piers were generally controlled by multiple proprietors, who were required to build and repair the piers, and keep the slips open for passage (e.g. MCC 1917:II 144, III 284-285, V 105). At Burling Slip, for example, a petition was filed in 1803 by John Riker, Simeon and Rem Remson, Jordan Wright, Thomas Pearsall, and other merchants that owned land near the slip in order to elongate it eastward. They further requested that the owner of the water lot adjoining the wharf (George Codwise) be directed to take out his grant and complete the construction of a 25-foot-wide wharf alongside the slip by December (MCC 1917:III 294). Responding to the petition, in 1807 Peter Schermerhorn and George Codwise filed a petition for the construction of a pier or wharf at Burling Slip and requesting compensation by the City of New York (Ibid.:IV 471). The Common Council concluded that Schermerhorn and Codwise should be permitted to contract with someone to build a pier and that the City would pay one-third of the expense. In return, they would be entitled to receive the wharfage on the east side of the pier for two berths of ships, or for the use of the water within 60 feet of the pier (Ibid.). The pier was to extend from the south side of South Street out into the East River. In 1811 inhabitants near the slip complained to the Common Council that sea vessels were in the habit of lying in the slip to the exclusion of the coasters, which was impeding trade in this part of the city (Ibid.:VI 698). The citation of Burling Slip being a "public slip" in 1810 indicates no private ownership (Ibid.:VI 73).

Furthermore, proposals from private citizens offering to remove hulks suggest that a hulk was somewhat valuable for its constituent parts. As with any contract, a cash payment for the removal was specified (MCC 1917:I 152, 170, 301, II 543, VII 275), but agreements often specified that the remover receive the hulk *and* a cash payment, as in 1812 (Ibid.:VII 237), and in 1788 at Albany pier (west side of Coenties Slip) (Ibid.:I 402). In 1804, the Council had a hulk sold for its own profit (Ibid.: III 475). Even the old wood was useful. In 1784 there were two recorded instances in which payments were assigned to third parties for breaking up hulks to provide "fewel [sic] for the Poor" (Ibid.:I 27; there are others, e.g. in 1824: XIII 790-791). The seriousness with which obstructions to commerce were viewed is perhaps evidenced by the fines assessed for "incumbering" public slips, when those who bought the hulks did not remove them quickly enough, as was the case in 1824 (Ibid.:XIII 790-791).

Orders for removal regularly demanded immediate compliance, "without delay" (MCC 1917:III 325, XVII 413), or threatening fines (Ibid.:VII 645-646), or legal action (Ibid.:I 52, 60-61; VII 232). Removal was not always immediate, but eventually it did occur. When legal action was necessary, it was not always the swiftest course. A privateer sunk in Beekmans Slip was ordered removed in June 1784, a judgment against the owners appears to have been made in September 1784, a bid for removal made in July 1785, and the matter settled in July 1786 (Ibid.:I:52, 152, 223, 230-231).

Research on sunken ships completed in 1992 for the Route 9A Project followed the fate of three ships which sank on Manhattan's Hudson River shore during the 19th century: at Warren Street (1829), Chambers Street (ca.1827), and Canal Street (ca.1812). The ship at Canal Street, the *Sally*, was ordered removed by the Council, which paid Joseph Brundidge $15 for the completed task in 1812 (MCC 1917:VII 275). The ship at Chambers Street was subsequently raised at the order of the Council (Ibid.:XVI 607, XVII 413). With the Warren Street wreck, there was no evidence from Council records that the ship had been raised. During the 20th century, teak timbers had been unearthed in the vicinity of Warren Street, which with the 19th-century report of the ship's sinking led to the designation of Warren Street as potentially sensitive for ship remains. Research on Warren Street noted, however, that the street had probably been filled by the time the vessel sank and was supposedly buried there, and that the ship may actually have sunk in the channel beyond the bulkhead. Furthermore, the teak timbers recovered were unmilled, and therefore probably not from a ship. As a result, the site was deemed not to be sensitive. (Hartgen and HPI 1992:11,12,14).

Archaeologists Kardas and Larrabee investigated the well-documented sinkings of the *Great Republic*, the *Joseph Walker*, and the *White Squall*, which occurred when a fire swept through the docking area around Dover Street in December 1853. Despite the "considerable litigation" which followed the burnings, the wrecks were eventually removed, which Kardas and Larrabee attribute to the pressure for usable dock space along a busy waterfront (Historic Sites 1977:45).

Considering the importance of the slips and wharfage to the commerce of the City, it is highly unlikely that a hulk would have entered the archaeological record in a functioning slip or dock via "accidental" sinking or simple abandonment, given the continuously increasing need for dock space and the inherent value of the hulk itself. This is especially true given the active interest in

preventing obstructions to commerce displayed by the Council. Furthermore, as ships became larger with deeper drafts during the 19th century, pier slips were made wider and deeper through dredging to accommodate them (Harbor Commissioner 1857; USC&GS 1906; Buttenwieser 1999:40-41), making it a virtual impossibility that a sunken vessel would escape removal. This phenomenon has also been noted by archaeologist J. Lee Cox, Jr. in his predictive model for shipwreck sites in the Philadelphia region (Cotter et al. 1992:464).

A second method of disposing of hulks, however, was to incorporate them into landfill by filling them with earth and sinking them. This does not seem to be the preferred method, at least by 1786, although to modern sensibilities it would seem to be the simplest. In the case of the privateer described earlier, the hulk was "partly on the Ground where the street is to be made," and attempts were made to remove it, but it was concluded that it "Cannot be raised." The Council's committee recommended "that the Hulk or wreck, lying in the slip be fill'd level with the street—That the petitioner be permitted to extend the street to the width of twenty feet at his own expence [sic]"[4] (MCC 1917: I 52, 230-231). A second incident, in 1815, involved a "dismantled sloop" in the head of New Albany Basin (Hudson River), which "prevents filling," and legal action had to be taken to have it removed so work could proceed (Ibid.:VIII 232).

Along the former East and Hudson River shorelines, several examples of such vessels have been found by construction workers, and fewer excavated and/or recorded by archaeologists. Most notable among these was the hull of an early-18th century vessel found in the basement of 209 Water Street, later part of the South Street Seaport Museum, and the ca. 1720 ship excavated at 175 Water Street.

The ship excavated at the 175 Water Street site, unofficially dubbed the *Ronson* after the site developer, is of great historical significance, since it is not only an example of 18th-century landfill techniques, but also the only surviving example of a cargo vessel built during that period (Brouwer 1980; Hartgen 1992) and "a rare example of the eighteenth-century shipwrights' art" which is poorly documented (Rosloff 1986). Once it had outlived its usefulness, the 92-foot long, 25-foot wide vessel had been purposely sunk parallel to the shoreline and covered with fill. The bottom of the hull was found at 18 feet below grade (Bergoffen 2002). Analyses could not determine its country of origin, but based on the warm water shipworms embedded in the *Ronson's* pitch-and-horsehair sheathing, it may have plied the waters of the Caribbean (Rosloff 1986; Cantwell and Wall 2001) or possibly served in the tobacco trade along the coast of North Carolina.

For the purposes of this discussion, the locations and time periods of these vessels are notable, since they were, without exception, further inland than the APE where the 18th century shoreline terminated, and therefore represent the filling practice of an earlier period. The *Ronson,* found in building lots on the north side of Front Street—a block northeast of the APE—dated to ca. 1720. Sections of another early 18th-century ship were recorded at 209 Water Street, a site also similar in relation to the APE chronologically and physically. Portions of ships were also noted in excavations for Hanover Square in the 1960s, an area filled before 1730 (Cohen and Augustyn 1997:55). The ship originally identified as the *Tijger* was encountered near Dey and Greenwich Streets, an area filled in by ca.1760 (Cantwell and Wall 2001:234; Bergoffen 2002:3-4; Cohen

[4]The location is presently Beekman Street between Water and Front Streets, outside the current APE.

and Augustyn 1997:64, 71). Archaeologist Celia Bergoffen also notes an example of this landfilling technique in England, during the 1720s (Bergoffen 2002:4).

As noted above, it is unlikely that a vessel would have entered the archaeological record via sinking or simple abandonment in a slip or other outboard location, given the importance and profitability of the slips and wharfage to the well-being of the City and its inhabitants, as well as the intrinsic value of the vessel itself. According to Common Council minutes, a much more strict and organized posture was adopted regarding sunken vessels and pier and slip maintenance during the reconstruction following the American Revolution. Documentary and archaeological research on known sunken vessels in slips identifies none that were not raised and removed subsequent to 1786, which predates the earliest documented pier and slip construction in the outboard sections of the APE by approximately 14 years. In addition, by the 1780s, the use of vessels as landfill retaining devices—at least in water lots which were to become municipal streets—was avoided by the Common Council, which appears to have monitored this practice also. The hulk noted on Beekman Street in 1786 was only permitted to remain because it could not be raised, and others noted were removed. Although archaeological evidence records vessels incorporated into landfill as late as the 1760s, this practice had fallen from favor by the 1780s, and certainly by ca. 1800, by which time the New York waterfront had been renovated and rebuilding was proceeding. As noted in the Route 9A Corridor report, early 19th-century landfill "dates from a time in the city's history when a conscious effort was made to standardize fill retaining devices and keep the harbor free of hulks and the potential for sunken ships to be incorporated into the landfill is limited" (Hartgen and HPI 1992:10).

Therefore, based on the preceding discussion, only sections of the APE that were bulkheaded and filled prior to 1800 will be considered potentially sensitive for this category of archaeological remains. The late date of the filling of this portion of the APE—the first half of the 19th century—would indicate that it would be unlikely to find vessels within landfill in this portion of the APE.

Landfill Retaining Structures, Wharves, and Piers

Historic cribbing and bulkheads—devices for retaining fill—have been a subject of archaeological investigation for many decades (See e.g., Historic Sites Research 1978), and docks and wharves, some of which eventually functioned as landfill retainers, are known to have existed throughout the APE prior to the construction of present South and Marginal Streets.[5] All utilized similar construction techniques, which evolved from an almost vernacular tradition in the 17th and 18th centuries, to the recorded, standardized construction practices of the late 19th century.

According to Architect Kevin Bone (1997), a bulkhead wall is "a retaining wall along a waterfront, which shores up the embankment in order to stabilize it for the construction of wharves and piers." The term is believed to have originated with New York City engineers (Bone 1997:272). A wharf refers generally to a structure at which vessels unload cargo (Ibid. 277), although some sources distinguish between a marginal wharf, or quay, which is a parallel extension of the shoreline, and wharves which extend more or less perpendicular to the shoreline, usually called piers (Joseph et al. 2004:178-179).

[5]Sunken ships, also used in this capacity, are discussed separately in the previous section.

Prior to the late 18th century, the chief method of land extension and wharf construction in the New York City area was by the creation of sheet-pile seawalls. Debarked logs of American white oak, sharpened to a point at one end and shaped at the head to accommodate a pile cap, would be driven side by side into the mud of the river floor with a log or stone drop hammer. They would then be anchored together with heavy horizontal wood planking secured to the outboard face of the piles. The planking would retain the fill which would be deposited on the landward side. Sheet piling was also employed in the construction of docks and wharves (Bone 1997:92-96), and according to a description written by Freeman Hunt in the April 3, 1840 edition of the *Merchants' Magazine and Commercial Review*, the practice continued well into the 19th century (Small 1941).

Other methods were developed for specific circumstances, such as shallowly-inundated building lots. At 7 Hanover Square, stone house foundations are believed to have been laid directly on the river bottom in ca. 1687-1697, in what was interpreted as the intertidal zone on the outboard side of present Pearl Street. The stone foundations not only supported the new houses, but also seem to have been employed to retain landfill (Cantwell and Wall 2001:236-237; Rothschild and Pickman 1990).

Sheet piling was also employed to surround riprap embankments, and combinations of piles, planks, stone embankments, and sheet piling were the dominant construction method to the time of the American Revolution. By the late 18th century, during the post-Revolutionary War rebuilding of Manhattan waterfront facilities, cribworks—wood-frame, "boxlike receptacles" with solid bottoms and open sides, filled with loose stone and sunk to river bottom—provided larger, sturdier supports for retaining walls and wharves, where pile-supported structures could not be built or proved unstable in the face of strong river currents and ice. The larger number of laborers available after ca. 1800 to man the required derricks and rigs made this type of construction more feasible. The river floor would be dredged, clearing mud and loose debris down to the bedrock or hardpan substratum. The crib bottom was fitted to the river floor's contours, and the cribwork was carefully filled with stone, mud, sand, and sometimes even concrete, and pinned to bottom. If the crib facing were constructed so tightly that earth alone could be used as the fill, it was called a "solid-filled crib" (Bone 1997:96-99; Joseph et al. 2004:178-179).

The more primitive construction form, using notched, unhewn logs, and larger fill cells, was known as a cobb[6] wharf, and the fill supposedly consisted entirely of stone (Joseph et al. 2004:179). Often the fill included other materials, such as ballast rock and coral, brush, and tree stumps (Louis Berger 1990:V-3). Cobb construction, with its less accurate joints, was less durable and stable than cribwork (Bone 1997:96-99). The 1690s cobb structure excavated at the Barclays Bank Site (75 Wall Street, corner of Wall and Water Streets) was built with rough logs joined to form a series of 5-foot-square compartments. The structure was secured in place by pilings, and filled with rock and coral (Louis Berger 1983).

[6]Cobb, or cob, may refer to a beating or spanking administered with a flat piece of wood, such as would make up the cribbing, or more likely, to the cobbles used in the fill.

Data illuminating 18th- and 19th-century wharf construction practices in Lower Manhattan has been accumulating since the 1960s, as examples of cobb-type construction have been uncovered at a number of archaeological sites. Archaeological excavations conducted in 1969 on the site of Cruger's Wharf, at present Old Slip and Water Street (west of the APE), also uncovered part of a wharf of cobb construction, built in ca. 1740 (Huey 1984). The cobb components were encountered approximately 5 feet below the 1969 street surface, and extended an additional 17 feet down to what had been the ca. 1740 riverbottom. As the shoreline was extended from Water Street to Front Street by ca. 1765, fill placed on the landward side of the L-shaped wharf had "transformed" it into a retaining wall/bulkhead.

During the excavations for the Telco Block (site bounded by Water, Fulton, Front and John Streets, west of the APE) the tops of the wooden members of a mid-18th-century cobb wharf complex were consistently encountered at or below mean sea level, which was at approximately 5.5 feet below the curb, and an exposed section extended to 9.5 feet below mean sea level, to what was interpreted as the riverbottom. Deposits within the cobb wharf were stones, as would be expected. Lines of plank bulkheading were added as the wharves were incorporated into the shoreline system (Rockman, Harris, and Levin 1982:60, 64-68, Figures 3.10, 3.12).

The most complete study of such structures in Lower Manhattan took place at the Assay Office Site, on the block between Front and South Streets, and Wall Street and Gouverneur Lane, a block west of the APE. Plank bulkheads, as well as a cobb wharf complex dating to the 1790s, were unearthed beneath the basement floor levels of modern buildings. These represented multiple fill episodes, and were encountered in a fill stratum beginning approximately 8 to 13 feet below street level. Large logs of approximately 1 foot in diameter were used in the cobb frame, which from its base was 15 feet high. The 4-foot by 8-foot cells had well-built, split timber floors. The various wooden elements were attached to each other through carefully-prepared wooden joinery, and even some metal fasteners (Greenhouse 1984: 2, 3, 4, 10, 13-14; Louis Berger 1990:Fig. 4.2, IV 3,14-17; 1991; Cantwell and Wall 2001:230-233).

Predating the cobb wharves, a wharf type known as "block and bridge," was also uncovered at the Assay Office Site. In this case a series of wooden "blocks" 20 feet square and 40 feet apart (the blocks could also be masonry), and spanned by plank "bridges," had been constructed before the 1780s. This design allowed the river currents to pass through the pier, avoiding some of the buildup of mud and debris which occurred with solid wharves. As with many other piers, when the adjacent river was filled, the underwater spaces between the blocks was closed with planking, and like the adjacent cobb wharves, became part of a landfill retention system (Cantwell and Wall 2001:232-233). Cantwell and Wall note, in retrospect, that the sections of Cruger's Wharf and the wharf on Beekman Slip at the Telco Block were actually parts of block and bridge piers (Ibid.:325).

Only one excavation along the Hudson River has revealed the presence of wharves, in this case, a cobb-type construction. The wooden members were encountered during monitoring at Site 1 of the Washington Street Urban Renewal Area, and were dated to the late-18th and early-19th centuries. Although somewhat distant geographically from the APE, the remains are notable for providing valuable information on the joinery and fastenings employed on such constructions (Louis Berger 1987).

A grillage/raft type wharf employed construction techniques similar to that of a cobb wharf. As the name implies, it was a solid raft-like structure built of timbers laid as headers and stretchers, incorporating layers of stone. Additional "rafts" were built and stacked until the required height was reached. It would then be floated out to the intended location, filled with stones, and sunk (Joseph et al. 2004:179). Although more famous for the excavation of the *Ronson*, the 175 Water Street site (on the block surrounded by John, Fletcher, Water, and Front Streets, west of the APE) also uncovered wharf construction of this type, dating to ca. 1750 (Geismar 1983:117,203; Louis Berger 1990).

As was the case at the Assay Office Site, the remains of wharves and landfill devices may still survive beneath modern building foundations. Soil borings and test pits performed during a preliminary archaeological assessment of Block 97 (lots along the east and west sides of Front Street between Beekman Street and Peck Slip, west of the APE), in 2002, encountered wooden beams apparently belonging to cribbing or other landfill devices beneath building foundations on and extending below the current water table, which was encountered between 3 feet 8 inches and 5.5 feet below grade (Test Pit 1, 214 Front Street Block 97 Lot 37), and in fragments in all the soil borings (Bergoffen 2002:11-12). Monitoring was recommended in this case, but unlike the APE, these were building lots, not streetbeds.

During the 1870s, with the establishment of the New York City Department of Docks and the advent of the modern bulkhead system, East River bulkheads, piers and wharves were constructed following "modern" techniques (Figures 8, 9, 10). Rather than cribbing, piers were built with a deck of wood or concrete atop wooden piles driven into the hard bottom in various combinations, often given greater stability by being driven through riprap or broken stone placed for that purpose (Greene 1917:28-33). A description of, and the impact of this construction on potential archaeological resources is provided later in this report.

Dry Docks

During the 19th century, the East River between Catharine and Rutgers Slips was an important center for shipwrights, with a number of floating docks devoted to the servicing of steamships Bromley 1891). In 1836, 72 steamships which had been built in New York were in service to and from the city (Morrison 1909:61). The floating dry dock was first patented in 1816 by J. Adamson. It was basically a wooden dry dock with a gate at the stern. Developed in ca.1840, balance dry docks were open at both ends, rather than only one. Pontoon-like chambers along the high sides of the dock could be flooded to sink the structure, and when the ship was floated over it, the chambers were pumped out, and the dry dock rose and lifting the ship out of the water. The design was patented by New Yorker John S. Gilbert (Raber and Brouwer 1985).

Sectional dry docks were a variation on the balance dry dock, and appeared shortly after that invention. They were made of identical segments which could be joined together to create dry docks of varying lengths, suited the size of vessel that required repairs. The New York Sectional Dock Company built a sectional dock just west of Rutgers Slip in 1839 (Raber and Brouwer 1985; Morrison 1909:61).

The first screw dock was put into operation by the New York Screw Dock Company at their slip between Market and Pike Slips along the East River (north of Segment 7, outside the APE) in September 1827. According to an engineer's description, the vessel to be raised was floated over a wooden platform sunk to about 10 feet below the surface, and suspended from a strong wooden frame by 16 4.5-inch-diameter iron screws. Approximately 30 men were required to raise the vessel "by the combined power of the lever, wheel, pinion and screw," and operation which took about a half hour with a vessel of about 200 tons (Morrison 1909:60).

A hydraulic or hydrostatic dock was built nearby a few years later (also between Peck and Market Slips, north of the APE), for shipwrights Ring & Co., and first used in 1835. It was designed to lift vessels of up to 800 tons ten feet above the water. Part of the mechanism was built in England by the steam engine builders Watt & Bolton. "The mode of raising a vessel on this dock was to bring the vessel in between the two wharfs exactly over the cradle; the chains were tightened so as to make the blocks come in contact with the keel; water was then forced into the cylinder through a small tube by means of a pump, which caused the ram to be forced out, drawing with it the sliding beams, raising the cradle in a slow but steady manner, to the required height" (Morrison 1909:60-61).

These floating docks were important contributions made by New Yorkers to shipbuilding technology. Archaeologically, however, the mechanisms and structures would not have left a unique footprint distinguishable from other piers and wharves of the same period, by virtue of the fact that their major components were floating, or above ground/water on the adjacent piers, or on shore. It is possible that artifacts associated with their use have survived, but as losses or discards from ship and shore, these would fall into the "Riverbottom Remains" category of potential archaeological resources.

Landfill Deposits

As described in the previous section, the APE was gradually filled in incorporating structures built using a variety of bulkhead- and wharf-building techniques. Given South Street's distance from the historical shoreline of Manhattan, landfill activities only impacted the APE during the 18th century, and continued through the 20th century. As wharves and bulkheads were built, rebuilt, and replaced, the slips and channels between piers were filled, eventually creating the land for South and Marginal Streets. Landfill is especially likely to contain artifactual material (e.g., Historic Sites Research 1978:14-15; Huey 1984), particularly in the strata closest to the surface (Historic Sites Research 1991:277-278, 282) (Figures 11, 12). Such archaeological evidence is useful for documenting past lifeways, as well as for dating when and how fill was deposited.

Questions have been raised regarding the interpretation of artifacts from landfill deposits. As noted in the Louis Berger Assay Office report (1990:VI-14,-15), earlier interpretations of the artifact content of landfill soils (Greenhouse 1984; Rothschild and Dallal 1983:10) were based on the supposition that the artifacts were representative of the material culture of New York City during the time period concerned, and could be used to examine social and economic processes taking place in the City. This is problematic, since the origin of the fill is generally unknown, and the artifacts cannot be tied in to specific households or businesses, or even general classes of these entities. This was already acknowledged in the 1982 Telco Block (bounded by Water,

Fulton, Front and John Streets) report, which reviewed the interpretation of the large amounts of leather and shoe fragments recovered in the excavations of six Lower Manhattan landfill deposits. Earlier analyses such as the 64 Pearl Street study (Pickman and Rothschild 1981) had attempted to connect these artifacts with nearby tanners and shoemakers, but the data from Telco suggests that the fill, a combination of domestic and commercial refuse, had been brought in from an unrelated outside source (Rockman, Harris, and Levin 1982:78).

The Berger report recommended "that landfill soils be used only to describe the specific depositional histories of the sites under investigation," that is, sampling these soils for the purposes of recording the landfill deposition history of a site (as e.g., at Telco), as opposed to in-depth artifact analysis. Of course, if "unusual" artifact deposits are found, such as a china "dump," or rare artifacts, these would be important for recovery as contributions to the study of the ranges and forms of available material culture in the City (Louis Berger 1990:VI-14, -15; Rockman, Harris, and Levin 1982:54,56ff). To this could also be added fill that can be reliably assigned a narrow date range. This has occurred on the 7 Hanover Square site (south side of Old Slip, between Water and Pearl Streets, 2 blocks west of the APE), where documentary research determined that the landfill episode occurred between 1687 and 1697. Thus, in addition to the recovery of examples of 17th-century utilitarian earthenwares from the Dutch potting center of Bergen op Zoom, it was possible to use the faunal evidence to study foodways in late 17th-century Manhattan (Rothschild and Pickman 1990).

Primary Landfill

As described in the previous section, within the landfill support structure, archaeologists have theorized two broad categories of fill strata. The first-deposited, and largest of the strata, would be the landfill placed within the various types of support constructions. Archaeologists Kardas and Larrabee, in their report on excavations on Schermerhorn Row at South Street, refer to this as "Primary Landfill," and the process as "land-making." The landfill consisted of large- and medium-sized rocks in a matrix of "dark grey to black muck with some clay." They suggest that the presence of clay in the matrix is probably beneficial, since it could inhibit its being washed out of the cribbing (Historic Sites Research 1978:138-139; 1991:277-278). On the other hand, this would depend on the support structure, since as discussed earlier, cobb-style wharves for example, were designed only for bulky fill such as rocks.

As at Schermerhorn Row, primary landfill at the Assay Office Site (southern side of Block 35, bounded by South Street, Old Slip and Front Street) was identified from the presence of timbers and mud—the components and contents of landfill structures—discerned from soil boring log descriptions. This stratum ranged from 10 to 20 feet thick, beginning approximately 8 to 13 feet or more below street level. During subsequent excavation, several types of wooden bulkhead and landfill structures, including cob and block-and-bridge wharves, representing multiple fill episodes, were identified in this stratum (Greenhouse 1984:13-14; Louis Berger 1990:Fig. 4.2, IV 3,14-17; Cantwell and Wall 2001:230-233).

On the Telco Block, discussion of the landfill encountered also separated the strata into two main groups, namely: "Fill category 1,"—found as high as 1 foot above mean sea level, and extending into the water table—which seems to correspond to what Kardas and Larrabee would term secondary fill; and "Fill category 2," corresponding to primary landfill, which lies beneath Fill

category 1 and extends to the former river bottom (Rockman, Harris, and Levin 1982:77). It was also noted that, like Schermerhorn Row, the lower landfill strata ("Fill category 2") had a much lower artifact density than the upper fill ("Fill category 1") (Rockman, Harris, and Levin 1982:77,79).

Few artifacts are to be expected in the primary landfill stratum (aside from the support structure and clean fill itself, which are technically artifacts), because decaying, artifact-rich garbage was avoided because it would compress unevenly, settle at varying rates, and cause instability (Historic Sites Research 1991:278).

Such was not the case at the end of the 17th century, when fill was deposited at 64 Pearl Street (between Broad Street and Coenties Slip, 3 blocks north of the APE). Analysis indicated that although comprising one fill episode, the landfill came from multiple loads of soil taken from different locations. Although archaeologists found that 19th-century building construction had virtually eliminated the secondary fill layers, the primary landfill strata were still present beneath the existing building's basement floor. The 64 Pearl Street landfill had been carried out under the supervision of private owners who seem to have acquired a combination of sterile subsoil and loads of artifact-bearing topsoil/garbage deposits. The artifacts were used to date the landfill to the late 17th century. Oddly, landfill retaining devices were not encountered, although in the "gray silt clay" stratum beneath the landfill, and interpreted as the 17th-century East River bottom, there was a concentration of planks, boards, rocks, and pieces of brick—materials suggestive of such constructions. Subsequent to this landfilling episode, the Common Council issued an order in December 1691 that lot owners "Vse the Dock Mudd Twenty ffoot into the Dock before their owne houses for the filling up of their owne Lotts." Archaeologists Rothschild and Pickman observed that the landfill from water lots filled with "Dock Mudd" could be virtually indistinguishable from the river deposits beneath it (MCC 1905:I 259; Pickman and Rothschild 1981).

In analyzing landfill from the time of the 1691 "Dock Mudd" order (1687-1697) at nearby 7 Hanover Square, Rothschild and Pickman noted the use river mud—a green gray silt in ca. 1697 landfill—at a location in which documents record Teunis DeKay's agreement to fill an area with "mudd" following construction in the summer of 1697. Landfill in these locations was distinguishable from that on other parts of the site, and may have been mud dredged from the river bottom, as DeKay agreed (Rothschild and Pickman 1990).

By the 1790s, however, in response to a series of yellow-fever epidemics, the City government made mandatory the use of clean, sterile sand for fill, based on the fear that the decaying garbage often included in fill was a source of disease. Archaeologist Joan Geismar compared the contents of two landfills, one created before the epidemics (175 Water Street), and the other after the fill legislation had been passed (Washington Street on the Hudson). She found that there were still some lawbreakers, but New Yorkers did add less garbage to the later fill (Geismar 1983; 1987; Louis Berger 1987).

Although the acquisition and deposition of landfill is poorly documented, various references suggest that clean landfill material was generally obtained from regrading and construction projects in other parts of Manhattan. An 1828 observation regarding the drained "fresh water

pond," in the City Hall vicinity, reports that "several large hills or mounds of earth that environed the pond ... have all been leveled, and the ground thrown into the ponds" (Stokes 1926:1,671, 1,828). As Geismar discovered, there were unscrupulous landowners who used "dirty" landfill, such as redeposited nightsoil encountered at the Assay site (Greenhouse 1984:14), but references to this behavior seem to concern organics in more surficial fill, rather than in the primary landfill (Historic Sites Research 1978:15).

Primary landfill, like the superstructure which it filled, would bring the location's elevation to about mean sea level or a few feet below, but notably not above the high tide level (Historic Sites Research 1991:279). At Schemerhorn Row, this stratum extended from five to more than 20 feet below the existing surface in 1981-82 (Historic Sites Research 1991:282) (Figures 11, 12). At the Assay Site this figure was between approximately 8 and 13 feet below the surface, with mean sea level noted at 5 feet below the surface (Louis Berger 1990:Fig. 4.2, IV 14-17). On the Telco Block, as noted earlier, primary landfill ("Fill category 2") appeared below the water table and extended to the former riverbottom (Rockman, Harris, and Levin 1982:77).

Secondary Fill

In the same excavations at Schermerhorn Row, Kardas and Larrabee noted a layer of reddish-brown sand atop the primary landfill, which they termed "Secondary Fill," and hypothesized that it was utilized to cover the rough and rocky primary landfill, providing a working surface for construction. It contained less rock than the primary landfill, and was where most of the artifacts recovered by the excavations were found (Historic Sites Research 1991:278-279). (Figures 11, 12) Archaeologists at the Telco Block likened this upper fill stratum to "redeposited refuse" (Rockman, Harris, and Levin 1982:77).

This corresponds to recorded historical observations of the filling of waterlots by their owners, using "earth and trash (whose buckles and bricks and china and bits of ships are treasures today)" (Shumway 1975, quoted in Historic Sites Research 1978:15). At a time of deadly yellow fever outbreaks, as noted above, there were objections to the prevalence of refuse in this stratum, but the worries seem to center on the unhealthiness of decaying organics in the refuse, rather than the presence of discarded artifacts. Four ordinances regarding the filling of sections of South Street at Whitehall were passed by the Common Council in 1796, indicating that the "filth" in the fill was the cause of illness. It is also significant that the artifact-rich refuse targeted by the Common Council seems to be secondary fill, since it was being added to a newly-filled location in order to bring it up to street level (Historic Sites Research 1978:15; Cantwell and Wall 2001:228-229).

Another encounter with secondary fill in the APE occurred at South Street and Clinton Street during the construction of the FDR Drive in 1952, when a section of 1836 cobble paving was uncovered. Intrigued by the survival of the early streetbed, then-Mayor Wagner's chief engineer Anthony J. Donargo dug beneath the cobbles and "brought out a veritable hoard of old clay pipes, which must have been smoked and unstemmed before the cobblestone paving was laid in 1836. There were also shards of iridescent old glass, a couple of hand-wrought nails, pieces of zinc, and some bricks probably brought here from Holland. Some of the pipes were decorated with the Masonic square and compass, with a G enclosed" (*New York Times* 1952:25).

Under normal circumstances, secondary fill was deposited on top of the primary landfill, which ended at or below mean sea level. At Schemerhorn Row, this stratum extended from two to five feet below the existing surface in 1982-1983 (Historic Sites Research 1991:282). At the Assay Office site, the secondary fill stratum above the primary landfill contained brick but no timbers, and extended between the modern pavement and as much as 13 feet below the surface (Louis Berger 1990: Figure 4.2); On the Telco Block the secondary fill, called "Fill category 1," was noted up to 1 foot above mean sea level, and extended below the water table (Rockman, Harris, and Levin 1982:77).

In some locations at Schermerhorn Row, the lowest levels of secondary fill exhibited "nearshore or tidal flat conditions," and just beneath the secondary fill stratum, a layer of river silts was recognized, probably a natural deposit from the time period between the filling of the cribbing and the placement of the secondary fill (Historic Sites Research 1991:278-279). Modern sources suggest that following the placement of landfill a period of from six to 18 months be set aside before construction takes place, so that the fill can settle and consolidate (Historic Sites Research 1978:15-16).

Land Transportation Elements

As the center of commerce, the South Street shore was the terminus for multiple horse-drawn trolley cars and omnibuses during the 19th century, and lines which were electrified during the 20th century (Lawesson 1973-1974; Bromley 1879). The discovery of an undisturbed section of 1836 stone pavement (within four feet of the surface) at South and Clinton Streets during the construction of the South Street Viaduct suggests that track from railway lines may still be present within the impact zone of the APE. Early horse-drawn trolley tracks, however, were too delicate to support the weight of later electrified cars, and were commonly ripped up and replaced. Since no other subsurface features are associated with horse-drawn systems, no remnants of an early track system are anticipated in the APE.

Electrified trolley tracks, consisting of two outside tracks and a third electrified center rail, are commonly found throughout Manhattan, dating from the 1890s onward. The track may also be associated with saddles and switching stations, but since many of these lines ran through the 1940s, they were normally modified and updated. Subsurface remains of these systems retain little or no evidence of their original components (Hartgen and HPI 1997:23).

Although the study of small sections of track rails can be useful in the study of technological adaptations and processes in the evolution of transportation and transportation systems, extensive documentation already exists regarding the routes, technology, and construction of Manhattan's trolleys. (Historical Perspectives 1992:15; Hartgen and HPI 1997:23-24, 28-29). As a result, according to Tom Harrington, curator at the New York Transit Museum (1997), the presence of trolley tracks alone is not sufficient reason to designate former routes as potentially sensitive (Ibid.:28).

Wooden Water Mains

Prior to the introduction of Croton water to Manhattan in 1842, water within the city was distributed through mains operated by a private concern, the Manhattan Company, the corporate ancestor of present JP Morgan Chase. The Manhattan Company maintained numerous mains in

Lower Manhattan, during its existence from 1799 to 1842 (Geismar 2005:1-3). At first, these water pipes were made of wood. On May 6, 1799, the Company water committee was empowered "to contract for as many pine logs as they think necessary for pipe and also for boring the same." The company also dug wells and built reservoirs and tanks, extending the distribution system to most parts of Manhattan south of City Hall (Anonymous ca. 1913), which in the APE would mean as far north as the Brooklyn Bridge, north of present Dover Street. Cast iron pipes and hydrants replaced the wooden mains beginning in 1827 (Geismar 2005:1-3). Since the Company's official history declares that it was not until approximately 1836 that the system was extended north of City Hall (and then only along Broadway to Bleecker Street), no wooden water mains should be expected in the APE north of the Brooklyn Bridge (Anonymous ca. 1913).

A number of the Manhattan Company's wooden mains have been recovered, most notably an old water gate which was dug up during construction on Park Row in 1900 (Anonymous ca. 1913). More recently, sections of pipe were found within 4 feet of the surface in Coenties Slip, west of the APE. The wooden mains are believed to have been shallowly-buried so that they could be tapped by firemen in the performance of their duties, (Geismar 2005:1-3). In the course of archaeological monitoring (2006) on Beekman Street between Water and Pearl Streets (about 2 blocks west of the APE), archaeologist Alyssa Loorya encountered an 11-foot long section of yellow pine pipe joined to a second, smaller section of main. The join was fitted with a metal collar. Once these surviving mains were recovered, DEP removed them for preservation treatment. (Lower Manhattan 2006). Additional sections of wooden water mains have also been excavated recently in present Titanic Memorial Park, on Fulton Street between Pearl and Water Streets (Amanda Sutphin, personal communication to Cece Saunders, 2006).

Since wooden mains were no longer installed after 1827, potential wooden mains could have been present in the APE from Whitehall to the Brooklyn Bridge, the northerly boundary of the distribution system at that time.

Subsurface Conditions: Soil Borings Review

Although soil borings are useful in determining the extent of subsurface disturbance, in the case of the APE, they generally serve to confirm what is already known of the project area through documentary sources: that the APE is comprised of a thick stratum of fill which extends below the water table to what was once the East River floor; and that this fill, particularly that below the water table, will contain large rocks, as well as evidence of wood from cribbing and piles. Also noted is the presence or absence of river mud/silt and sand strata, important for discerning the survival of former submerged ground surfaces. Soil boring logs, unless they are created specifically with archaeological concerns in mind, do not generally provide the detail necessary to determine the difference between primary landfill and secondary fill, despite the fact that both documentary and archaeological evidence indicates the potential for the existence of a thin deposit of river silt between the two fill strata. Rock Data Maps provided by DDC record miscellaneous fill and the presence of wood/timber and organic silt, but as already stated, do not differentiate substrata within the fill or provide the elevation of the water table (WPA 1937).

A soil profile based mainly on a program of 49 soil borings performed for the construction of the FDR Drive provides a more detailed subsurface view of the APE between Robert F. Wagner Sr. Place and Montgomery Street, although the locations of the borings within the APE are not precisely pinpointed (CNYDPW 1960). (See Appendix.) Again, although the fill and other strata are described in greater detail than in the Rock Data Maps, there is no differentiation of substrata within the fill, and the presence of timbers, riprap, and boulders are precisely what is to be expected in an area of filled riverbed punctuated by buried wooden piers, bulkheads, and cribbing. An additional set of soil borings with precise locations within part of the APE has been incorporated into the segment evaluations below (CNYDGS 1982), and included in the Appendix. As with the profile, although the confirmation of the presence of expected fill materials supports the documentary evidence, it does not provide data regarding disturbance. Simply put, disturbance to—and the archaeological integrity of—historical fill, pier, and wharf resources and the other categories of potential archaeological resources discussed above are unfortunately not discernable through soil borings.

On the other hand, soil boring logs should prove useful in determining the depth of fill strata, as well as the general elevations of river and glacial deposits. This data would help to identify the potential precontact land surface which existed prior to inundation by rising sea levels after the last glacial retreat, i.e., if they have survived adverse impacts from tidal and current action, dredging, and construction disturbance.

Types of Recorded Subsurface Disturbance

Although many forms of subsurface disturbance have occurred with the APE, documented disturbance can be divided under several major headings.

Subway Tunnels
The current Sanborn records one subway tunnel passing beneath this section of the APE, at Rutgers Slip. This subaqueous tunnel, built by the shield tunneling method, was begun west of South Street, and by the time South Street was reached, was many feet below the current APE. For example, the Clark Street Tunnel shaft was begun on Front Street and is 54 feet below grade at South Street (Olmsted 1995). Therefore this construction would have had no impact on archaeological resources in the APE.

Dredging
Dredging is a regular feature of port maintenance to remove accumulated mud and debris (artifacts) from channels and slips, and as a result, harbors and their channels are not generally environments conducive to the preservation of submerged archaeological sites (Stewart 1999:578). Contracts for dock, slip, and wharf maintenance farmed out by the New York City Common Council during the 17th and 18th centuries required the cleaning of "the said Dock, & slip in the Dock of all the Mudd & filth therein Soe deep as till they finde A sandy Bottom and During the said Lease shall soe Keep the same Clean" (4/13/1700, MCC 1905:I 104-105). The Common Council usually specified cleaning to the "sandy Bottom" (5/26/1702 , Ibid.: I:191; 2/15/1705, Ibid.: I 294), or "A Sandy foundation" (12/9/1703, Ibid.: I 250). Logically, this would mean that each time a dock or slip was cleaned some of the river bottom beneath the river mud and silts would be impacted by the procedure. One study of a number of 19th-century ships

which burned and/or sank at Manhattan docks concluded that all were either raised or removed, partly because of the pressure for usable dock space (Historic Sites 1977).

Dredging activity was regularly recorded in the Department of Docks annual reports during the late-19th and early-20th centuries (e.g., Docks 1899:photos n.p.; 1937:15; Marine and Aviation 1950:14). According to the 1906 report, channels between the piers in the APE were dredged to varying depths between 26 and 35 feet below mean high water (Docks 1906:382-385). Furthermore, as old piers were removed and new piers constructed, dredging of the pier location consistently followed the removal of the "old works" and preceded the deposit of a new riprap foundation. Dredging reports also record the square yardage of "mud" and "crib" removed (Ibid.:175-181; 382-385).

Research by archaeologists Kardas and Larrabee concluded that between 1929 and 1976 the Army Corps of Engineers conducted at least 80 dredging and obstruction removal projects along the Manhattan riverfront. As test cases, the evidence regarding several well-known 19th-century wrecks which burned and/or sank at Manhattan docks was also examined, and all were either raised or removed to return the piers to revenue-producing status (Historic Sites 1977).

Dredging would most certainly have impacted archaeological resources on the riverbottom (and therefore below mean low water). In general, however, the impact of dredging upon potential archaeological resources, especially the most deeply buried precontact resources, is not precisely known, since the exact depths and frequency of the activity are not always recorded, particularly prior to the 20th century.

Pier Construction, Modernization, and Reconstruction

Manhattan's East River piers were constantly being updated and altered through time to meet the demands of more and larger vessels (Graham 1873). A comparison of historical maps shows major changes in the numbers and configuration of East River piers between 1891 and the 1910s, by which latter period the piers approximated their modern configuration. Some piers were removed and their locations became channels between enlarged piers; others were simply enlarged and renumbered (Viele 1865; Bromley 1891; Sanborn 1905; WPA 1936-1940) (e.g., Figure 7).

The earliest piers that reached as far into the East River as the APE were recorded on maps from the closing years of the 18th century (Directory 1789; Taylor Roberts 1797; Commissioners 1811), corresponding to the reconstruction of New York City's pier facilities following the depredations of the Revolutionary War. As described earlier in this report, construction methods during that period entailed preliminary dredging, followed by construction utilizing combinations of piles and crib or cobb work.

Civil engineer Carleton Greene's 1917 treatise on the construction of "modern" (i.e., late-19th to early-20th century) American piers and wharves describes not only the driving of wooden piles, but site preparation prior to pile-driving. This included measuring the depth of the "hard bottom" by means of wash borings and test piles, in order to determine the length of piles necessary. At the time, piles up to 60 feet in length were easily obtainable, and various species of pine were considered the most durable and economical. Lengths of 60 to 85 feet were difficult to come by,

and the engineer would sometimes have to settle for inferior spruce. If piles greater than 85 feet were needed, splicing was necessary, although the availability of reasonably-priced fir piles of 110 feet in length, shipped from the Pacific Coast via the Panama Canal (completed in 1914) were anticipated (Greene 1917:28-33; Bone 1997:117).

Piles were generally driven down to rock or hardpan. Where the hard bottom was too deep to be reached, the pile was driven until the friction and cohesion between the mud/sand and the pile was so great that the pile could be driven in no deeper. Such conditions were frequently encountered along the Hudson shoreline, where "friction piles" had to be driven to depths of about 100 feet (Bone 1997:117).

Dredging was generally advised before testing. Greene noted an example from New York in which, prior to the driving of test piles, the center line of the pier was dredged to a depth of 15 feet, and 30 feet at the sides, although he does not provide the specific location. Where the water depth is not greater than 25 feet, Greene notes that "ordinary wooden piling" has a diameter of 14 to 16 inches. In deeper waters, or where the piles need additional support, riprap or broken stone not greater than 16 inches in any dimension, or round cobbles not greater than 6 inches in diameter, are placed before the piles are driven (Greene 1917:28-33).

Greene reports that the New York City Department of Docks follows the principles he describes "with the greatest thoroughness." Specifically, once the slips alongside the piers were dredged, pine piles were driven in a combination of the "single-pile" and "double-pile" row systems. Transverse rows of single piles were placed 10 feet apart. Within the single-pile row the piles were spaced 6 feet apart from center to center. The outer three rows of piles were doubled, and the number of piles in each row was doubled, resulting in a spacing of 2.5 feet, with double rows spaced about 23 feet apart. Additional white oak piles would be placed as fenders at the outer corners of the pier (Greene 1917:34, 38, Figs.1, 2) (Figure 8).

The annual reports of the Department of Docks support Greene's outline of the construction process, as they record the expenditures involved in replacing existing old piers in five steps: "Removal of old work"; "Dredging"; "Rip-rap foundation"; "Pier proper"; and "Shed." Records of completed dredging programs record not only the volume of mud, but also the volume of "crib" removed from the channels (Docks 1906:175-181; 382-385).

In addition to the impacts of dredging for pier construction, the driving of thousands of piles throughout the APE would have impacted potential archaeological resources which were then submerged and now, for the most part, are below the water table.

Bulkhead Wall Construction

Civil Engineer Greene also describes the evolving building methods for the construction of the East and Hudson River bulkheads and associated structural systems inaugurated in 1871 by the New York City Department of Docks (Bone 1997:99,102).[7] In the original bulkhead wall design of 1876, as well as modifications to 1899, the concrete and masonry bulkhead itself only extended about 15 feet below mean low water (Figures 9, 10). Because of the great depth of

[7]For the historical background of the East and Hudson River bulkheads, see the discussion in the Historical Period Overview section of this report.

mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency." According to Greene's schematic drawings, this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet out into the riverbed. Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead (Greene 1917:88-94).

Where rock was not particularly deep, that is, about 40 feet or fewer below mean high water (mhw), or when the "hard bottom" was sufficient to keep the piles stationary without the addition of riprap, concrete was placed directly on the rock or atop the piles in the hard bottom. This still required the removal of mud, silt, sand, and clay through dredging so that the constructions could rest on the firm, relatively level surface. Greene's schematic drawings these bulkhead walls show greater horizontal impact on extending inland on landward side of the wall (greater than 25 to 30 feet), than that extending from the wall into the river (9 to 17 feet), although both are substantial (Greene 1917:62-65) (Figures 9, 10). Since dredging is not a precise art, a conservative estimate of 20 feet for the minimum *horizontal* distance of impact will be employed in the evaluation of disturbance. Dredging depths will be discussed within the individual APE segment evaluations.

Utility Installation

Numerous utility lines, including sewer and water mains, both recorded and unrecorded, exist beneath South and Marginal Streets. Because modern water mains, for example, are generally installed with 42" to 48" of surface cover, underground utilities are expected to be the chief sources of subsurface disturbance in the APE. Disturbance is particularly extensive at junctions of multiple lines, which generally occur at street intersections and at piers. Schematic maps of current sewer and water lines were provided by DEP: Amended Drainage Plans (ADP 2006) and Water Main Distribution Map (WMDM 2006). More detailed maps of utility placement, particularly of earlier lines—apparently not employed by present utility companies in their excavations—were created by the Works Progress Administration (WPA) were provided by the DDC (WPA 1936-1940).

The potential impact to archaeological resources by existing utility lines is limited by the size of the line and the depth and width of the trench required for installation. Two recent projects carried out adjacent to the Tweed Courthouse on Chambers Street (Hartgen 2003; 2004) have recovered numerous historical artifacts, as well as a number of intact features, in the midst of utility lines and other subsurface disturbance, both recorded and unrecorded. The overarching concern of the two studies, however, was the recovery of human remains, since both locations were within the African Burial Ground and Commons Historic District, and fragmentary human remains had been found in an adjacent part of Chambers Street in 1998 during work to repair a water main break. As a result, even highly disturbed contexts were considered to have high archaeological sensitivity.

At the same time, the Tweed Courthouse report also noted: "[c]ertain areas that have been disturbed by modern construction (various utility lines) are characterized by no to minimal sensitivity; areas disturbed by historic construction of utilities are moderate to highly sensitive,

particularly for the presence of disturbed human remains" (Hartgen 2003:31). At the behest of the LPC, three test units to determine sensitivity were excavated within a 6- to 7-foot deep, 300-foot long trench (Chambers Street Trench 1), from which a 19th-century water main was removed and replaced. Two of the three identified historical fill deposits containing secondarily deposited human remains and scattered historical materials from 4 inches to 6.5 feet below the base level of the street.

The 2004 report on the archaeological monitoring of Con Edison utility trenches on Chambers Street between Broadway and Elk Street (north side of the Tweed courthouse) reported similar results, locating ten disturbed burials in two trenches. The report noted that "despite the amount of ground disturbance in the area, isolated pockets of intact human remains and other cultural features still exist" (Hartgen 2004:41). Meaningful conclusions drawn from the pockets of redeposited artifacts—from what might be a single, disturbed feature, possibly related to the military barracks or almshouse which once stood nearby—are more elusive. Regarding these 806 artifacts, the report was forced to conclude that "due to the amount of disturbance to these contexts little information about the feature from which they derived can be gleaned." (Ibid.:41). Another part of the trench, "characterized by modern disturbance associated with numerous utilities" yielded "cultural materials consisting of a mix of historic artifacts, modern trash, and a broken ceramic sewage pipe" (Ibid.).

In contrast to recorded land use in the APE, which after the deposition of fill from unknown sources became part of a wharf and/or street, the two sites discussed above were part of a graveyard, and later the grounds adjacent to a military barracks and then an almshouse. The sites were populated by small, discrete features (e.g., burials, ossuary pit, brick drain, etc.) which might be preserved if they were between utility line trenches. Although large numbers of historical artifacts were recovered from severely disturbed contexts, because the chronology of the almshouse and barracks is known, the artifacts provide some data because they can be related with some certainty to the occupants of the known structures.

Sections of wooden water mains (installed by the Manhattan Company from 1799 to 1827) have also been recovered in the midst of later utility line disturbance. In general, the mains were shallowly buried so that they could be tapped by firemen in the course of their duties, and sections of pipe have been found within 4 feet of the surface in Coenties Slip, west of the APE (Geismar 2005:1-3). Since wooden mains installation was discontinued in 1827, and the Company's official history declares that it was not until approximately 1836 that the system was extended north of City Hall, no wooden water mains should be expected in the APE north of the Brooklyn Bridge (Anonymous ca. 1913).

During archaeological monitoring conducted on Beekman Street between Water and Pearl Streets (about 2 blocks west of the APE) by Chrysalis Archaeological Consultants, archaeologist Alyssa Loorya has found that the top two feet of the Beekman Street corridor lack archaeological potential due to disturbance from the creation of the roadbed (personal communication, Alyssa Loorya to Cece Saunders and Richard Schaefer, September 12, 2006). Monitoring on Beekman has also found deposits or pockets of historical artifacts, between and around existing utility trenches that run beneath the two-foot depth of disturbance. The precise nature and depositional history of the Beekman Street materials have yet to be interpreted, although newspapers have

already reported the recovery of more than 3,000 historical artifacts (Hope 2006). Although Loorya has identified undisturbed deposits/features, including a foundation tentatively dated to ca. 1800, these have been recovered at approximately eight feet below grade, generally below existing utility line disturbance.

South Street Viaduct Construction (1951-1954) and Reconstruction (1980s)
Numerous column footings for the original 90 spans of the South Street Viaduct were constructed in South and Marginal Streets. At present, the clearest picture of the subsurface impacts from viaduct construction is a photograph from the Opening Day Program of the viaduct (Borough 1954), showing a completed column footing. The foundation extends substantially below the projected five-foot impact zone of the current project, but since the viaduct will not be removed, no new excavation is planned for the column locations. In area, disturbance from column footing construction extends approximately three feet or less around the existing columns.

During a site inspection (7/6/06), it was observed that more than one type of viaduct column is present in the APE, suggesting that additional columns were added or earlier columns replaced during reconstruction in the early 1980s. This was also noted in a newspaper article of 1980 (*New York Times* 1980). The impact and significance of these later columns to this project are assumed to be similar to that caused by the original construction in the 1950s.

Roadbed Construction
As noted in the discussion of buried utility disturbance, and important in this section of the APE in which the majority of proposed impacts are not expected to extend more than two feet below the current street surface, recent archaeological monitoring on Beekman Street has noted that the top two feet of the streetbed lack archaeological potential due to disturbance from the creation of the roadbed (personal communication, Alyssa Loorya to Cece Saunders and Richard Schaefer, September 12, 2006).

Areas of Potential Archaeological Sensitivity

The following section incorporates data on recorded subsurface disturbance episodes in each section of the APE, as well as the potential locations of archaeological resources. Sections of the segments within the APE boundaries that have been eliminated from further archaeological consideration are:

- **Areas filled post-1900:** Bulkhead construction by the Department of Docks along the shoreline in this part of the APE shoreline was completed in ca. 1900 and later. The replacement of old piers with new piers was roughly contemporary with bulkhead construction, while according to detailed maps of the shoreline dating from 1903 to 1910 (SSS 1903a; 1903b; 1907; 1910), real estate atlases from 1891 and 1905 (Bromley 1891; Sanborn 1905), and Department of Docks annual reports (e.g., Docks 1899; 1906; 1914) the filling and widening of South/Marginal Street lagged behind new bulkhead construction (see the Historical Overview section of this report for an extended discussion). Based on this cartographic and documentary evidence, those areas filled in ca. 1900 and later have been eliminated from further consideration for historical cultural

remains, since any resources in the impact zone of the APE would date from the first decades of the 20th century and are not considered to be significant.

- **FDR Drive Columns:** As noted above, FDR Drive column foundations penetrate beyond the proposed five-foot below surface impact zone for the pavilion sections of the APE. The original columns of the South Street Viaduct and added or replaced columns from the 1980s reconstruction would have destroyed archaeological potential in their locations, and approximately three feet around those locations. Since the viaduct columns will not be altered or removed by this project, their locations will receive no further evaluation.

For ease of evaluation, the part of APE Segment 7 discussed in this report—the inboard area north of the Brooklyn Bridge, to Montgomery Street—will be divided and analyzed in smaller sections.

North of the Brooklyn Bridge (former Roosevelt Street) to Catharine Slip West

Historical Period Usage

According to historical maps, the entire Segment 7 APE north of the Brooklyn Bridge was submerged beneath the waters of the East River when the first European settlers during the 17th century. The shoreline was irregular, along the north side of present South Street from James to Catharine Slips, but a deep cove indented the shoreline as far as north the line of Pearl Street, between Dover Street (west of this section of the APE) and James Slip (Viele 1865) (Figure 5). The cove was filled in as far as sections of present Front Street by 1797 (Taylor Roberts 1797), although no fill or the construction of piers and bulkheads had extended into this section of the APE at that time.

South Street was laid out as a 70-foot-wide street by 1798, when the Common Council ordered the proprietors of water lots along the future South Street from Coenties Slip to Catharine Slip to fill in the lots "with good wholesome Earth" by January 1799 (Stokes 1926:1,350). This, however, did not take place in the vicinity of Catharine Slip, since in 1815, South Street east of James Slip was noted as only 40 feet wide (MCC 1917:VIII 255).

The 1811 Commissioners Plan records South Street (labeled Front Street) extending through this part of the APE from Roosevelt Street to Catharine Slip, with only a break at James Slip (Commissioners 1811). In this part of the APE the map appears to be more of a projection than an accurate depiction, since the Common Council minutes record South Street ending at Dover Street in 1819 (MCC 1917:X 443). The 1811 map also includes areas of made land that are not corroborated by maps made more than 35 years later (Goodrich 1828; Desobry 1834; Alvord 1849) (Figures 13, 15).

East of James Slip, what was then Front Street, ordered built in 1814 (MCC 1917:VIII 28), was renamed South Street, and ordered widened from its original 40 feet to 70 feet in 1815. The lot owners between James and Catherine Slips were ordered to build a new bulkhead 30 feet to the south by May 1816 (MCC 1917:VIII 255). Catharine Slip was ordered filled in and bulkheaded along the southern line of South Street in 1814 and 1829, and the same was done regarding James Slip in 1830 (MCC 1917:VII 785, XVIII 137-138, 619-620).

West of James Slip, a solution to the extension of South Street east of Dover Street was more complex. The natural eastward curve of the Manhattan shoreline in this area created a difficulty in extending both Front and South Streets further uptown, since the lines of the streets, if continued, would meet at James Slip (Goodrich 1828). The Common Council resolved to continue South Street east to the pier at the foot of Roosevelt Street in 1819, and ordered the owners of the water lots to have the bulkhead made (MCC 1917:X 443-444, 502). This still left a sharp turn to the north at Roosevelt Street in order to continue eastward along South Street (Desobry 1834; Disturnell 1835; Colton 1836). The quirk in the street layout was not rectified until between 1851 and 1857, when South Street was finally extended east to James Slip, intersecting with Front Street, and creating a block-long triangular intersection between Roosevelt Street and James Slip (Dripps 1851; Harbor Commissioner 1857). This area was never lotted, it had been reserved by the City as a public slip as early as 1817, before it was filled in (MCC 1917:IX 257-258, X 444).

As surveyed in 1857, the intersection was 230 feet wide on the west side of Roosevelt Street, and narrowed to 106 feet at James Slip (Harbor Commissioner 1857), of which the southern 85 feet parallel with the modern bulkhead are within the current APE (and approximately 40 feet presently lie between the 19th century bulkhead and the modern bulkhead).

Beyond this intersection, the earliest actual measurements of South Street east of James Slip, completed in 1849 under the supervision of City Surveyor Daniel Ewen, showed that the wishes of the Common Council for a 70-foot-wide thoroughfare had been followed. South Street varied in width between 72.8 to 81.7 feet, from the north side of the street to the bulkhead along the south side (Alvord 1849) (Figure 15). This can be compared with the intended width of South Street, 70 feet, which was noted multiple times by the Common Council since construction at the southern tip of Manhattan began in the 18th century (City Surveyor 1817; MCC 1917: II 254, 260).

As described above, bulkhead construction during this period most likely used the cobb or cribwork method. This is further suggested by the phrase used in Common Council ordinances, which was often "sinking a Bulkhead" (E.g., MCC 1917:VIII 137, 619-620, X 444).

Piers and Wharves

The earliest recorded piers and wharves constructed within the section of the APE between Roosevelt Street and Catharine Slip were built along the south side of Front Street (renamed South Street in 1815) in ca. 1810, and also after its widening from 40 to 70 feet in ca. 1816 (Figure 13) (MCC 1917:VI 424, VIII 28, 255). Given the approximately 70-foot width of early South/Front Street, and the current width of South/Marginal Street of as much as 210 feet in the section west of Catharine Slip, much of the early pier locations is now filled in as part of the APE.

The six somewhat short piers were located: at the foot of Roosevelt Street; midway between Roosevelt and James Slip; on each side of James Slip; at the foot of Oliver Street; and on the west side of Catharine Slip (Goodrich 1828) (Figure 13). Given the early 19th-century period of their construction, they would have been built using the cobb/crib technique, with platforms

bridging the cells. Resolutions for lengthening the piers during this period recommend "adding a Block and Bridge" (MCC 1917:IX 769, XVIII 52, XIX 165).

As noted earlier, the Common Council reserved "the Basin or Slip between the foot of Roosevelt Street and James' Slip" as public property in 1819 (MCC 1917:X 390). The pier at the foot of Roosevelt Street within the APE marked the western boundary of the basin. It was in private hands, known as "Minturn & Champlin's Wharf," and mentioned as early as 1810. Benjamin F. Minturn and John T. Champlin requested a newly-improved parcel near the "New Slip" (James Slip), "with a wharf in the East River in front thereof" in December of that year (Ibid.: VI 424). Minturn & Champlin was an importer of British goods, and later a shipping and ship-owning concern, which operated throughout Europe and later the Pacific. The company suffered during the Napoleonic Wars, and the American embargos associated with them. It went out of business in 1815 (Proud n.d.). The wharf, which continues to be shown on maps during the 1830s (Colton 1836), is no longer shown by the 1840s (Disturnell 1838; USC&GS 1845). The creation of a pier slip in the same location by 1849 (Alvord 1849) (Figure 15), used by the Bridge Street Ferry in the 1850s (Harbor Commissioner 1857), suggests that the earlier cribworks were removed, and the location dredged. By the 1870s it had become part of Pier 29, extending to one of the Brooklyn Bridge abutments (Graham 1873; Bromley 1879).

Alvord's 1849 pier and wharf survey provides the standard pier numbering system which was valid until the construction of new piers in ca. 1900. The remaining five piers were numbered consecutively from 30 to 34. Pier 30, midway between Roosevelt Street and James Slip—the area reserved by the Council as a public basin—was proposed and approved by the Common Council in 1824 (MCC 1917:XIII 723), and is depicted on the 1828 map (Goodrich 1828). In the Alvord survey, it had been lengthened, and extended 308 feet beyond the bulkhead on south side of the street (Alvord 1849). By the 1850s the slip west of the pier was being used by the Bridge Street[8] Ferry (Harbor Commissioners 1857).

Piers 31 and 32, on the west and east sides of James (or New) Slip, were contracted for construction in 1813, and completed in ca. 1814 (MCC 1917:VII 599, 787). They were lengthened in 1830 with the addition of "a Block and Bridge to each" (MCC 1917:XIX 95, 165), resulting in piers 261.5 and 257 feet long, respectively (Alvord 1849) (Figure 15).

Pier 33, at the foot of Oliver Street, was ordered built in 1818, and planned as "three blocks and three bridges, making 190 feet" (MCC 1917:IX 769). A 70-foot extension with the addition of fourth block and bridge was authorized in 1830 (Ibid.:XIX 301). The 1849 Alvord survey records the completed 1830 extension, measuring Pier 33 as 255 feet long (Alvord 1849) (Figure 16).

Pier 34, at the west side of Catharine Slip, and serving the Catharine Ferry, was contracted by ordinance in 1814, when the ferry lessee, Rodman Browne, complained that the slip itself was not large enough to accommodate both the ferry and the market boats. The slip was ordered filled and a 130-foot pier ordered for each side (MCC 1917:VII 285, VIII 15). It was ordered extended with a "Block and Bridge" when the slip was again ordered to be filled in and bulkheaded in 1829 (MCC 1917:XVIII 138). In 1849 Pier 34 was recorded at 258.4 feet long

[8]Bridge Street is east of the Manhattan Bridge in Brooklyn.

(Alvord 1849) (Figure 16). It was lengthened an additional 90 feet to the pierhead line during the early 1850s (Dripps 1851; Harbor Commissioner 1857).

East River Bulkhead

The next major development in this portion of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. According to the Department's own 1873 map, the bulkhead project also involved substantial landfill along the river side of South Street. South Street was to be widened, and a Marginal Street added to provide pedestrian and vehicular access to the piers and bulkhead. As noted above, the proposed combined width was originally 200 feet, but this was modified to 150 feet to provide an additional 50 feet for piers in the somewhat narrow East River (*New York Times* 1895).

Few changes in this section of the APE were made during the 19th century, however, as early bulkhead work tended to take place further downtown. The 1879 atlas records the width of South Street as between approximately 73 and 78 feet between James and Catharine Slips, little different than it was in 1849 (Graham 1873; Bromley 1879). The last pier and wharf maps made in the early 20th century before modern bulkhead work was performed show the same area with a width to bulkhead of 83.5 feet (SSS 1903b, 1907).

The major alteration to the APE during the late 19th century was the construction of ferry terminals, waiting rooms, and warehouses outboard of the old crib bulkhead, south of what was then the southern line of South Street, yet within the current APE (Figure 21). These structures were built on the piers, on pile-supported platforms and "bridges" between the piers (Bromley 1879; Sanborn 1905; SSS 1903b, 1907). The proximity of the Roosevelt Street to Catharine Slip APE to Brooklyn and Long Island City made it a natural location for commuter ferries. The Williamsburg ferry occupied the slip to the west of Pier 30; the ferry to Broadway in Brooklyn used the slip between Piers 30 and 31, and a large terminal for passengers and freight had been erected along the north side of the two piers, from the line of Roosevelt Street to just west of James Slip. The ferry to Hunters Point, Long Island City docked in the slip between Piers 31 and 32 at the foot of James Slip, with its own terminal; and the Bridge Street Ferry, displaced by the construction of the Brooklyn Bridge abutment, employed the slip on the east side of Pier 32, also with a large building outboard of the South Street bulkhead. Pier 33 was leased by the Philadelphia & New York Steamship Co., and Pier 34 by Lorillard & Co., each with a structure covering most of the pier and extending to the southern line of South Street. Along the east side of Pier 34 was the slip of the Catharine Ferry, which also served Brooklyn, and had a structure built out beyond the bulkhead (Bromley 1879).

Department of Docks reports record bulkhead construction both to the west of this section of the APE (west of Dover Street) and to the east (east of Catharine Slip) between 1899 and 1904, but construction did not proceed in this section of the APE (Docks 1899:82, 115; 1906). It is probable that the City was reticent about disrupting the commuter ferries that were concentrated there. As late as 1906, expenditures for the area between Roosevelt and Catharine Slip had only proceeded as far as plans and land acquisition (Docks 1906:179, 213).

By the 1914 report, the bulkhead wall had been completed from the center line of Pier 31 west of James Slip, through the upper side of old Pier 33 at Oliver Street. Old Pier 33 had also been removed and replaced with new Pier 25. The only expenditures on the section from Oliver to Catharine were for plans and specifications, for the new Pier 26 (Docks 1914:172), which replaced old Pier 34 by 1919 (USC&GS 1919).

The remainder of the bulkhead work was completed between 1924 and 1938. Old 31 on the west side of James Slip was renamed Pier 22, and Old Piers 30 and 32 had been removed completely. A 1938 WPA utility map records the pier reconfiguration, as well as a combined South/Marginal Street width to the bulkhead at between 207 and 215 feet wide (measured at James and Catharine Slips) (USC&GS 1924; 1959; WPA 1936-1940).

Disturbance

Bulkhead Construction

Because of the great depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency." According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[9] Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead drawing (Figure 9) (Greene 1917:88-94). In this section of the APE, the impact of 20th-century bulkhead construction would have extended at least 42.5 feet north of the bulkhead, and to a depth of 35 to 40 feet below mhw.

Dredging

Dredging was and is a normal part of harbor and pier slip maintenance, which would have occurred within this part of the APE during the early 19th century. Accurate records of dredging, or even maps of pier slip depths prior to 1857 are not available, in order to document routine dredging impact in now-filled sections of the APE.

With the exception of "Minturn & Champlin's Wharf" at the foot of Roosevelt Street, which was removed, and certainly dredged for use as a pier slip during the late 1830s, no instances of pier removal and accompanying dredging within this part of the inboard APE can be documented until the early 20th century, when this procedure occurred at the same time as bulkhead construction.

Buried Utility Lines

Current and historical utilities in the sections of South Street/Marginal Street in this part of the Segment 7 APE are concentrated in the landward 38 feet of South Street, and especially immediately south of the present sidewalk. These include telephone ducts, a 5'x8' sanitary interceptor sewer, a 4' circular sewer (1888), a 12" water main (1884), a 16" high pressure water

[9]Greene's calculations were based on mean low water 4.85 feet below mean high water (mhw).

main, and 8" and 6" gas mains. In the remaining parts of South/Marginal Street to the south, a widely-spaced 16" high pressure water main and 30" water main (1932) run parallel to South/Marginal Streets (WPA 1939:45,76; ADP 2006; WMDM 2006).

A second concentration of utilities is in the southern part of the Wagner Place intersection. Here, most of the water mains in the northern (landward) part of South Street turn north and run perpendicular to South Street through the APE. Two electrical lines turn southward toward the river's edge, and a 6' sewer main and chamber runs down Wagner Place through South and Marginal Streets to the East River shore (WPA 1939:45).

A third concentration of utilities is in the former James Slip intersection, from about 350 to 430 feet east of Wagner Place, in addition to the mains running parallel with South/Marginal Street, this intersection has hosted a 4" water line and three 12" water mains, all running perpendicular to South Street, as well as four associated manholes. An electrical conduit also runs through the west side of the intersection (WPA 1939:45).

The fourth concentration of utility mains begins approximately 80 feet west of Catharine Slip, and extends east of Catharine Slip. A 6'3" sewer line (1870) cuts diagonally through the western end of this area, and then divides into two mains of the same diameter, turning south along the west side of the Catharine Slip intersection and crossing the Marginal Street onto former Pier 26 (Old Pier 34) (WPA 1939:45).

In the remainder of the South Street and Marginal Street sections of this portion of Segment 7, utilities are more widely spaced, but generally run along the old ca. 1900 shoreline. Running parallel with South Street are postal cable ducts, a 30"/48" water main (1932), and a 12" water main (1985/1963). An area of South and Marginal Streets (approximately 25'x225') within the ca. 1900 shoreline contains only a postal cable duct running through it, parallel to South Street, and an electric duct and telephone duct crossing perpendicular to South Street.

Current and historical utilities in Marginal Street at the filled location of former Pier 30 (at the foot of former Roosevelt Street, Bromley 1891; SSS 1903b) include a 30" water main (1932) crossing the pier head parallel with South Street, an electrical duct and manhole, and a <12" steam line extending onto the former pier location (WPA 1939:44, 45; ADP 2006; WMDM 2006).

Current and historical utilities in Marginal Street at the filled location of old Pier 31 (west side of former James Slip) and old Pier 32 (Bromley 1891; SSS 1903b; 1907) are limited to a 4" water main and an electrical conduit running perpendicular to the street. This leaves a large area extending from the ca. 1900 shoreline (east of the 30" water main of 1932) to the eastern edge of the segment, between Wagner Place and about 140 feet north of former James Slip, with almost no documented utility disturbance.

Current and historical utilities in Marginal Street at the filled location of old Pier 33 (at the foot of former Oliver Street, west of Catharine Slip; Bromley 1891; SSS 1903b; 1907) are limited to an electrical conduit manhole. Current and historical utilities in Marginal Street at the filled

location of old Pier 34 (west side of Catharine Slip) (Bromley 1891; SSS 1907) include two 6'3" sewer lines running perpendicular to the street through the pier location.

Potential Archaeological Sensitivity
Soil borings conducted within the APE between Roosevelt Street and Catharine Slip in 1950 provide a fairly consistent picture (WPA 1965 Sheet 5:#149-#168). A substantial fill stratum extends below the pavement generally to between 23 and 40 feet below mhw. Ten of the logs record timbers and wood in the fill stratum, and their locations are scattered throughout this section of the APE (#150, #152, #155, #156, #159-#161, #165, #167, #168) as would be expected in a location for which multiple episodes of bulkheading and pier construction have been recorded since the early 19th century. The timber/fill stratum generally extends to between 31 and 40 feet below mhw, indicating that this was the depth to a fairly hard sandy bottom, upon which wooden cribs could be sunk and stabilized. River mud and silt is recorded in the strata containing timbers, but does not appear in the stratum *below* the timbers,[10] which would be expected if the river bottom were dredged of mud prior to the sinking of the cribs. River silt/mud is found in only eight of 19 boring logs, amid the timber/fill, but only three logs record these deposits directly beneath a fill stratum (#149, #163, #168), pointing to the removal of river mud, probably by dredging, prior to filling activity in general.

Categories of potential archaeological resources in this section of the APE include submerged precontact resources; 19th-century landfill retaining structures, wharves and piers; 19th-century landfill; and 19th-century riverbottom remains.

Submerged Precontact Resources
Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected in the first few feet of the sandy, glacial till layer beneath river-deposited strata, such as mud and silt. This sandy stratum could represent the pre-inundation land surface of ca. 12,500 to 2,600 BP.

Although dredging episodes and depths have not been individually and specifically recorded, soil borings indicate that much of the river mud stratum in the Roosevelt Street to Catharine Slip section of the APE was removed in preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century, since historical fill and/or timbers rest directly on a sand stratum, the top of which ranges in depth between 32 and 40.1 feet below mhw.[11] If the river mud stratum has been removed by dredging, then the part of this sandy stratum which is potentially sensitive for precontact resources would have been adversely impacted .

The second major historical disturbance impact to potential precontact resources was the construction of the modern bulkhead. As noted above, dredging depth preparatory to bulkhead construction was from 35 to 40 feet below mhw, which would have severely impacted the potential pre-inundation surface in an area of the APE extending approximately 42.5 feet north of the current bulkhead.

[10]With the exception of #168, on the west side of Catharine Slip.
[11]A single boring (#158) records the sand stratum beginning at 47.4 feet below mhw.

If potential precontact, submerged archaeological resources had survived inundation, tidal action, and river currents, which is unlikely, they would have been removed or severely impacted by historical dredging and construction. No further study or testing for this potential resource is recommended.

Riverbottom Remains

Riverbottom remains, such as discards and losses from both the shore and from ships, would be expected within river mud and silt strata, some of which represent historical shoreline deposits which have accumulated after the construction of piers and wharves. Although as noted in the soil boring log review, dredging appears to have taken place prior to the construction of historic bulkheads and piers during the first half of the 19th century, soil borings identify a number of locations in which river mud and silt accumulated after the piers were complete. These potentially sensitive strata are noted between 23 and 39.5 feet below mhw.

Because preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw, and given the relative shallowness of the river mud recorded in the soil boring logs, this mud would have been removed prior to construction, eliminating potential sensitivity for this category of potential remains in the portions of the APE within 42.5 feet of the modern bulkhead.

The remainder of this section of the APE is potentially sensitive for riverbottom remains. These potential riverbottom resources are buried at least 23 feet below mhw. For recommendations, see the Conclusions section of this report.

Landfill Retaining Structures, Wharves, and Piers

Landfilling work for South Street as far uptown as Catharine Slip was first ordered in 1798, although Common Council Minutes indicate that bulkheading and filling in this section of the APE did not occur until ca. 1814, when the first 40-foot-wide section of South Street between James and Catharine Slips was built, widened to 70 feet after 1815. Further bulkheading and street construction continued the street from Roosevelt Street to James Slip in ca. 1819, and the triangular intersection east of Roosevelt Street was bulkheaded and filled in between 1851 and 1857.

Six historical piers were also constructed within the APE, between ca. 1810 and 1824, some earlier than the completion of the street itself. Therefore, their cribworks would have been preserved when the street was further filled and widened around them.

As noted in the soil boring log review , timbers were encountered in ten of 18 soil borings throughout this section of the APE, as would be expected. It is not possible to distinguish between landfill retaining devices and piers from soil borings, especially since many of the same techniques were used for both, and piers were often transformed into retaining structures. These timbers are present, however, occurring in fill and mud strata ranging between 4.4 feet above mhw (immediately beneath 1.5 feet of surface paving) and 40.1 feet below mhw.

Preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw. Given the relative shallowness of the cribworks recorded in the soil boring logs,

they would have been would have been removed prior to construction, as was standard practice (Docks 1914:172). This activity would have eliminated potential sensitivity for this category of potential remains in the portions of the APE within 42.5 feet of the modern bulkhead.

Utility installation would also have destroyed the upper sections of piers and landfill retaining devices in the remaining sections of the Roosevelt Street to Catharine Slip section of the APE, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed to depths greater than the five feet below the present surface that would be impacted by this project, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 40 feet below mhw). Unfortunately, utility maps do not provide the accuracy necessary to pinpoint these areas, as even the utility agencies do not rely on them to locate their own mains. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for buried landfill retaining structures, wharves, and piers, dating from ca. 1810 through the end of the 19th century. See the Conclusions section of this report for recommendations.

Landfill Deposits

As noted in the previous discussion, landfilling on present South Street as far uptown as Catharine Slip was first ordered in 1798, although Common Council Minutes indicate that bulkheading and filling in this section of the APE did not occur until ca. 1814, when the first 40-foot-wide section of South Street between James and Catharine Slips was built (widened to 70 feet after 1815). Further street construction on landfill continued the street from Roosevelt Street to James Slip in ca. 1819, and the triangular intersection east of Roosevelt Street was bulkheaded and filled in between 1851 and 1857.

Six historical piers were also constructed within the APE, between ca. 1810 and 1824, some earlier than the completion of the street itself. Therefore, their cribworks would have been filled at the time of their construction and then surrounded with later fill, as they were engulfed by the widening of the street beyond 70 feet by 1900.

Soil borings note "miscellaneous fill"—often with associated timbers which represent landfill retaining devices and piers—throughout this section of the APE. Historical fill ranges in depth from 4.4 feet above mhw (immediately beneath 1.5 feet of surface paving) to 40.1 feet below mhw. Although it is not possible to distinguish between primary landfill and secondary fill from the generalized descriptions provided by the available soil borings, secondary fill was earlier defined as extending from the surface to a few feet below mean low water, which in the APE is approximately 4.85 feet below mhw. The remaining strata of fill beneath the secondary fill would be considered primary landfill.

Preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw. Given the relative shallowness of the fill strata recorded in the soil boring logs, they would have been would have been removed prior to construction along with the cribworks, as was standard practice (Docks 1914:172). This activity would have eliminated potential sensitivity for this category of potential remains in the parts of the APE within 42.5 feet of the

modern bulkhead, and as noted earlier, any fill placed beyond the old 19th-century crib bulkhead during modern bulkhead construction would not be considered to have archaeological potential.

Utility installation also would have impacted the upper strata of landfill in the remaining sections of the Roosevelt Street to Catharine Slip section of the APE, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 40 feet below mhw).

Unfortunately, utility maps do not provide the accuracy necessary to pinpoint the areas of deep disturbance caused by utility installation, as well as to identify the small locations—often between and abutting buried mains—which may have archaeological potential. Even the utility companies and agencies do not rely on their own maps to locate their own mains, because they are not sufficiently precise; rather, they routinely excavate test pits for this purpose. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for historical landfill dating from ca.1810 through the end of the 19th century. See the Conclusions section of this report for recommendations.

Catherine Slip West to Rutgers Slip West

Historical Period Usage

According to historical maps, the entire Segment 7 APE north of the Brooklyn Bridge was submerged beneath the waters of the East River when the first European settlers during the 17th century. The shoreline was irregular, between the north side of present South Street at Catharine Slip, receding to the south side of present Water Street at Market Slip, and running along the north side of present Water Street from Market Slip to Rutgers Slip (Viele 1865) (Figure 5). South Street was laid out and ordered filled in 1798, but only as far as Catharine Slip (Stokes 1926:1,350), and east of James Slip it was only 40 feet wide in 1815, not its ordered 70 feet (MCC 1917:VIII 255).

The 1811 Commissioners Plan records South Street (labeled Front Street) extending through this part of the APE from Catharine Slip to Rutgers Slip, with breaks at Catharine Slip, Market Slip (then called George Slip), Pike Slip (then called Charlotte Slip), and Rutgers Slip (Commissioners 1811). The map appears to be more of a projection than an accurate depiction, since the Common Council minutes record South Street ending at Dover Street in 1819 (MCC 1917:X 443), and Front Street was not ordered built from James Slip to Market Slip until 1814 (MCC 1917:VIII 28). Front Street was renamed South Street and ordered widened from its original 40 feet to 70 feet in 1815 (MCC 1917:VIII 255).

Catharine Slip was ordered filled in and bulkheaded along the southern line of South Street in 1814 and again in 1829 (MCC 1917:VII 785, XVIII 137-138), although the 1828 Goodrich map already shows the Front (South) Street crossing the bulkheaded Catharine Slip, and extending to the west side of Market Slip. Beyond Market Slip West, the future South Street location was still under water (Goodrich 1828), as the bulkhead had only been built as far as Water Street, one block inland (MCC 1917:VII 587). Early piers along Water Street from Market Slip to Rutgers Slip only extended as far south as the north side of South Street, just outside the APE (Goodrich

1828) (Figures 13, 14). Between 1834 and 1836, South Street from Pike Slip West to Rutgers Slip East had been bulkheaded, still leaving gaps from Market Slip East to Pike Slip West. There, three already existing piers on Water Street had been extended into the APE between 1828 and 1836 (Desobry 1834; Colton 1836). All the gaps were filled, and South Street was finally completed to Rutgers Street by 1842 (Cohen and Augustyn 1997:118-119; USC&GS 1845).

The earliest actual measurements of South Street from Catharine to Rutgers Slip were completed in 1849 under the supervision of City Surveyor Daniel Ewen, showed that the wishes of the Common Council for a 70-foot wide thoroughfare had, in general, been followed. South Street varied in width between 61 to 87 feet, from the north side of the street to the bulkhead along the south side. The narrowest section was immediately east of Catharine Slip, which was between 61 and 68 feet wide, and the widest was east of Pike Slip, which was between 87 and 82 feet wide (Alvord 1849) (Figures 16-18).

Bulkhead construction during this period most likely used the cobb or cribwork technique. This is further suggested by the phrase used in Common Council ordinances, which was often "sinking a Bulkhead" (E.g., MCC 1917:VIII 137, 619-620, X 444).

Early Piers and Wharves

As of 1849, there were eleven piers extending from the south side of South Street, and in this section of the APE were numbered 35 through 43 (Alvord 1849). The earliest pier in this section of the APE, Pier 35, was built in 1814 along the eastern side of Catharine Slip a few months before Pier 34 on the western side. It was ordered by the Common Council at the same time it directed that the slip itself be filled and bulkheaded to the south side of 70-foot South Street. (MCC 1917:VII 785). The pier was originally 130 feet long, therefore extending through this section of the APE. By 1849 it had been lengthened substantially, to 319 feet (Alvord 1849) (Figure 16).

Pier 36, midway between Catharine Slip and Market Slip, was built between 1843 and 1849, when it is recorded as 309 feet long (USC&GS 1845; Alvord 1849) (Figure 17). A smaller, unnumbered pier is also recorded to the west, halfway between Piers 35 and 36 in 1857. Never identified, it was built after 1852, was still present in 1873 (Dripps 1852, 1867; Graham 1873), and was removed by 1879 (Bromley 1879).

Pier 37 was constructed on the west side of Market Slip between 1831 and 1836 (Colton 1836). The slip itself was noted in 1817, and a resolution to pave South Street between Catharine and Market Slips was passed in 1831 (MCC 1917:IX 70; XIX 619). The Alvord survey records the Pier 37 as 230 feet long in 1849 (Figure 17), and by 1852 it hosted two buildings, utilized by the Housatonic Railroad (Alvord 1849; Dripps 1852). It was extended to 359 feet long by 1857 (Harbor Commissioner 1857).

The early piers along the Market Slip to Pikes Slip section of the East River shoreline were built along the south side of Water Street during the first decades of the 19th century. This part of the shoreline hosted a number of shipbuilding and ships-repairing businesses as early as the 1760s (Cohen and Augustyn 1997:74-75), and they were still evident in the 19th century with the

presence of a screw or hydrostatic lifting dock, as well as sectional and balance dry docks. Initially, the associated piers did not extend into the line of South Street (Goodrich 1828) (Figure 13), but by 1834 three had been lengthened until they were partially within this portion of the APE.

Pier 38, along the east side of Market Slip, was first built on the south side of Water Street, between 1821 and 1828, although it was not long enough to reach the northern edge of the APE (MCC 1917: XII 14; Goodrich 1828) (Figure 13). The pier was lengthened by 1834, extending into this part of the APE, and by 1836 a short section was built at the tip of the pier (within the APE) extending westward into the mouth of Market Slip, parallel to Water and South Streets, giving the pier the shape of a backwards "L"(Desobry 1834; Colton 1836). This oddity was represented on subsequent maps in 1838, and possibly was related to the fact that Market Slip was being filled in (Bradford 1838). With the bulkheading and completion of South Street by 1842, the new Pier 38 was built by 1843, and extended across the APE and 200.2 feet into the East River, with no peculiar angles (USC&GS 1845; Alvord 1849) (Figure 17). The pier was lengthened to 350 feet between 1852 and 1857 (Dripps 1852; Harbor Commissioner 1857).

Pier 39, midway between Market and Pike Slips, was a pier built in 1828 by the Screw Dock Company, which had its premises on the adjacent block. It was proposed to be "used exclusively for the accommodation of Steam Boats," although the Common Council struck down that provision (MCC 1917:XVII 213). Since the block between Water and South Streets had not yet been filled in 1828, it would have been erected on the south side of Water Street, which helps clarify the Council's requirement that the pier, "to be composed of Block and Bridges . . . not extend into the river more than Two hundred and fifty feet beyond the Southerly line of South Street" (Ibid.). The pier is depicted on maps in 1834, 1836, and 1838, extending into the as-yet-unfilled northern 70 feet of present South Street (Desobry 1834; Colton 1836; Bradford 1838). With the extension of the shoreline completed by ca. 1843, a new 344-foot pier was built from the south side of South Street between 1843 and 1849. The 1849 Alvord survey records the pier and three related smaller piers to the east (Figure 17), which Dripps identifies as "Hydrostatic Lifting Docks" in 1851. In the slip immediately east of the dock, the slip between Piers 39 and 40, was the "Floating Ch[urch] of our Savior" (USG&GS 1845; Alvord 1849; Dripps 1852).

Pier 40 was originally constructed for the firm of Dunlap & Grant from the south side of Water Street, at the west side of Pike (formerly Charlotte) Slip in 1810. The Common Council had been ordering the water lot grantees to build the pier since 1804 (MCC 1917:III 452, IV 124, V 583, VI 324), but the piers were only "sunk and filled with stone to the low water mark" by August of 1810 (Ibid.:VI 324) (Figure 14). The pier did not reach into the APE until it was lengthened between 1828 and 1834, and was given an oddly angled tip extending to the southeast by 1836 (Goodrich 1828; Desobry 1834; Colton 1836). After the completion of South Street by 1842, the new Pier 40 was constructed with its base in the APE, and extending 341 feet into the East River by 1849 (Alvord 1849; Harbor Commissioner 1857) (Figure 18).

Pier 41, on the east side of Pike/Charlotte Slip, was built by Isaac Clason by 1804. It was 120 feet long, extending from the south side of Water Street (MCC 1917:III 452-453) (Figure 14). The pier did not reach the northern edge of the APE until it was lengthened between 1828 and 1834 (Goodrich 1828; Desobry 1834). By 1836, however, Pike Slip to Rutgers Slip had been

bulkheaded and filled, and the pier was removed, perhaps in preparation for the new pier, which was completed between 1838 and 1843 (Bradford 1838; USC&GS 1845). The Alvord Survey records a 331-foot-long pier extending through the APE and into the East River (Alvord 1849; Harbor Commissioner 1857) (Figure 18).

Pier 42 was midway between Pike/Charlotte Slip and Rutgers Slip. Although a number of piers were constructed in this vicinity by 1828, none were extended into the APE (Figure 14). A new 342-foot-long pier was built with its base on South Street in the APE between 1843 and 1849 (USC&GS 1845; Alvord 1849) (Figure 18). Between 1847 and 1852, a balance dry dock was constructed in the pier slip to the west of Pier 42, and a sectional dry dock appears on the slip on the east side. Both were partially within the APE. These floating dry docks persist until at least 1891, but no longer appear on maps by 1905 (Bromley 1891; Sanborn 1905) (Figure 22).

The "propriety" of building a pier (Pier 43) along the west side of Rutgers Slip was discussed and approved by the Common Council in 1810 (MCC 1917:VI 205). Water Street, however, was not completed in this location until ca.1816, when the water lot grantees were ordered to build wharves and piers "to the southerly line of South Street" (and therefore into the APE) by May 1817 (MCC 1917:VIII 587). Only one pier, a large, backwards L-shaped construction on the west side of Rutgers Slip, extended that far south, and is recorded partially in the APE in 1828 (Goodrich 1828) (Figure 14). The pier was rebuilt with the completion of South Street between Pike and Rutgers Slips between 1834 and 1836, although the L-shape was retained (Colton 1836; USC&GS 1845). Pier 43 was lengthened again by 1849 with the addition of another straight section, creating an irregular, zigzag-shaped pier which extended 334 feet into the East River, with its base in the APE (Alvord 1849; Harbor Commissioner 1857) (Figure 18). Between 1847 and 1852, a sectional dry dock was constructed in the pier slip to the west of Pier 43, partially within the APE. This floating dry dock persists until at least 1891, but no longer appears on maps by 1905 (Bromley 1891; Sanborn 1905) (Figure 22).

East River Bulkhead

The next major development in this part of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. According to the Department's own 1873 map, the bulkhead project also involved substantial landfill along the river side of South Street. South Street was to be widened, and a Marginal Street added to provide pedestrian and vehicular access to the piers and bulkhead. As described above, the proposed combined width was originally 200 feet, but this was modified to 150 feet to provide an additional 50 feet for piers in the somewhat narrow East River (*New York Times* 1895).

Few changes in this section of the APE were made during the 1870s and 1880s, however, as early bulkhead work tended to take place further downtown. The 1879 atlas records the width of South Street as between approximately 70 and 91 feet between Catharine and Rutgers Slips, slightly wider in some locations than it was in 1849 (Alvord 1849; Graham 1873; Bromley 1879) (Figures 16-18).

The major alteration to the APE during the late 19th century was the construction of a number of piersheds and warehouses outboard of the old crib bulkhead, south of what was then the southern line of South Street, yet within the current APE (Figures 21, 22). These structures were built on the piers, bridging between piers, and on pile-supported platforms adjacent to the piers (Bromley 1879; Sanborn 1905; SSS 1907). The Catharine Ferry to Brooklyn docked in the slip to the west of Pier 35, with a large passenger waiting room at the foot of the former slip by the 1850s, and still present in 1906 (Dripps 1852; SSS 1907). The Bridgeport Steamship Line occupied Pier 35 on Catherine Slip East, and its building dating from the 1870s abutted the Catharine Ferry terminal structure (Bromley 1879). The foot of the slip between Piers 35 and 36 was the location of the Long Island Rail Road freight building in 1879, but this was taken over by the Central Vermont Railroad and Steamship Line by the 1890s, which also occupied the west side of Pier 36, which it shared with Lawrence, Son & Gerrish, proprietors of U.S. Bonded Warehouses on the east side of the pier (Bromley 1879, 1891).

Pier 37 was a City pier at Market Slip West with no structure on it, and Pier 38 at Market Slip East was used by the Maine Steamship Line, which erected a small building at the head of the slip along its western side during the 1880s (Bromley 1879, 1891). Pier 39, the pier of the New Bedford & New York Steamship Line, later the "Old Colony Steamboat Line," had a small structure on its west side at the head of the slip by the 1870s (Bromley 1879). To the east of Pier 39, the screw or hydrostatic docks were still present in the 1890s, as was the floating church adjacent to Pier 40 (Bromley 1891) (Figure 22). Pier 40 on Pike Slip West was used by the Mediterranean Steamship company during the 1870s, but passed to the New York and Northern Railroad by the 1890s. A small building was erected at the foot of Pike Slip on the eastern side of the pier in the 1880s (Bromley 1879, 1891).

The remaining piers—Piers 41, 42, and 43, from Pike Slip East to Rutgers Slip West—were City piers, with few or no structures. The slips still contained three dry docks in the 1890s: one on the western side of Pier 42, one on its eastern side, and one on the western side of Pier 43 (Bromley 1879, 1891) (Figure 22).

With modern bulkhead construction between Catharine and Rutgers Slips, all of these additional structures within and straddling the old bulkhead within the APE were removed. Department of Docks reports record bulkhead construction commencing before 1899, beginning with the replacement of old Pier 35 with new Pier 27, at the foot of Catharine Slip East, and the preparation for the construction of new Piers 31, 32, and 33 (roughly between Pike Slip West and Rutgers Slip West) which included the removal of old Piers 40 to 43 and the dredging of their sites and adjoining slips to between 30 and 37 feet below mhw (Docks 1899:82, 115, 212).[12] By 1905, Old Pier 36, midway between Catharine and Market Slips, was the only 19th-century pier remaining (Sanborn 1905), and after the standard removal of "old work," dredging, and the laying of a riprap foundation, it was replaced with new Pier 28 by 1906 (Docks 1906:179-181). Only the old crib bulkhead across Catharine Slip (width 100 to 112 feet), and a small section west of Market Slip (width 71 to 74 feet) remained in 1906 (SSS 1907). By the 1914 report, the bulkhead wall had been completed in this section of the APE, creating a South/Marginal Street

[12]The construction of the concrete platform and masonry pier for the Manhattan Bridge that is at the foot of Pike Slip began in ca. 1903, after the adjacent section of the modern bulkhead was completed. It lies outside the APE (SSS 1907).

with a combined width of 125 feet. The years' expenditures were mainly confined to the paving of the new Marginal Street (Docks 1914:173-174; USC&GS 1919).

Disturbance

Bulkhead Construction

Because of the great depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency." According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, thus, approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[13] Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead drawing (Figure 9) (Greene 1917:88-94). In this section of the APE, the impact of 20th-century bulkhead construction would have extended at least 42.5 feet north of the bulkhead, and to a depth of 35 to 40 feet below mhw.

Dredging

Dredging was and is a normal part of harbor and pier slip maintenance, which would have occurred within this part of the APE during the early 19th century. Accurate records of dredging, or even maps of pier slip depths prior to 1857 are not available to document routine dredging impact in now-filled sections of the APE.

No instances of pier removal and accompanying dredging within this part of the inboard APE can be documented until the late 19th and early 20th century, when this procedure occurred at the same time as bulkhead construction. Recorded depths of dredging in 1899 along the old crib bulkhead at Rutgers and Pike Slips were between 30 and 37 feet below mhw (Docks 1899, 1906).

Buried Utility Lines

Current and historical utilities which run the length of the northern 75 feet of the streetbed include a 16" high pressure water main and a 30" water main (1932), both of which run parallel to South/Marginal Streets. Also in this northern part of the streetbed is a 5'x8' sanitary interceptor sewer (Market Slip to Clinton Street), a <24" water main (Market through Rutgers Slips), and a telephone duct (Pike to Rutgers Slips); In Marginal Street—along the old 1900 shoreline/old bulkhead line—is a 30" water line (sections 1932, 1952, 1991) that runs from Market through Rutgers Slips (WPA 1939:45,76,79; ADP 2006; WMDM 2006).

A second concentration of utility mains begins approximately 80 feet west of Catharine Slip and extends to Market Slip. The current drainage plan (ADP 2006:4GC) records a 7'x8' interceptor sewer in this location, indicating that the original 5'x8' line recorded at Market Slip on the WPA maps has been upgraded.

[13]Greene's calculations were based on mean low water 4.85 feet below mean high water (mhw).

Additional lines running perpendicular to the street appear in the Catharine and Market Slip intersections. In the Catharine Slip intersection are three <24" water lines and an electrical conduit. In the Market Slip intersection are three small water lines with four associated manholes, an electrical conduit and a manhole, and a sewer regulator chamber (approximately 26'5"x19') with a 54" sewer line running from Market Slip across the segment and onto former Pier 29. The section of this main from the chamber to the pier shown on the WPA maps was subsequently replaced by a 6'3"x4'6" sewer line in the same location. The 30" water main which traverses the rest of this part of Segment 7 was rerouted through the intersection to the south of the chamber in 1952.

No current or historical utilities have been recorded in Marginal Street at the filled locations of former Piers 35 (east of Catharine Slip) and 36 (west of Market Slip; Bromley 1891; SSS 1907).

Current and historical utilities in Marginal Street at the filled location of former Piers 37 (west side of Market Slip) and 38 (east side of Market Slip) (Bromley 1891; SSS 1907) are limited to a 54" sewer line running perpendicular to the street through the old pier location. This line was discontinued, and a 6'3"x4'6" sewer line is also recorded in the same location.

At the filled locations of old Piers 39 through 43, the only recorded utility is the 30" water main along the old bulkhead line at the northern edge of Marginal Street from Market to Rutgers Slips, mentioned in the first paragraph.

The remaining parts of this portion of Segment 7 contain small diameter water mains (some are connections to fire hydrants) and electrical conduits, but these are too widely spaced (i.e., 15 feet or more apart) and shallow (electrical conduits) to eliminate areas of potential archaeological sensitivity.

Potential Archaeological Sensitivity
Soil borings conducted within the APE from Catharine Slip to Rutgers Slip in 1950 provide a fairly consistent picture (WPA 1965 Sheet 5:#169-#172, Sheet 10:#79-#116). A substantial fill stratum extends below the pavement to between 18.5 and 55.7 feet below mhw. Eighteen of the logs record timbers in and below the fill stratum (an additional 7 note "wood"), and their locations are scattered throughout this section of the APE, as would be expected in a location for which multiple episodes of bulkheading and pier construction using timber cribs have been recorded since the early 19th century. Three logs (#91, #94, and #106) note combinations of timbers and boulders, in what appears to be a classic description of logs cribs and their fill; a fourth (#99) records timber and riprap. These strata extend to more than 50 feet below mhw, directly onto sand, suggesting that the bottom was dredged of mud and prepared for the crib sinking. The exception (#91) has timber and boulders to a depth of -34.4 feet below mhw, and has 11 feet of river mud/silt beneath it, an indication that crib sinking was not done in a uniform manner for each water lot or pier. In several locations there is evidence of multiple fill sources: two fill strata separated by a sand (#92, #96) layer, or a silt layer (#90, #108) indicating that fill operations halted and started again after a long time period in which silt could accumulate.

Not surprisingly, the deepest fill strata, to depths greater than 50 feet below mhw, tend to rest directly on sand, with the bottom of the deepest mud/silt strata ranging from about 40 feet to as

much as 65.7 feet below mhw. This would suggest that the sand beneath this river mud could represent the preinundation ground surface now below the waters of the East River.

Categories of potential archaeological resources in this section of the APE include submerged precontact resources; 19th-century landfill retaining structures, wharves and piers; 19th-century landfill; and 19th-century riverbottom remains.

Submerged Precontact Resources

Since they would pre-date the inundation of the APE, potential precontact archaeological resources would be expected in the first few feet of the sandy, glacial till layer beneath river-deposited strata, such as mud and silt. This sandy stratum could represent the pre-inundation land surface of ca. 12,500 to 2,600 BP.

Dredging episodes and depths have not been individually and specifically recorded, but soil borings logs indicate that although some of the river mud stratum in the Catharine Slip to Rutgers Slip section of the APE has been removed during the preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century, much of it remains, extending to depths between 35.7 and 65.7 feet below mhw. The sandy stratum beneath this river mud may represent the preinundation land surface.

A second major historical disturbance impact to potential precontact resources that could exist on this possible land surface was the construction of the modern bulkhead. As noted above, dredging depth preparatory to bulkhead construction was from 35 to 40 feet below mhw, which may have severely impacted the potential pre-inundation surface in an area of the APE extending approximately 42.5 feet north of the current bulkhead. Although this depth of dredging may have adversely impacted some areas of the potential preinundation surface, the great depth of the top of this possible surface (greater than 35.7 to 65.7 feet below mhw) indicates that many areas may have survived within this section of the APE.

If potential precontact, submerged archaeological resources have survived inundation, tidal action, and river currents, which is unlikely, this section of the APE is potentially sensitive for deeply buried precontact archaeological resources. For recommendations, see the Conclusions section of this report.

Riverbottom Remains

Riverbottom remains would be expected within river mud and silt strata, some of which represent historical shoreline deposits which have accumulated after the construction of piers and wharves. Although routine dredging would have taken place prior to the construction of historic bulkheads and piers during the first half of the 19th century, soil borings identify a number of locations in which river mud and silt has accumulated, apparently dating to both before construction of the piers and after the piers were completed. These potentially sensitive strata are noted as beginning between 18.5 and 55.7 feet below mhw.

Because preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw, and given that the recorded pier channel depths in 1857 in this part of the APE are all shallower than 30 feet below mhw, it is unlikely that 19th century riverbottom

remains would have extended beyond these depths. Therefore this potentially sensitive stratum would have been removed prior to construction, eliminating potential sensitivity for this category of potential remains in the parts of the APE within 42.5 feet of the modern bulkhead.

The remainder of this section of the APE, however, would be potentially sensitive for 19th-century riverbottom remains. For recommendations, see the Conclusions section of this report.

Landfill Retaining Structures, Wharves, and Piers

Landfilling work for South Street (then Front Street in this part of the APE) from Catharine Slip West to Market Slip West was first ordered in 1814. Further bulkheading and street construction continued the street from Market Slip West to Pike Slip West between 1838 and 1842, and from Pike Slip West to Rutgers Slip West in the period 1834 to 1836.

Eleven historical piers were also constructed within the APE, between ca. 1814 and 1859, some earlier than the completion of the street itself, and therefore their cribworks would have been preserved when the street was further filled and widened around them.

As noted in the soil borings log review, timbers and wood were encountered in 25 of 42 soil borings throughout this section of the APE, as would be expected. Three logs (#91, #94, and #106) note combinations of timbers and boulders, the components of log cribs and their fill. It is not possible to distinguish between landfill retaining devices and piers from soil borings, especially since many of the same techniques were used for both, and piers were often transformed into retaining structures. These timbers are present, however, occurring in fill and mud strata ranging between 3.2 feet above mhw (immediately beneath 1.5 feet of surface paving) and 56 feet below mhw.

The area of the Catharine to Rutgers Slips section of the APE beyond the limits of the late 19th century bulkhead would not be considered sensitive for this 19th-century resource, since landfilling did not occur here until the modern bulkhead was constructed. Preparation for the construction of the modern bulkhead involved dredging and removal of river mud and old cribworks prior to construction, as was standard practice (Docks 1914:172). This activity would have eliminated potential sensitivity for this category of potential remains in this area of the APE. Since 19th-century South Street varied from 61 to 87 feet wide, and the modern bulkhead is at 125 feet, this non-sensitive area varies between approximately 38 and 64 feet north of the bulkhead.

The installation of underground utilities would also have destroyed some of the upper sections of piers and landfill retaining devices in the remaining sections of the Catharine Slip to Rutgers Slip section of the APE, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed to depths greater than the five feet below the present surface that would be impacted by this project, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 56 feet below mhw).

Unfortunately, utility maps do not provide the accuracy necessary to pinpoint the areas of deep disturbance caused by utility installation, as well as to identify the small locations—often

between and abutting buried mains—which may have archaeological potential. Even the utility companies and agencies do not rely on their own maps to locate their own mains, because they are not sufficiently precise; rather, they routinely excavate test pits for this purpose. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for buried landfill retaining structures, wharves, and piers, dating from ca.1814 through the end of the 19th century. See the Conclusions section of this report for recommendations.

Landfill Deposits

As noted in the previous discussion, landfilling work for South Street (then Front Street in this part of the APE) from Catharine Slip West to Market Slip West was first ordered in 1814. Further bulkheading and street construction continued the street from Market Slip West to Pike Slip West between 1838 and 1842, and from Pike Slip West to Rutgers Slip West in the period 1834 to 1836.

Eleven historical piers were also constructed within the APE, between ca. 1814 and 1859, some earlier than the completion of the street itself, and therefore their cribworks would have been preserved when the street was further filled and widened around them.

Soil borings note "miscellaneous fill"—often with associated timbers which represent landfill retaining devices and piers—throughout this section of the APE. Historical fill ranges in depth from 3.2 feet above mhw (immediately beneath 1.5 feet of surface paving) to 60.6 feet below mhw. Except for the three out of 42 logs (#91, #94, and #106) which note combinations of timbers and boulders, the components of logs cribs and their primary landfill, it is not possible to distinguish between primary landfill and secondary fill from the generalized descriptions provided by the available soil borings. Secondary fill was earlier defined as extending from the surface to a few feet below mean low water, which in the APE is approximately 4.85 feet below mhw. The remaining strata of fill beneath the secondary fill would be considered primary landfill.

The area of the Catharine to Rutgers Slips section of the APE beyond the limits of the late 19th century bulkhead would not be considered sensitive for this 19th-century resource, since landfilling did not occur here until the modern bulkhead was constructed. Since 19th century South Street varied from 61 to 87 feet wide, and the modern bulkhead is at 125 feet, this non-sensitive area varies between approximately 38 and 64 feet north of the bulkhead.

The installation of underground utilities would also have adversely impacted some of the shallowest landfill deposits in the remaining sections of the Catharine Slip to Rutgers Slip section of the APE, depending on the size of the main and the depth to which it was installed. Although some areas of potential sensitivity may have been destroyed to depths greater than the five feet below the present surface that would be impacted by this project, buried utilities could not have completely eliminated potential sensitivity for this category of remains, given their great depth (basically from the surface to as much as 60 feet below mhw).

Unfortunately, utility maps do not provide the accuracy necessary to pinpoint the areas of deep disturbance caused by utility installation, as well as to identify the small locations—often between and abutting buried mains—which may have archaeological potential. Even the utility

companies and agencies do not rely on their own maps to locate their own mains, because they are not sufficiently precise; rather, they routinely excavate test pits for this purpose. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for historical landfill dating from ca.1814 through the end of the 19th century. See the Conclusions section of this report for recommendations.

Rutgers Slip to Montgomery Street

Historical Period Usage

The early historical shoreline in this section of the APE lay along the northern side of Water Street from Rutgers Slip to Clinton Street, and from Clinton to Montgomery Streets was slightly north of the northern side of South Street (Viele 1865) (Figure 5). During the late 18th century there were a number of shipyards extending along the shoreline up to Corlears Hook. The presence of the shipyards seems to have obstructed the construction of streets in the vicinity. In 1826, remonstrance was presented to the Common Council against the opening of Water Street (one block north of South Street) from Clinton Street to Corlears Hook, because it would "be the cause of breaking up the Ship Yards which afford employment and profit to so many of the Citizens in that portion of the City" (MCC 1917:XV 216). Apparently the remonstrance went unheeded, since by April 1828, the Council was entertaining a petition to open Front (now South) Street from Clinton to Corlears Street (Ibid,:XVII 101), and the section of the APE from Clinton Street to Montgomery Street appears on maps by 1828 (Goodrich 1828) (Figure 14).

It is probable that the Rutgers Slip to Clinton Street portion of South Street was bulkheaded and filled later than the adjacent sections based on a combination of the topography and because it was adjacent to the Rutgers Estate, which basically blocked east/west public traffic near the shoreline (Directory 1789). In 1817, Col. Henry Rutgers requested the water lot grant from Rutgers to Clinton Streets, and was given the grant to the north side of future South Street, which was to be 70 feet wide when it was built. The Common Council reserved the shoreline there for a public basin (MCC 1917:IX 70, 231, 234). Despite this early activity, South Street was not opened from Rutgers Slip to Clinton Street until 1831 (MCC 1917:XIX 678-679). The last section of South Street to be filled was Rutgers Slip itself, an operation which was completed between 1838 and 1843 (USC&GS 1845).

Based on the 1849 Alvord Survey, South Street was between 68 and 76 feet wide up to Clinton Street West, but at the Clinton/South Street intersection it had been widened to between 107 and 108 feet as far as the east side of Montgomery Street (Figures 19, 20). A street widening had been advised for this stretch of South Street in 1831 (MCC 1917:XIX 678-679), and an earlier survey performed for the Common Council shows the street here as already 70 feet wide with additional filled areas to the south, which appear to be three stubby piers separated by two short slips (four and three respectively in 1836 (City Surveyor 1817; Colton 1836). These locations were incorporated into the widened South Street by 1838 (Bradford 1838; Alvord 1849).

Early Piers and Wharves

The pier on the east side of Rutgers Slip was noted as out of repair as early as 1809, but this pier must have been built on the south side of Cherry Street (MCC 1917:V 683). Another pier was ordered built in 1816, and is shown there in 1828, on the south side of Water Street, but according to maps, like its predecessor it was not long enough to extend into the APE (Goodrich

1828; MCC 1917:VIII 625) (Figure 14). With the completion of South Street along Rutgers Slip East in 1831, a pier was extended from the south side of the 70-foot-wide street between 1834 and 1836 (Desobry 1834; Colton 1836), and eventually labeled Pier 44. As surveyed in 1849, Pier 44 was 250 feet long, with its base in the APE (Figure 19). Based on the time period of its construction, the crib/cobb method would have been used.

Pier 45, midway between Rutgers Slip and Jefferson Street, was a short pier built from the south side of South Street with its base in the APE, between 1834 and 1836 (Desobry 1834; Colton 1836). By 1849 it had been lengthened to 316 feet (Alvord 1849) (Figure 19). Based on the time period of its construction, the crib/cobb method would have been used.

Pier 46 was at the foot of Jefferson Street, built from the south side of South Street with its base in the APE, between 1834 and 1836 (Desobry 1834; Colton 1836). By 1849 it had been lengthened to 340 feet (Alvord 1849) (Figure 19). Based on the time period of its construction, the crib/cobb method would have been used. The slip immediately to the east hosted a balance dry dock built between 1849 by 1852, and which appears on maps until the 1860s (Alvord 1849; Dripps 1852; Dripps 1867).

Pier 47 was built midway between Jefferson and Clinton Streets between 1849 and 1852. It originally appears as a future construction on the Alvord Survey in 1849 (Figure 19). The pier, extending from the south side of South Street with its base in the APE, was 356 feet long (Alvord 1849; Dripps 1852).

Pier 48 was constructed at the foot of Clinton Street between 1828 and 1836 (Goodrich 1828; Colton 1836). The Alvord Survey depicts the pier extending 282 feet into the East River from the Clinton/South Street intersection, at a point where South Street was 76 feet wide on the west side, and 108 feet wide on the west side (Figure 19). Between 1852 and 1857, the pier was lengthened an additional 72 feet (Alvord 1849; Dripps 1852; Harbor Commissioner 1857).

Pier 49 was built about 120 feet east of Clinton Street between 1843 and 1849, when it is recorded as 326 feet long, extending from the south side of South Street at a point at which the street was 108 feet wide (Alvord 1849) (Figure 20). By 1852 a balance dry dock had been constructed in the pier slip on the west side of Pier 49, and the dry dock appears on subsequent maps through the 1860s (Dripps 1867; Bromley 1879).

East River Bulkhead

The next major development in this part of the APE was the construction of the modern bulkhead system, under the program begun in 1871 by the New York City Department of Docks. The bulkhead eventually defined the present southern boundary of this segment of the APE. According to the Department's own 1873 map, the bulkhead project also involved substantial landfill along the river side of South Street. South Street was to be widened, and a Marginal Street added to provide pedestrian and vehicular access to the piers and bulkhead. The proposed combined width was originally 200 feet, but this was modified to 150 feet to provide an additional 50 feet for piers in the somewhat narrow East River (*New York Times* 1895).

Few changes in this section of the APE were made during the 1870s and 1880s, however, as early bulkhead work tended to take place further downtown. The 1879 atlas records the width of South Street at about 80 feet at Rutgers Slip, approximately 70 feet from Rutgers Slip East to Clinton Street, and more than 100 feet wide from the east side of Clinton Street eastward, not appreciably different than it was in 1849 (Alvord 1849; Bromley 1879) (Figures 19, 20).

Several structures were erected between piers on the outer side of the old bulkhead in the last decades of the 19th century. Part of the reason for the small number of structures was that Piers 44, 46, and 48 were public piers in 1879. This had changed slightly in 1891, by which time the New England Freight Line was occupying both Piers 45 and 46, and had constructed a covered platform on piles between the base of each pier in the APE outside the old crib bulkhead (Bromley 1891; SSS 1907) (Figure 23). The company was later the New York, New Haven & Hartford Railroad Co.

The other building in this part of the APE was the freight depot of the New York, New Haven & Hartford Railroad Co., erected in the 1880s in the basin along the west side of Montgomery Street, east of Pier 49, and extending 180 feet along the south side of the old crib bulkhead, and about 90 feet along the west side of Montgomery Street (Bromley 1891; SSS 1910) (Figure 23).

Department of Docks reports record the new bulkhead wall completed at Rutgers Slip, as well as the removal of old Pier 44 and the construction of new Pier 34 in 1899 (Docks 1899:82, map n.p). Preparation involved the removal of the old works and dredging to 30 feet below mhw (Ibid.:212). By 1906, the bulkhead wall and new piers had been completed from Rutgers Slip to Montgomery Street, with the exception of the section between Rutgers Slip East and Jefferson Street (Docks 1906:181). As late as 1914, only plans for new Pier 35, which was to replace old Piers 45 and 46. had been drawn up (Docks 1914:174), and the new Pier 35, along with the remaining section of bulkhead, was not completed until after 1924 (USC&GS 1924; 1959).

Disturbance

Bulkhead Construction

Because of the great depth of mud—in some places up to 170 feet deep—along the Manhattan shoreline, the bulkhead had to rest on piles, even though the piles could not extend to the hard bottom in all cases. According to Greene, the river mud was dredged "for a width of about 85 feet to a depth of 30 feet, more or less, depending on the consistency." According to Greene's schematic drawings (Figures 9, 10), this width of dredging extended an equal distance on each side of the proposed bulkhead, therefore, approximately 42.5 feet into the area of the APE on present South/Marginal Street, and to a depth of 35 to 40 feet below mhw.[14] Into that dredged surface the piles were driven, and the open spaces filled in with cobbles and riprap, to serve as a base and support for the concrete and masonry bulkhead. The new street area would have been further filled with "earth, ashes, &c." as Greene notes in his 1876 bulkhead drawing (Figure 9) (Greene 1917:88-94). In this section of the APE, the impact of 20th-century bulkhead construction would have extended at least 42.5 feet north of the bulkhead, and to a depth of 35 to 40 feet below mhw.

[14]Greene's calculations were based on mean low water 4.85 feet below mean high water (mhw).

Dredging

Dredging was and is a normal part of harbor and pier slip maintenance, which would have occurred within this part of the APE during the early 19th century. Accurate records of dredging, or even maps of pier slip depths prior to 1857, are not available to document routine dredging impact in now-filled sections of the APE.

No instances of pier removal and accompanying dredging within this part of the inboard APE can be documented until the late 19th and early 20th century, when this procedure occurred at the same time as bulkhead construction. The recorded depths of dredging in 1899 along the old crib bulkhead at Rutgers Slips was 30 feet below mhw (Docks 1899).

Buried Utility Lines

Current and historical utilities which run parallel to the street in this part of Segment 7 (WPA 1936:76,79; 1937:80,82; ADP 2006; WMDM 2006) are as follows: in South Street: a 5'x8' sanitary interceptor sewer (Market Slip to Clinton Street), a 30" water main (Jefferson to Clinton Streets); and in Marginal Street (at the ca. 1900 shoreline/old bulkhead line), a 8'x7'6" sanitary interceptor sewer (Clinton to Montgomery Streets).

Aside from these utility lines, concentrations of buried utilities within the streetbed are confined to small areas of several intersections, where mains running perpendicular to South Street meet the existing mains on South and Marginal Streets. At "new" Pier 35 west of Jefferson Street, a 5'9"x11'9" circular sewer runs north/south across the APE to the pier; two 12" water mains extend across South Street and south onto the pier as well.

At Clinton Street, the 30" water main described above cuts northeastward through the intersection from Marginal Street to the north side of South Street. A second 30" water main crosses Marginal and South Streets on the west side of Clinton Street, and a <12" water line cuts across Marginal and South Streets to a hydrant on the west side of Clinton Street. A cluster of three small water mains (5", 6", and 8", respectively) dating from 1884 run north/south across Marginal and South Streets along the east side of Clinton Street. Lastly, an electrical conduit and manhole extends south from Clinton Street into South Street. The center of the intersection appears to be free of recorded utility disturbance.

The remaining parts of this portion of Segment 7 contain small diameter water mains (some are connections to fire hydrants) and electrical conduits, but these are too widely spaced (i.e., 15 feet or more apart) and shallow (electrical conduits) to eliminate areas of potential archaeological sensitivity.

Current and historical utilities recorded in Marginal Street at the filled location of former Piers 45 (between Rutgers Slip and Jefferson Street) and 46 (foot of Jefferson Street) (Bromley 1891; SSS 1907) include two 30" water mains running through the pier locations parallel with the street. No current or historical utilities are recorded in Marginal Street at the filled location of former Piers 48 (foot of Clinton Street) and 49 (between Clinton and Montgomery Streets) (Bromley 1891; SSS 1907).

Potential Archaeological Sensitivity

Soil borings conducted within the APE from Rutgers Slip to Montgomery Street in 1950 illustrate a contrast between the eastern and western parts of this section, with the dividing line midway between Jefferson and Clinton Streets, i.e., about 160 feet west of present Clinton Street (WPA 1965 Sheet 10:#117, #118, Sheet 11:#65-#96). The boring logs from the western part, from Rutgers Slip to east of Jefferson Street show substantial fill strata extending from beneath the pavement to between -22.0 feet and 61.5 feet below mhw, with eight of the 16 logs showing timbers or wood (#117, #118, #67, #72, #75-#78). In only three instances (#66, #68, #72) is there a river mud/silt stratum beneath the fill layer, representing the shallowest fill depths (22.0 feet and 33.6 feet below mhw), and one case of river silt mixed with fill (#66). In the remaining logs, the fill stratum rest directly upon a sand or sand and gravel strata, which extend down to rock. The rock stratum is quite deep, generally over 100 feet below mhw, although it becomes shallower to the east of Jefferson Street, where it rises to 47.3 feet below mhw. This is not unexpected in a location that before filling would have been two blocks offshore. The lack of river mud/silt in the soil borings also suggests that much of that stratum was removed in preparation for the construction of the various piers and bulkheads built there during the 19th century.

East of this location, and continuing eastward to the west side of Montgomery Street, was an area much closer to the pre-fill/bulkheading shoreline, with very shallow rock depths (generally 32.3 feet to 45.1 feet below mhw, only declining to more than 50 feet below mhw at the edge of Montgomery Street), and high surface elevations (#79-#96). Whereas to the west surface elevations were rarely greater than 5.0 feet above mhw, here elevations rise as one moves eastward, from 5.3 feet above mhw west of Clinton Street, to a high of 9.3 feet above mhw near Montgomery Street, and also rise as one proceeds northward. This explains the discovery of a portion of old 1836 cobble pavement in 1952, approximately four feet below the then-current paving; regrading had raised the streetbed elevation since the 1830s.

In each of the 18 boring logs in this part of the APE, fill strata rest directly on a sand stratum, without any intermediate river mud or silt layer. In two cases (#81 and #82), fill strata appear to rest directly on rock. Timber is identified in both of those logs, and in general this scenario indicates that during one or more of the bulkheading/pier construction episodes that took place here, the general shallowness of the strata made it possible for the removal of large portions of the mud/silt and sand strata, even down to the rock, prior to the sinking of cribworks.

Categories of potential archaeological resources in this section of the APE include submerged precontact resources; 19th-century landfill retaining structures, wharves and piers; 19th-century landfill; and 19th-century riverbottom remains, i.e., ship and shore losses or discards.

Submerged Precontact Resources

Although dredging episodes and depths have not been individually and specifically recorded, soil borings indicate that much of the river mud stratum in the Rutgers Slip to Montgomery Slip section of the APE was removed in preparation of the riverbottom for the sinking of cribworks for piers and bulkheads during the first half of the 19th century, since historical fill and/or

timbers rest directly on a sand stratum, the top of which ranges in depth between 6.3 feet[15] and 46.2 feet below mhw. If the river mud stratum had been removed by dredging, then the part of this sandy stratum which is potentially sensitive for precontact resources would certainly have been adversely impacted as well.

The second major historical disturbance impact to potential precontact resources was the construction of the modern bulkhead. As noted above, normal dredging depth preparatory to bulkhead construction was from 35 to 40 feet below mhw. In areas of shallow rock, such as the section of the APE east of Jefferson Street, the new bulkhead could be built directly on rock, with the removal of all the intermediate strata. This preparation would have severely impacted the potential pre-inundation surface in an area of the APE extending approximately 42.5 feet north of the current bulkhead.

If potential precontact, submerged archaeological resources had survived inundation, tidal action, and river currents, which is unlikely, they would have been removed or severely impacted by historical dredging and construction.

Riverbottom Remains

Riverbottom remains would be expected within river mud and silt strata, some of which represent historical shoreline deposits which have accumulated after the construction of piers and wharves. Soil boring logs show only two instances of river mud/silt beneath a fill stratum out of 34 soil borings performed here. The history of this section of South Street may provide a clue as to the absence of silt/mud. Unlike other areas, no piers were constructed on the location of the street prior to its original bulkheading in the first half of the 19th century. Therefore, bulkheading activity took place in an area free of earlier structures, which would either have trapped silt/mud, or caused fill to be placed over or around them. This situation would also have facilitated the removal of river silt/mud prior to the sinking of cribs for the bulkheads.

Piers that occupied the South Street shorefront from Rutgers Slip to Montgomery Street during the 19th century may have caused the accumulation of riverbottom remains in the areas now within the modern bulkhead. Because preparation for the construction of the modern bulkhead involved dredging from 35 to 40 feet below mhw, and given that the recorded pier channel depths in 1857 in this part of the APE are all shallower than 28 feet below mhw, however, it is unlikely that 19th century riverbottom remains would have extended beyond these depths. Therefore this potentially sensitive stratum would have been removed prior to construction, eliminating potential sensitivity for this category of potential remains in the parts of the APE within 42.5 feet of the modern bulkhead.

Landfill Retaining Structures, Wharves, and Piers

The earliest section of this part of the APE to be bulkheaded and filled was the northern 70 feet of South Street from Clinton to Montgomery Streets, where this work was completed by 1828. Further bulkheading and street construction continued the street west to Rutgers Slip East by

[15]As was noted in the soil boring discussion, since this is an elevated location, the fill depth to 6.3 feet below mhw represents 1.5 feet of pavement and 12.5 feet of fill. One log also recorded fill atop a sand stratum beginning at 61.5 feet below mhw (#118).

1831. Clinton Street to Montgomery Streetwas widened to 107/108 feet between 1831 and 1838, and Rutgers Slip was filled in between 1838 and 1843.

Six historical piers were also constructed between ca. 1828 and 1849, extending from the southern side of the old crib bulkhead. With the construction of the modern bulkhead, parts of these pier locations were incorporated into the APE.

As would be expected, timbers and wood were encountered in the fill strata of 13 of 34 soil borings, throughout this section of the APE. It is not possible to distinguish between landfill retaining devices and piers from soil borings, especially since many of the same techniques were used for both, and piers were often transformed into retaining structures. These timbers are present, however, occurring in fill and mud strata ranging between 6.4 feet above mhw (immediately beneath 1.5 feet of surface paving) and 61.5 feet below mhw.

The area of the Rutgers Slip to Montgomery Street section of the APE beyond the limits of the late 19th-entury bulkhead would not be considered sensitive for this 19th-century resource, since landfill did not occur here until the modern bulkhead was constructed. Preparation for the construction of the modern bulkhead involved dredging and removal of river mud and old cribworks prior to construction, as was standard practice (Docks 1914:172). This activity would have eliminated potential sensitivity for this category of potential remains in this area of the APE. Since 19th-century South Street in this part of the APE varied from 68 to 108 feet wide, and the modern bulkhead is at 125 feet, this non-sensitive area varies between approximately 17 and 57 feet north of the bulkhead.

The installation of underground utilities would also have destroyed some of the upper sections of piers and landfill retaining devices in the remaining parts of the Rutgers Slip to Montgomery Street section of the APE, depending on the size of the main and the depth to which it was installed. Buried utilities could not have completely eliminated potential sensitivity for this category of remains, however, given their great depth (basically from the surface to as much as 61.5 feet below mhw).

Unfortunately, utility maps do not provide the accuracy necessary to pinpoint these areas, as even the utility agencies do not rely on them to locate their own mains. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for buried landfill retaining structures, wharves, and piers, dating from ca.1828 through the end of the 19th century. See the Conclusions section of this report for recommendations.

Landfill Deposits

The earliest section of this part of the APE to be bulkheaded and filled was the northern 70 feet of South Street from Clinton to Montgomery Streets, where this work was completed by 1828. Further bulkheading and street construction continued the street west to Rutgers Slip East by 1831. Clinton to Montgomery Streets were widened to 107/108 feet between 1831 and 1838, and Rutgers Slip was filled in between 1838 and 1843.

Six historical piers were also constructed here between ca. 1828 and 1849, extending from the southern side of the old crib bulkhead. With the construction of the modern bulkhead, parts of these pier locations were incorporated into the APE.

Soil borings note "miscellaneous fill"—often with associated timbers which represent landfill retaining devices and piers—throughout this section of the APE. Historical fill ranges in depth from 6.4 feet above mhw (immediately beneath 1.5 feet of surface paving) to 61.5 feet below mhw. From the soil boring logs it is not possible to distinguish between primary landfill and secondary fill based on the generalized descriptions provided by the available soil borings. Secondary fill was earlier defined as extending from the surface to a few feet below mean low water, which in the APE is approximately 4.85 feet below mhw. The remaining strata of fill beneath the secondary fill would be considered primary landfill.

The area of the Rutgers Slip to Montgomery Street section of the APE beyond the limits of the late 19th-century bulkhead would not be considered sensitive for this 19th-century resource, since landfill did not occur here until the modern bulkhead was constructed. Preparation for the construction of the modern bulkhead involved dredging and removal of river mud and old cribworks prior to construction, as was standard practice (Docks 1914:172). This activity would have eliminated potential sensitivity for this category of potential remains in this area of the APE. Since 19th-century South Street in this part of the APE varied from 68 to 108 feet wide, and the modern bulkhead is at 125 feet, this non-sensitive area varies between approximately 17 and 57 feet north of the bulkhead.

The installation of underground utilities would also have adversely impacted some of the shallowest landfill deposits in the remaining parts of this section of the APE, depending on the size of the main and the depth to which it was installed. Buried utilities could not have completely eliminated potential sensitivity for this category of remains, however, given their depth (basically from the surface to as much as 61.5 feet below mhw).

Unfortunately, utility maps do not provide the accuracy necessary to pinpoint these areas, as even the utility agencies do not rely on them to locate their own mains. Therefore, the remaining areas of this section of the APE must be considered potentially sensitive for buried landfill retaining structures, wharves, and piers, dating from ca.1828 through the end of the 19th century. See the Conclusions section of this report for recommendations.

V. CONCLUSIONS AND RECOMMENDATIONS

According to both the Standards for Cultural Resource Investigations (1994, adopted by the New York State Historic Preservation Office [SHPO]) and the Guidelines for Archaeological Work in New York City (LPC 2002), the first level of evaluation for archaeological sensitivity is based on documentary evidence. This report, based primarily on documentation of subsurface disturbance, has fulfilled this first level of evaluation for the inboard locations of the East River Waterfront Esplanade and Piers APE to the north of the Brooklyn Bridge.

Based on the discussion of the categories of potential archaeological resources which may be present within this section of the APE, and also upon the examination of land use within the APE, the categories of potential archaeological remains were limited to submerged precontact resources; 19th-century landfill retaining structures, wharves and piers; 19th-century landfill; and 19th-century riverbottom remains.

According to present design specifications, the majority of the section of the APE analyzed in this report will undergo subsurface disturbance of no greater than two feet below present grade. Because the first two feet below grade have already been adversely impacted by various episodes street paving and grading, these locations are not sensitive for potential archaeological resources, and no further study or testing is recommended.

The remaining areas under consideration are the footprints of six pavilions—each approximately 30 feet by 200 feet in size—which are proposed for this section of the APE. With their long axes running east/west or parallel with South/Marginal Street, they will be built in pairs, one on each side of Catharine Slip, Pike Slip, and Rutgers Slip, leaving the intersections with these streets open (Figures 26, 27). As currently designed, the pavilions will be erected within Marginal Street, within 55 feet of the present bulkhead, with projected impacts of five feet below the current surface. In order to connect the pavilions to the utility grid on South Street, it may also be necessary to excavate the area between the pavilions and the north side of South Street, with projected impacts of up to five feet below the current surface. Based on the locations of potential archaeological resources and their depths below the current ground surface, excavation for five of the pavilions and the six areas of potential utility connections would affect locations potentially sensitive for 19th-century landfill retaining structures, wharves and piers, and for 19th-century landfill. The exception is the pavilion proposed for the east side of Rutgers Street, which would not affect any potentially sensitive locations (Figure 27).

Although not depicted cartographically on the sensitivity figures (Figures 24-27), the column footings for the FDR Drive viaduct were noted earlier in the discussion of subsurface disturbance types. The impact zone of the completed column footings consists of the column areas themselves as well as an area approximately three feet in radius surrounding each column. The depth of disturbance from the columns is greater than the depth of the projected impacts from the proposed project (approximately five feet). The column footings would not be altered with the project. In these distinct areas, the conclusions presented below regarding the potential for archaeological sensitivity do not apply.

Precontact Archaeological Resources

Soil boring logs indicate deeply buried strata of glacial till beneath a layer of river mud/silt. The upper feet of the sandy till stratum may represent the preinundation land surface exposed during the precontact period – the possible locus of precontact archaeological potential. Given the lack of recorded disturbance in these areas, and the estimates that precontact sites from 10,000 years BP would be found at depths no greater than approximately 90 feet (below mhw) (Merwin et al. 2003:46-47), the possibility of submerged and then deeply buried former land surfaces which might contain precontact remains cannot be ruled out, providing these archaeological resources survived currents and tidal action at the time of inundation.

The five pavilions and adjacent potential utility connections proposed for the area between Catharine Slip West and Rutgers Slip West would be located in areas that are potentially sensitive for precontact archaeological remains, expected at depths ≥35.7 feet below mhw (Figure 24). Because of the great depth of the potentially sensitive strata, however, and because proposed subsurface disturbance for the pavilions and utility connections is not expected to extend beyond five feet below the current ground surface, no potential precontact archaeological resources would be impacted by construction of the pavilions or the utility main trenches. Therefore, no additional study, monitoring, or testing of this category of archaeological resources is recommended.

Table 1
Potentially Affected Locations of Archaeological Sensitivity

Resource	Location	Depth	Notes
Landfill retaining structures, wharves, piers	Pavilions/Utility Connections from Roosevelt Street to Catharine Slip West	2.0 feet below grade to 40.1 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Landfill retaining structures, wharves, piers	Pavilions/Utility Connections from Catharine Slip West to Rutgers Slip West	2.0 feet below grade to 56 feet below mhw	Area 38 to 64 feet north of bulkhead not sensitive
Landfill deposits	Pavilions/Utility Connections from Roosevelt Street to Catharine Slip West	2.0 feet below grade to 40.1 feet below mhw	Area within 42.5 feet of bulkhead not sensitive
Landfill deposits	Pavilions/Utility Connections from Catharine Slip West to Rutgers Slip West	2.0 feet below grade to 60.6 feet below mhw	Area 38 to 64 feet north of bulkhead not sensitive

Riverbottom Remains

Five of the proposed pavilion and potential utility connection locations, which lie within areas between Roosevelt Street and Rutgers Slip West, are considered sensitive for potential riverbottom remains (Figure 25). These potential resources are expected at depths ≥23 feet below mhw to the west of Catharine Slip, and ≥18.5 feet below mhw from Catharine Slip West to Rutgers Slip West. Because of the great depth of these potential archaeological resources, and because proposed subsurface disturbance in the pavilion and utility connection locations is not expected to extend beyond five feet below the surface, no potential riverbottom remains would

be impacted by construction of the pavilions or their utility connections. Therefore, no additional study, monitoring, or testing of this category of archaeological resources is recommended.

Landfill Retaining Structures, Wharves, and Piers

The conclusion of this report is that five of the proposed pavilion locations, as well as the potential utility connection areas associated with all six pavilions, within this section of the APE are considered sensitive for 19th-century landfill retaining structures, wharves, and piers. These locations are shown on Figures 26 and 27. The depths of potential sensitivity for these resources in each location are provided in Table 1.

Because potential sensitivity for these resources begins beneath the current pavement—that is, beneath the two feet of disturbance caused by the creation of the roadbed—this potential resource would be impacted by proposed subsurface disturbance at the five proposed pavilion locations as well as the potential utility connection locations associated with all six pavilions, where construction disturbance of five feet below the present ground surface is planned. See below for recommendations for further action in this location.

Landfill Deposits

The conclusion of this report is that five of the proposed pavilion locations, as well as the potential utility connection areas associated with all six pavilions, within this section of the APE are considered sensitive for 19th-century landfill. These locations are shown on Figures 26 and 27. The depths of potential sensitivity for these resources in each location are provided in Table 1.

Because potential sensitivity for these resources begins beneath the current pavement, that is, beneath the two feet of disturbance caused by the creation of the roadbed, this potential resource would be impacted by proposed subsurface disturbance at the five proposed pavilion locations as well as the potential utility connection locations associated with all six pavilions, where construction disturbance of five feet below the present surface is planned. See below for recommendations for further action in this location.

Recommendations

As noted in the Introduction, the review of the Phase 1A technical report, which will include a Soil Borings Appendix, is to be conducted by SHPO and LPC. As established in the PA, "subsequent to the review of the Phase 1A by SHPO, LMDC and the City will cooperate in the preparation of a protocol ("Archaeology Monitoring and Testing Protocol") to define which portions of the Archaeological APE would be monitored during construction or would undergo Phase 1B field testing prior to construction, depending on the nature of the potential resources identified in the Phase 1A and the extent of construction that would take place in specific locations. The protocol will include an assessment of the feasibility and utility of monitoring versus field testing for all potentially sensitive archaeological areas that would be affected by the Esplanade Project. The protocol will also outline any areas to receive monitoring or field testing and will set forth the methodology."

In the proposed pavilion locations, where impacts to potentially sensitive areas will extend to five feet below existing grade, and where the proposed area of impact has sufficient horizontal square footage to afford visibility of potential resources, testing could be undertaken immediately prior to construction. The excavated area would need to be large enough to allow for the sides to be canted during excavation, as mandated by OSHA regulations. In potentially sensitive areas where narrow trench excavations (extending more than two feet below existing grade) would be undertaken for proposed utility lines, trench excavations could be monitored at the time of construction.

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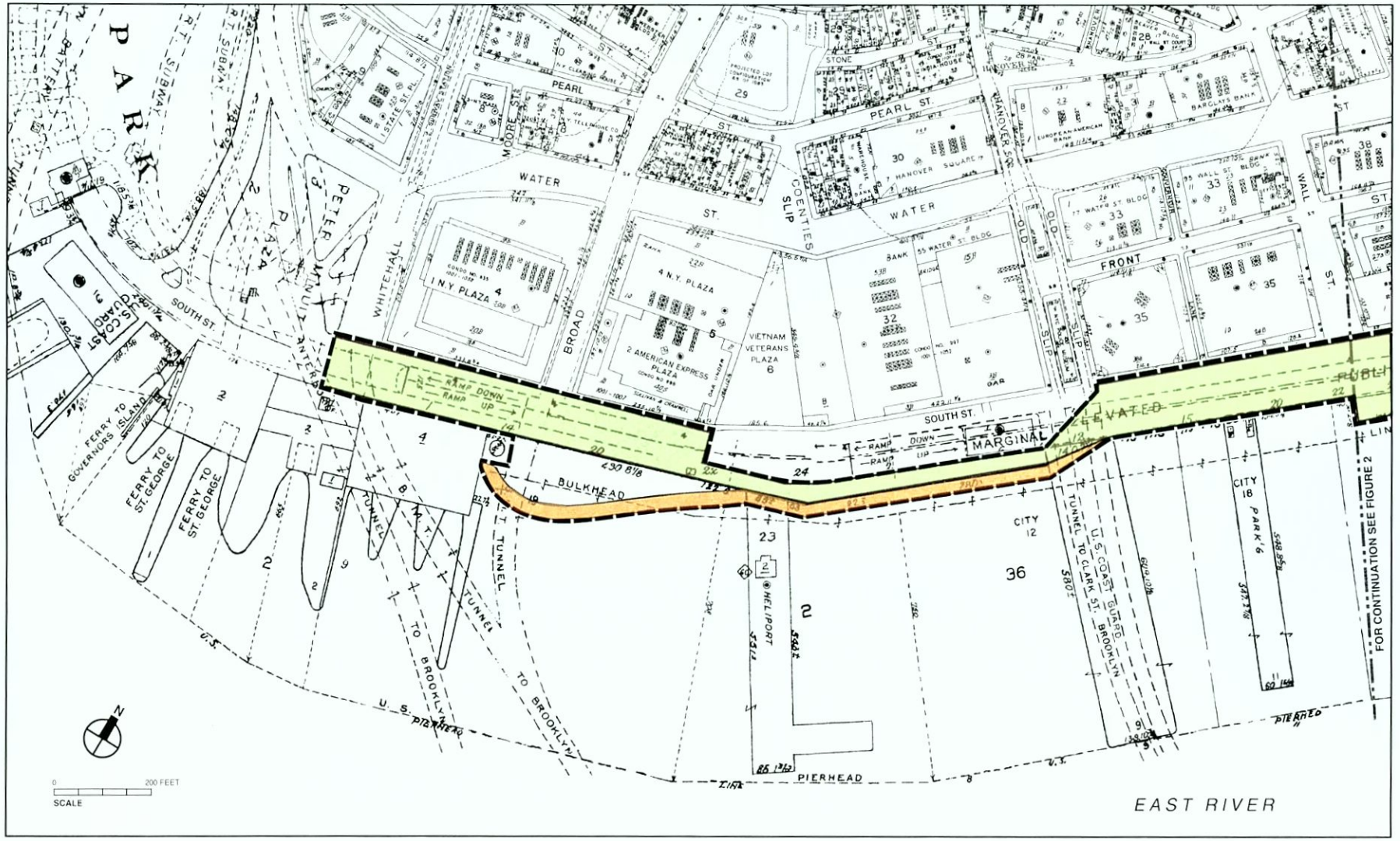
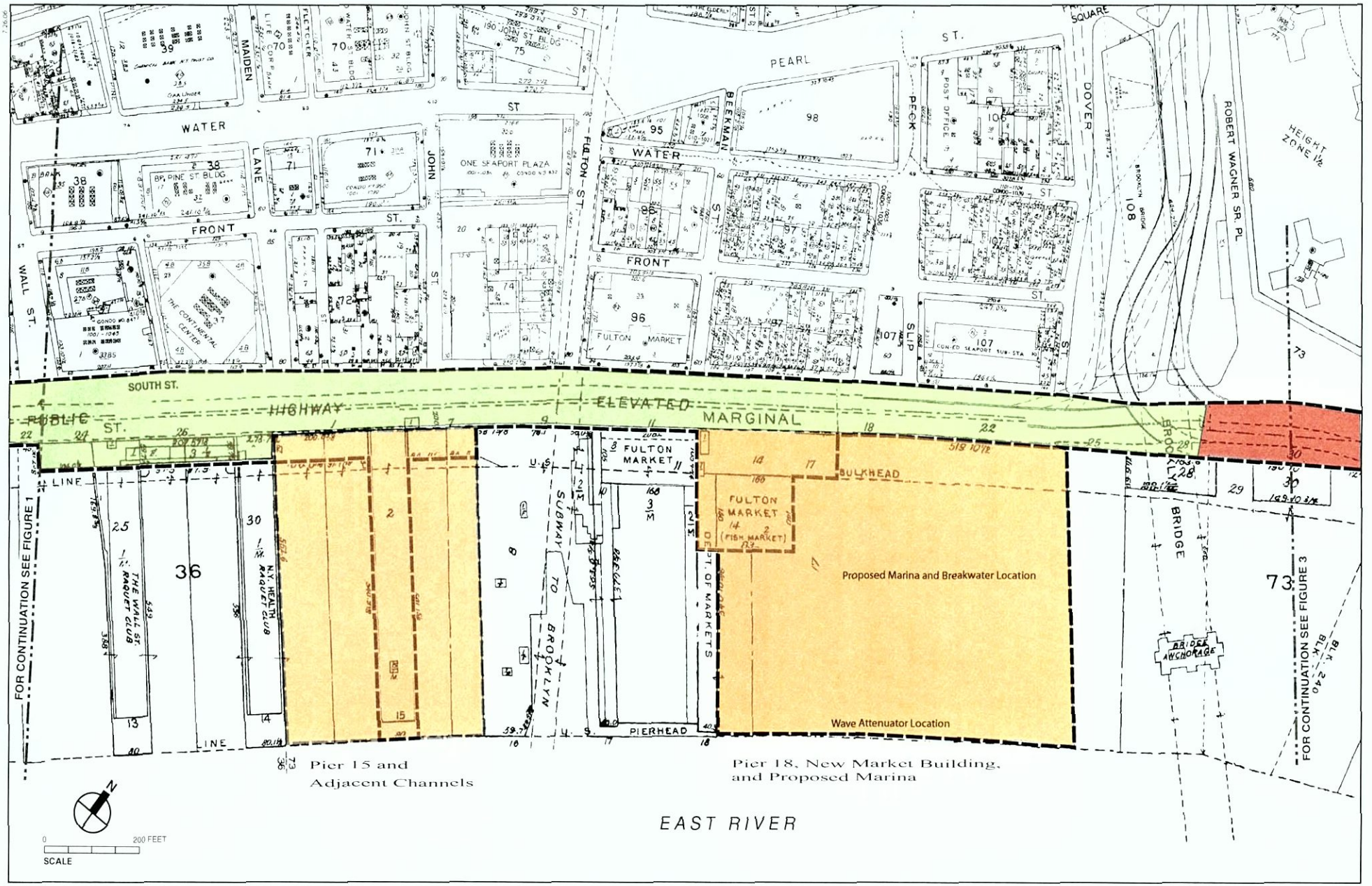


LEGEND

Area of Potential Effect	Outboard Resources APE -- Broad Street through Old Slip
APE South of the Brooklyn Bridge	APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

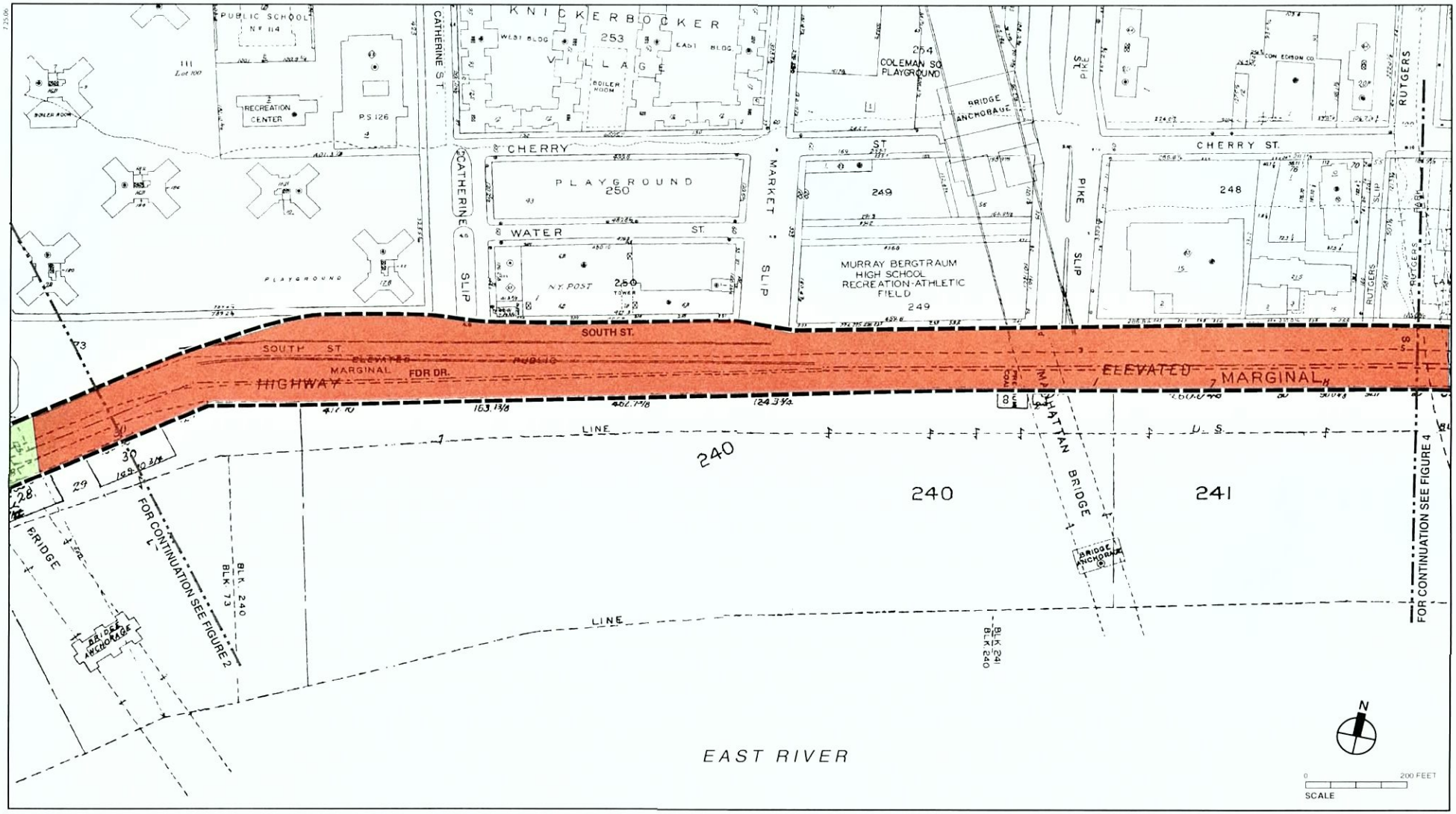
FIGURE 1: Current Sanborn Map (Battery Park to Wall Street)



Area of Potential Effect
APE South of the Brooklyn Bridge
Outboard Resources APE
APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

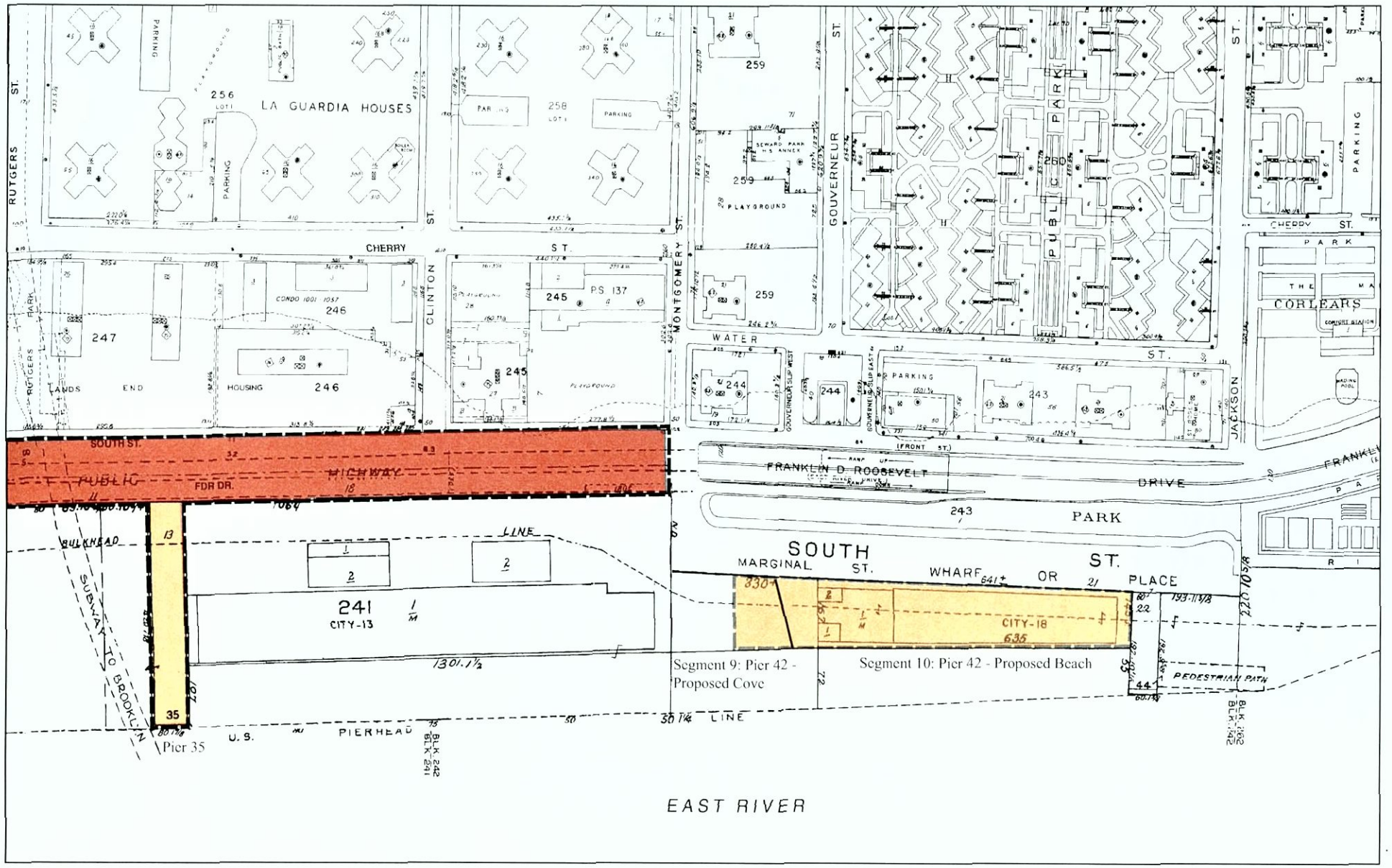
FIGURE 2: Current Sanborn Map (Wall Street to R. F. Wagner Place)



Area of Potential Effect
APE South of the Brooklyn Bridge
Outboard Resources APE
APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

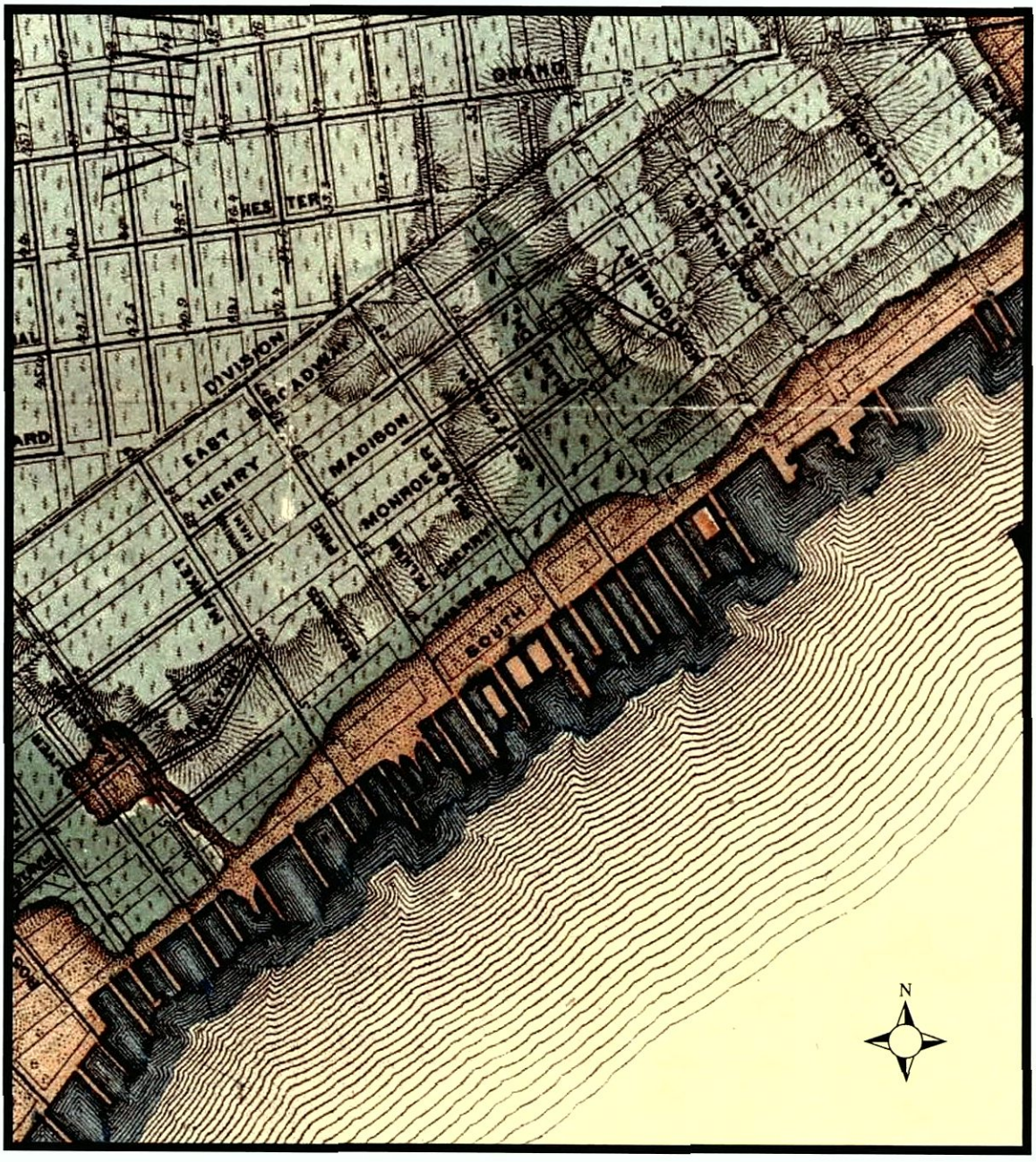
FIGURE 3: Current Sanborn Map (R. F. Wagner Place to Rutgers Street)



Area of Potential Effect
APE South of the Brooklyn Bridge
Outboard Resources APE
APE North of the Brooklyn Bridge

EAST RIVER Waterfront Esplanade and Piers

FIGURE 4: Current Sanborn Map (Rutgers Street to Jackson Street)



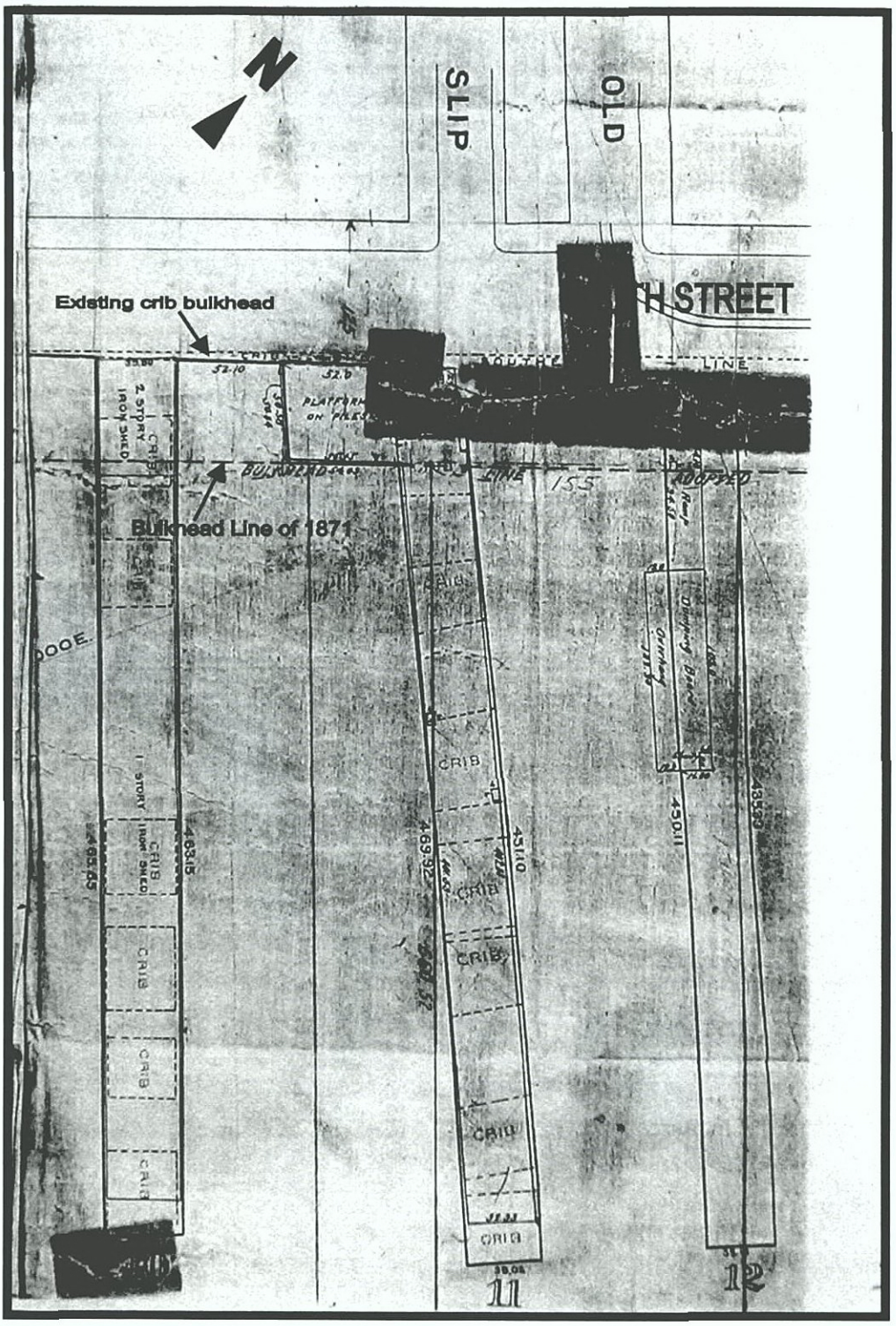
LEGEND

Green - Manhattan Island at the time of Contact
Orange - Made land (17th to mid-19th centuries)

SOURCE: David Rumsey Historical Map Collection - www.davidrumsey.com

EAST RIVER Waterfront Esplanade and Piers

FIGURE 5: Viele, Topographic Map of the Island of New York, 1865
(Detail: Roosevelt Street to Jackson Street)



SOURCE: Department of Docks Pier Maps (SSS 1903a). Collection: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

FIGURE 6: Dock Map, Old Slip to Fulton, ER., 1903

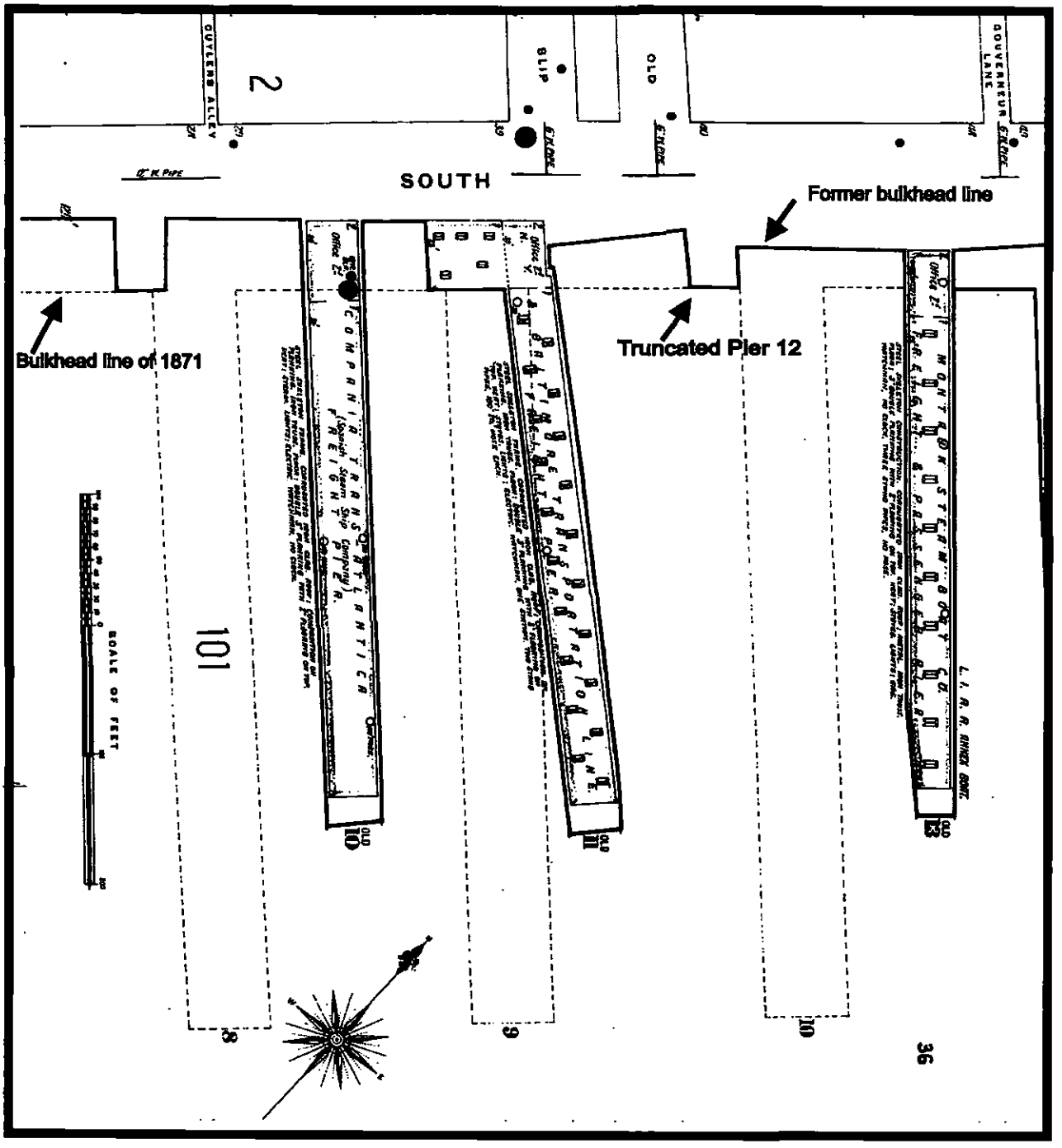


FIGURE 7: Sanborn, Atlas of the Borough of Manhattan, 1905
(Detail: Plate 102, South Street from Cuylers Alley to Gouverneur Lane, with Old Slip)

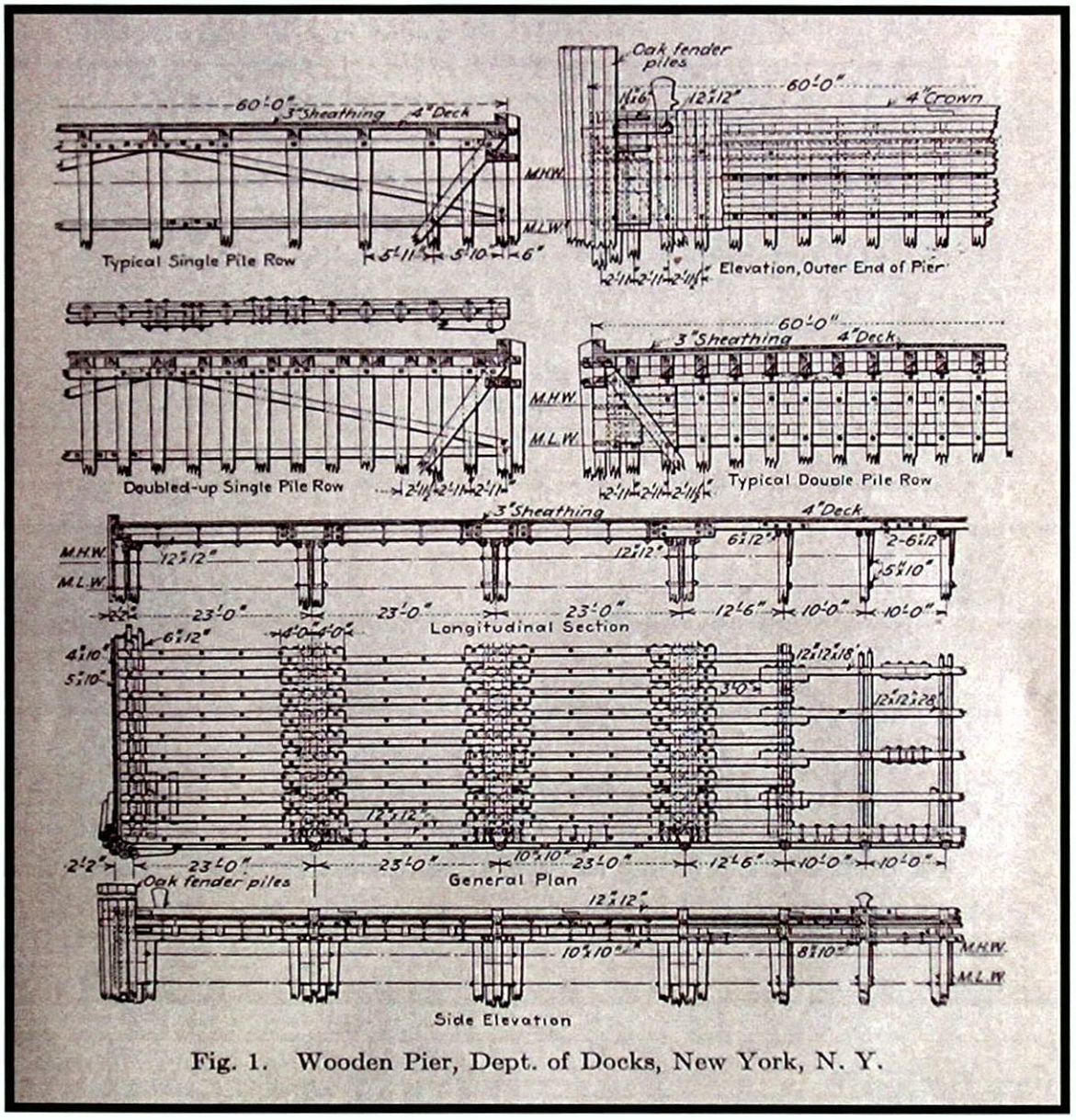


Fig. 1. Wooden Pier, Dept. of Docks, New York, N. Y.

SOURCE: Greene, *Wharves and Piers*, 1917

EAST RIVER Waterfront Esplanade and Piers

FIGURE 8: Wooden Pier, plan and elevations, 1917

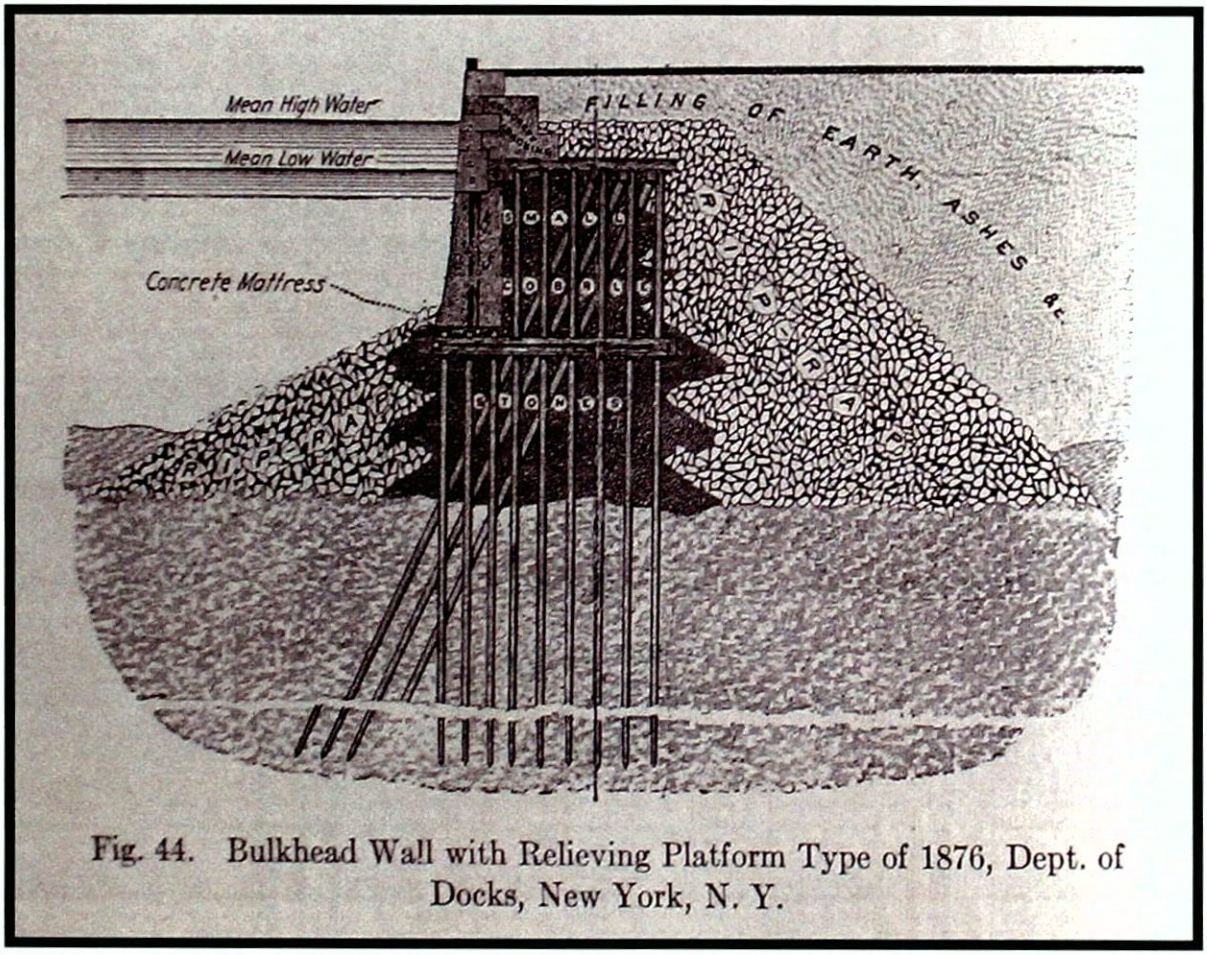


Fig. 44. Bulkhead Wall with Relieving Platform Type of 1876, Dept. of Docks, New York, N. Y.

SOURCE: Greene, *Wharves and Piers*, 1917

EAST RIVER Waterfront Esplanade and Piers

FIGURE 9: Bulkhead Wall, Type of 1876

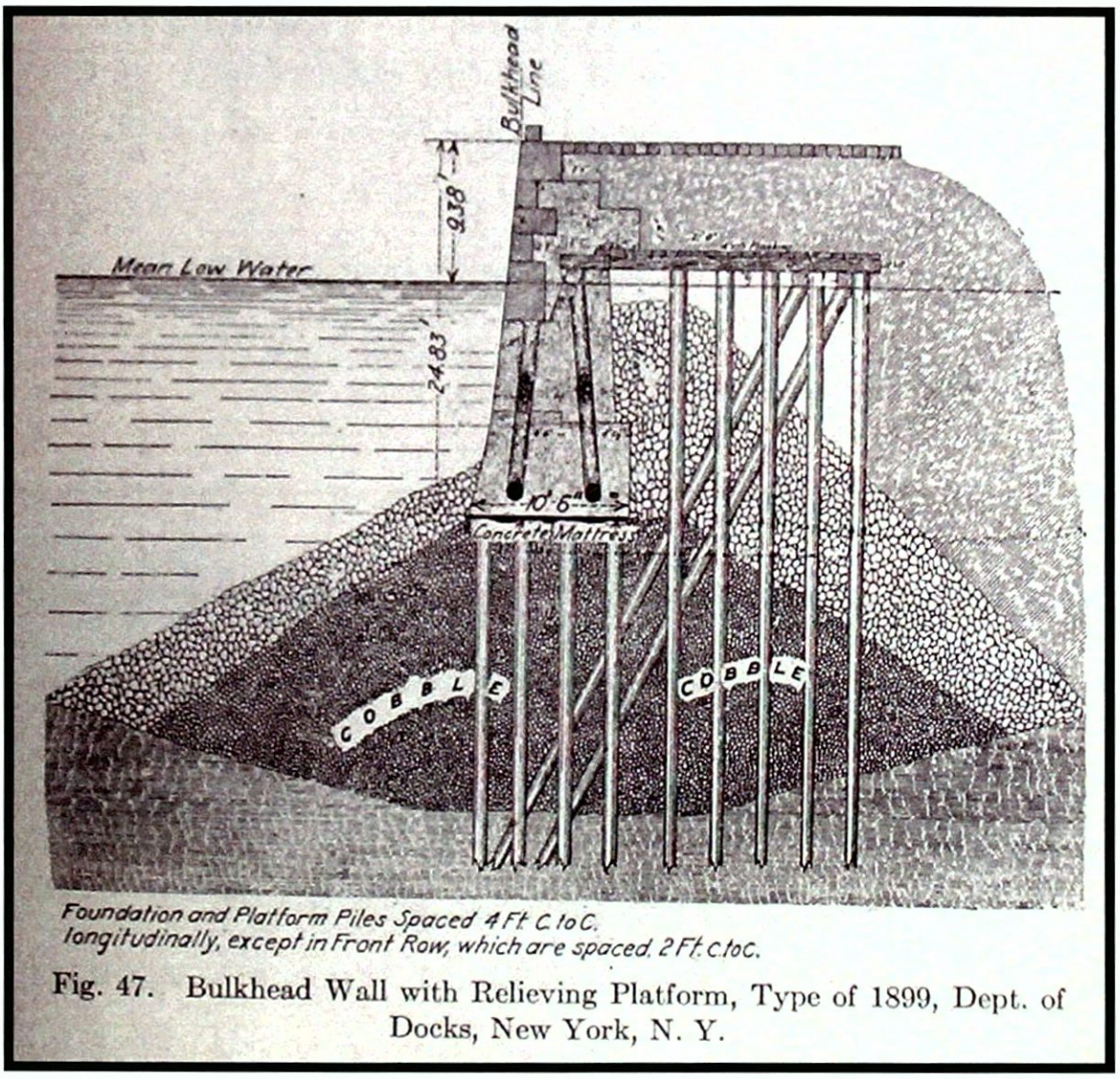


Fig. 47. Bulkhead Wall with Relieving Platform, Type of 1899, Dept. of Docks, New York, N. Y.

SOURCE: Greene, *Wharves and Piers*, 1917

EAST RIVER Waterfront Esplanade and Piers

FIGURE 10: Bulkhead Wall, Type of 1899

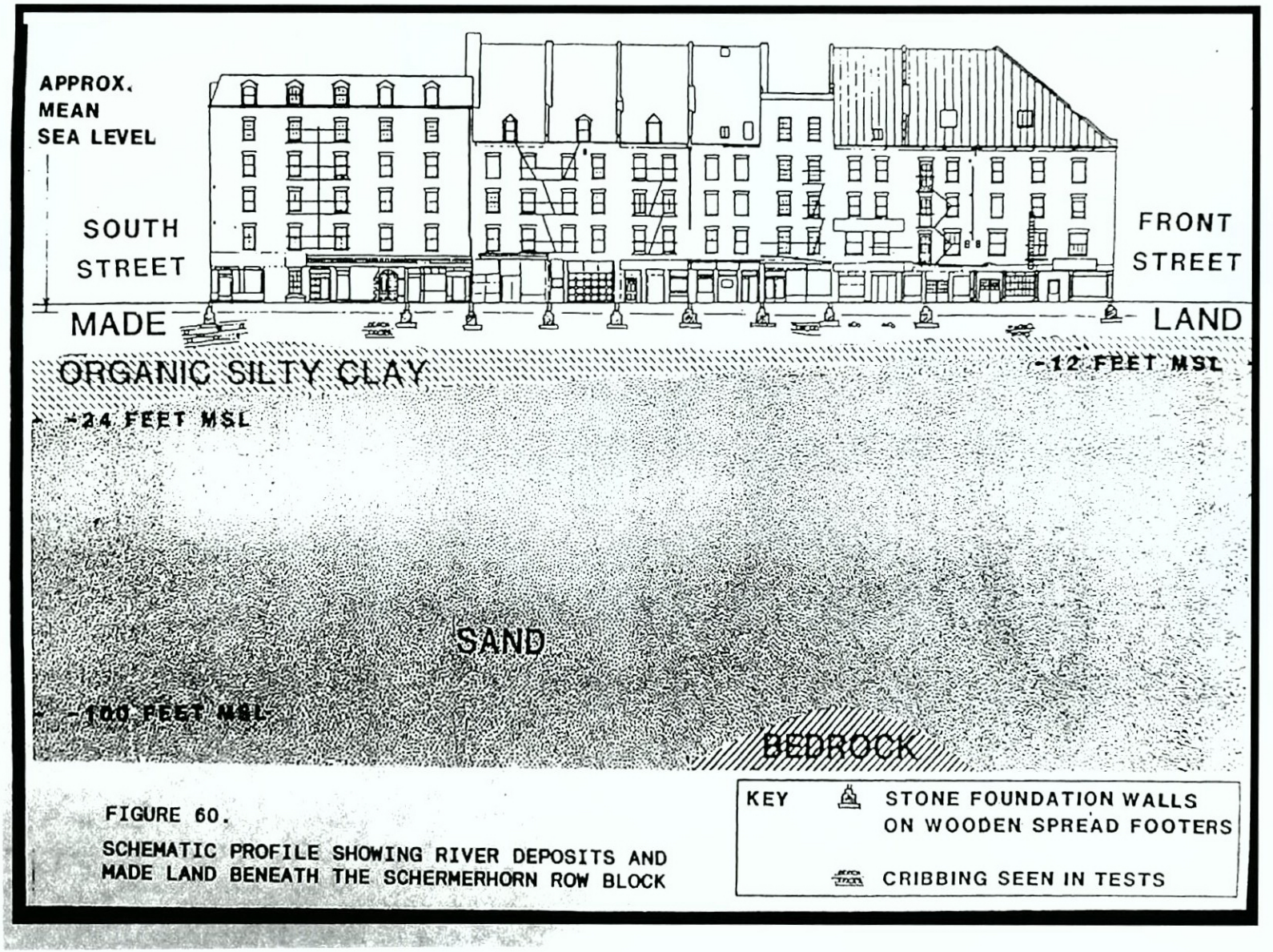


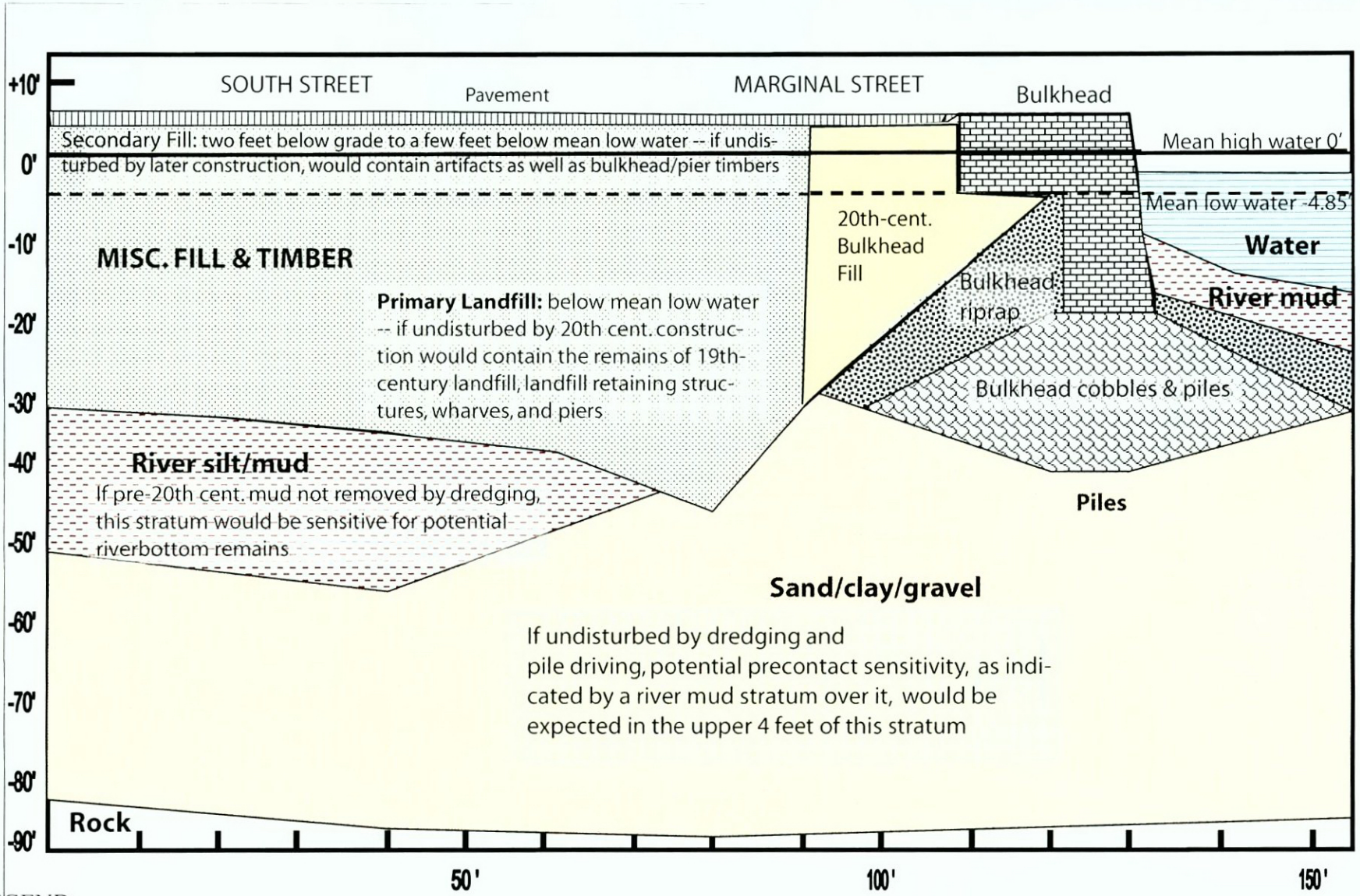
FIGURE 60.

SCHEMATIC PROFILE SHOWING RIVER DEPOSITS AND MADE LAND BENEATH THE SCHERMERHORN ROW BLOCK

SOURCE: Kardas and Larrabee 1991: Figure 60

EAST RIVER Waterfront Esplanade and Piers

FIGURE 11: Schematic Profile Showing River Deposits and Made Land Beneath the Schermerhorn Row Block

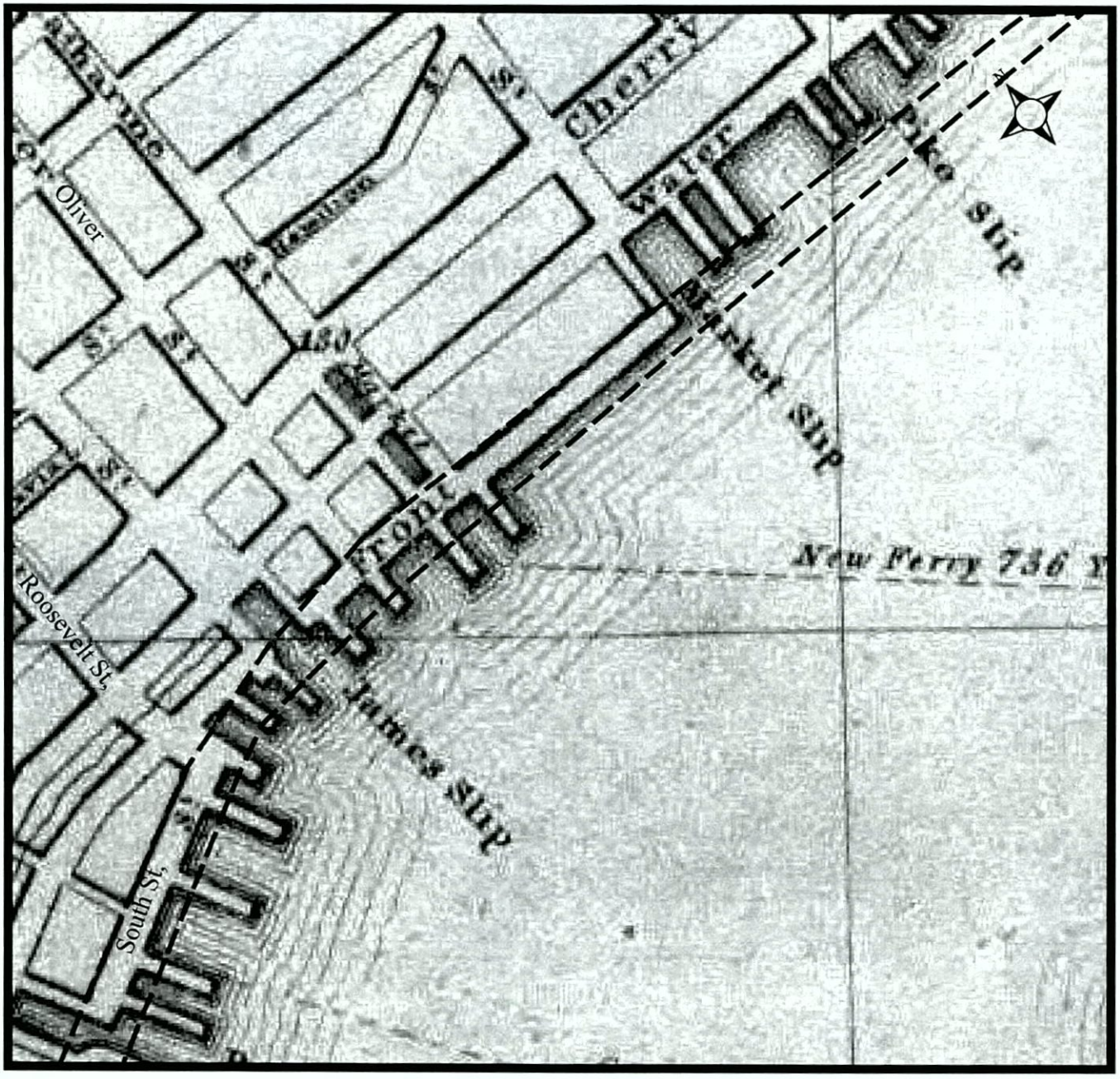


LEGEND

This profile is a ***generalized*** graphic depiction of the APE, from the north side of South Street to the modern bulkhead, showing potentially sensitive strata types. It is based on sources cited in this report, in particular: soil boring logs at Market Slip (WPA 1965: Sheet 10 #87, #88), bulkhead plans (Greene 1917 -- see Figure 10). Depths of strata vary among and within the East River Esplanade APE segments.

EAST RIVER Waterfront Esplanade and Piers

FIGURE 12: Generalized Profile of Potential Resource Depths



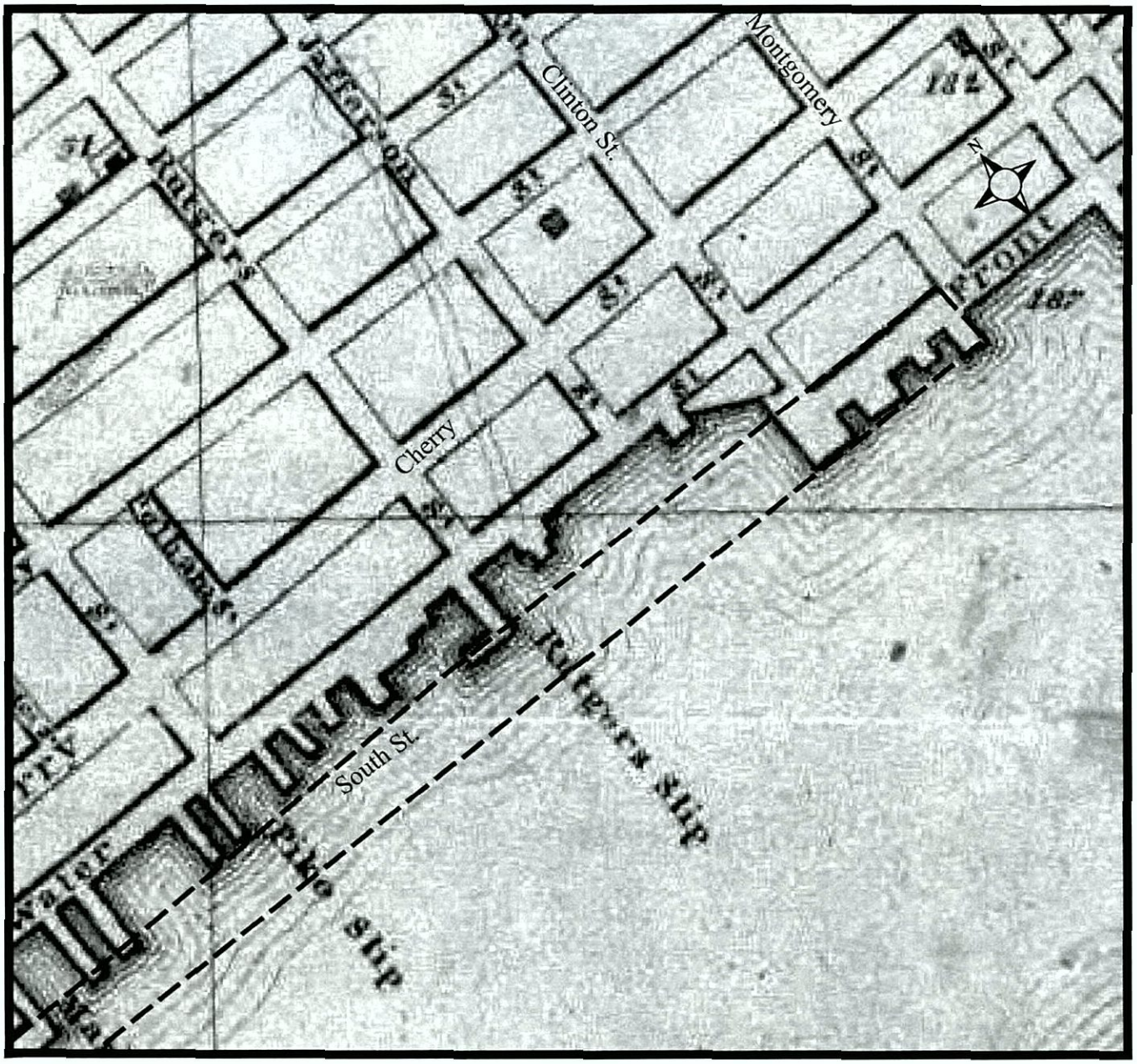
LEGEND

— — Area of Potential Effect

SOURCE: The New York Public Library, www.nypl.org/digital

EAST RIVER Waterfront Esplanade and Piers

FIGURE 13: Goodrich, Plan of the city of New York and of the island, 1828 (Detail: Peck Slip to Pike Slip)



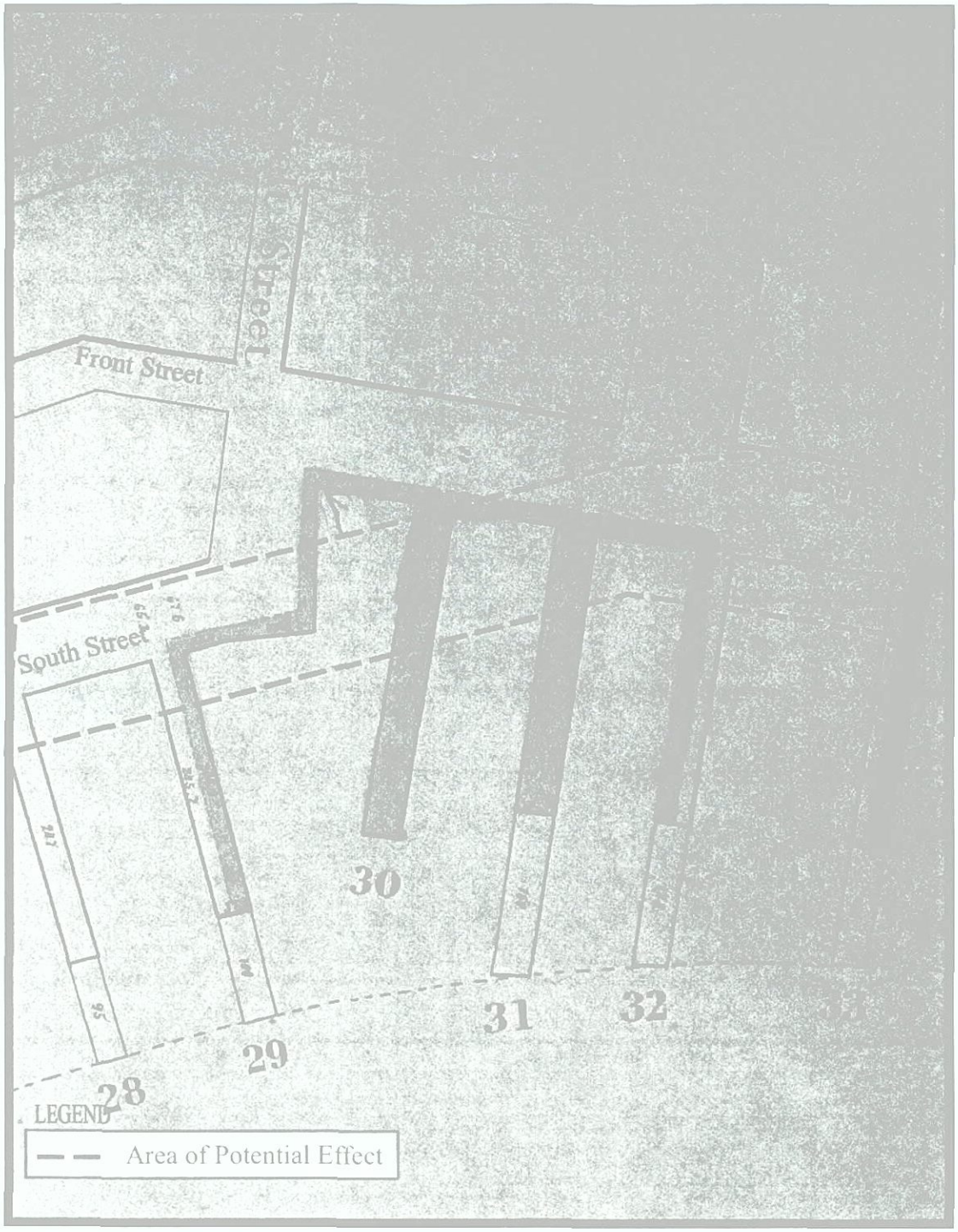
LEGEND

— — Area of Potential Effect

SOURCE: The New York Public Library, www.nypl.org/digital

EAST RIVER Waterfront Esplanade and Piers

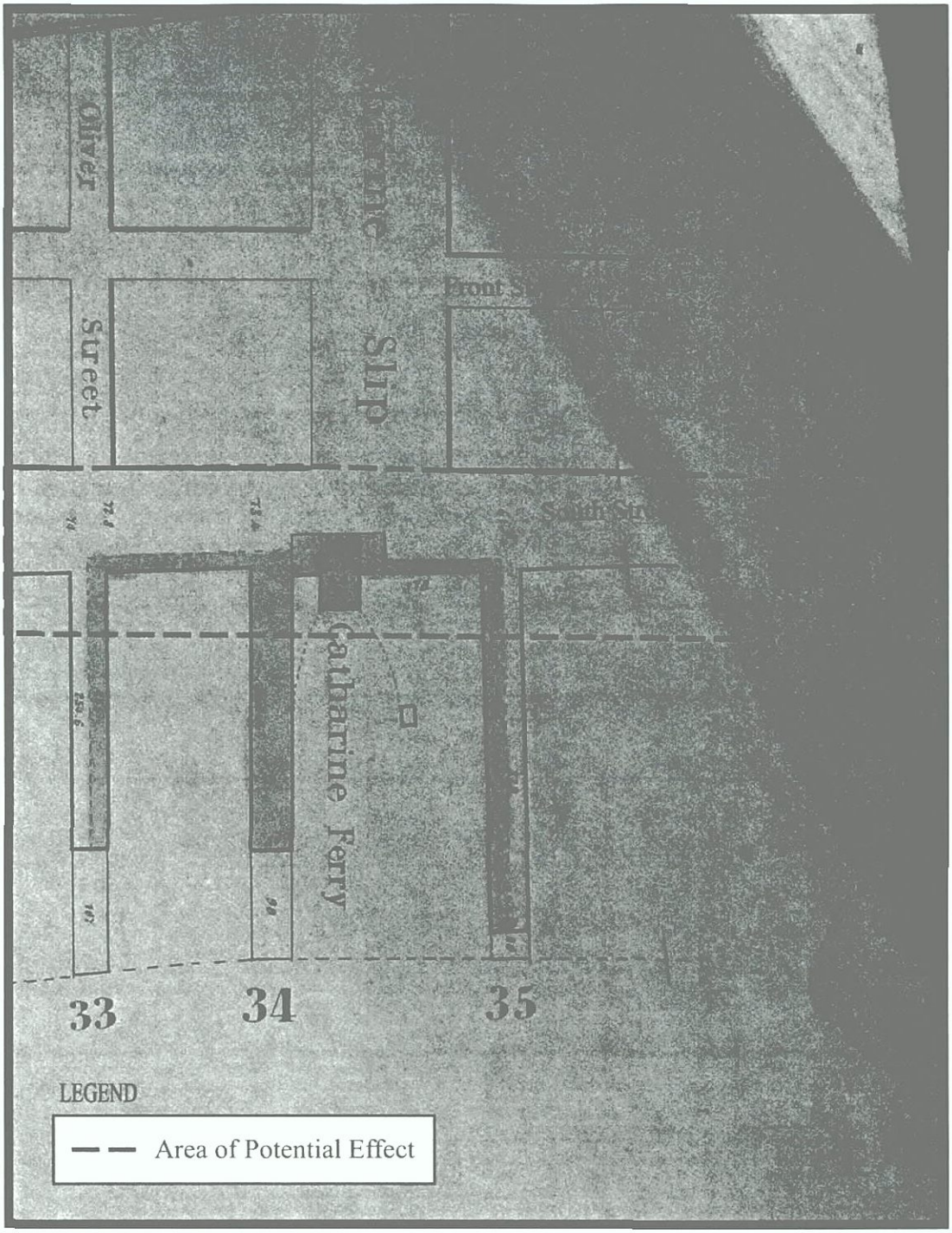
FIGURE 14: Goodrich, Plan of the city of New York and of the island, 1828
(Detail: Pike Slip to Montgomery Street)



SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

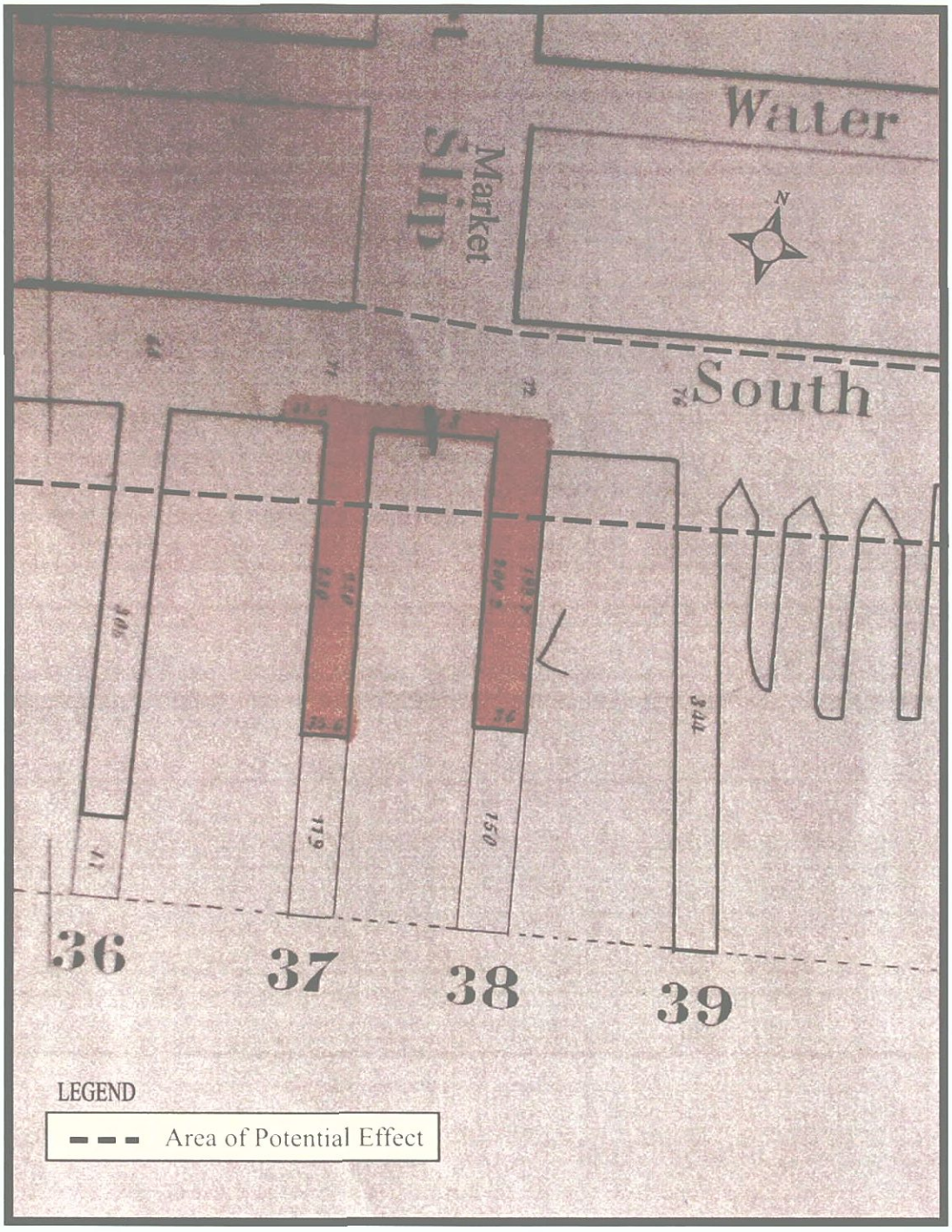
FIGURE 15: Alvord, Maps of the Wharves and Piers of the East River, 1849
(Detail Roosevelt Street to James Slip)



SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

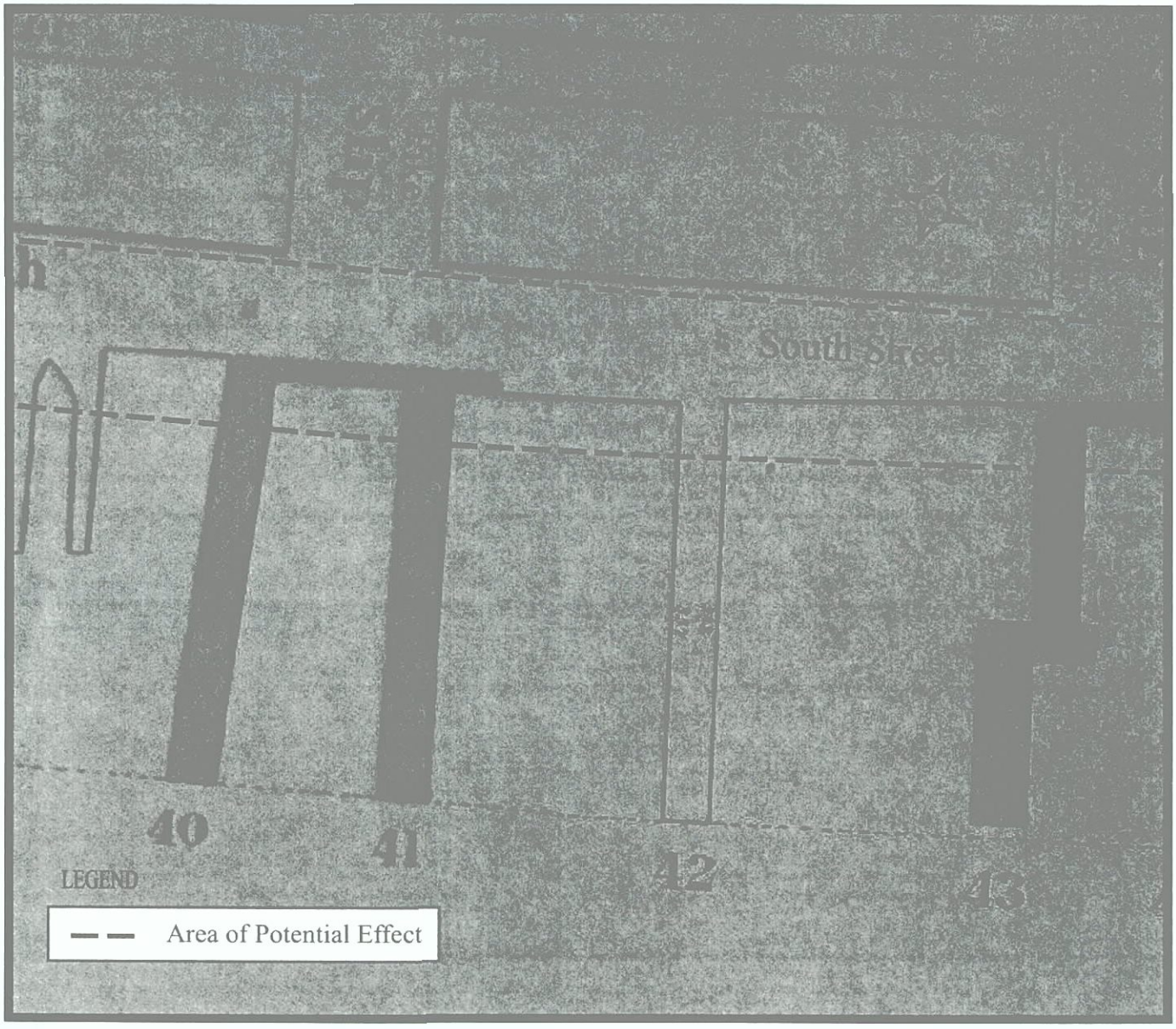
FIGURE 16: Alvord, Maps of the Wharves and Piers of the East River, 1849
(Detail: Oliver Street to Catharine Slip)



SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

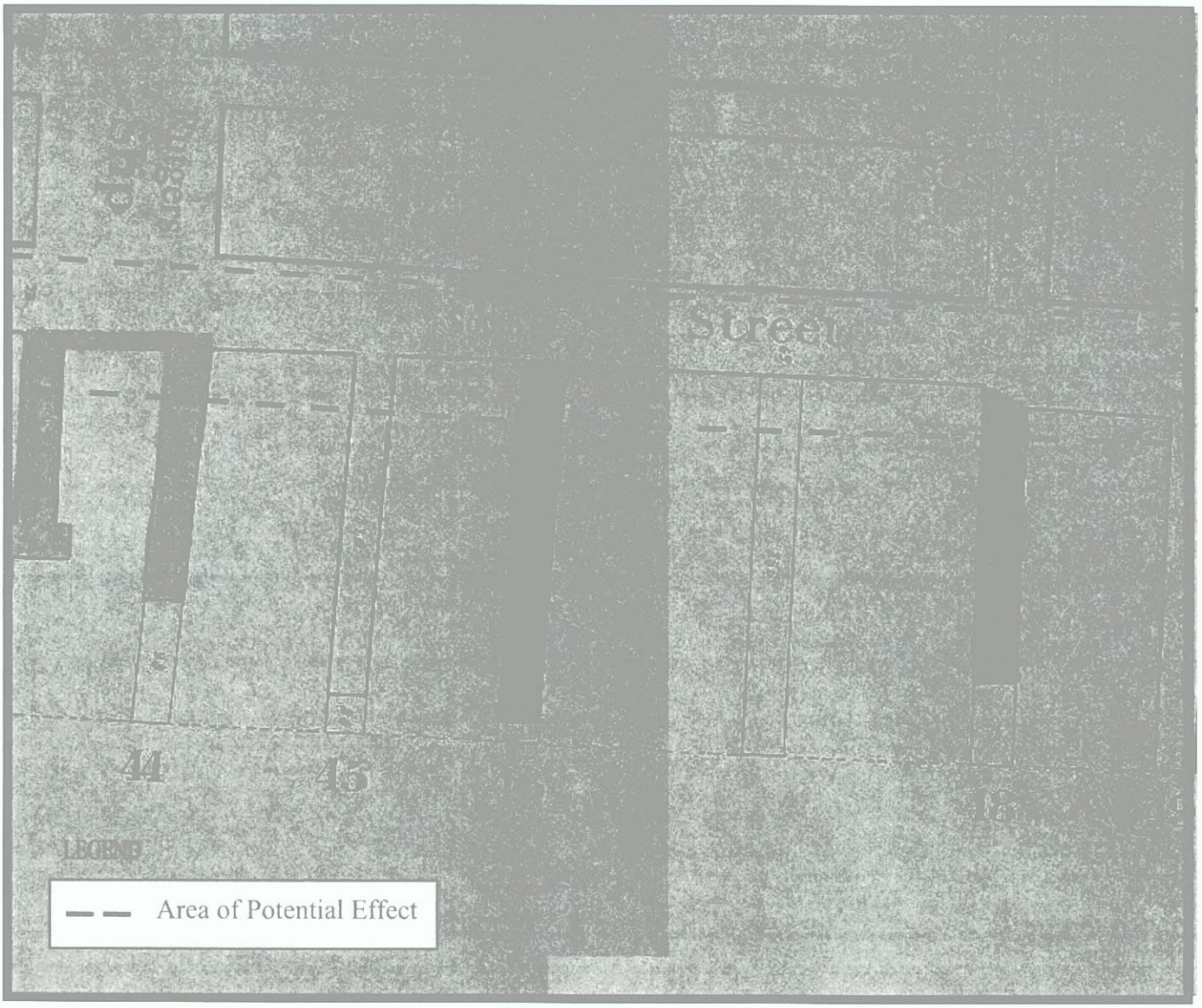
FIGURE 17: Alvord, Maps of the Wharves and Piers of the East River, 1849
(Detail: Market Slip and vicinity)



SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

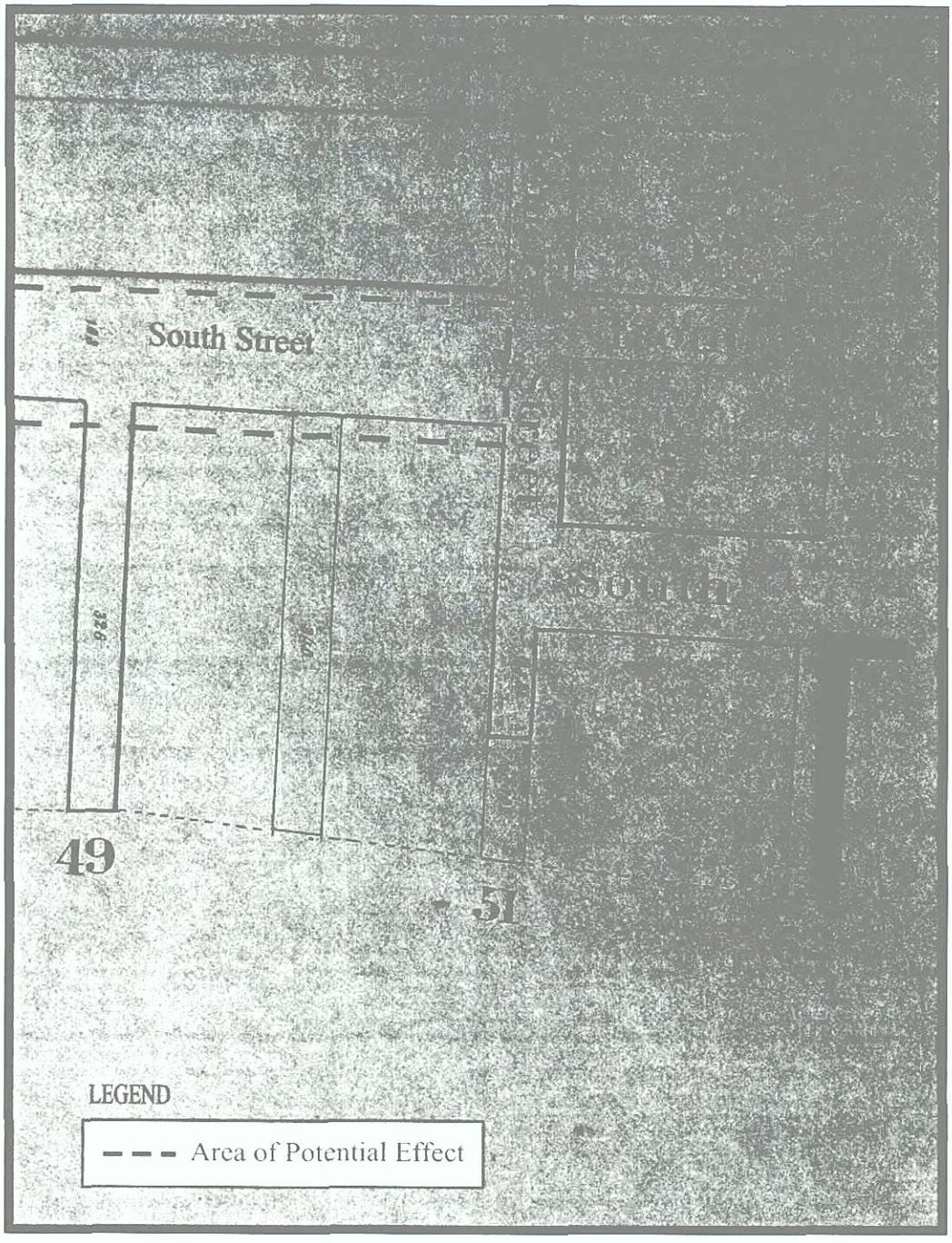
FIGURE 18: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Pike Slip to Rutgers Slip)



SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

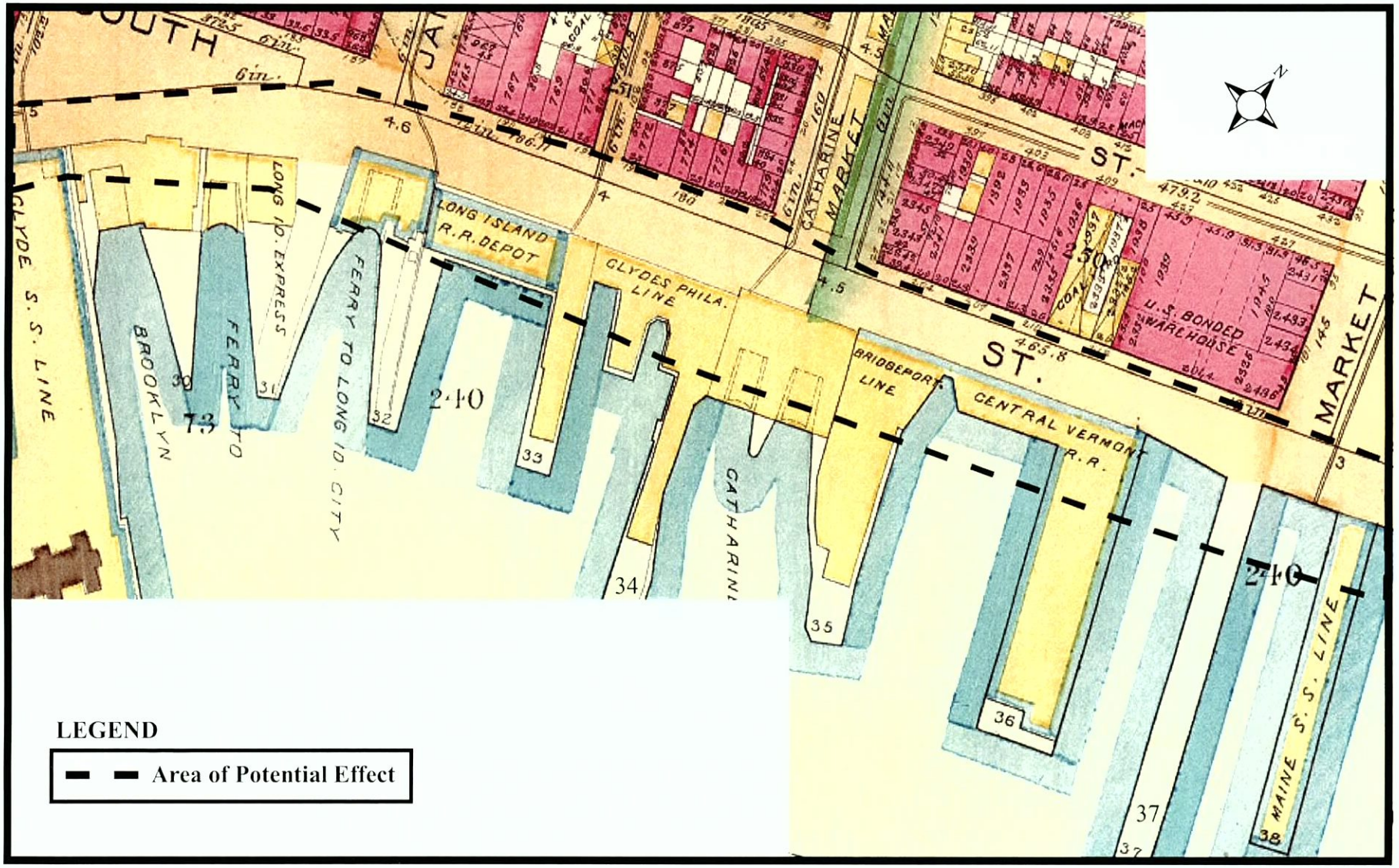
FIGURE 19: Alvord, Maps of the Wharves and Piers of the East River, 1849
(Detail: Rutgers Slip to Clinton Street)



SOURCE: South Street Seaport Museum Library

EAST RIVER Waterfront Esplanade and Piers

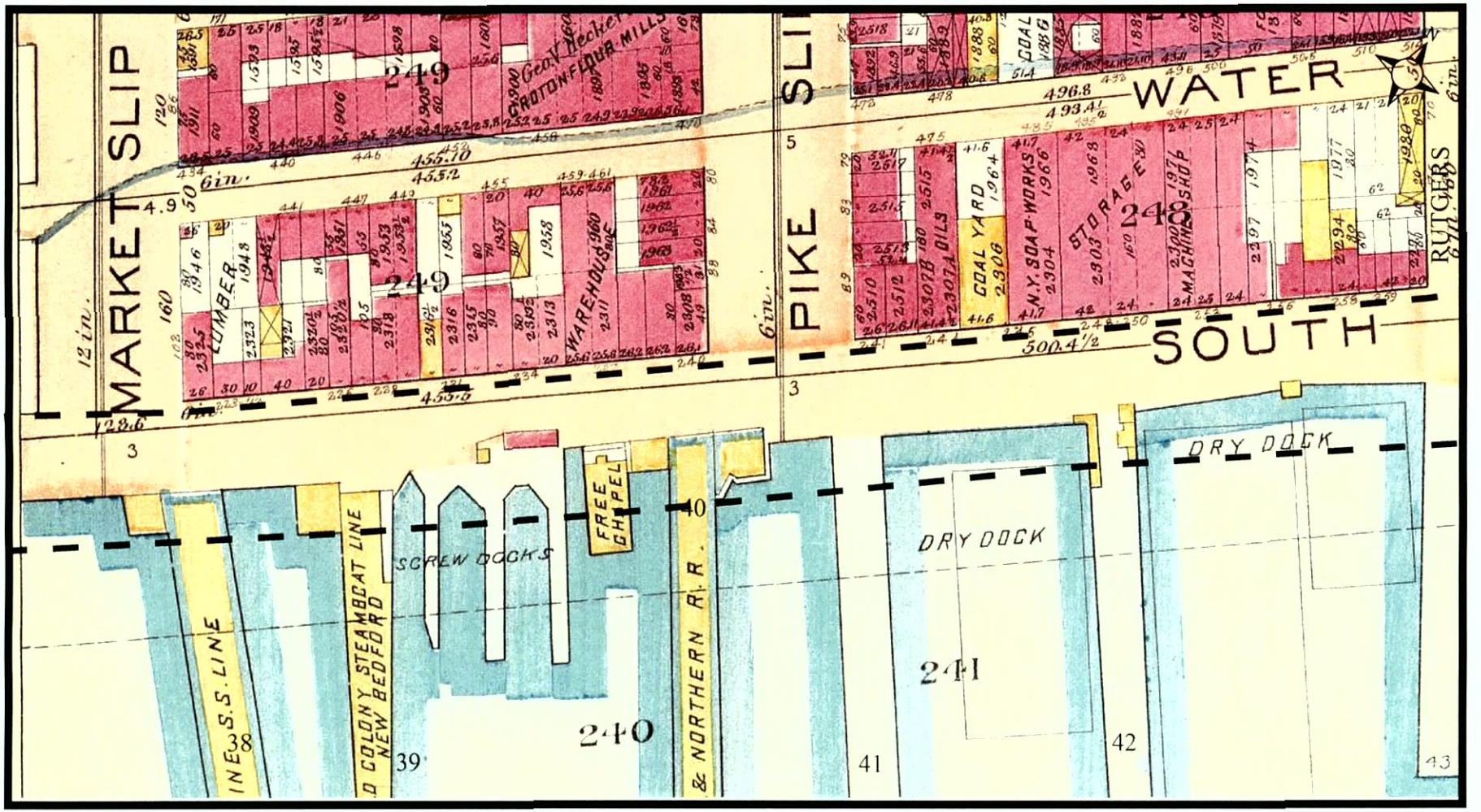
FIGURE 20: Alvord, Maps of the Wharves and Piers of the East River, 1849 (Detail: Montgomery Street and vicinity)



SOURCE: David Rumsey Historical Map Collection, www.davidrumsey.com

EAST RIVER Waterfront Esplanade and Piers

FIGURE 21: Bromley, Atlas of the City of New York, 1891 (Detail: Roosevelt Street to Market Slip)



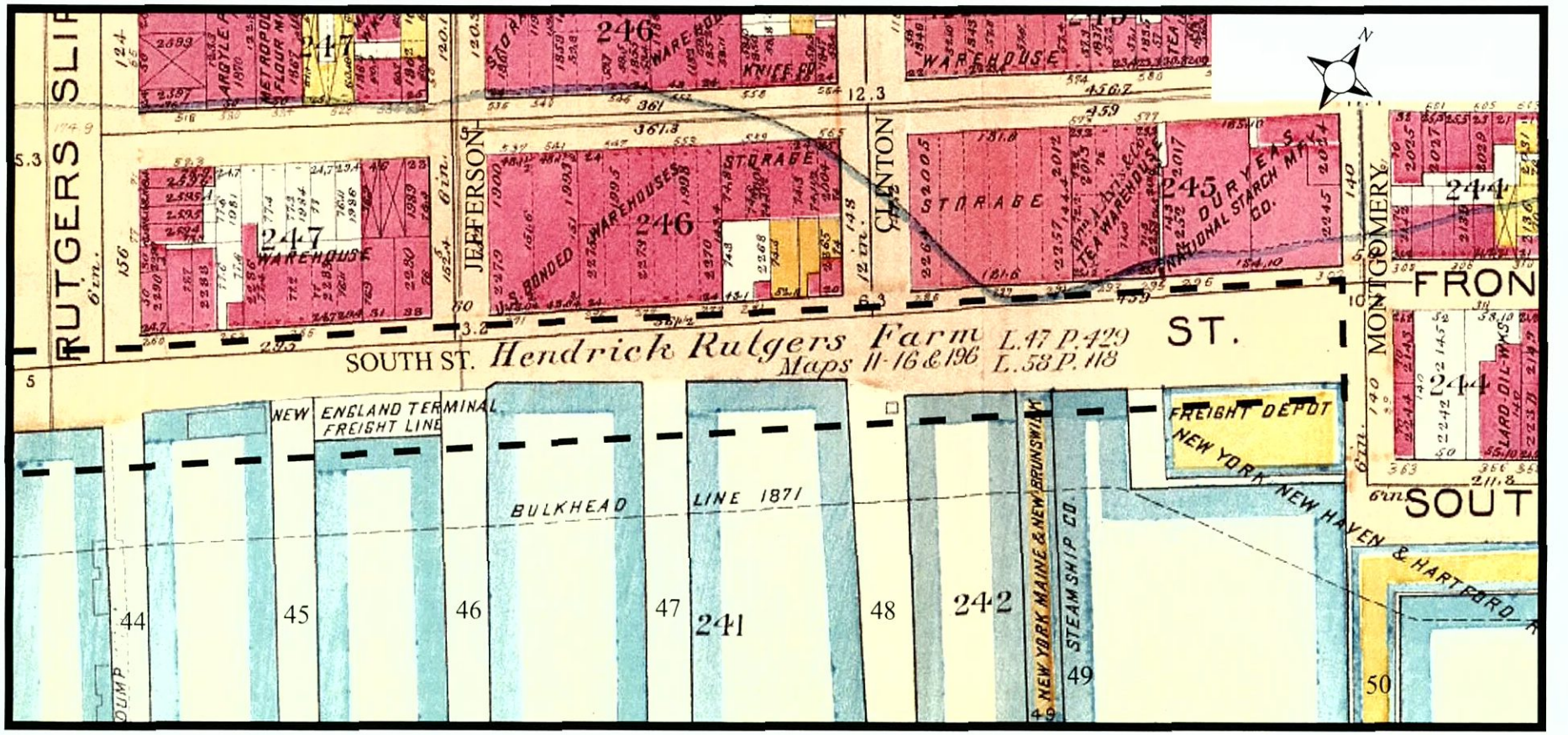
LEGEND

Area of Potential Effect

SOURCE: David Rumsey Historical Map Collection, www.davidrumsey.com

EAST RIVER Waterfront Esplanade and Piers

FIGURE 22: Bromley, Atlas of the City of New York, 1891 (Detail: Market Slip to Rutgers Slip)



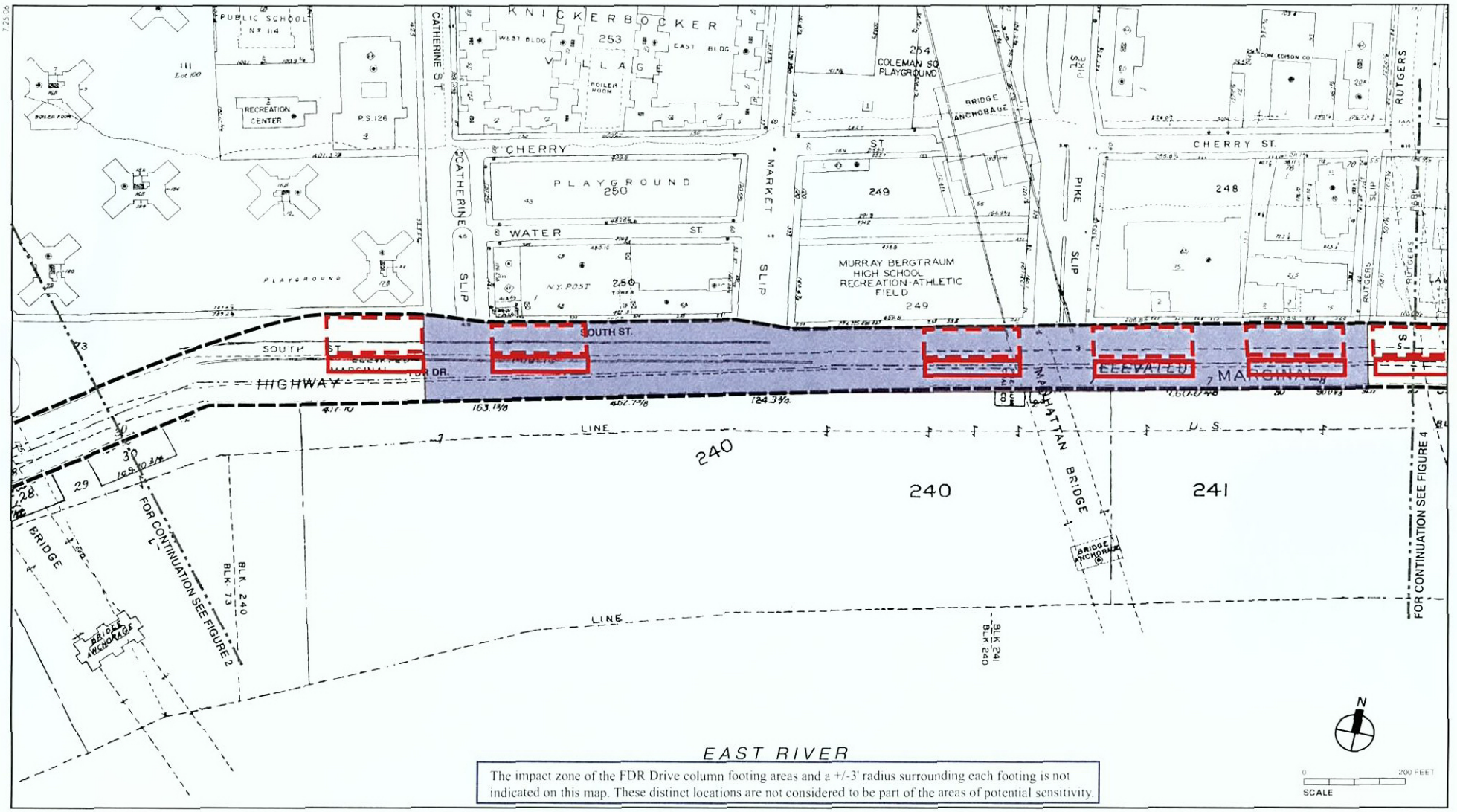
LEGEND

Area of Potential Effect

SOURCE: David Rumsey Historical Map Collection, www.davidrumsey.com

EAST RIVER Waterfront Esplanade and Piers

FIGURE 23: Bromley, Atlas of the City of New York, 1891 (Detail: Rutgers Slip to Montgomery Street)

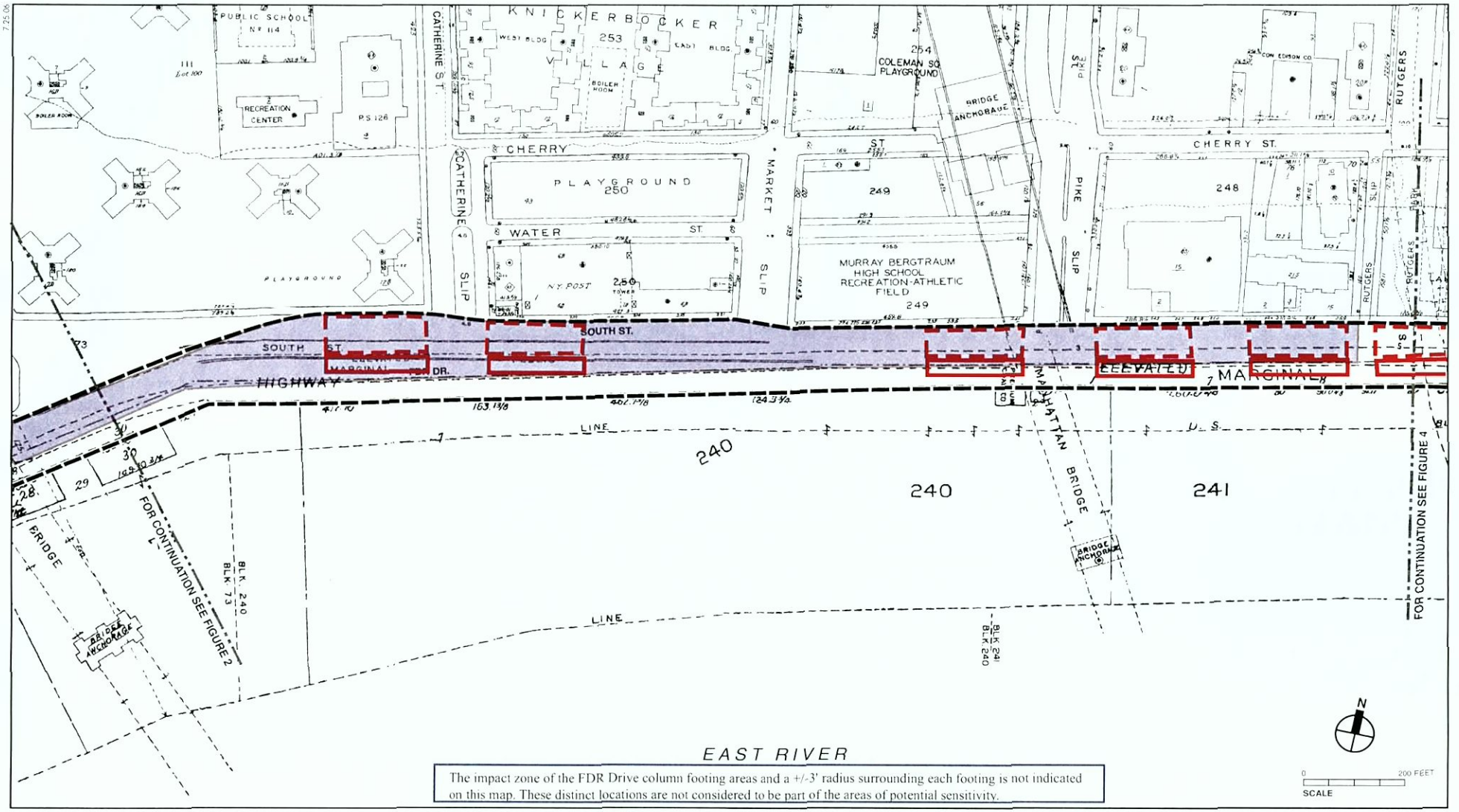


LEGEND

---- Area of Potential Effect | Area of Potential Archaeological Sensitivity | Proposed Pavilion Location | Potential Pavilion Utility Connection Area

EAST RIVER Waterfront Esplanade and Piers

FIGURE 24: Area of Potential Archaeological Sensitivity: Precontact Resources



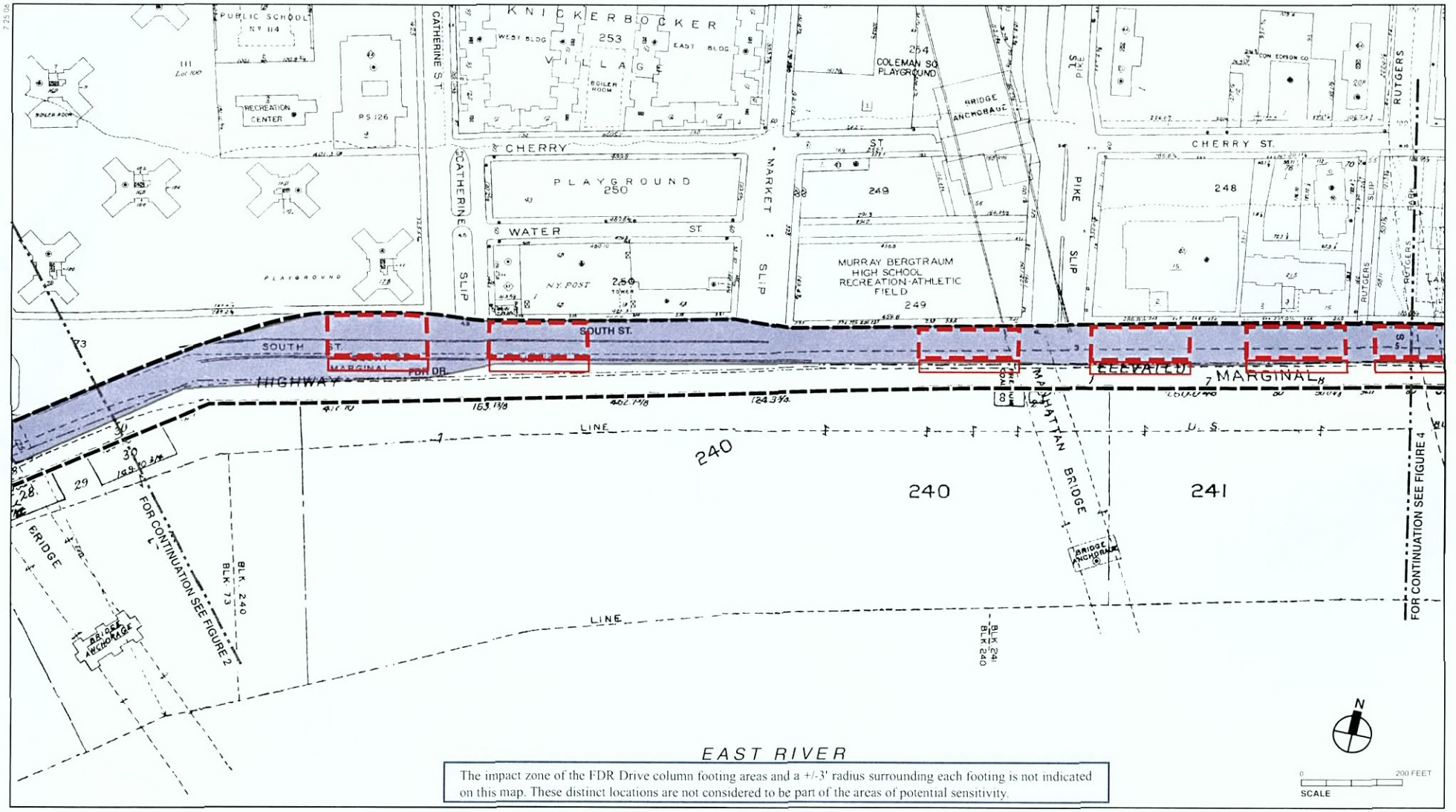
The impact zone of the FDR Drive column footing areas and a +/-3' radius surrounding each footing is not indicated on this map. These distinct locations are not considered to be part of the areas of potential sensitivity.

LEGEND

Area of Potential Effect | Area of Potential Archaeological Sensitivity | Proposed Pavilion Location | Potential Pavilion Utility Connection Area

EAST RIVER Waterfront Esplanade and Piers

FIGURE 25: Area of Potential Archaeological Sensitivity: Riverbottom Remains

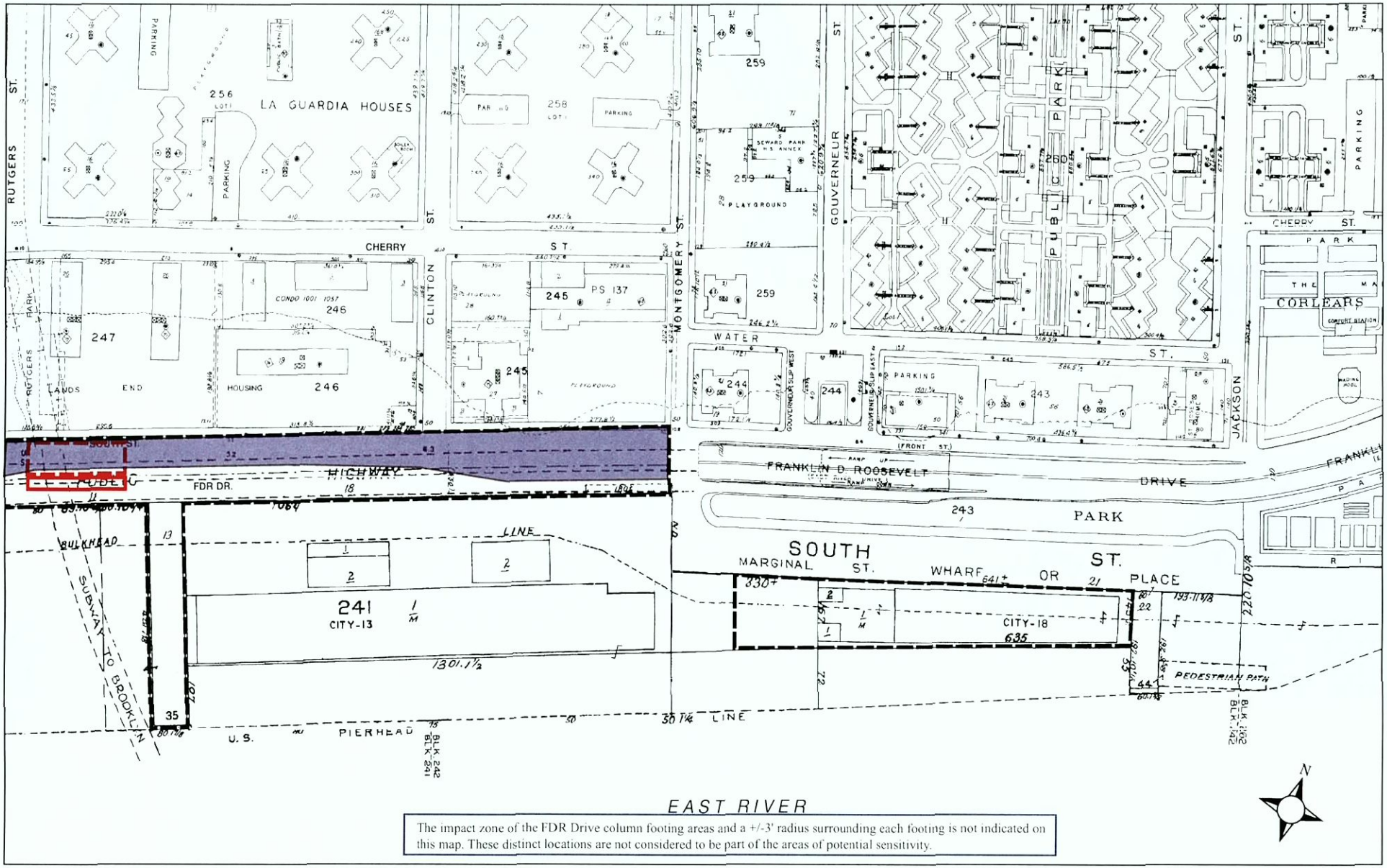


LEGEND

Area of Potential Effect | Area of Potential Archaeological Sensitivity | Proposed Pavilion Location | Potential Pavilion Utility Connection Area

EAST RIVER Waterfront Esplanade and Piers

FIGURE 26: Area of Potential Archaeological Sensitivity: Landfill Retaining Structures, Wharves, and Piers; and Landfill Deposits (Roosevelt Street to Rutgers Slip)



EAST RIVER Waterfront Esplanade and Piers

FIGURE 27: Area of Potential Archaeological Sensitivity: Landfill Retaining Structures, Wharves, and Piers; and Landfill Deposits (Rutgers Slip to Montgomery Street)

East River Waterfront Esplanade and Piers

Inboard Resources North of Brooklyn Bridge

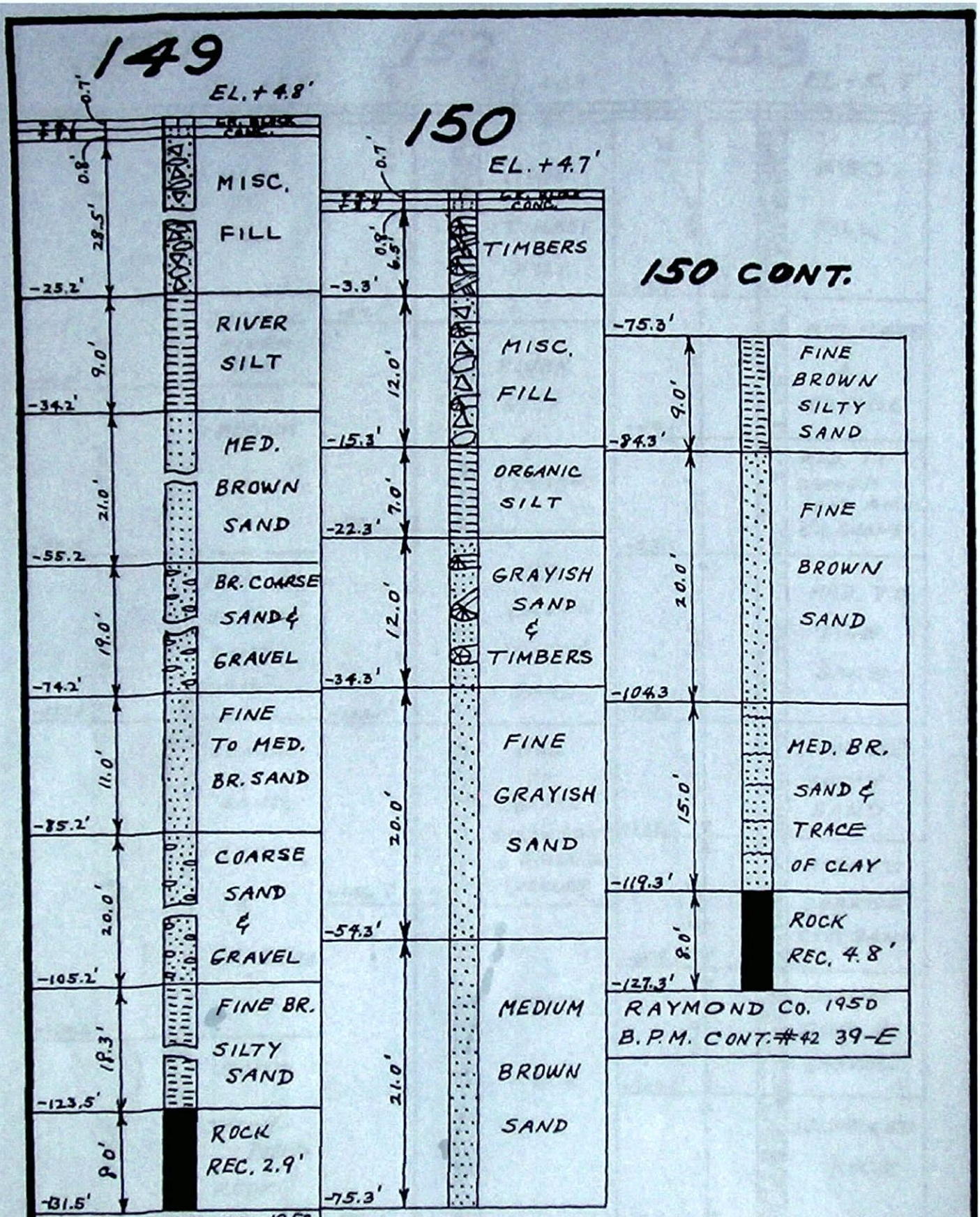
Phase 1A

APPENDIX

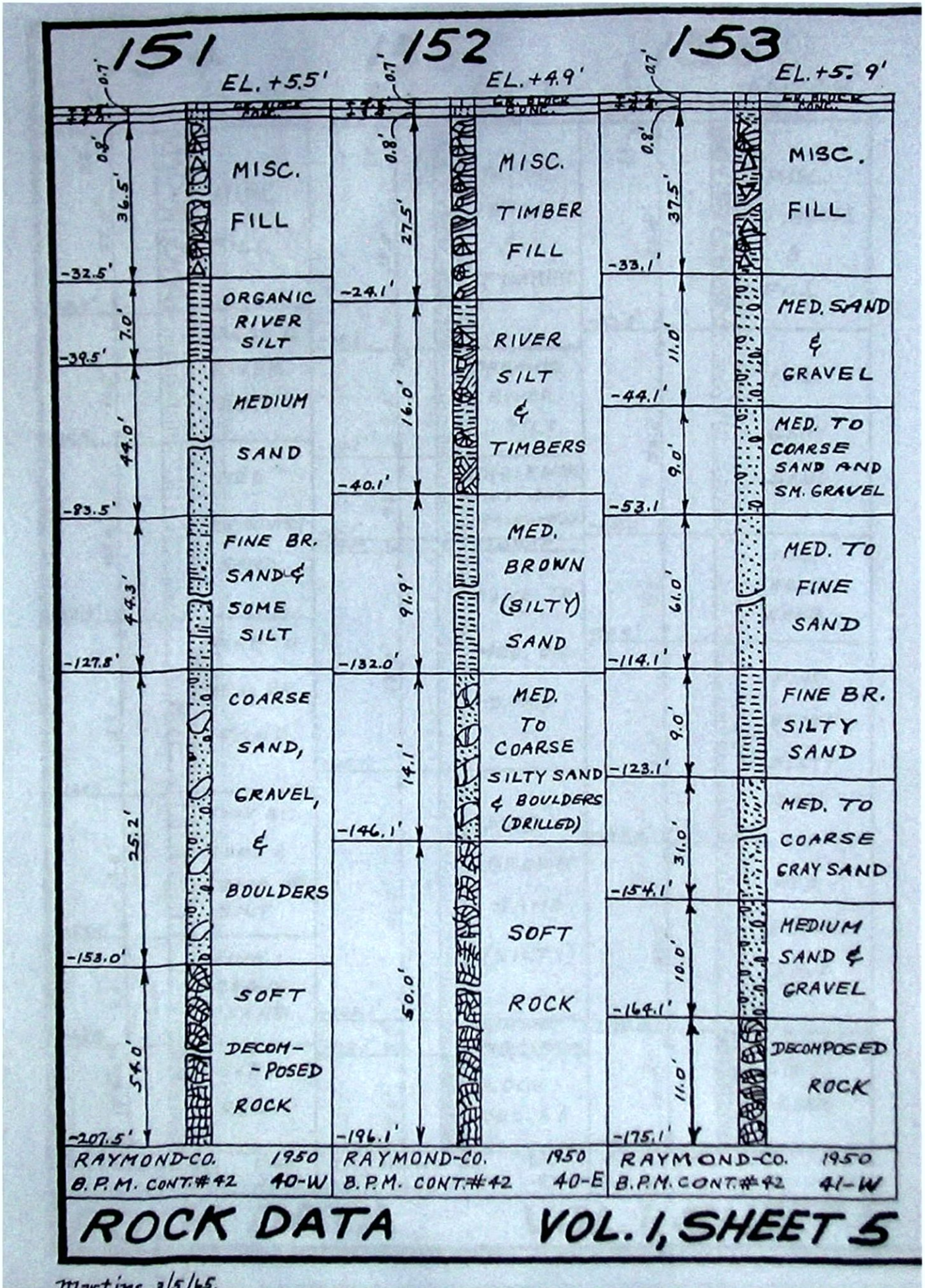
Soil Boring Logs

and

Locational Maps



Martins 3/3/65.



ROCK DATA VOL. 1, SHEET 5

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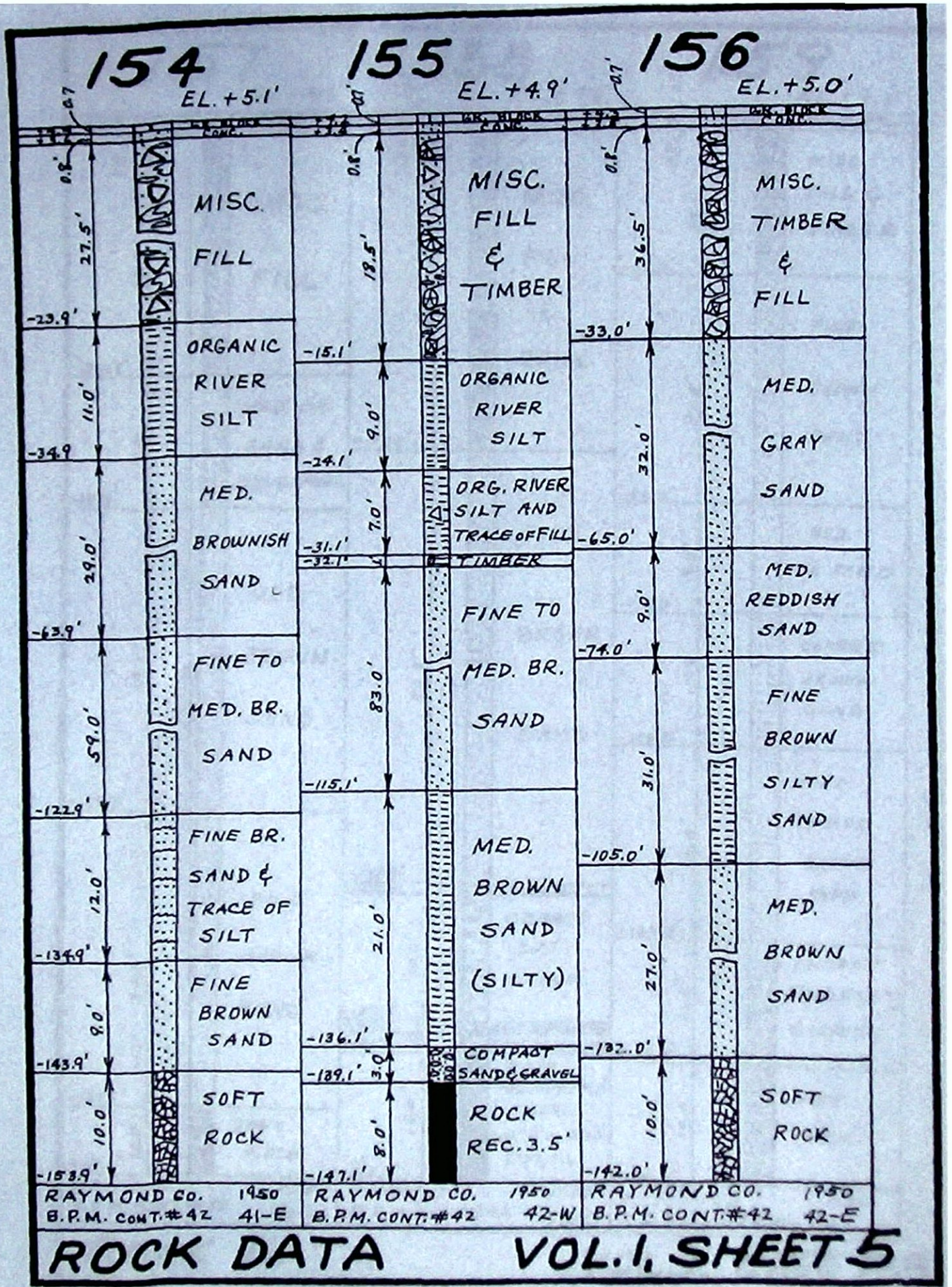

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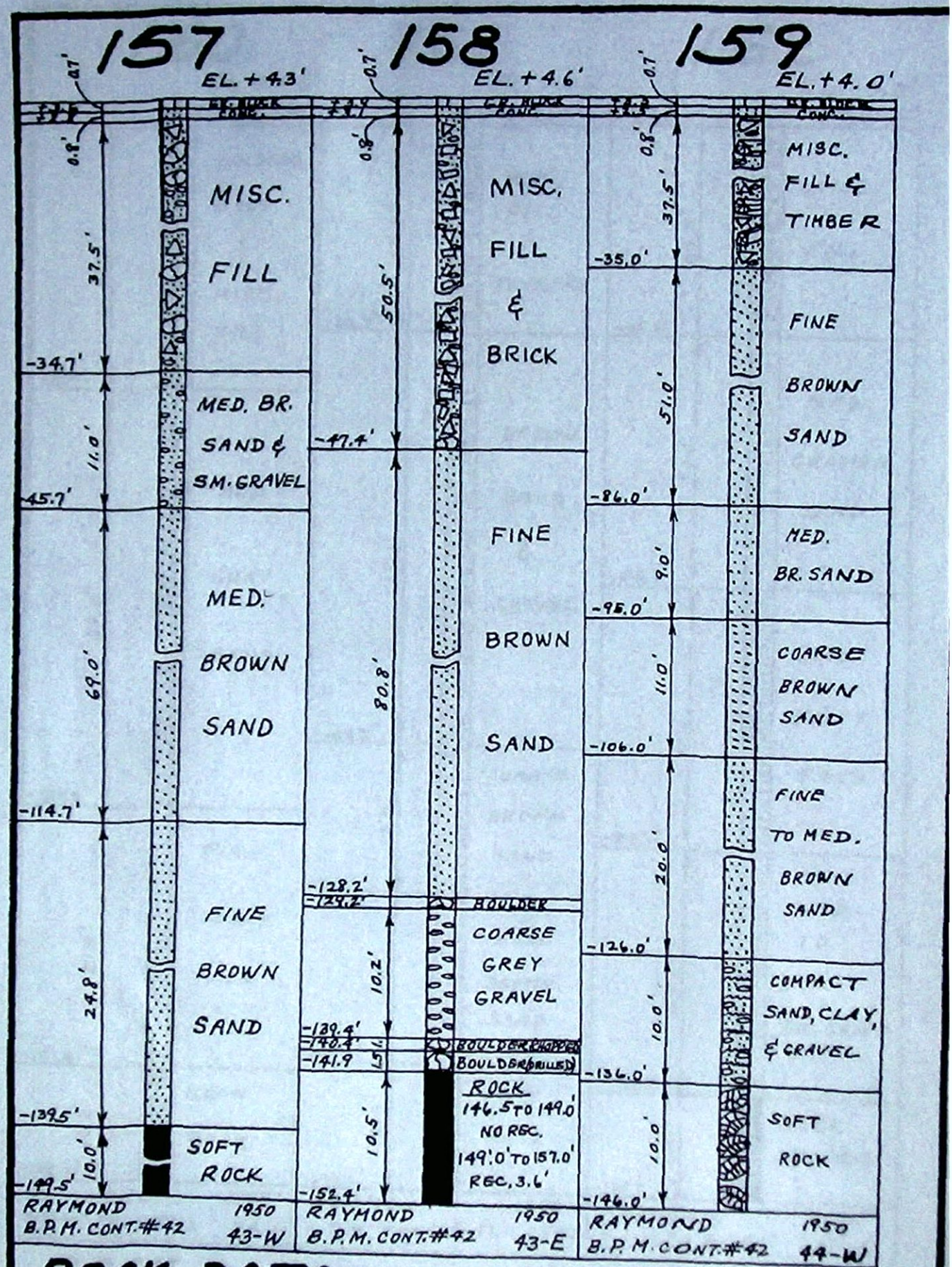

ROCK DATA

VOL. I, SHEET 5

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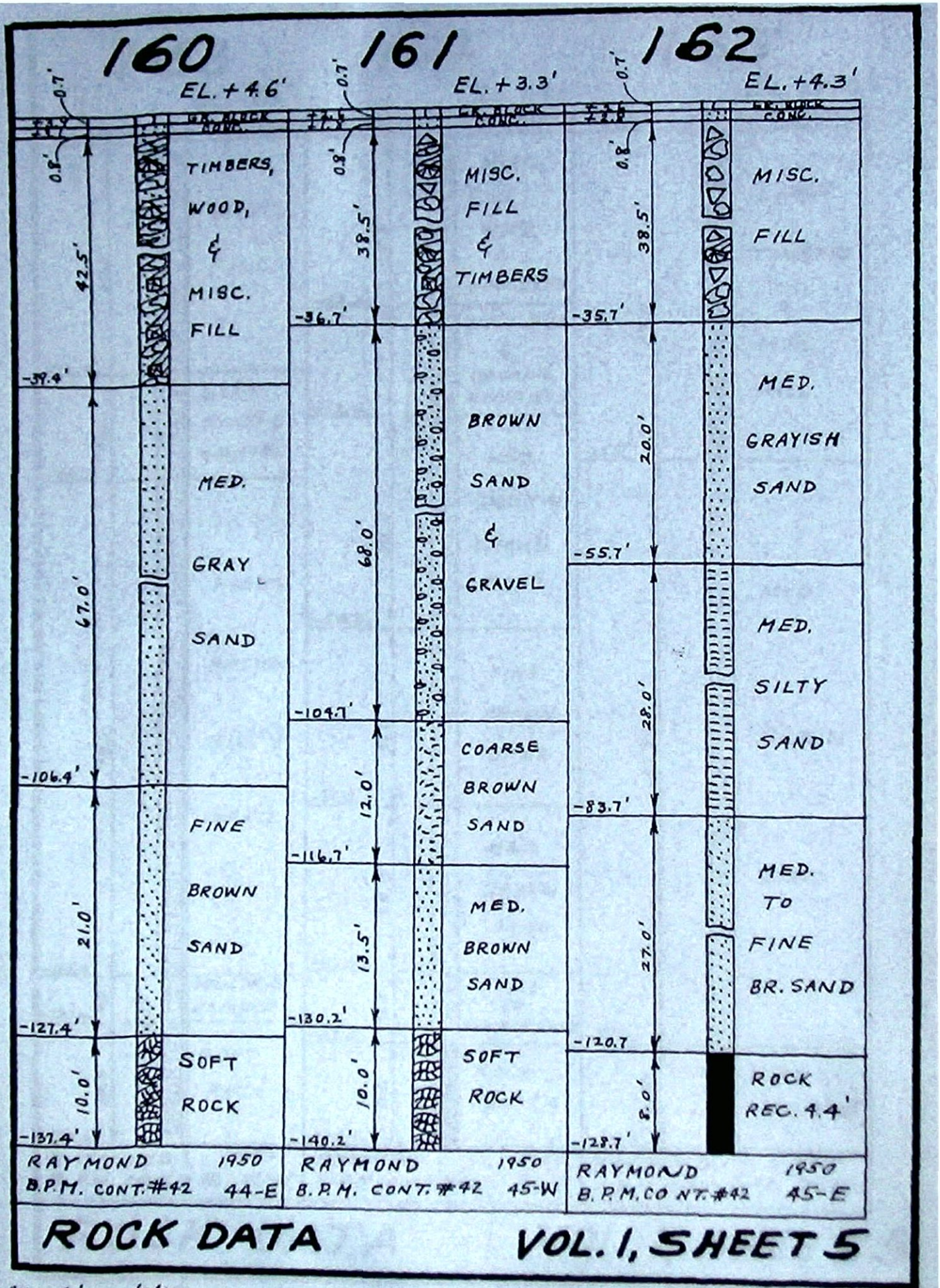

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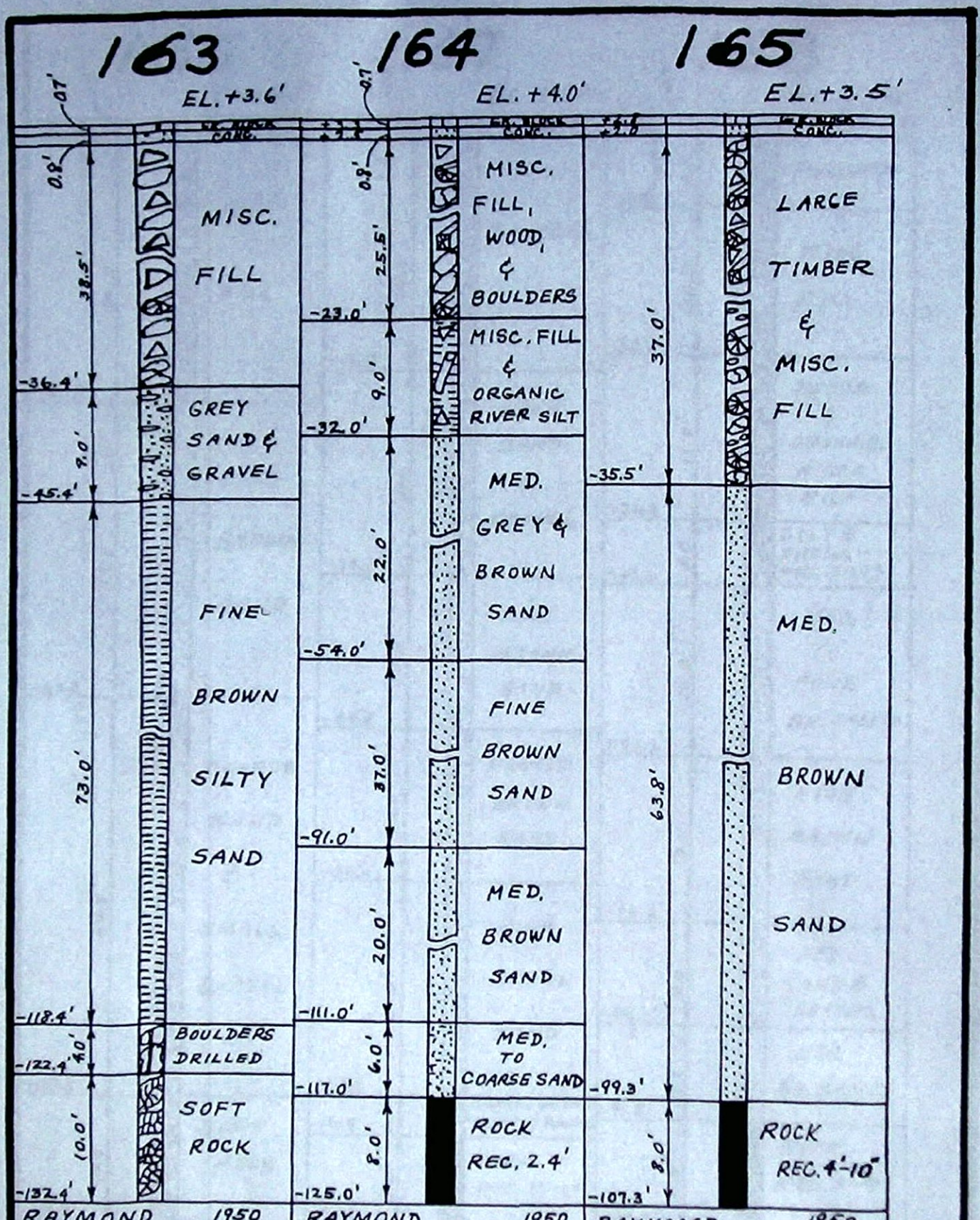

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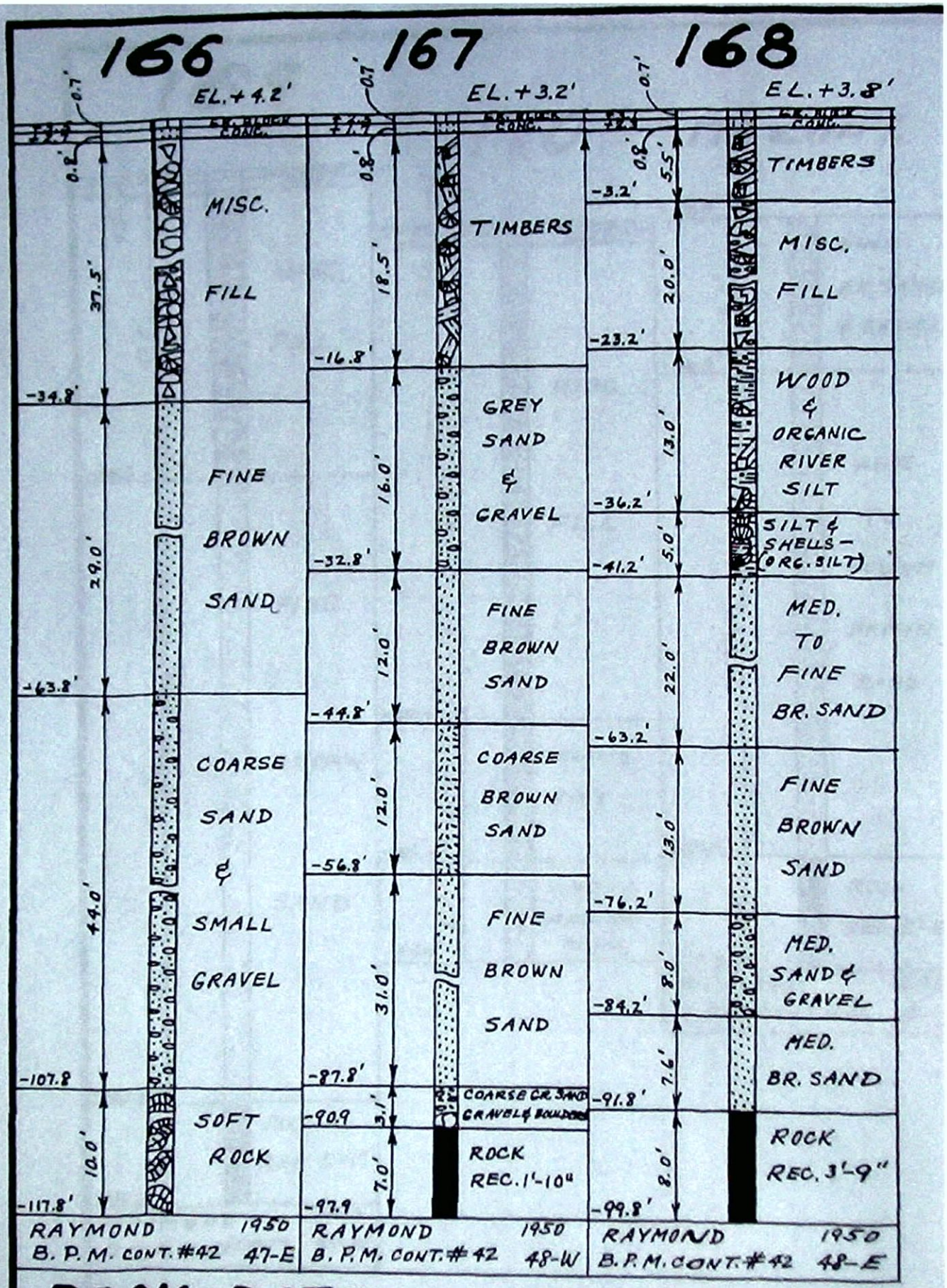

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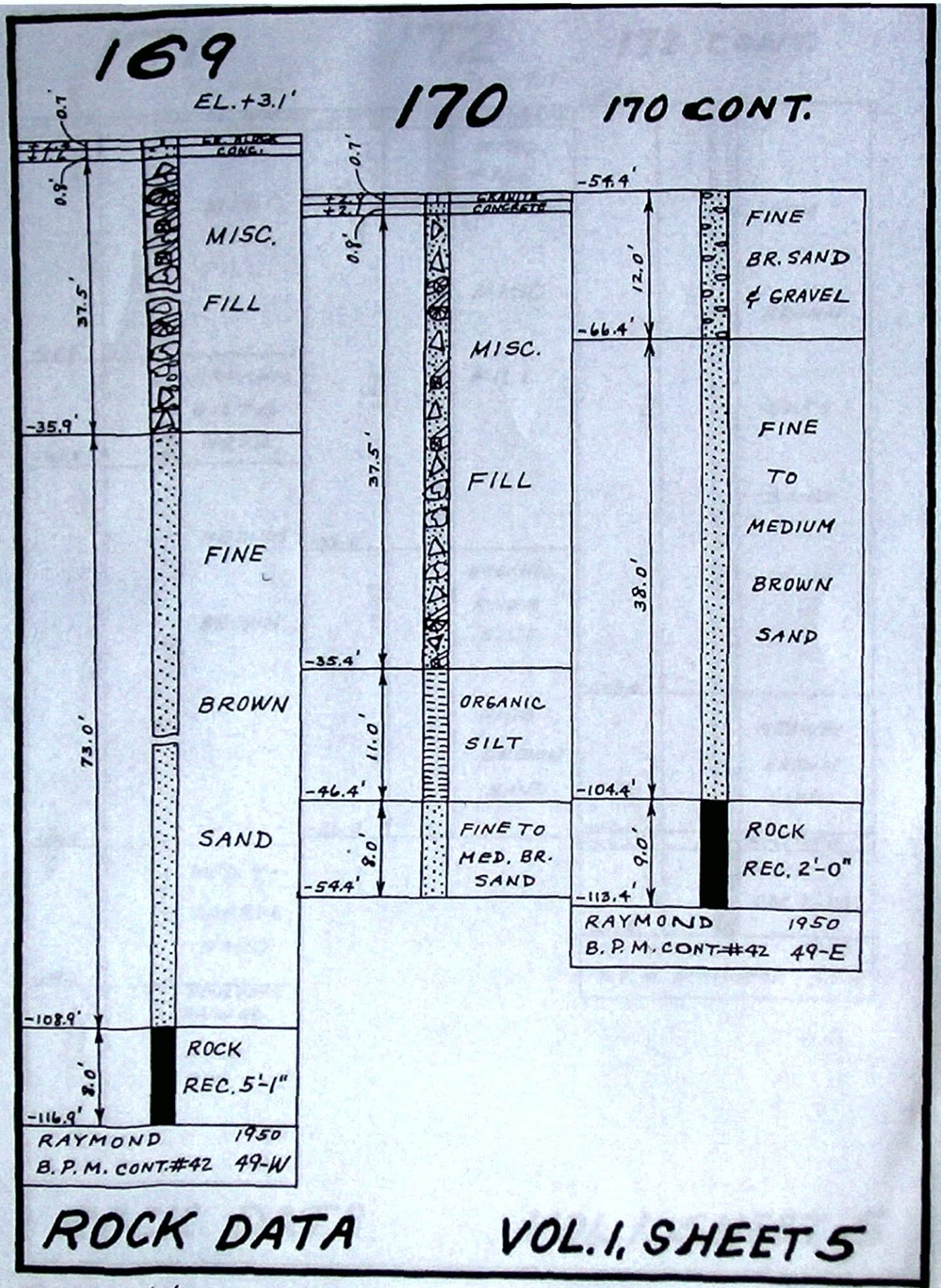

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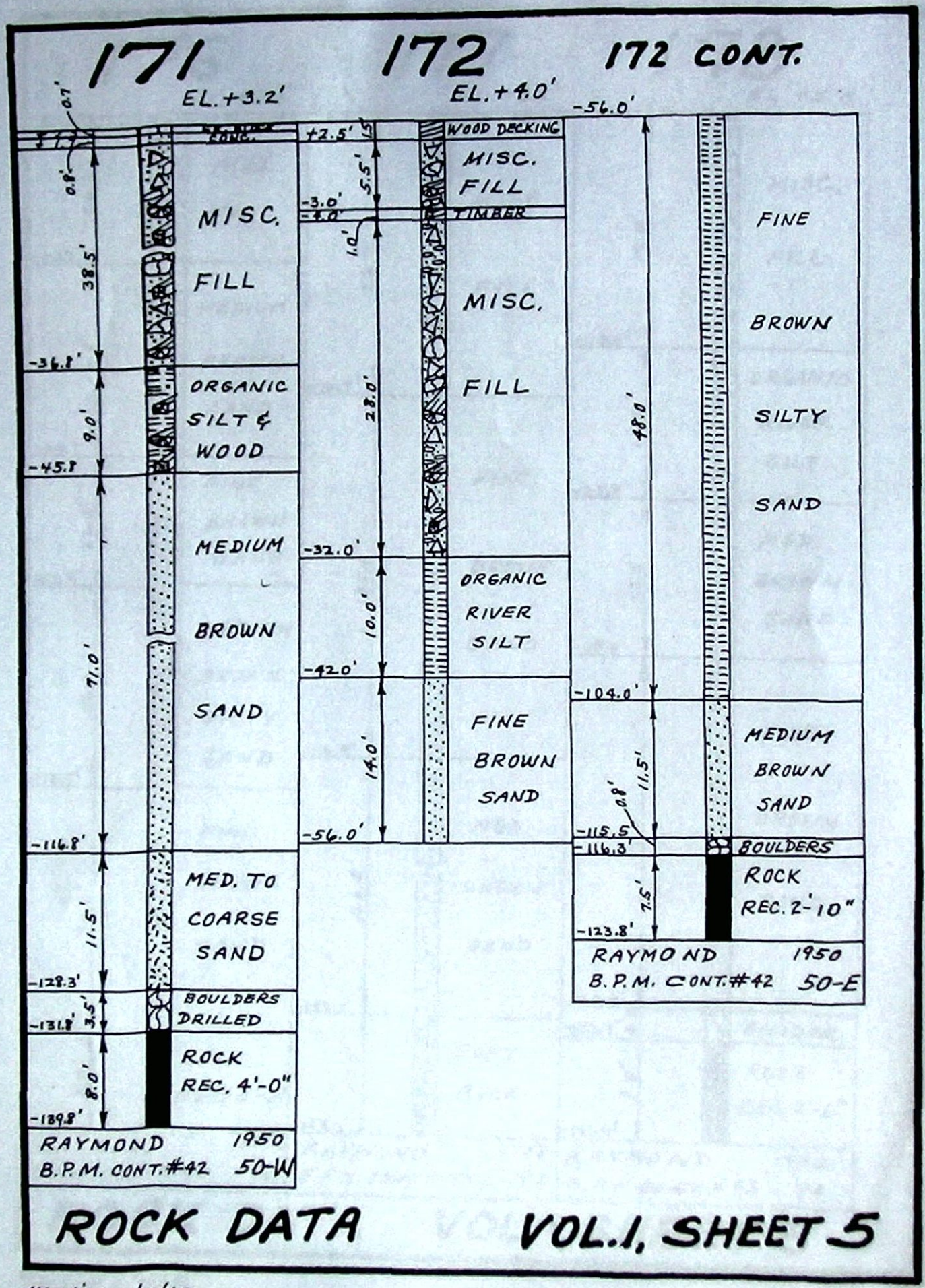

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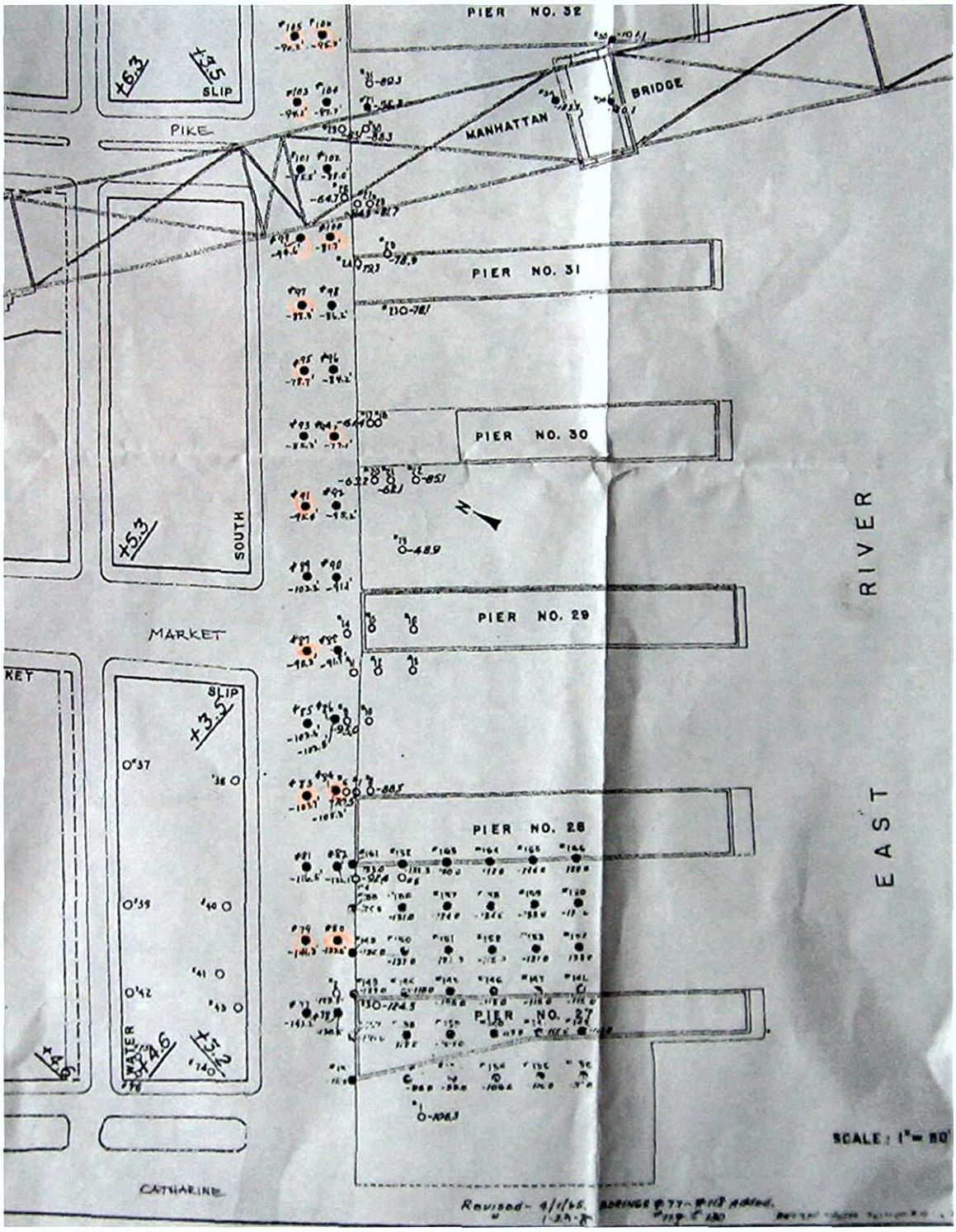
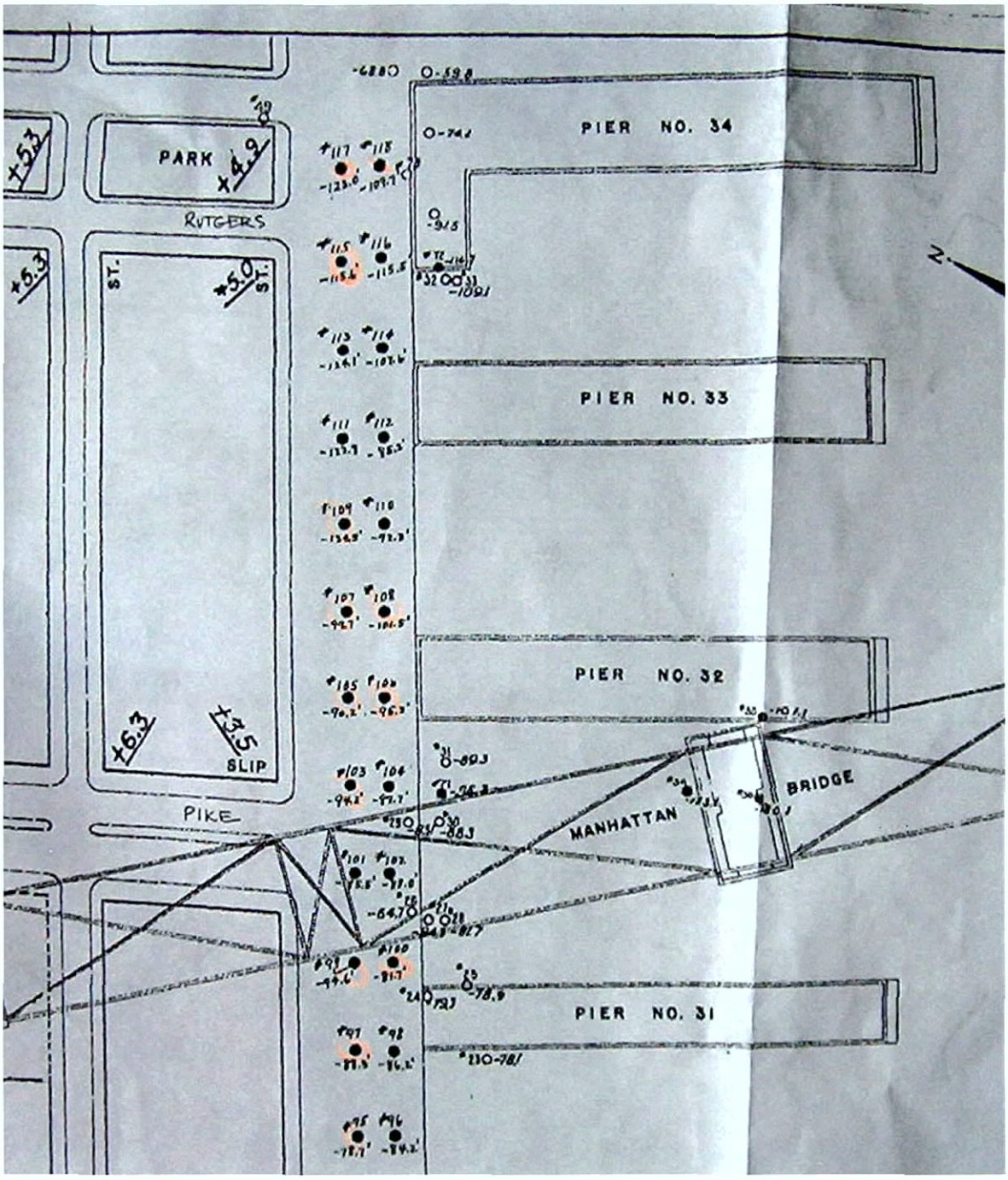
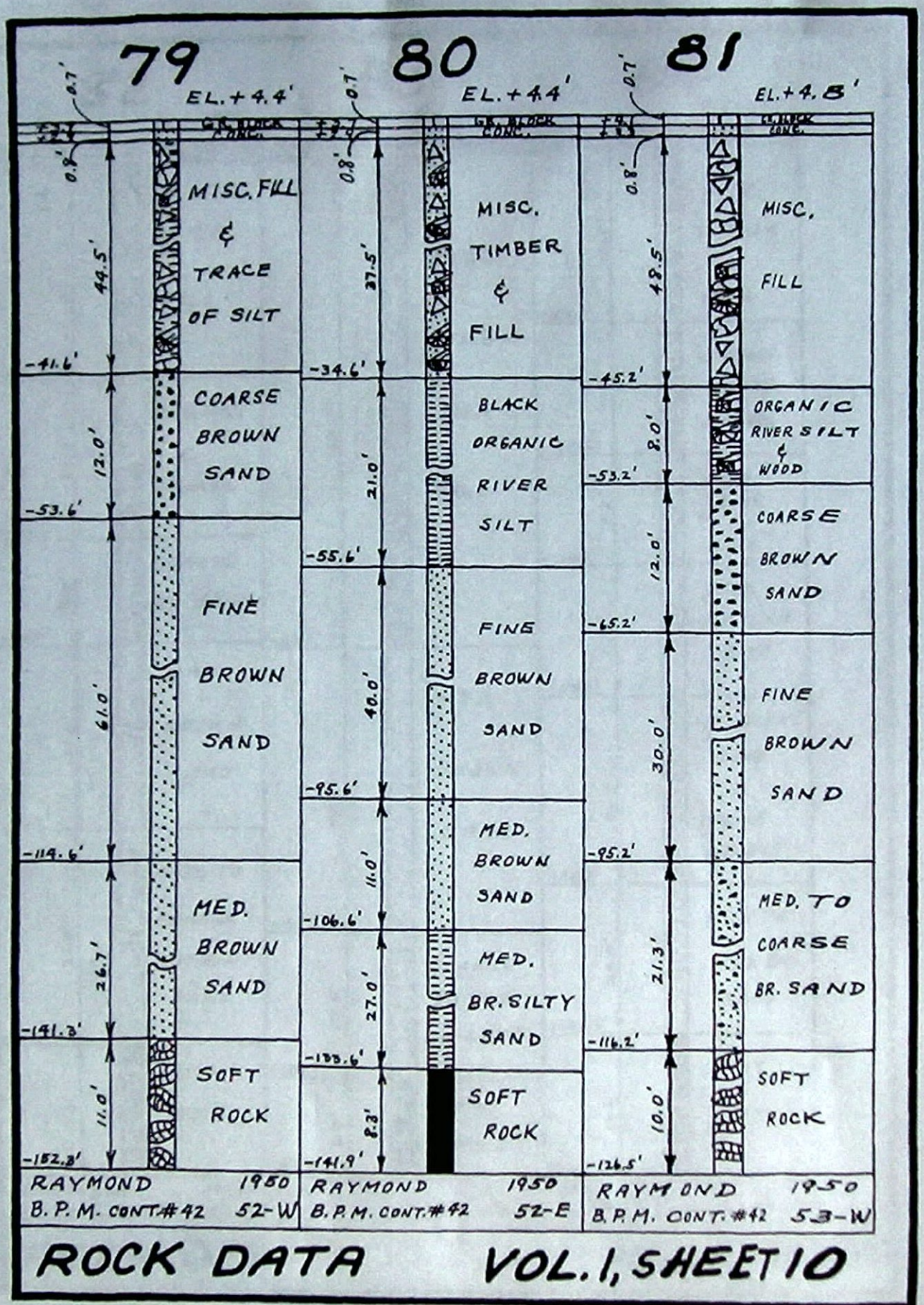


WPA Rock Data – Locational Map 10a
(Volume 1, Sheet 10. Borough of Manhattan, Office of the President, 1937, revised)



WPA Rock Data – Locational Map 10b
(Volume 1, Sheet 10. Borough of Manhattan, Office of the President, 1937, revised)



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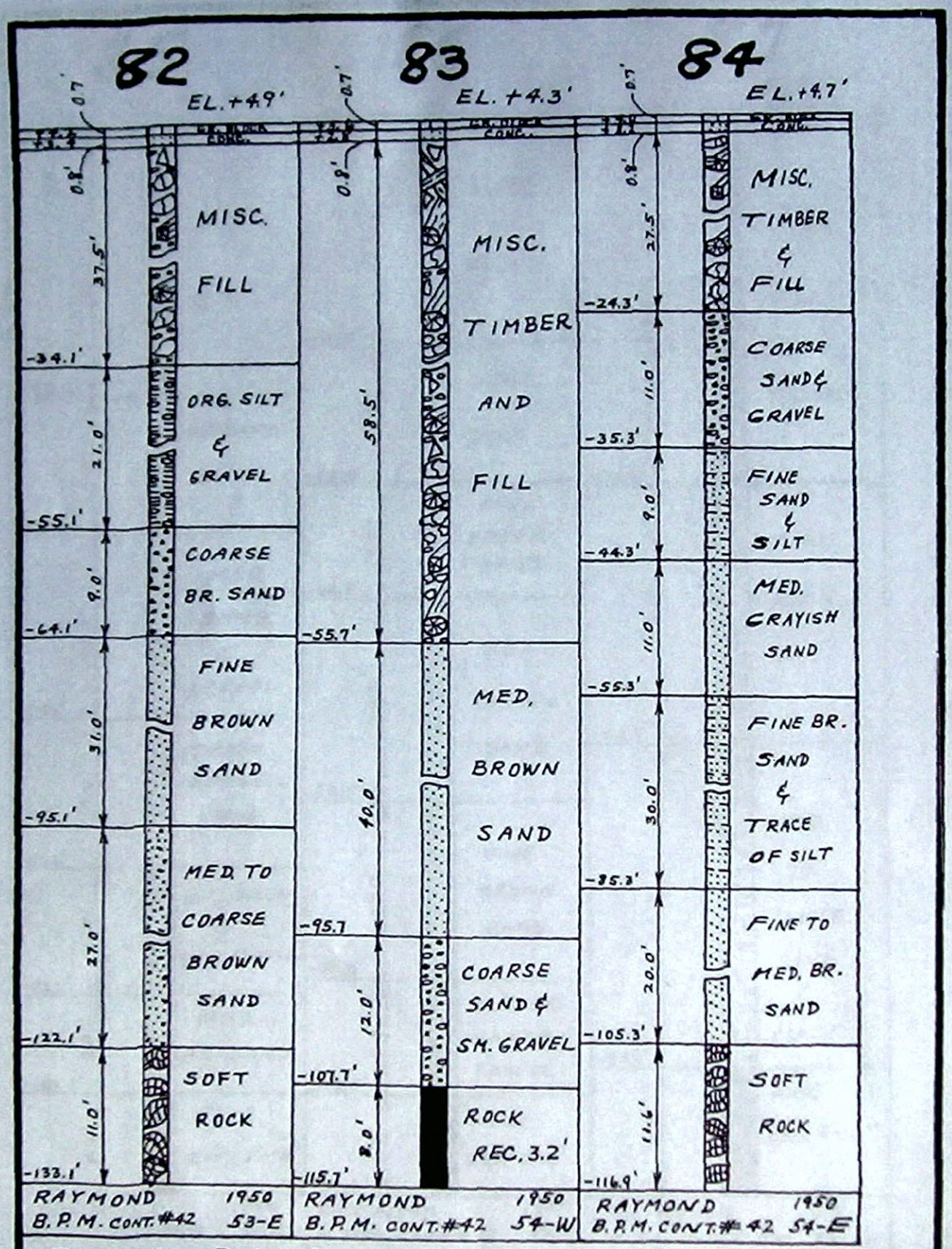

ROCK DATA

VOL. I, SHEET 10

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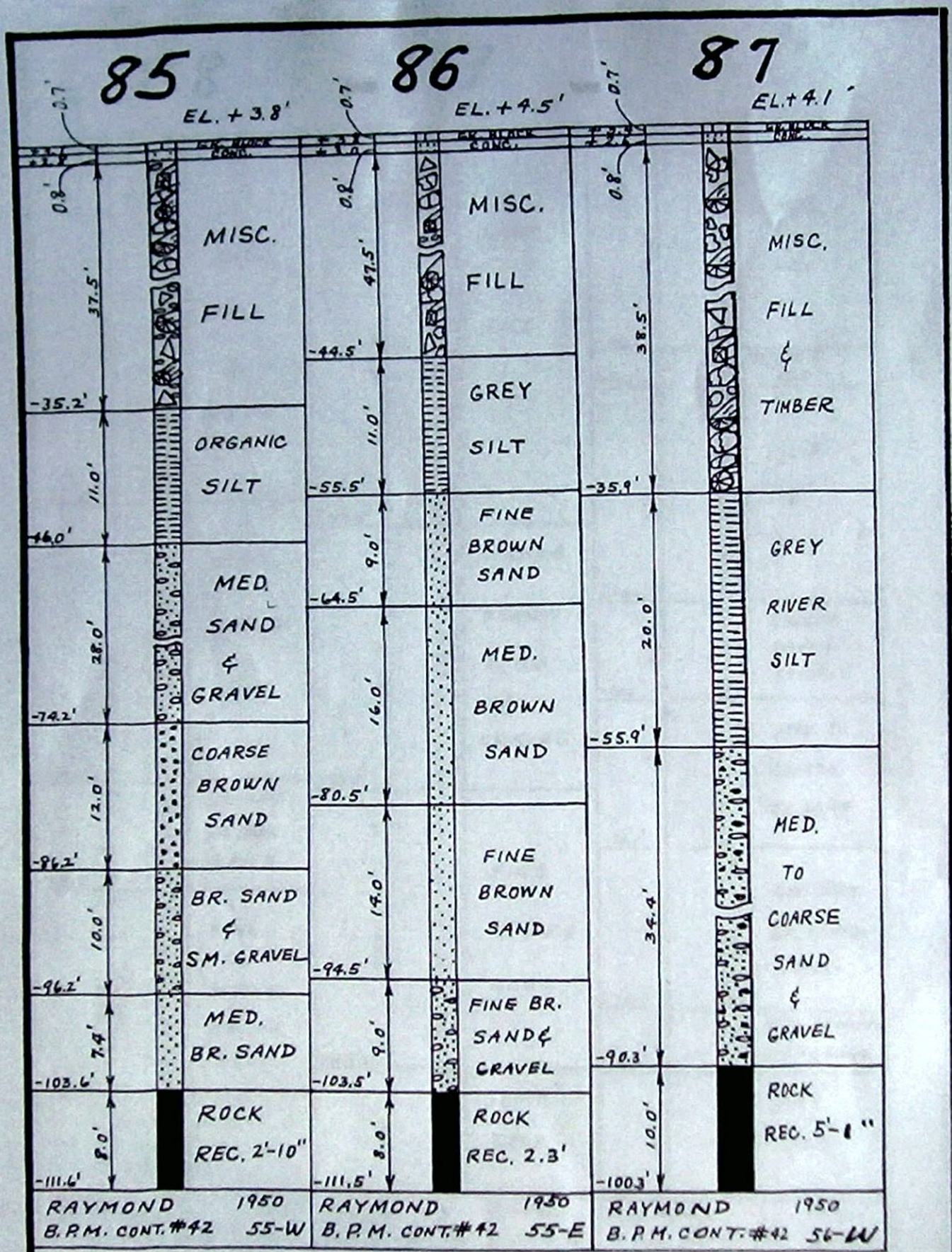

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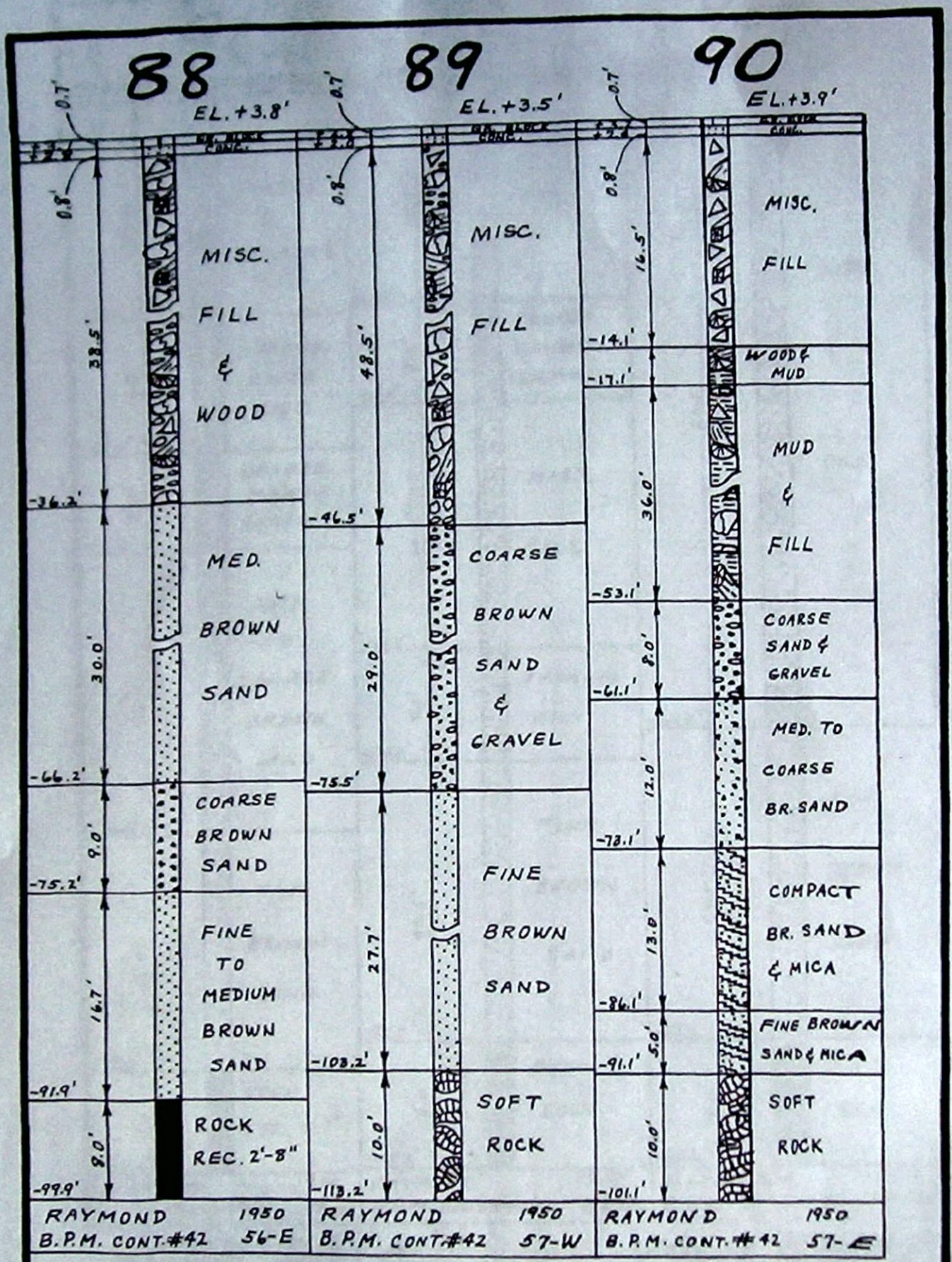

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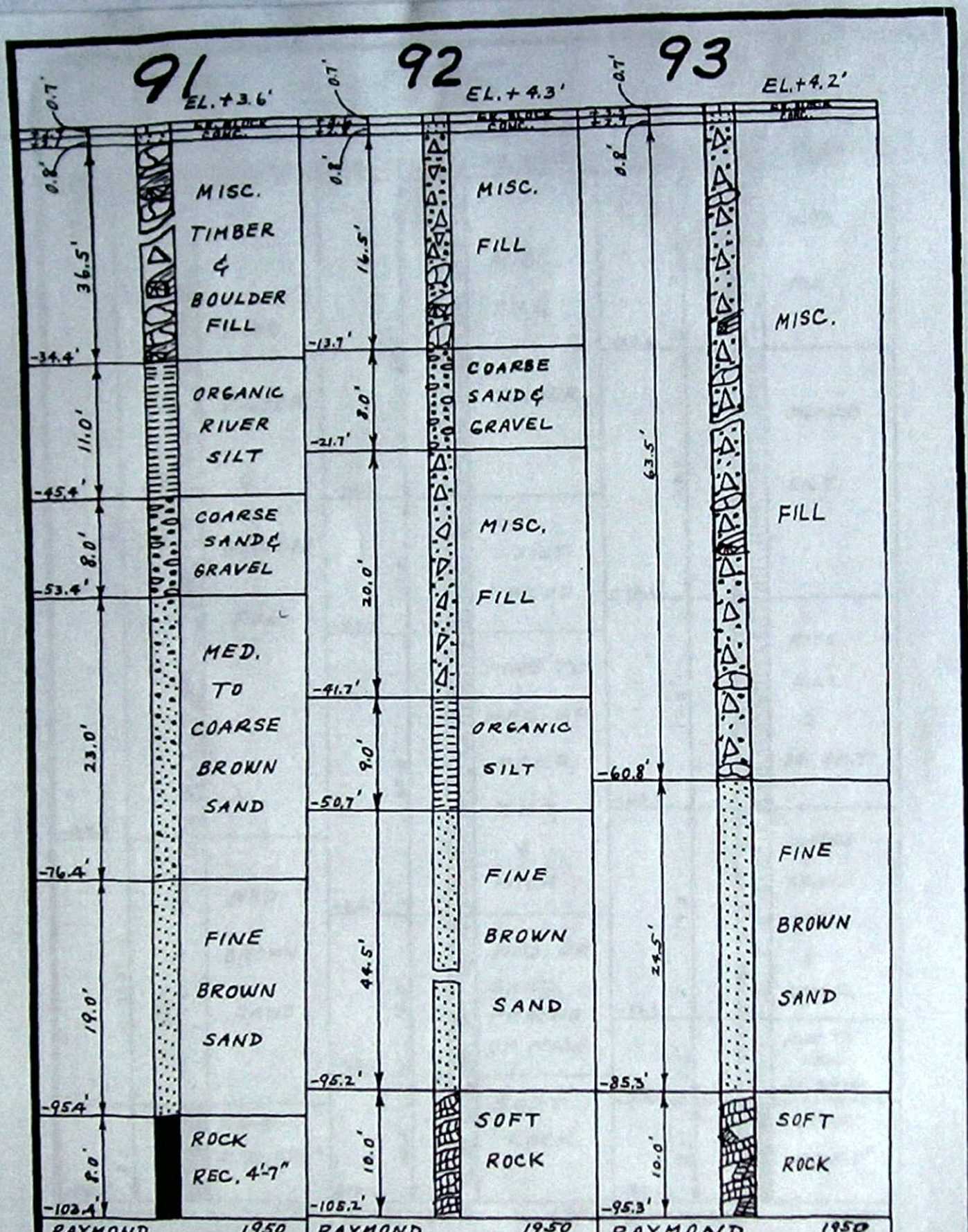

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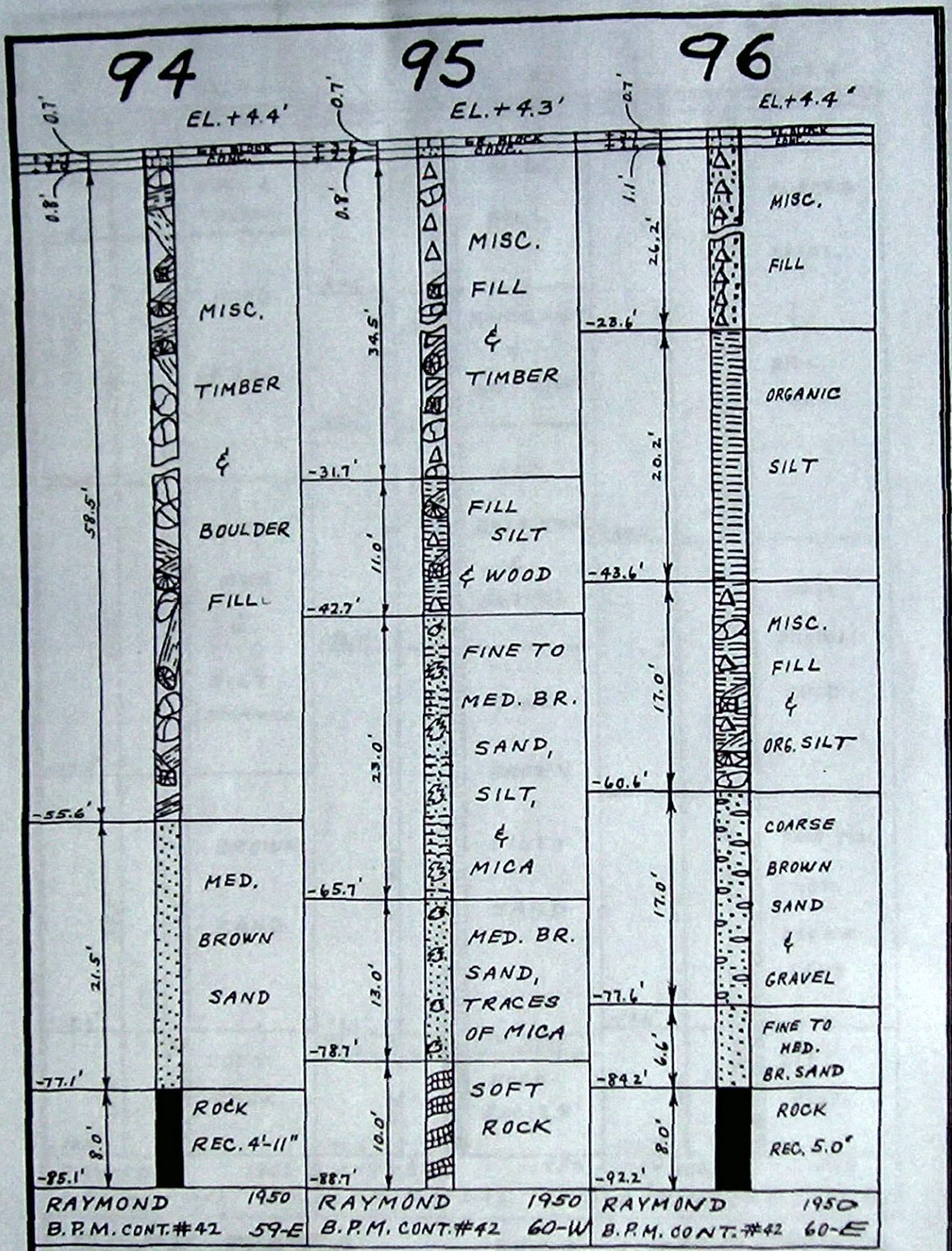

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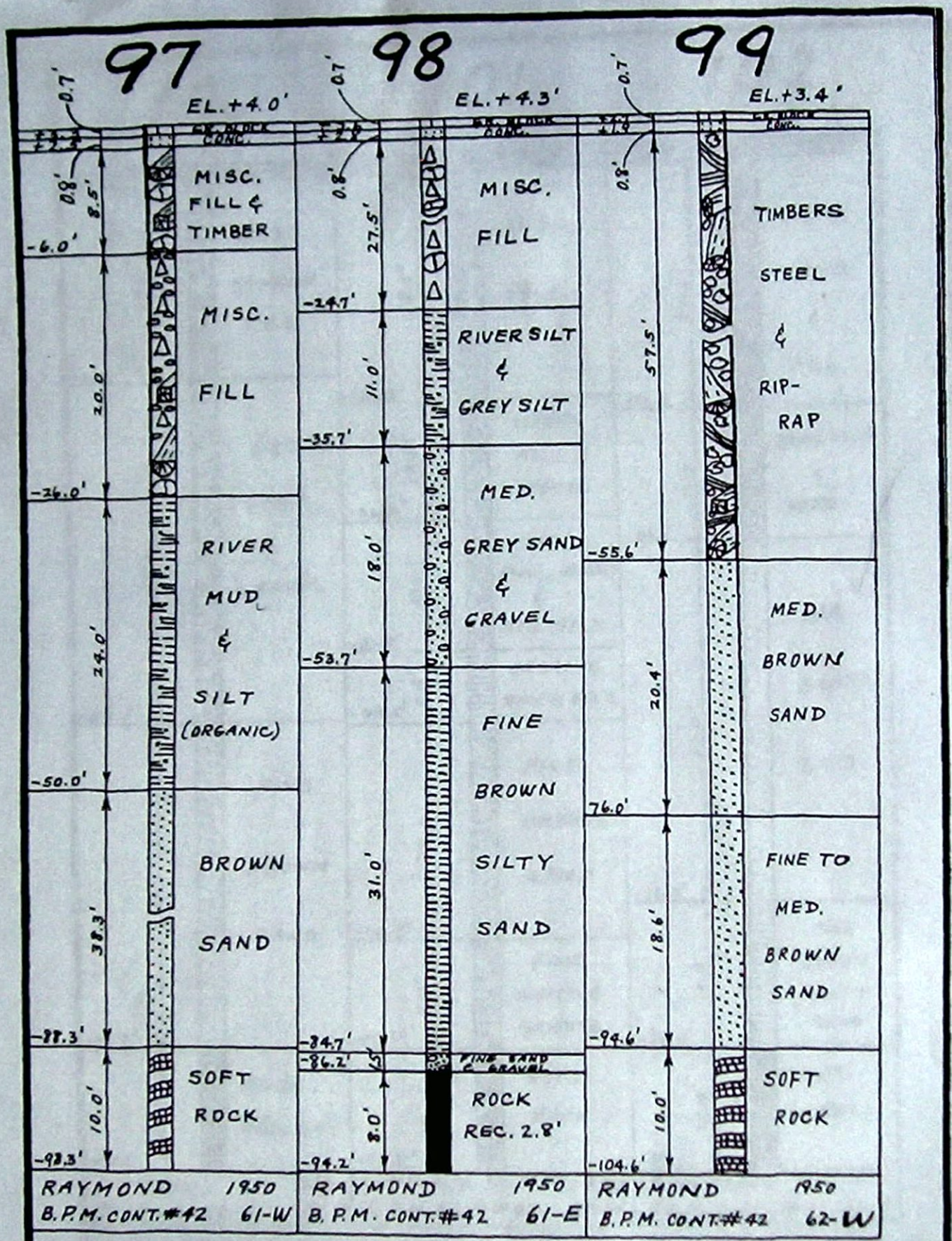

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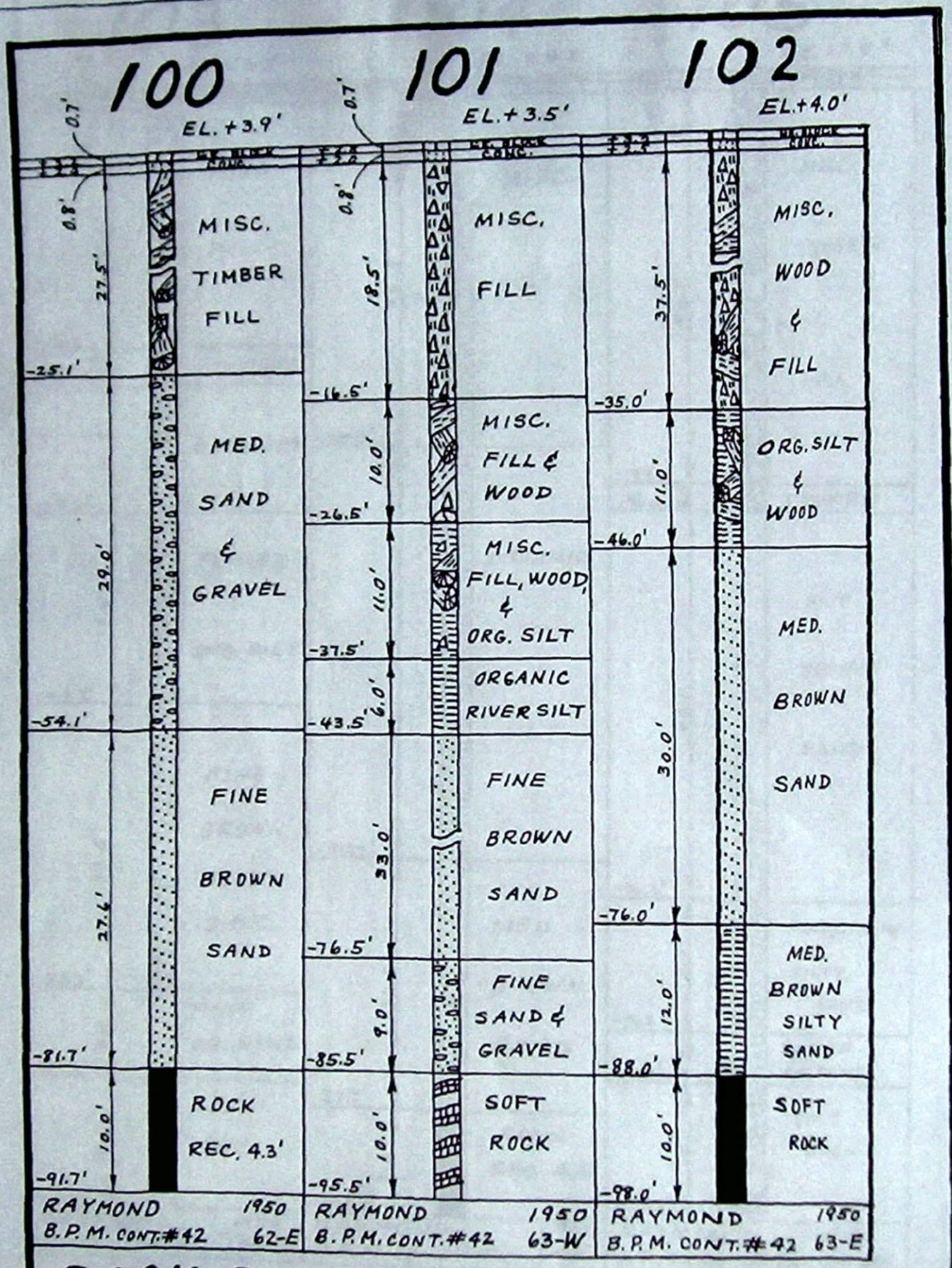

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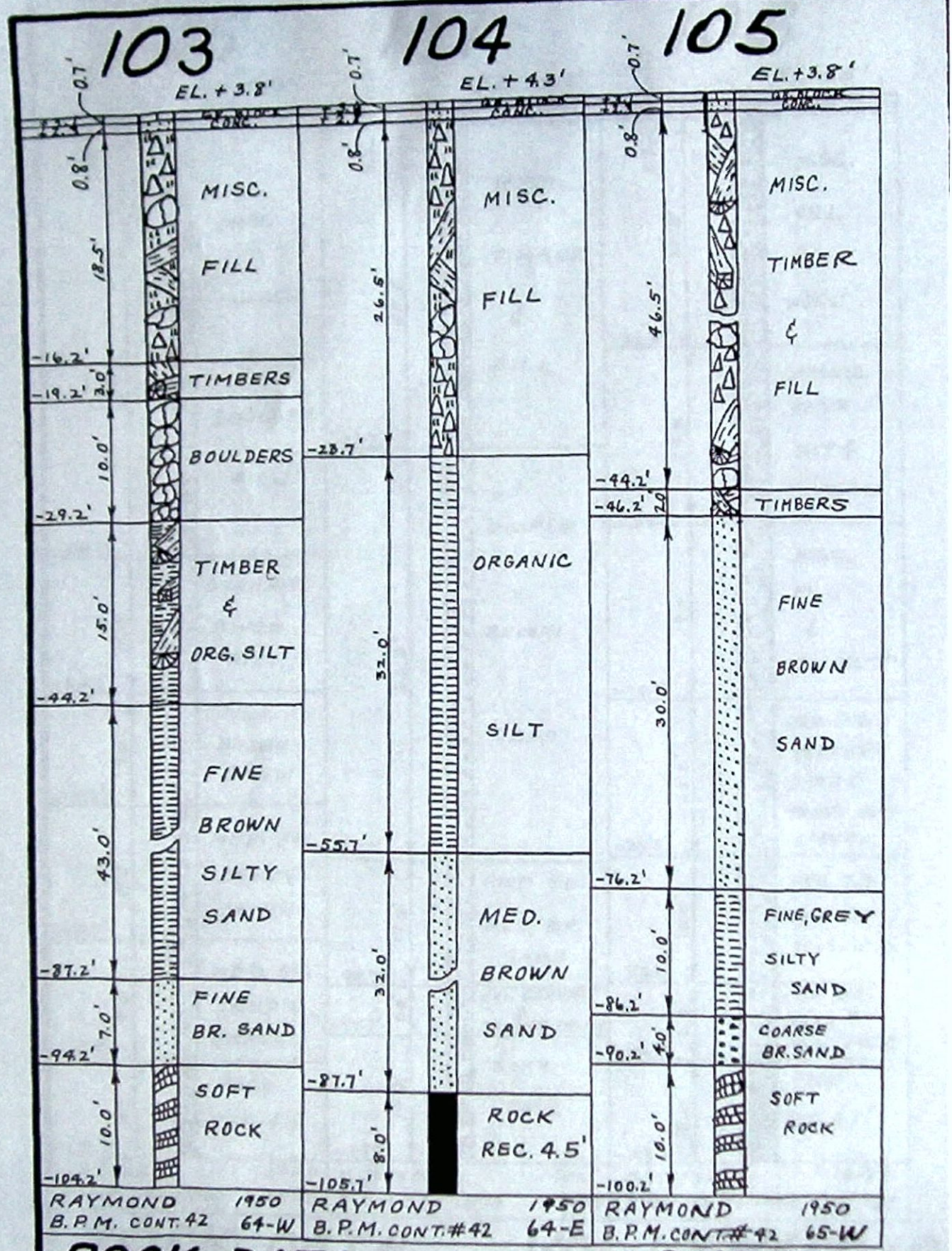

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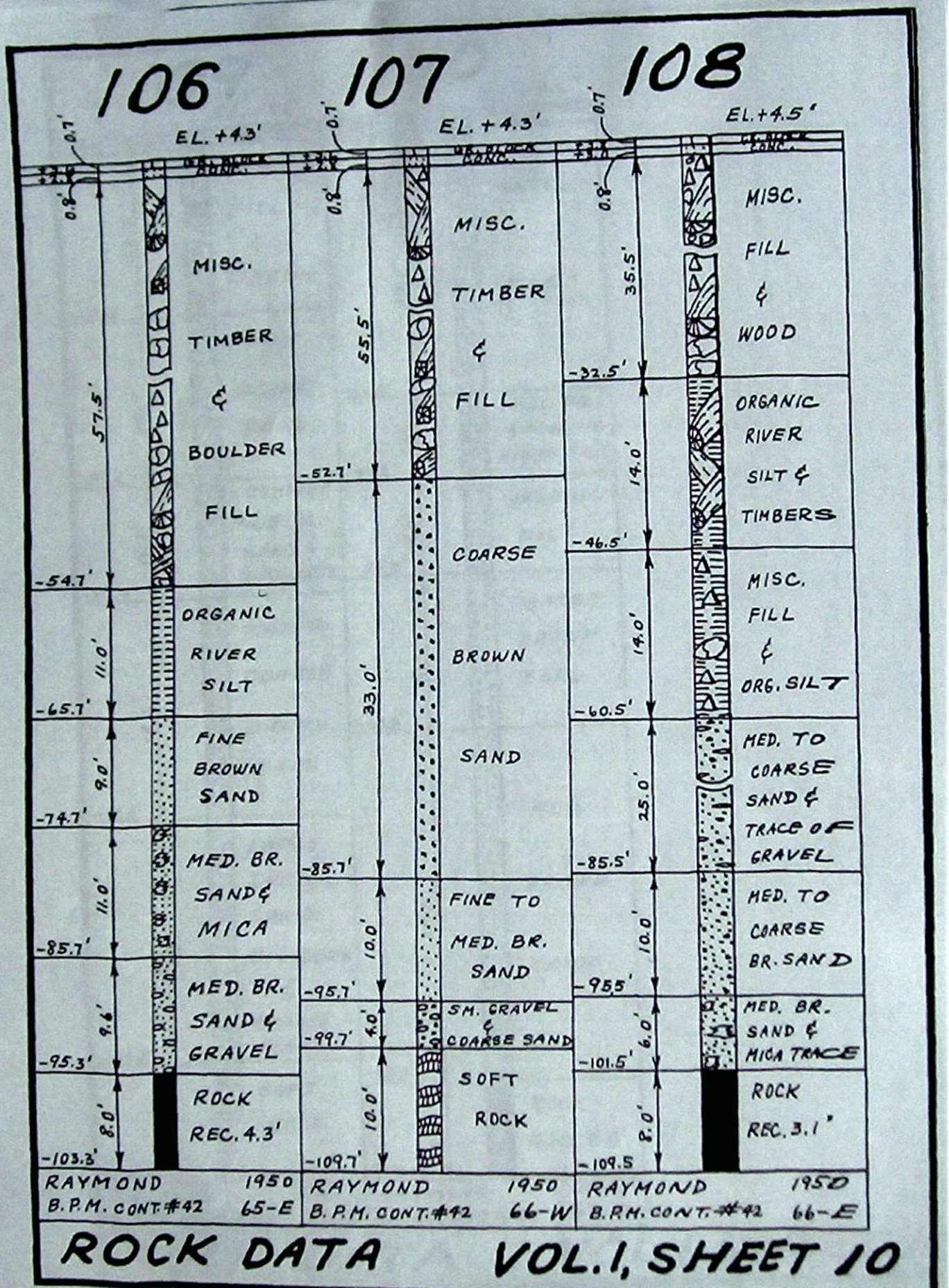

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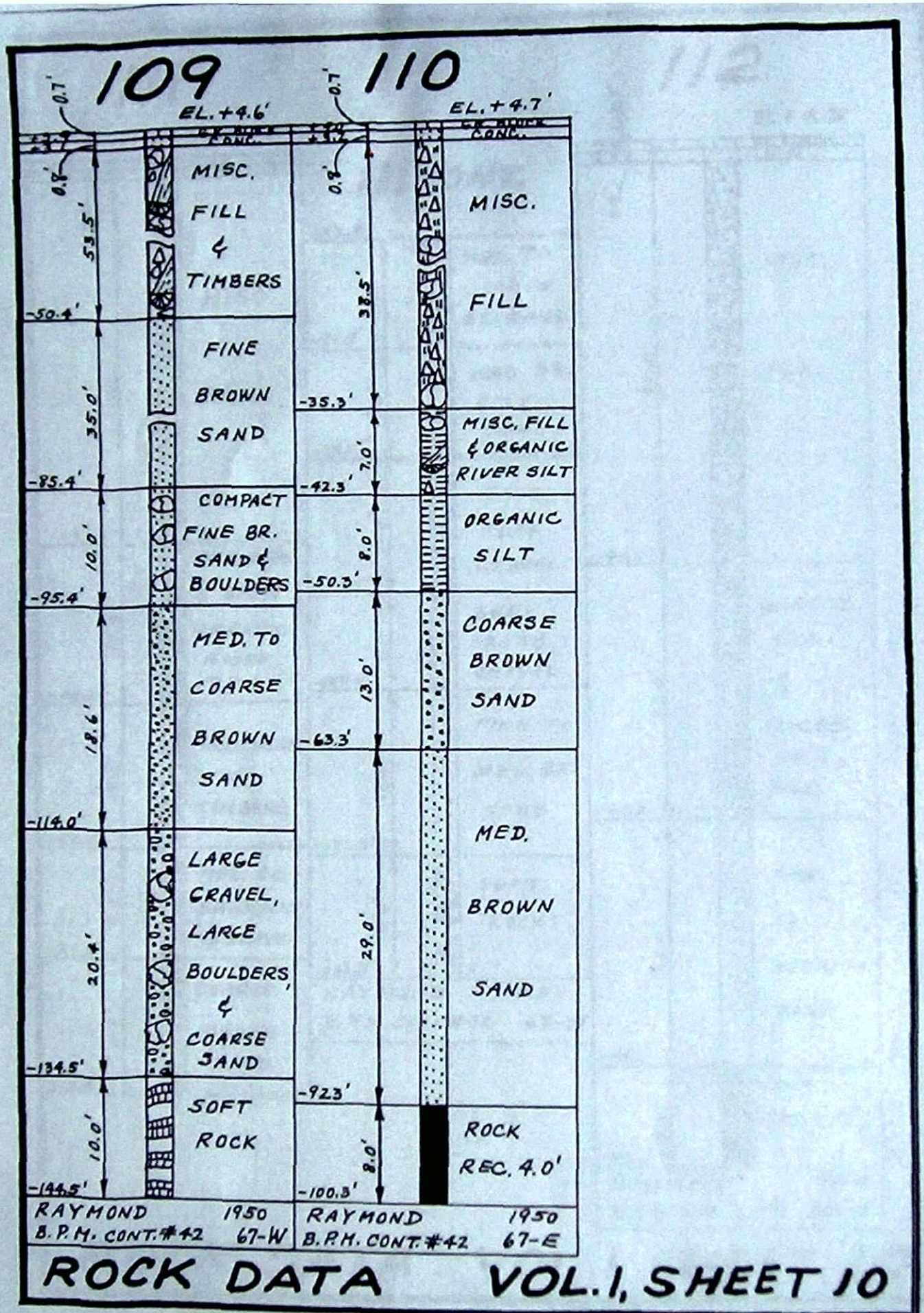

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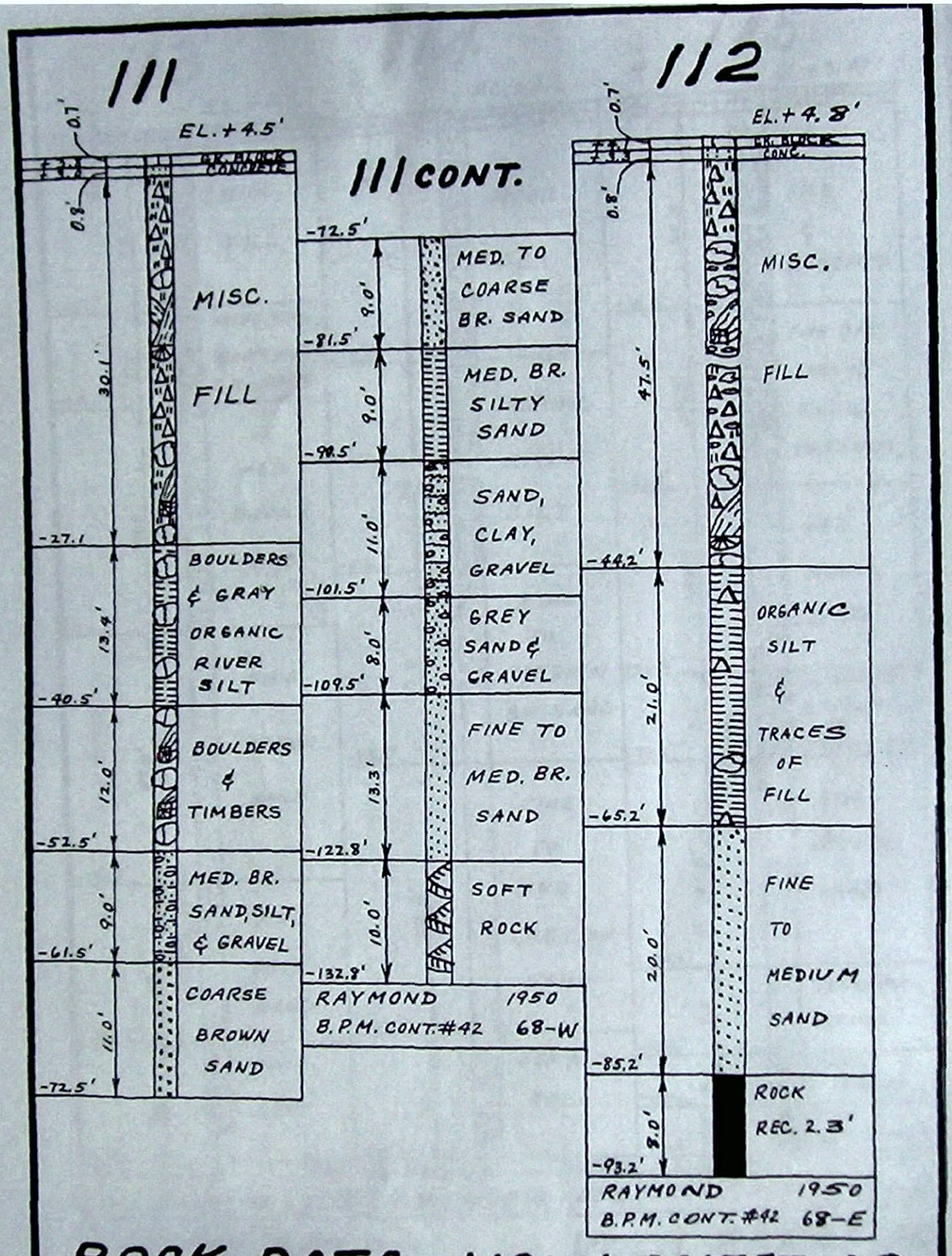

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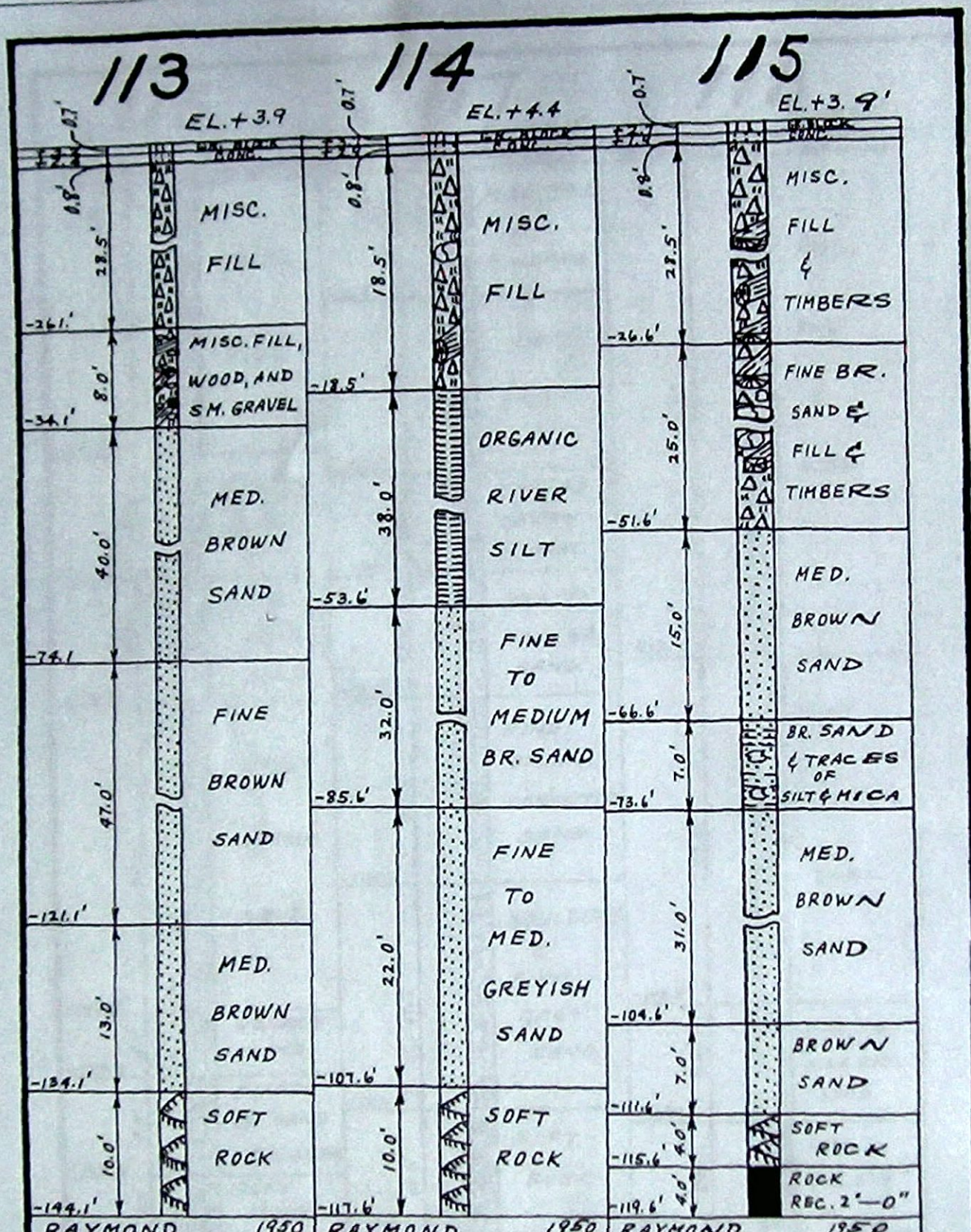

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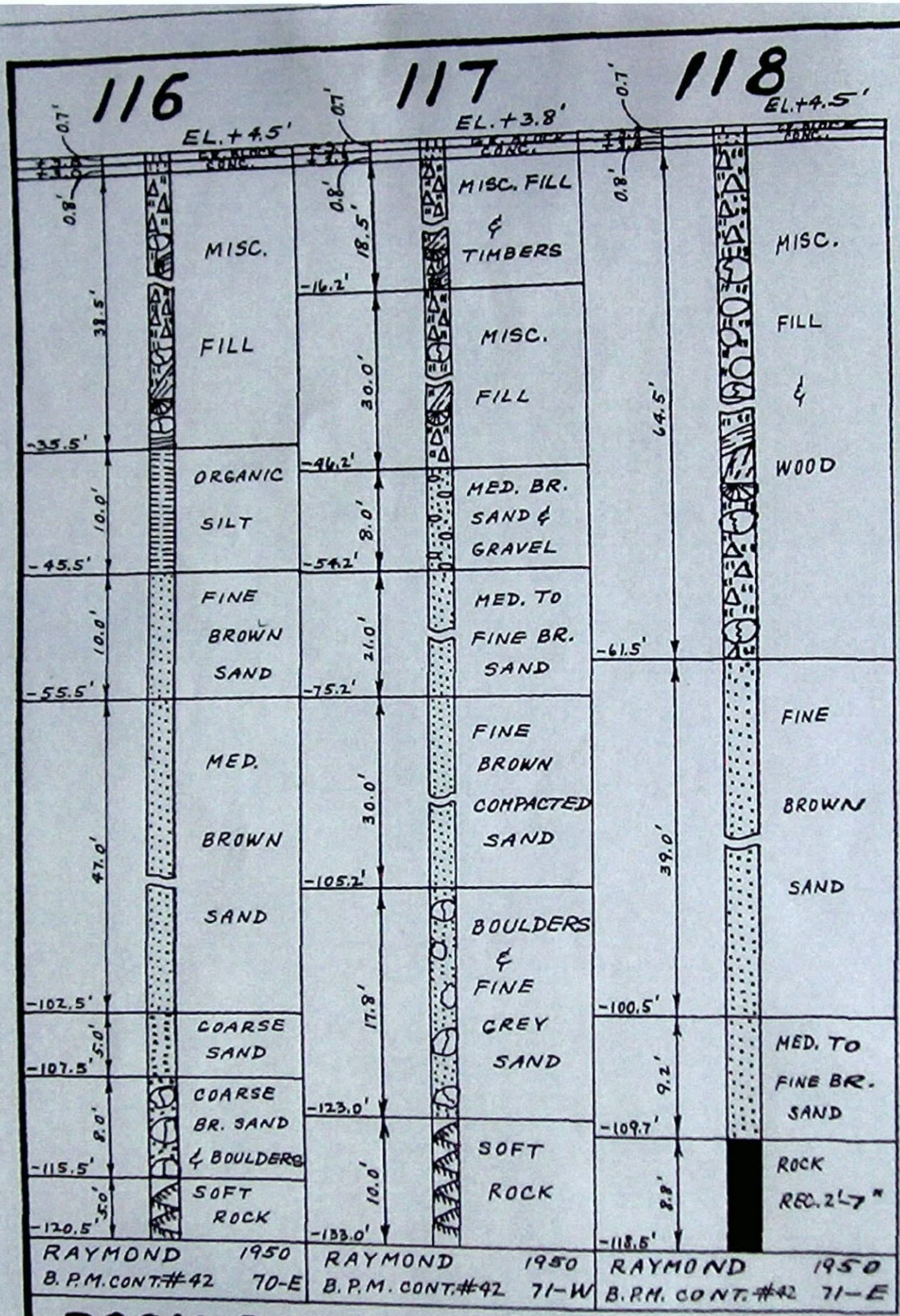

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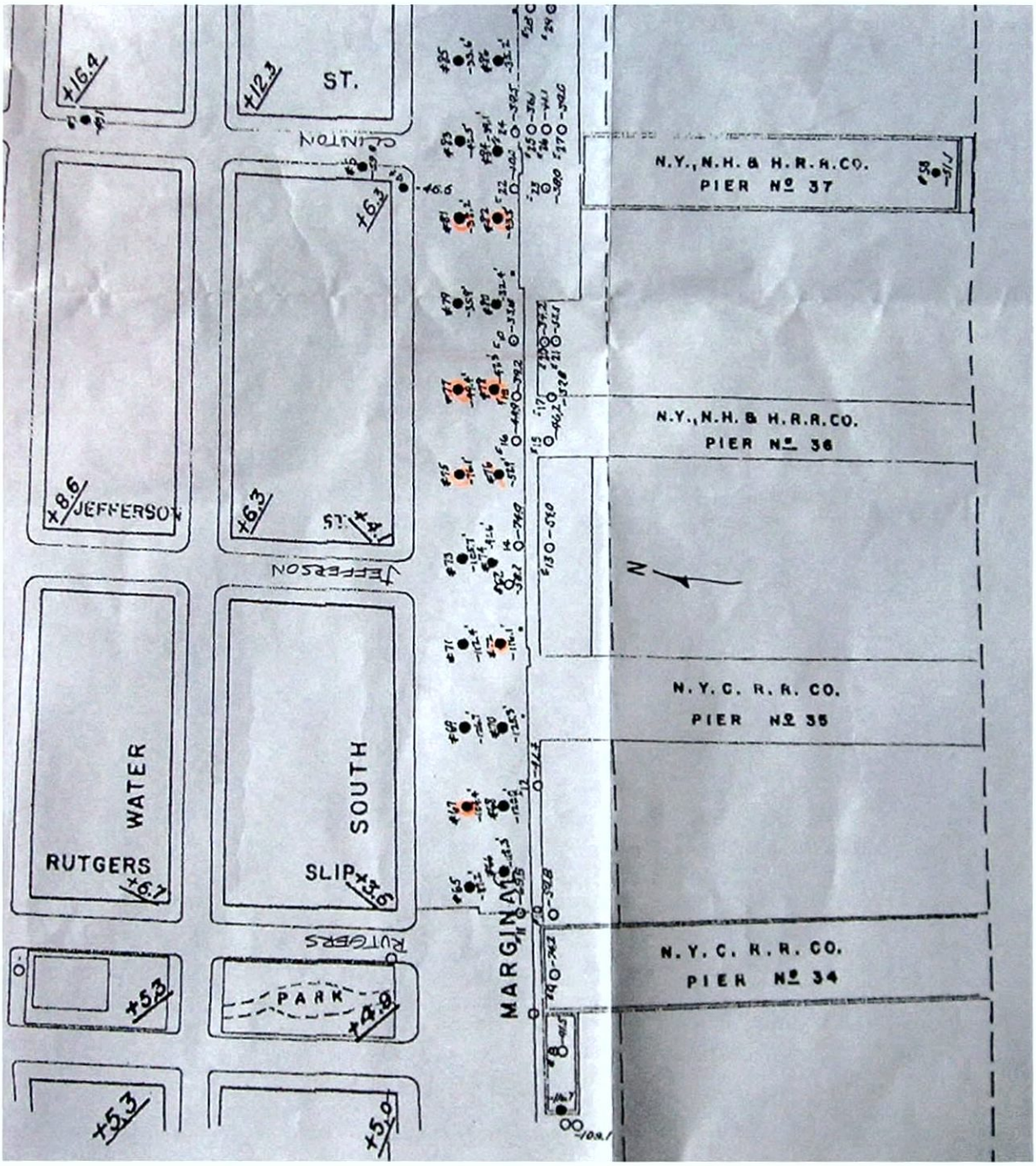
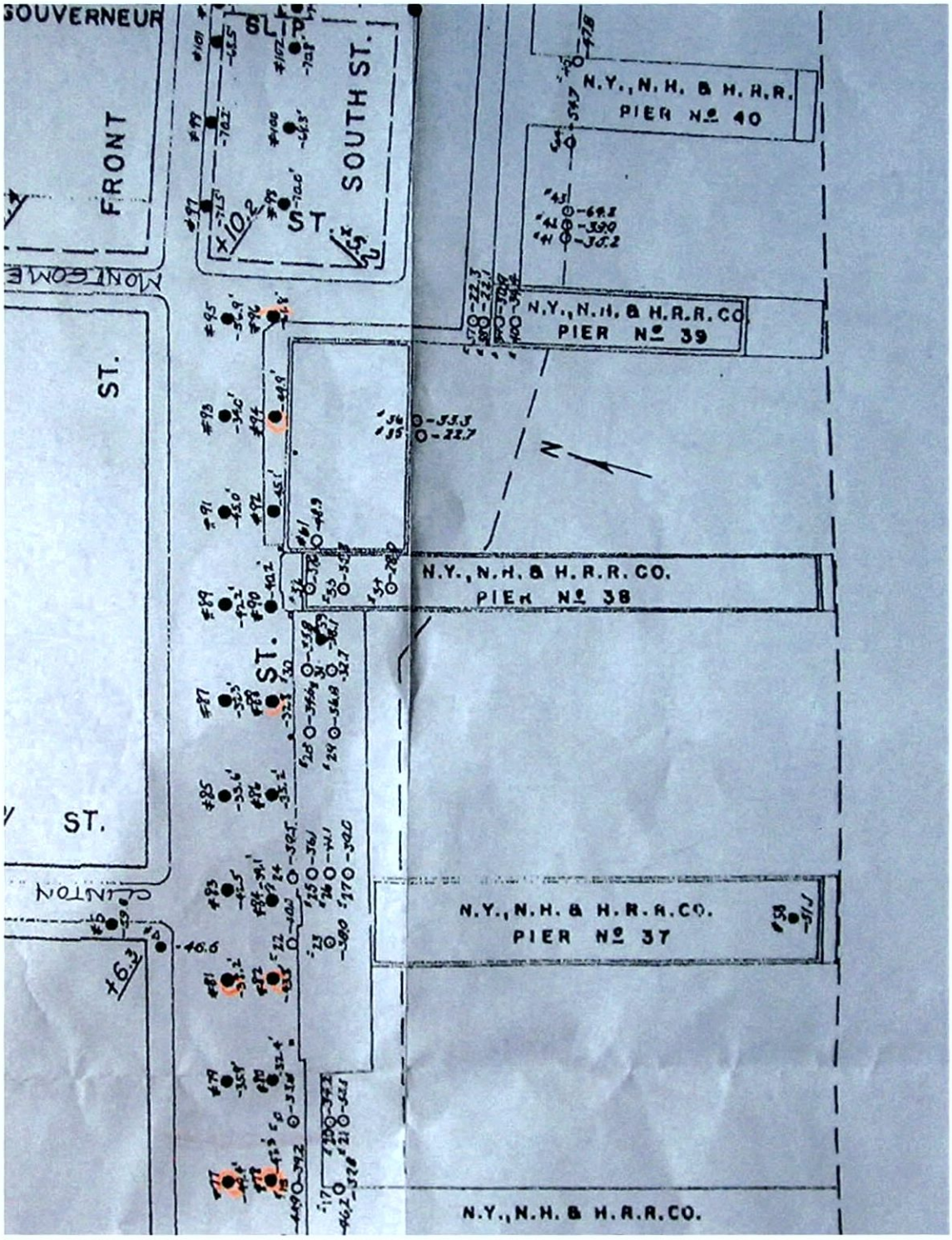
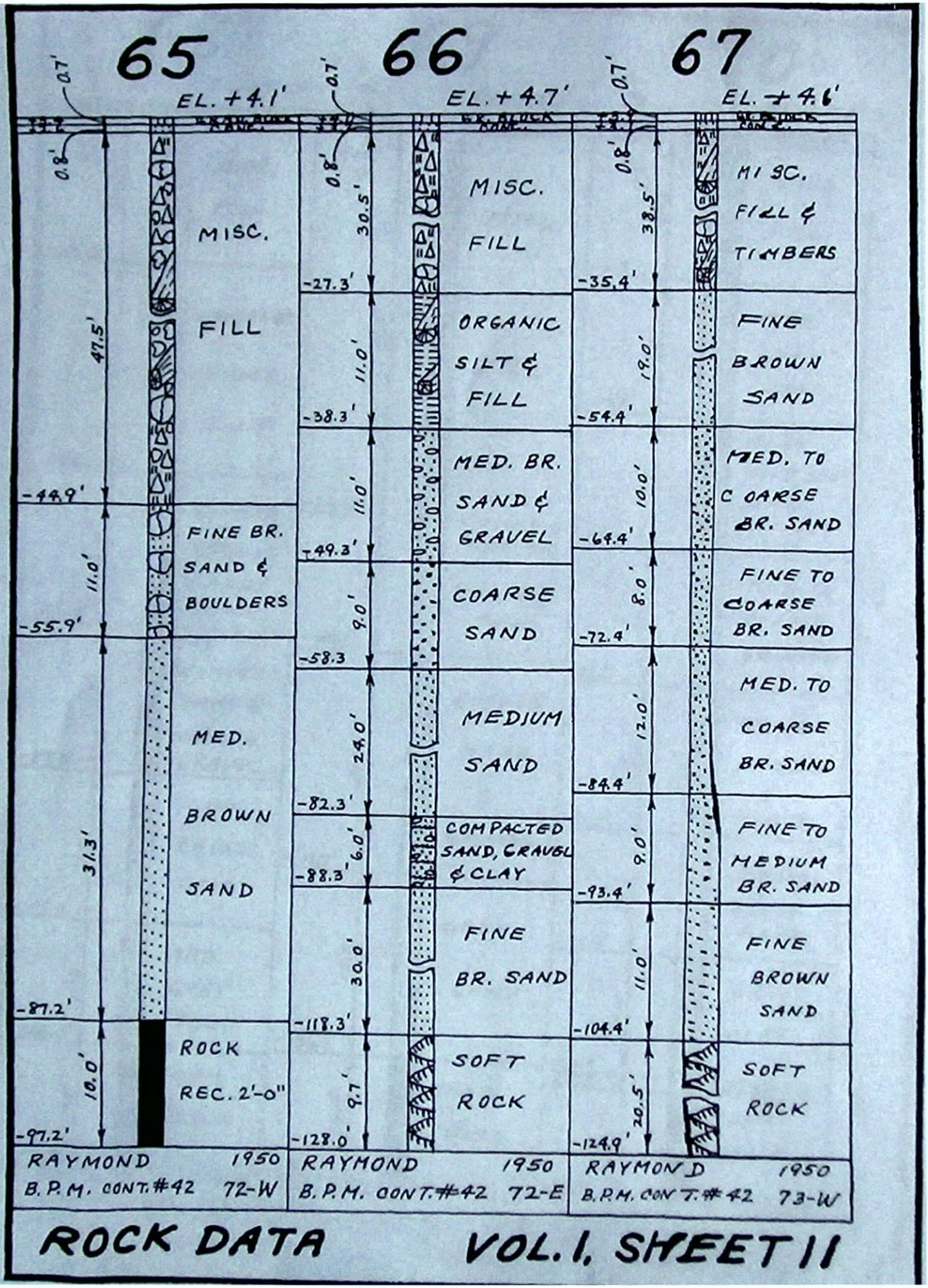


WPA Rock Data – Locational Map 11a
(Volume 1, Sheet 11. Borough of Manhattan, Office of the President, 1937, revised)



WPA Rock Data – Locational Map 11b
(Volume 1, Sheet 11. Borough of Manhattan, Office of the President, 1937, revised)



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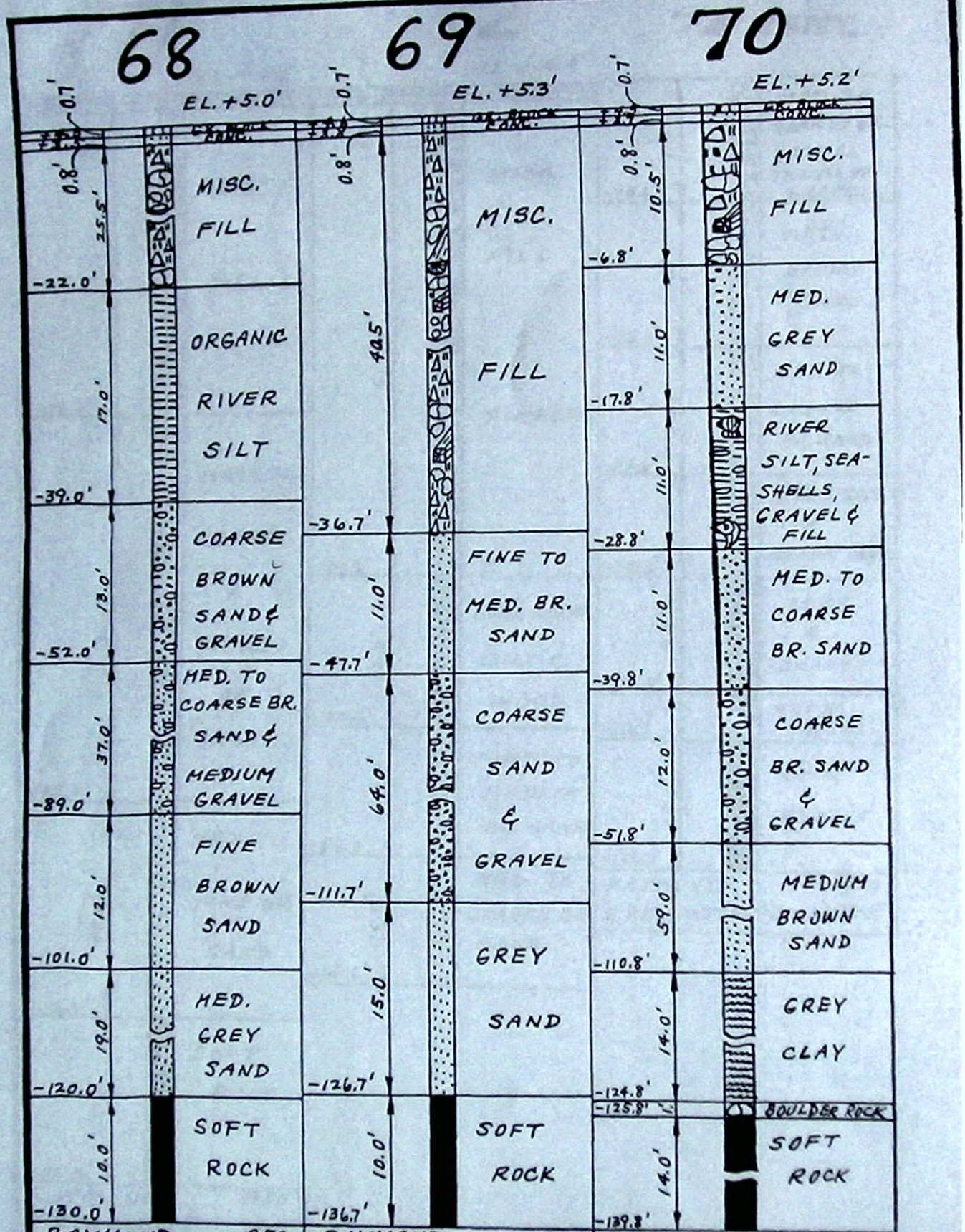

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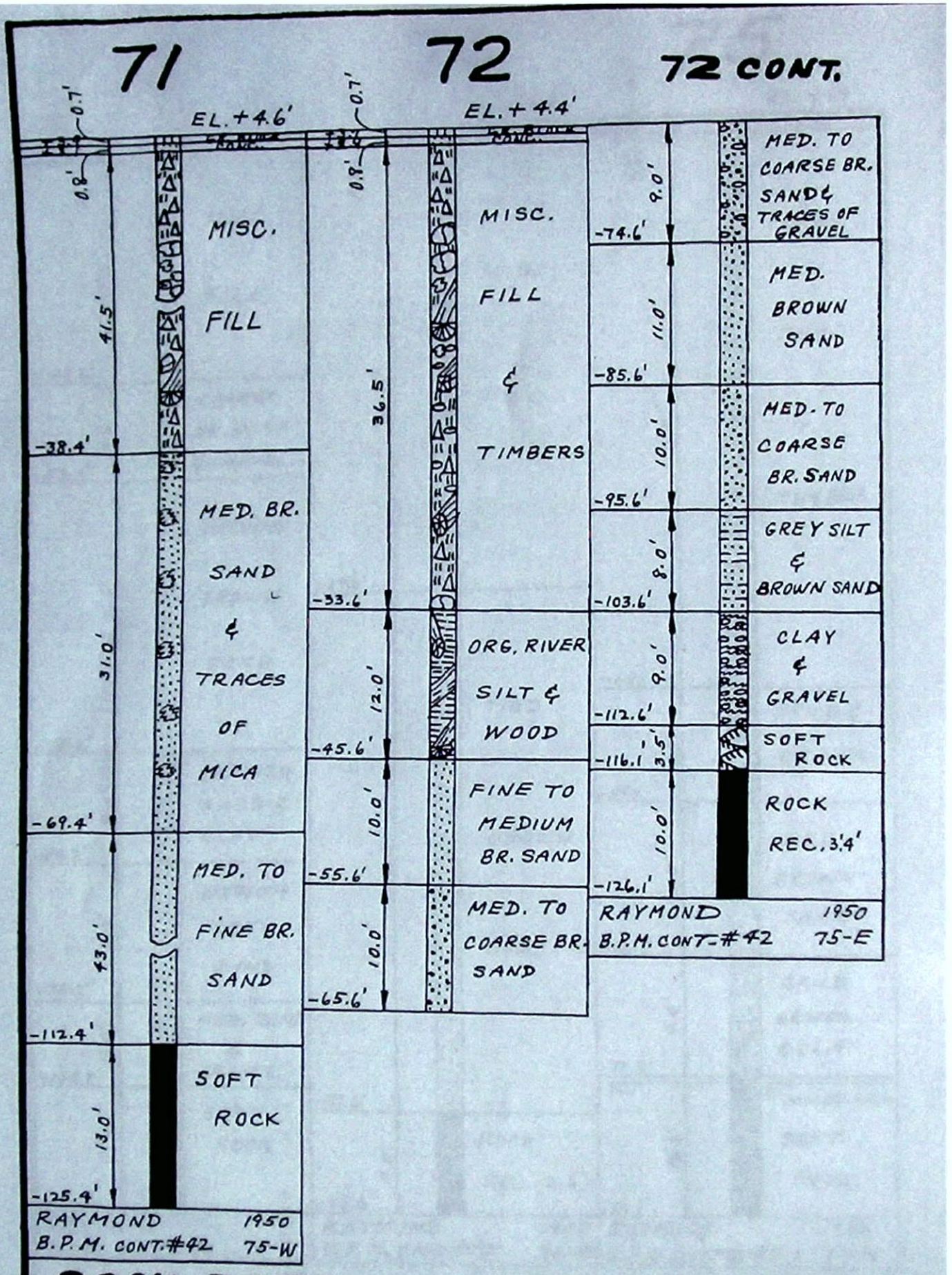

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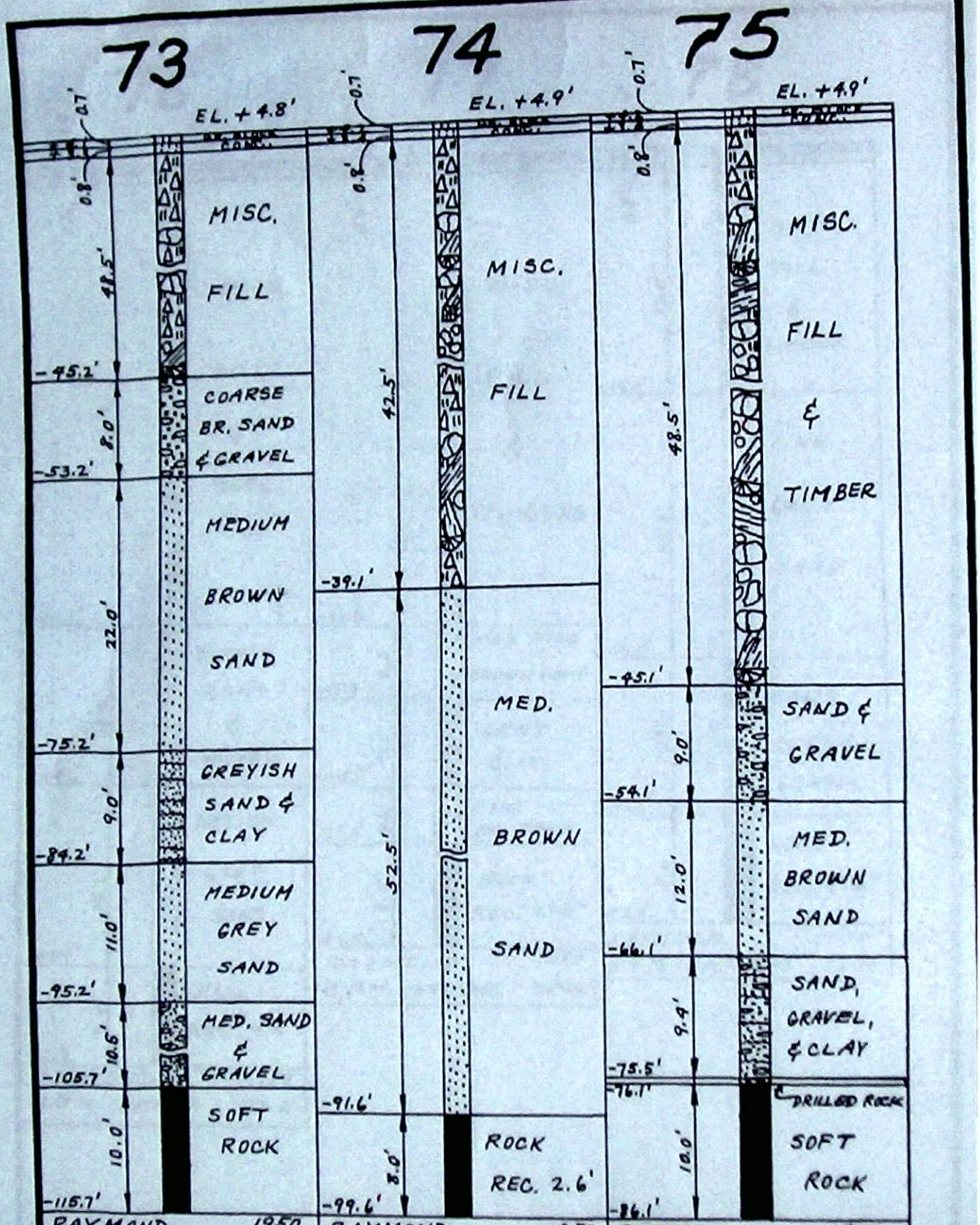
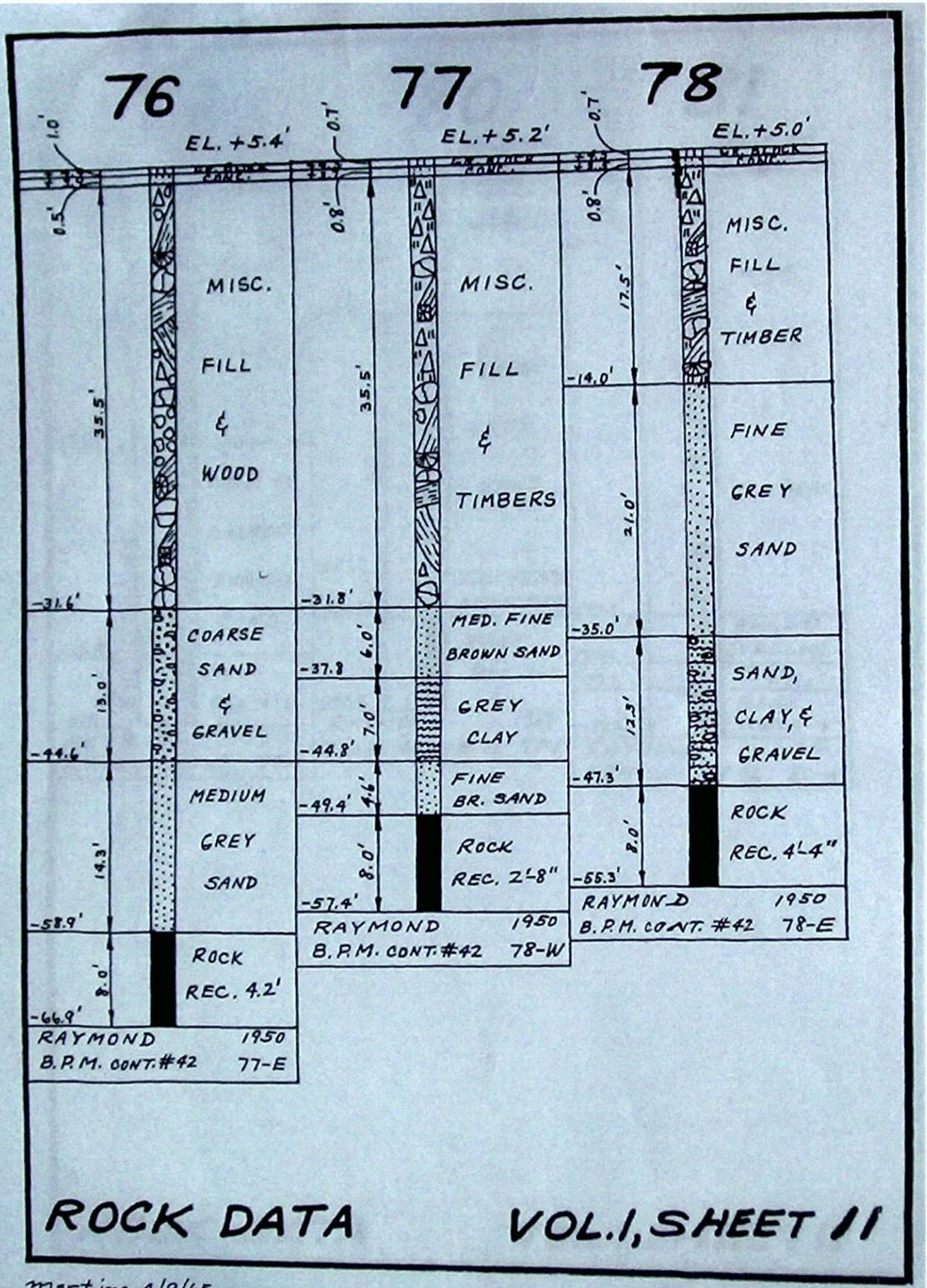


ROCK DATA

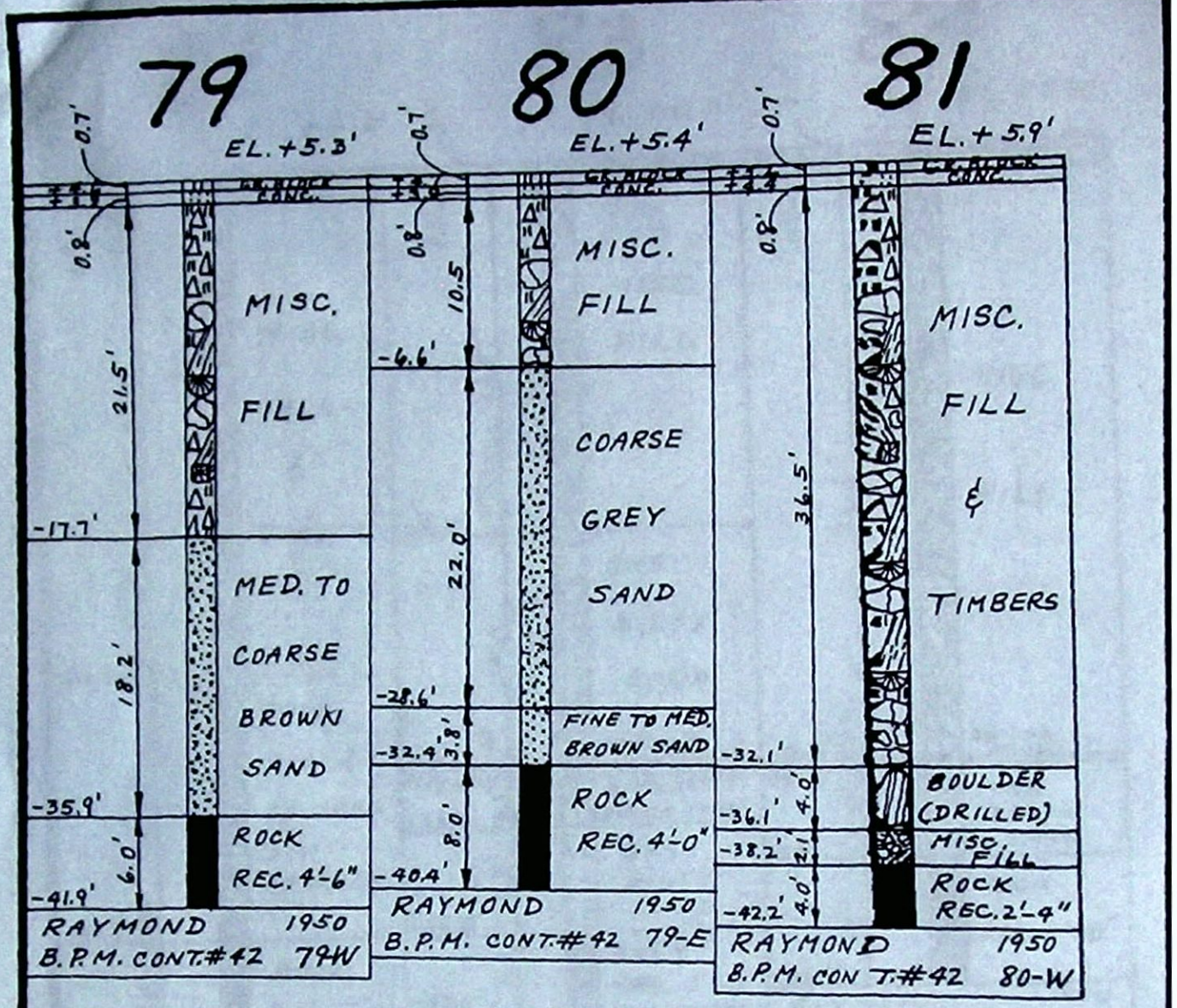
VOL. I SHEET 11

Martins 4/7/65.



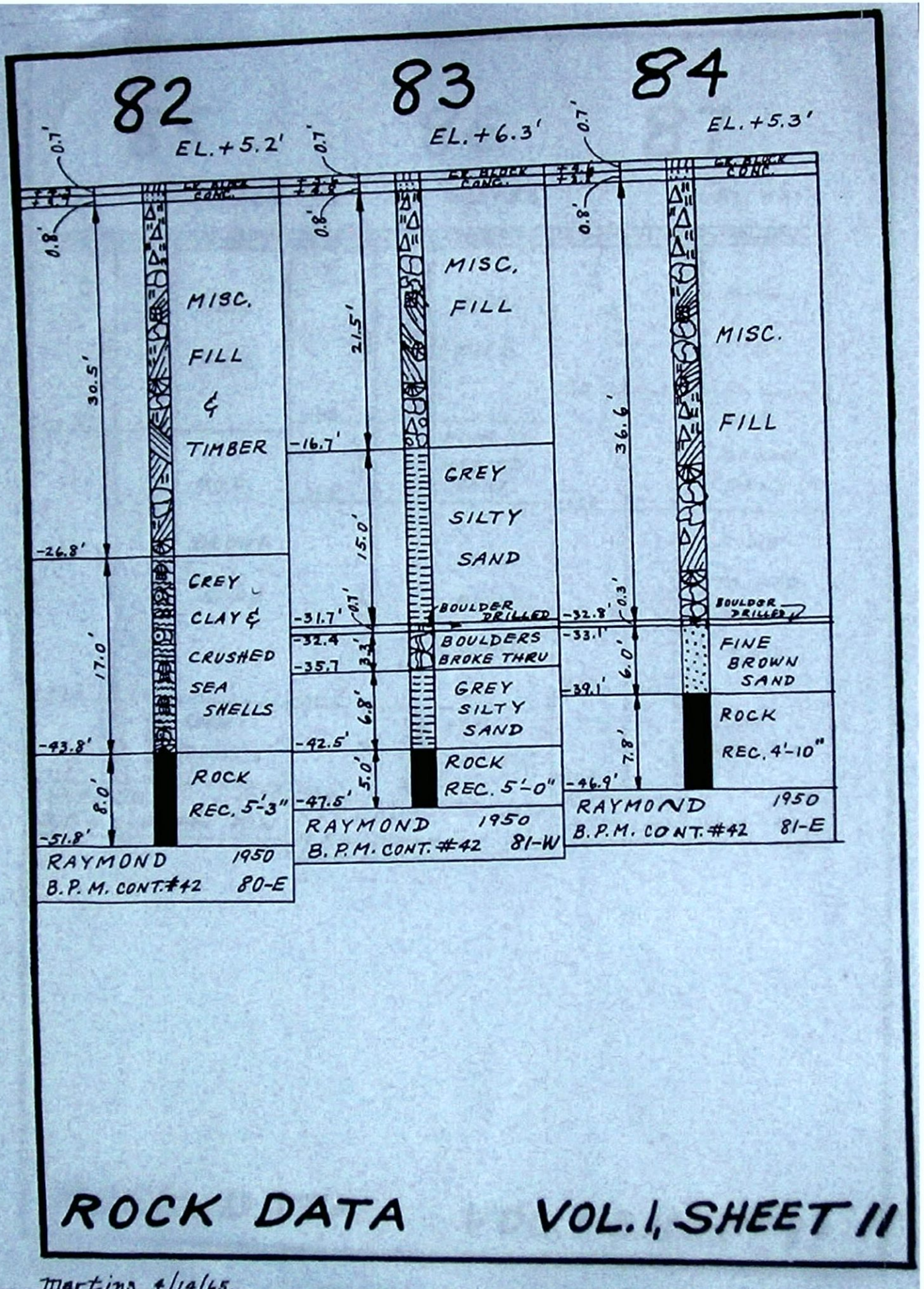
ROCK DATA VOL. I, SHEET 11

Martins 4/9/65



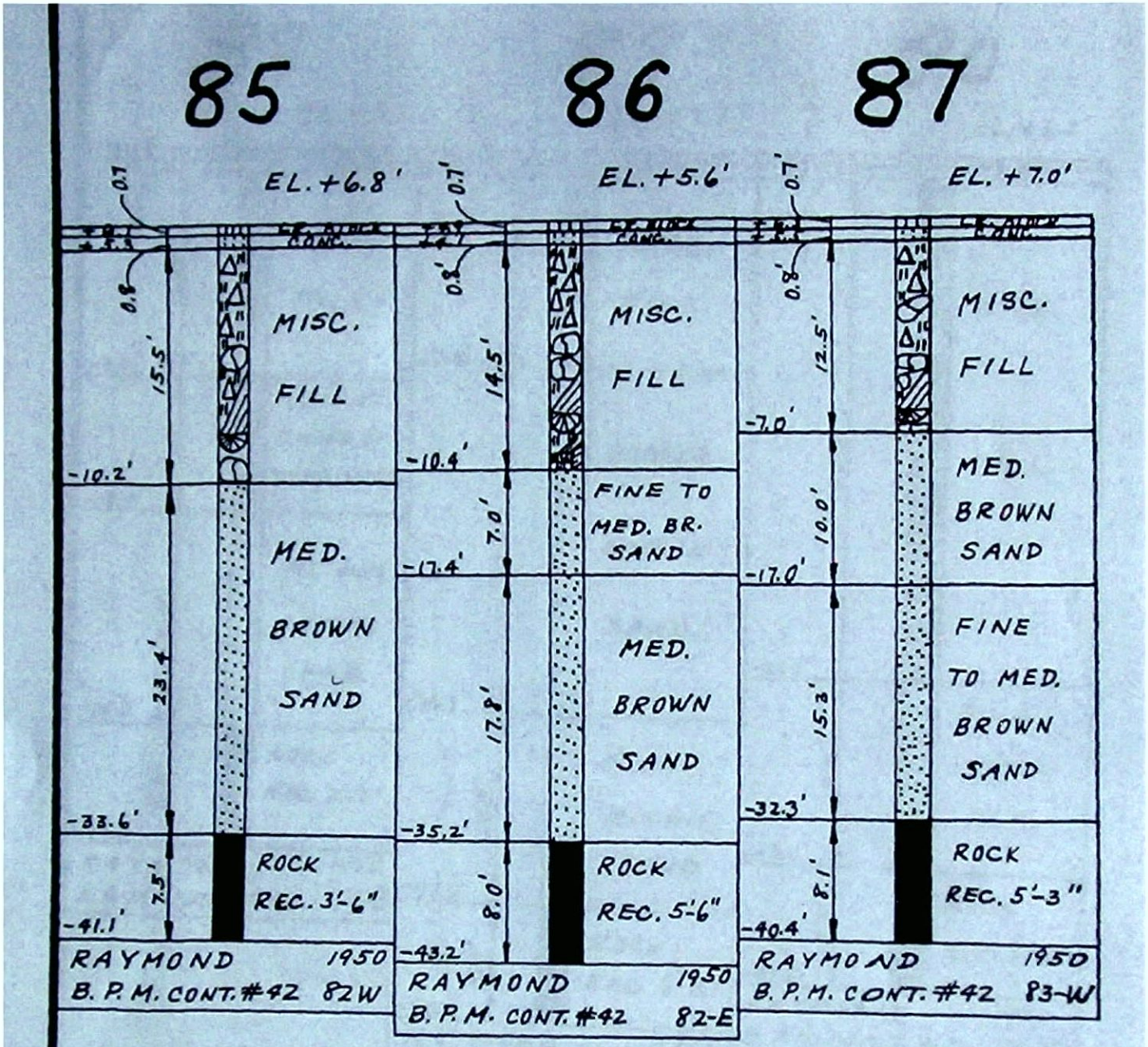
ROCK DATA VOL. I, SHEET II

Martins 4/9/65.



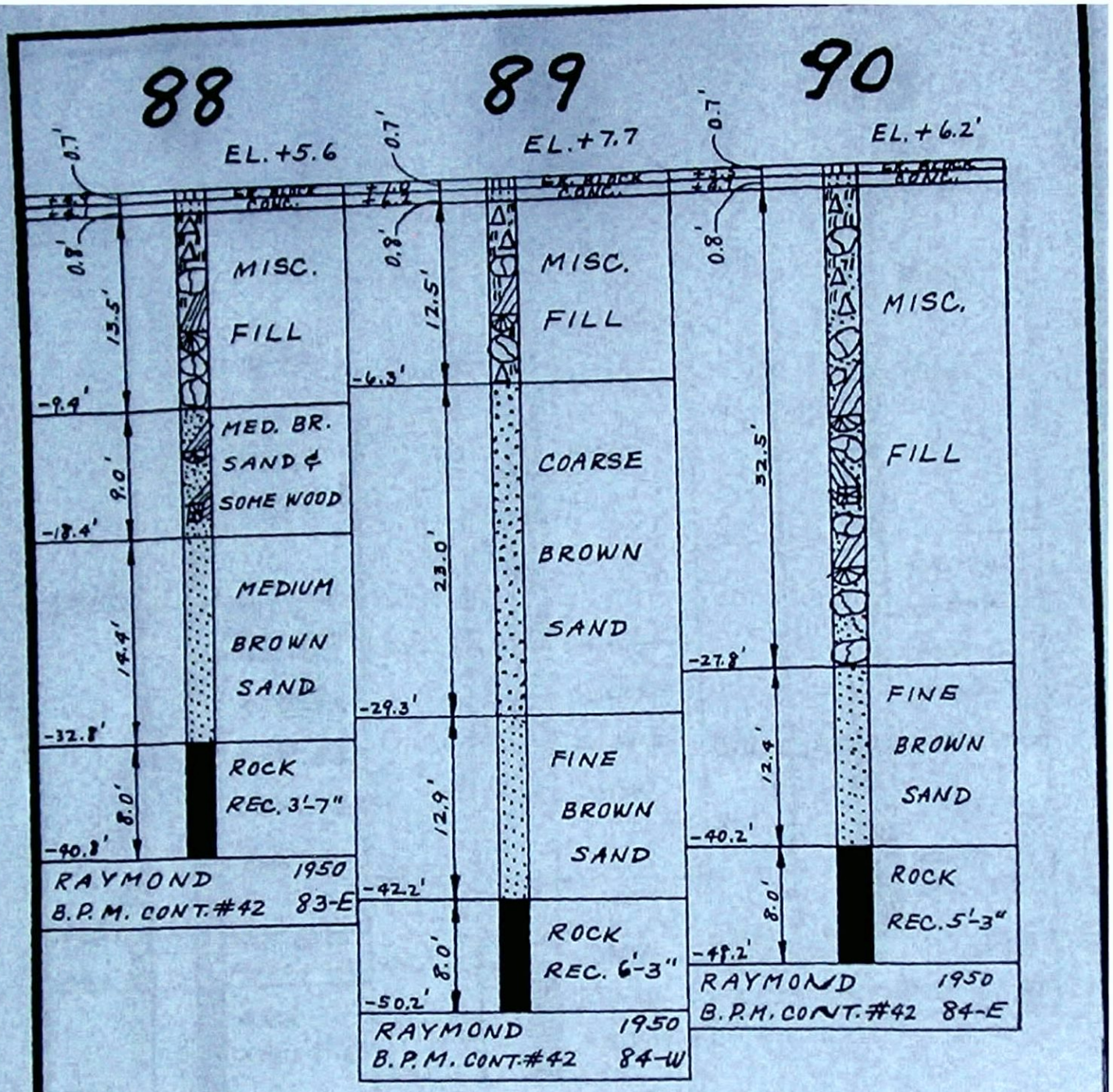
ROCK DATA VOL. I, SHEET II

Martins 4/14/65.



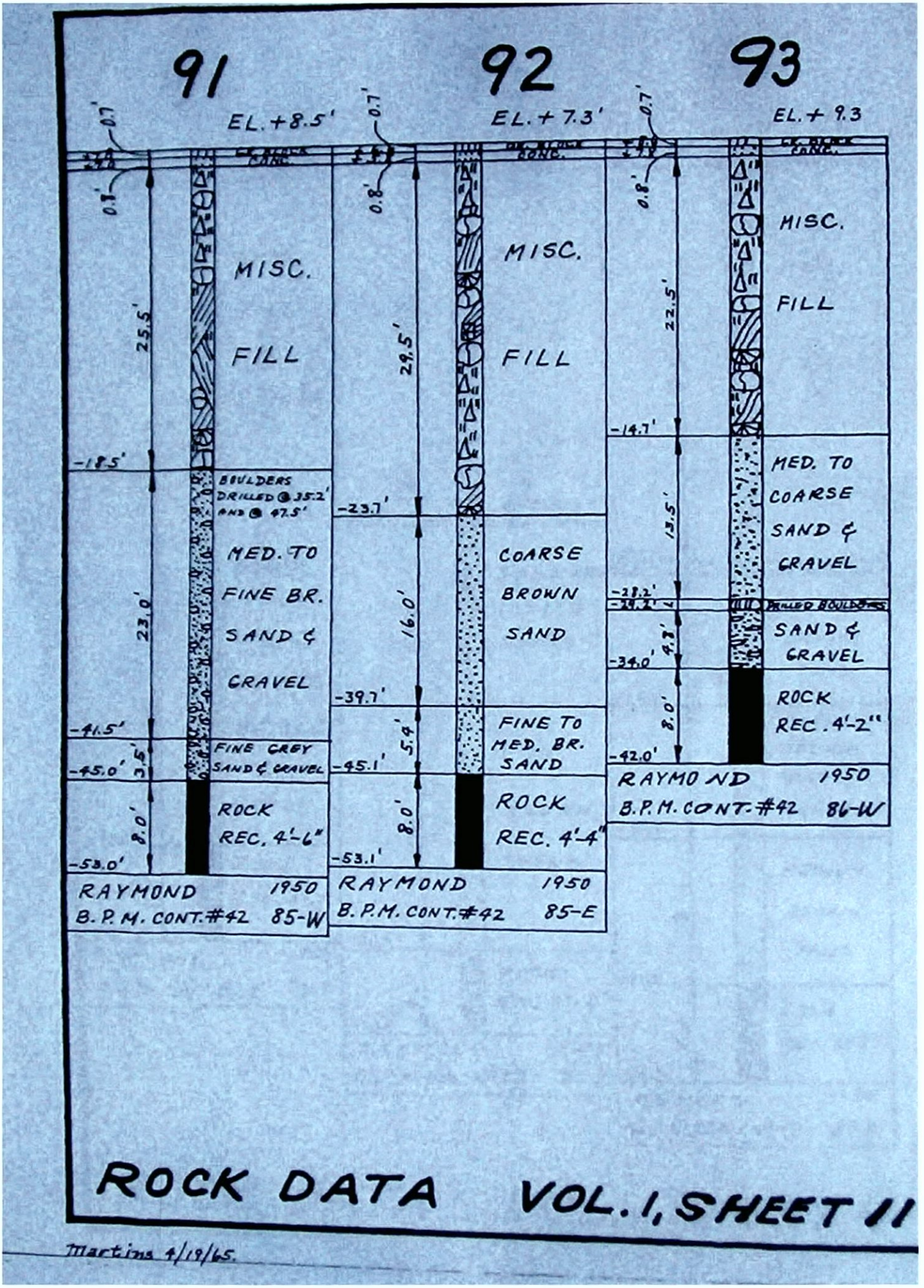
ROCK DATA VOL. I, SHEET 11

Martins 4/14/65.



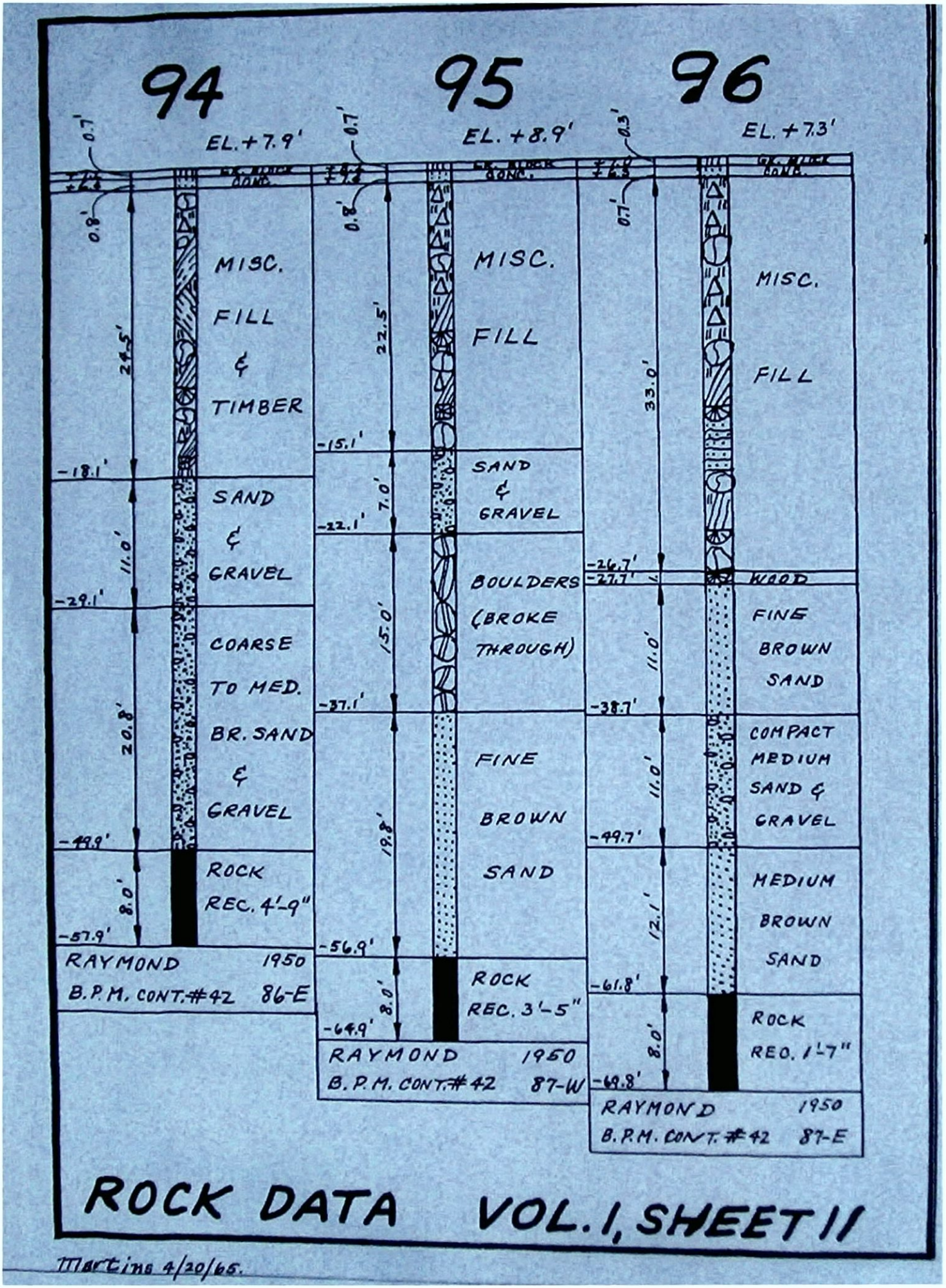
ROCK DATA VOL. I, SHEET 11

Martins 4/9/65.



ROCK DATA VOL. I, SHEET 11

Martins 4/19/65.



ROCK DATA VOL. I, SHEET II

Martins 4/20/65.