PHASE 1A ARCHEOLOGICAL SENSITIVITY STUDY
NYCDEP WATER TUNNEL #3
SHAFTS 25B, 28B, AND 29B
New York, New York

prepared for
Schiavone Construction Co., Inc.,
J.F. Shea Construction, Inc.
Frontier-Kemper Constructors, Inc.,
A Joint Venture
and the
New York City Department of Environmental Protection

by
John Milner Associates, Inc.
Croton-on-Hudson, New York

January 2005
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January 2005
John Milner Associates, Inc. (JMA) conducted a Phase 1A archeological survey of three proposed new shaft sites (25B, 28B, and 29B) located along the previously excavated South Leg of Stage 2 of the Manhattan portion of City Tunnel No. 3. The Phase 1A survey was conducted for the New York City Department of Environmental Protection (DEP) under a subcontract with the Joint Venture firm of Schiavone Construction Co. Inc., J.F. Shea Construction, Inc., Frontier-Kemper Constructors, Inc. Shaft site 25B is located northwest of the intersection of Tenth Avenue and West 48th Street, and occupies a portion of Lot 29 on Block 1077. Shaft site 28B is located northeast of the intersection of Hudson and West Houston Streets, and occupies a portion of Lot 45 on Block 581. Shaft site 29B is located southeast of the intersection of Laight and Hudson Streets, and occupies a portion of Block 213.

Shaft 25B is located completely within the building footprints of the late-nineteenth-century, five-story tenements that formerly occupied Historical Lots 29–31. Recent geo-technical borings document the presence of bedrock within five feet of the existing ground surface within the proposed shaft site. Based on these factors, it is the opinion of JMA that there is very little likelihood that undisturbed archeological deposits are present within the proposed location of Shaft 25B. No additional archeological work is recommended for this location.

Shaft 28B is located on what was once a bluff overlooking the Minetta Brook, in the vicinity of a historically recorded Native American village. The limits of excavation associated with Shaft 28B are located within the building footprint of a late-nineteenth-century, five-story, commercial structure — the construction of which likely destroyed archeological deposits associated with previous historical-period occupation(s) of the lot. However, geo-technical boring logs document the presence of potentially intact alluvial and wetland soil horizons between 15 and 24 feet below the existing surface of the adjacent streets. These horizons are buried beneath deep deposits of fill. In the opinion of JMA, these buried soils have the potential to include intact deposits associated with the Native American occupation of the area. JMA recommends a program of archeological monitoring during the excavation of the proposed shaft to determine whether intact soil horizons are present.

The vicinity of Shaft 29B has experienced dramatic episodes of disturbance throughout its history. In the opinion of JMA, the cumulative effect of each of these episodes (most significantly construction of the eastbound exit ramps from the Holland Tunnel) preclude the possibility that intact archeological deposits are present at the proposed location of Shaft 29B. No additional archeological work is recommended for this location.
# TABLE OF CONTENTS

Management Summary

Figures

Plates

1.0 INTRODUCTION

1.1 Purpose and Goals of the Investigation ........................................... 1
1.2 Project Description and Location .................................................. 1

2.0 ENVIRONMENTAL AND CULTURAL CONTEXTS ..................................... 3

2.1 Environmental Setting and History ............................................... 3
2.2 Prehistoric (Native American) Cultural Context ................................. 4
  2.2.1 The Paleo-Indian Period, ca. 12,500 to 10,000 B.P. ....................... 4
  2.2.2 The Archaic Period, ca. 10,000 to 2,700 B.P. .............................. 5
  2.2.3 The Woodland Period, ca. 3,000 B.P. to European Contact ............. 6

2.3 Historic Period Cultural Context ................................................. 7
  2.3.1 Contact and Colonial Periods ............................................... 7
  2.3.2 The Nineteenth and Twentieth Centuries ................................. 8

3.0 RESEARCH METHODS ................................................................. 10

3.1 Prehistoric Sensitivity Study .................................................... 10
3.2 Historical Research ............................................................... 11

4.0 RESULTS ....................................................................................... 12

4.1 Shaft 25B (Block 1077, Lot 29) ..................................................... 12
  4.1.1 Prehistoric Archeological Potential, Shaft 25B ........................... 12
  4.1.2 Lot History, Shaft 25B ......................................................... 13

4.2 Shaft 28B (Block 581, Lot 45) ..................................................... 14
  4.2.1 Prehistoric Archeological Potential, Shaft 28B ........................... 15
  4.2.2 Lot History, Shaft 28B ......................................................... 16

4.3 Shaft 29B (Block 213, Lot 1) ....................................................... 17
  4.3.1 Prehistoric Archeological Potential, Shaft 29B ........................... 17
  4.3.2 Lot History, Shaft 29B ......................................................... 18

5.0 CONCLUSIONS AND RECOMMENDATIONS ...................................... 21

5.1 Summary and Conclusions .......................................................... 21
  5.1.1 Archeological Sensitivity Evaluation, Shaft 25B ......................... 21
  5.1.2 Archeological Sensitivity Evaluation, Shaft 28B ......................... 21
  5.1.3 Archeological Sensitivity Evaluation, Shaft 29B ......................... 22

5.2 Recommendations ........................................................................ 22

6.0 REFERENCES CITED ...................................................................... 24

Appendix A: Geo-technical Boring Logs

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**PHASE 1A ARCHEOLOGICAL SENSITIVITY STUDY**
**NYCDEP WATER TUNNEL #3, SHAFTS 25B, 28B, AND 29B**
**NEW YORK, NEW YORK**
LIST OF FIGURES

Figure 1. Detail of the Central Park, N.Y. and Brooklyn, N.Y. 7.5-minute USGS topographic quadrangles showing the proposed locations of the NYC Water Tunnel #3 Uptake Shafts 25B, 28B, and 29B.

Figure 2. Project plans showing the location of proposed Shaft 25B within Block 1077; photographic views are indicated by Plate Number.

Figure 3. Project plans showing the location of proposed Shaft 28B within Block 581; photographic views are indicated by Plate Number.

Figure 4. Project plans showing the location of proposed Shaft 29B within Block 213; photographic views are indicated by Plate Number.

Figure 5. Detail of the 1865 Viele Sanitary & Topographical Map of the City and Island of New York showing the pre-development topography in the vicinity of Block 1077 (Shaft 25B).

Figure 6. Detail of the 1836 Colton Topographical Map of the City and County of New York showing the vicinity of Block 1077 (Shaft 25B).

Figure 7. Detail of the 1852 Dripps Map of the City of New York showing the vicinity of Block 1077 (Shaft 25B).

Figure 8. Detail of the 1879 Galt & Hoy perspective drawing/bird’s eye map showing the vicinity of Block 1077 (Shaft 25B).

Figure 9. Detail of the 1885 Robinson Atlas of the City of New York showing the vicinity of Block 1077 (Shaft 25B).

Figure 10. Detail of the 1890 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 1077 (Shaft 25B).

Figure 11. Detail of the 1930 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 1077 (Shaft 25B).

Figure 12. Detail of the 1951 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 1077 (Shaft 25B).

Figure 13. Detail of the 1865 Viele Sanitary & Topographical Map of the City and Island of New York showing the pre-development topography in the vicinity of Block 581 (Shaft 28B).

Figure 14. Detail of the 1852 Dripps Map of the City of New York showing the vicinity of Block 581 (Shaft 28B).
LIST OF FIGURES

Figure 15. Detail of the 1879 Galt & Hoy perspective drawing/bird’s eye map showing the vicinity of Block 581 (Shaft 28B).

Figure 16. Detail of the 1885 Robinson Atlas of the City of New York showing the vicinity of Block 581 (Shaft 28B).

Figure 17. Detail of the 1891 Bromley Atlas of the City of New York showing the vicinity of Block 581 (Shaft 28B).

Figure 18. Detail of the 1904 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 581 (Shaft 28B).

Figure 19. Detail of the 1951 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 581 (Shaft 28B).

Figure 20. Detail of the 1865 Viele Sanitary & Topographical Map of the City and Island of New York showing the pre-development topography in the vicinity of Block 213 (Shaft 29B).

Figure 21. Detail of the 1836 Colton Topographical Map of the City and County of New York showing the vicinity of Block 213 (Shaft 29B).

Figure 22. Detail of the 1852 Dripps Map of the City of New York showing the vicinity of Block 213 (Shaft 29B).

Figure 23. Early-nineteenth-century engraving of St. John’s Chapel from within Hudson Square (Block 213) (Stokes 1918:Plate 106-a).

Figure 24. Detail of the 1879 Galt & Hoy perspective drawing/bird’s eye map showing the vicinity of Block 213 (Shaft 29B).

Figure 25. Detail of the 1885 Robinson Atlas of the City of New York showing the vicinity of Block 213 (Shaft 29B).

Figure 26. Detail of the 1891 Bromley Atlas of the City of New York showing the vicinity of Block 213 (Shaft 29B).

Figure 27. Detail of the 1894 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 213 (Shaft 29B).

Figure 28. Detail of the 1922 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 213 (Shaft 29B).

Figure 29. Schematic plan and profile drawing of the Holland Tunnel (from Gray and Hagen 1930) showing the exit plaza at Block 213 (Shaft 29B).

Figure 30. Detail of the 1951 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 213 (Shaft 29B).
LIST OF PLATES

Plate 1. Block 1077, Lot 29 (proposed Shaft 25B) from the corner of Tenth Avenue and West 49th Street; view to the west.

Plate 2. Block 1077, Lot 29 (proposed Shaft 25B) from the corner of Tenth Avenue and West 49th Street; view to the northwest.

Plate 3. The proposed location of Shaft 25B; view to the northwest.

Plate 4. The proposed location of Shaft 25B; view to the southeast.

Plate 5. Block 581, Lot 45 (proposed Shaft 25B) from the corner of Hudson and West Houston Streets; view to the east.

Plate 6. The proposed location of Shaft 28B; view to the south.

Plate 7. The proposed location of Shaft 29B (Block 213); view to the southwest.

Plate 8. The proposed location of Shaft 29B (Block 213); view to the south.
1.0 INTRODUCTION

1.1 PURPOSE AND GOALS OF THE INVESTIGATION

John Milner Associates, Inc. (JMA) conducted a Phase 1A archeological survey of three proposed new shaft sites (25B, 28B, and 29B) located along the previously excavated South Leg of Stage 2 of the Manhattan portion of City Tunnel No. 3. The Phase 1A survey was conducted for the New York City Department of Environmental Protection (DEP) under a subcontract with the Joint Venture firm of Schiavone Construction Co. Inc., J.F. Shea Construction, Inc., Frontier-Kemper Constructors, Inc.

The information and recommendations contained in this report are intended to assist the DEP in complying with the requirements of the New York City Environmental Quality Review Act (CEQR), and/or Section 14.09 of the New York State Parks, Recreation, and Historic Preservation Law. It is JMA’s understanding that no federal funds, permits, or approvals are associated with the construction of the three shafts and that therefore Section 106 of the National Historic Preservation Act (NHPA) is not applicable.

The purpose of the Phase 1A investigation is to identify previously recorded archeological or historic resources and assess the likelihood for there to be previously unrecorded archeological resources within the area of potential effect associated with each of the three shaft sites. The information contained in this report is intended to help assess whether or not construction and/or operation of the shafts could potentially affect significant archeological resources. All research and report preparation were conducted in accordance with the following:

- the New York City Landmarks Preservation Commission’s Guidelines for Archaeological Work in New York City;
- Section 3F of the New York City Environmental Quality Review Technical Manual; and
- the New York Archaeological Council’s Standards for Cultural Resources Investigations and the Curation of Archaeological Collections recommended for use by the New York State Office of Parks, Recreation, and Historic Preservation (OPRHP).

1.2 PROJECT DESCRIPTION AND LOCATION

In 1954, New York City recognized the need for a third water tunnel to meet the growing demand on the more than 150-year old water supply system. Planning for City Tunnel No. 3 began in the early 1960s and actual construction commenced nearly a decade later in 1970. City Tunnel No. 3 is the largest capital construction project in New York City’s history. The tunnel will eventually span more than 60 miles and is expected to be complete in 2020.

The three shaft locations discussed in this report are located along Stage 2 of Tunnel No. 3 (Figure 1). Stage 2 will provide water to the lower west side of Manhattan and sections of Queens, Brooklyn, and Staten Island. The nine-mile long Manhattan section begins at the Stage 1 valve chamber in Central Park and run south along the west side of Manhattan, east to the vicinity of South Street Seaport and north along the east side of Manhattan to 34th Street.
1.0 INTRODUCTION

Shaft site 25B (Figure 2) is located northwest of the intersection of Tenth Avenue and West 48th Street, and occupies a portion of Lot 29 on Block 1077. Shaft site 28B (Figure 3) is located northeast of the intersection of Hudson and West Houston Streets, and occupies a portion of Lot 45 on Block 581. Shaft site 29B (Figure 4) is located southeast of the intersection of Laight and Hudson Streets, and occupies a portion of Block 213.
2.0 ENVIRONMENTAL AND CULTURAL CONTEXTS

2.1 ENVIRONMENTAL SETTING AND HISTORY

The bedrock geology of New York City consists of Manhattan schist, a hard metamorphic rock, and Inwood dolomite that formed during the Archeozoic period (ca. 5,000 to 1,500 million years ago). Erosion processes during the late Mesozoic period (ca. 220 to 70 million years ago) resulted in the formation of many present features of the landscape, including incising the Hudson River and shaping the Palisades (Homberger 1994:14). During the last 20,000 years, both natural and cultural processes have dramatically altered the contemporary surficial geology and topography of Manhattan.

At the height of the Wisconsin glaciation, ca. 21,000 B.P. (Before Present), the New York Metropolitan area was covered by ice. Around 18,000 B.P. global temperatures gradually warmed and the glaciers began the slow process of melting and retreating northward. The Ronkonkoma Moraine, an enormous deposit of mixed sands, silts, clays, and boulders deposited ca. 15,300 B.P., marks the final advance of the glaciers. The Ronkonkoma Moraine forms the southern side of Long Island extending from Lake Success at the border of Queens and Nassau Counties to Montauk Point (Snow 1980; Wolfe 1995:460). A few centuries later the retreating ice paused again, depositing a second band of sediments identified as the Harbor Hill Moraine. The Harbor Hill Moraine extends southwest across Queens from Little Neck Bay, across Brooklyn and Staten Island and into New Jersey.

During the Pleistocene vast quantities of water were trapped as ice in the glaciers. As a result, sea levels were considerably lower than at present and large tracts of the continental shelf were exposed as dry land (Cantwell and Wall 2001:37; Snow 1980:105). At the height of the glaciation, sea levels were at least 90 meters below their present level (Funk 1991:52) and the coast was located as much as 120 miles east of its current position (Cantwell and Wall 20001:14). The post-glacial environment supported a diversity of flora and fauna. Paleontological remains recovered on Manhattan include the remains of mammoth, giant bison, saber-tooth tigers, giant ground sloth, mastodon, and prehistoric horse (Wolfe 1995:461).

The retreat of the glaciers initiated a period of dramatic topographic and ecological change, including a rapid rate of sea-level rise beginning ca. 14,000 B.P. By 6,000 years ago sea levels were only about 9 meters below their current position, and continued to rise at a slower rate reaching about 2 meters below present by 2,000 B.P. (Funk 1991:52). After 12,000 B.P., the tundra environment gradually came to include more cold-adapted evergreen species. This environment has been characterized as ‘open park-like woodlands’, constituted primarily of spruce, pine, and later fir with a ground cover of lichens, and small quantities of deciduous species such as oak and hornbeam. Palynological evidence indicates that vegetative and corresponding faunal communities changed concurrently with the warming climate. A pine-birch-adler forest complex was established by 9,000 B.P. and was followed by generally more temperate deciduous forest complexes (Snow 1980:114). These forests achieved an essentially modern character, with corresponding faunal communities, by about 4,000 B.P. (Funk 1991:52).

In the past three centuries, the landscape of Manhattan has been dramatically altered by various activities associated with the urban development of the island. Significant changes during this time include the expansion of the island by filling shoreline areas and numerous episodes of
excavation, grading, and filling various areas of Manhattan to facilitate construction of residential, industrial, and commercial buildings and spaces (Cantwell and Wall 2001:224-227).

2.2 PREHISTORIC (NATIVE AMERICAN) CULTURAL CONTEXT

Evidence from known archeological sites reveals dramatic cultural changes occurred throughout the long period of human occupation in coastal New York. Environmental changes and technological innovations influenced subsistence practices and choices of settlement location of prehistoric Native American groups. The availability and changing importance of ecological resources affected the distribution of camp sites, special activity sites, and village locations across the landscape. Settlement locations and cultural practices were also affected by increasing exchange and social contact between Native American groups in the later prehistoric periods and the influence of Europeans in the Contact and Colonial periods.

The prehistory of Eastern North America is commonly divided into three major temporal periods: Paleo-Indian, Archaic, and Woodland. These periods are each characterized by distinctive subsistence practices, social organization, settlement systems, and material culture. The definition of these cultural systems and an explanation for changes in culture through time provide a structure upon which archeological research questions can be framed. Archeologists continually debate many details regarding chronology, adaptation, and culture change but a generally accepted outline of regional prehistory is presented here.

2.2.1 THE PALEO-INDIAN PERIOD, CA. 12,500 TO 10,000 B.P.

Based on radiocarbon age estimates of sites associated with Paleo-Indian fluted points, it appears that human beings first occupied the northeastern United States about 13,000 B.P. (Levine 1990). The distinctive lithic components of Paleo-Indian assemblages consist of long, fluted projectile points and a variety of end scrapers, side scrapers, knives, gravers, and perforators (Fiedel 2000; Funk 1976; Ritchie 1971). This tool-kit is superbly designed for hunting, butchering, and animal processing activities. The association of fluted Clovis points with extinct megafauna such as mammoth and mastodon at sites in the western and southern United States suggests that Paleo-Indians were largely dependent on big game hunting for subsistence (Fiedel 2000). However, there is no clear evidence for Paleo-Indians hunting Pleistocene fauna other than caribou in the northeastern United States. Like historically documented hunters and gatherers, Paleo-Indian subsistence patterns were likely very dependent on the collection of a variety of fruit and vegetable resources (Funk 1976; Levine 1990; Ritchie 1980; Snow 1980:150). Paleo-Indian peoples probably lived in small, mobile bands and their choice of settlement seems to have been conditioned by access to upland forest resources, low-lying swamp areas, medium to large sized drainages, and high-quality lithic sources (Fiedel 2000; Funk 1976).

Evidence for Paleo-Indian occupations in the New York City region comes from scattered surface finds of fluted projectile points on Staten Island and Long Island. Artifacts recovered from the Port Mobil Site on Staten Island include at least 21 fluted points and more than 120 stone tools. The site is now located in a extensively disturbed oil-tank farm that in the early Holocene would have been a high point of land overlooking the Arthur Kill (Cantwell and Wall 2001:41). Fishermen have recovered a large number of mammoth and mastodon teeth from the continental shelf, indicating that the exposed portions of the continental shelf were inhabitable in the early post-glacial period (Snow 1980:105). Archeologists assume that numerous Paleo-Indian and
Early Archaic period sites in the New York City area were located off of the present coastline, and were subsequently inundated by the post-glacial rise in sea levels (Funk 1991:57; Cantwell and Wall 2001:38).

2.2.2 The Archaic Period, ca. 10,000 to 2,700 B.P.

The Archaic Period subsumes a diverse group of hunting and gathering cultures that occupied North America throughout the dramatic environmental changes of the early Holocene. Archaic cultures in the Northeast are generally characterized as small, mobile social groups, and their sites are usually small and lacking permanent structures, fortifications, extensive storage pits, and elaborate mortuary remains (Ritchie 1980:32). Archaic settlement and subsistence practices in southeastern New York were organized around seasonal movements between coastal and inland riverine areas with a reliance on both woodland and aquatic resources (Tuck 1978).

The Early Archaic Period (ca. 10,000 to 8,000 B.P.) is poorly represented in the Northeast generally (Snow 1980:157), perhaps due to relatively unfavorable or inhospitable climactic conditions during the period (Funk 1976). Very few Early Archaic sites have been excavated or radiocarbon dated in the Northeast; as a result these sites are usually identified by the presence of projectile points that resemble types found in better-documented, stratified sites in the southeastern United States. Early Archaic sites are identified based on the presence of diagnostic Kanawha, Le Croy, Stanly, Hardaway, and Palmer projectile points, in association with a variety of scrapers, choppers, and ground stone woodworking tools (Ritchie and Funk 1971; Snow 1980:161-163).

The Middle Archaic (ca. 8,000 to 6,000 B.P.) is often characterized as a period of adaptation to the emerging temperate climactic conditions of the Holocene, including the exploitation of a wide variety of floral and faunal species similar to those of the modern era (Snow 1980:182-183). Middle Archaic sites in the Northeast are identified by diagnostic Neville, Stark, and Merrimack projectile points. Several new technological innovations appeared during this period including stone gouges and axes, large ground stone semi-lunar knives, notched net-sinkers and plummets, and ground stone spear-thrower (or atatl) weights (Dincauze 1971; Snow 1980:184).

The Late Archaic Period (ca. 6,000 to 3,000 B.P.) in southeastern New York is identified by the presence of distinctive narrow stemmed projectile points (Tuck 1978). Local variants of this tradition include Lamoka, Wading River, Sylvan Lake or Sylvan Stemmed, Taconic, and Bare Island projectile points (Fiedel 1986; Ritchie 1971). The foraging economy of the Late Archaic was based on the scheduled exploitation of specific seasonally available resources, including an emphasis on marine resources as evident from large shell middens on coastal and riverine sites (Funk 1991:54-55; Ritchie 1980:142). The significantly greater numbers of sites in the area, the larger size of some sites, and the diversification of exploited environments suggest that substantial population growth occurred during this period.

The Terminal Archaic (or Transitional Period, ca. 3,500 to 2,700 B.P.) is characterized by technological innovations and subsistence practices that are often viewed as precursors to developments that occurred in the subsequent Woodland Period. In southeastern New York, distinctive Orient Fishtail projectile points serve as a diagnostic marker of this period, along with carved steatite (or soapstone) vessels and elaborate mortuary practices (Ritchie 1971, 1980; Snow 1980:239-244).
2.0 ENVIRONMENTAL AND CULTURAL CONTEXTS

Archaic Period sites in New York City tend to be located along the East and Hudson Rivers, and Archaic Period sites have been identified in Lower Manhattan, the Bronx, and on Ellis Island. During the Archaic Period, sea levels were lower than present and many sites are located on uplands adjacent to areas that would have been estuarine marsh but have been subsequently inundated (Lenik 1992). Late Archaic occupations have been investigated in northern Manhattan at the Tubby Hook and Inwood sites (Cantwell and Wall 2001:57-58).

2.2.3 THE WOODLAND PERIOD, CA. 3,000 B.P. TO EUROPEAN CONTACT

The Woodland Period is often distinguished from earlier prehistoric periods by significant changes in technology (notably the widespread production and use of ceramics), more intensive subsistence practices (often including the domestication of plants), increasing trends towards sedentism and larger settlements, and changes in social organization (Ritchie 1980:179-180; Versaggi 1999). Woodland sites are distinguished from earlier periods by the appearance of fired clay ceramic vessels in the archaeological record.

During the Early Woodland Period (ca. 2,700 to 2,000 B.P.) Native American groups continued the hunting, gathering, and fishing practices of the Terminal Archaic, supplemented by an increase in shellfish collecting as evidenced by large shell middens located on sites near the coast or estuaries (Funk 1976; Snow 1980:283). The Early Woodland in New York State has traditionally been identified by the presence of diagnostic Meadowood and Adena projectile points (Ritchie 1971, 1980). The distribution of these points, and related evidence for elaborate mortuary ceremonialism, within the state is generally restricted to central and western New York (Ritchie 1980; Snow 1980:266; Tuck 1978). Many researchers have recently begun to question whether Adena and Meadowood are appropriate diagnostics of the Early Woodland in the Hudson Valley and southeastern New York, and argued that projectile point chronologies for the Terminal Archaic and Early Woodland need to be reevaluated (Versaggi 1999). Rossville points serve as another diagnostic marker of Early Woodland occupations in the region, and are usually recovered in association with coastal shell middens. Vinette I pottery, a thick grit-tempered ware decorated on interior and exterior surfaces with impressed cordage or fabrics, represents one of the earliest ceramic traditions in the region (Ritchie 1980; Tuck 1978).

The Middle Woodland Period (ca. 2,000 to 1,000 B.P.) in eastern New York is characterized by changes in social and economic organization, including increasing trends towards sedentism and long-distance exchange of smoking pipes and lithic materials. Diagnostic artifacts from the Middle Woodland include Fox Creek stemmed and lanceolate projectile points, Jack's Reef points, Greene points, and a variety of decorated pottery styles (Funk 1976; Kostiw 1995; Ritchie 1971; Snow 1980:276).

In southeastern New York, the Late Woodland Period (ca. 1,000 to 400 B.P.) is divided into the Bowman's Brook and subsequent Clason's Point Phases. These cultures are known from large village sites near tidal pools and small coves, often characterized by numerous pits for cooking, storage, and the disposal of refuse (Ritchie 1980:269), as well as smaller activity sites. The Late Woodland economy in coastal New York seems to have been primarily oriented to marine resources, supplemented by horticulture and seasonal hunting and gathering (Ritchie 1980:268-270). Diagnostic artifacts for the period include Levanna and Madison style points (Ritchie 1971) and distinctive types of pottery including Bowman's Brook Incised and Stamped, East River Cord Marked, Munsee Incised, Castle Creek Beaded, and Wickham Punctate and Incised (Ritchie 1980:270-272).
Sites with Middle and Late Woodland components are the most numerous types of sites identified in New York City. Late Woodland settlements were dispersed throughout the city, at locales such as Archery Range, Ward’s Point, Washington Heights-Inwood, Clasons Point, Bowman’s Brook, and Aqueduct. Many of these locations continued to be occupied throughout the early period of European Contact (Cantwell and Wall 2001:114-116).

### 2.3 Historic Period Cultural Context

In the Late Woodland and Early Contact Periods, the Lower Hudson Valley and coastal areas of New York were inhabited by Munsee-speaking groups of the larger Lenape (or Delaware) cultural group of Native Americans (Burrows and Wallace 1999; Cantwell and Wall 2001:120; Goddard 1978; Snow 1980:96). The Munsee generally lived in multi-family longhouse structures about 20 feet wide and up to 100 feet long. These houses were usually arranged as loose clusters in hamlets as opposed to nucleated villages. In addition to speaking a similar dialect of the Eastern Algonkian language, Munsee groups generally shared similar modes of subsistence, settlement, social organization, and forms of material culture (Goddard 1978; Grumet 1995:26; Snow 1980:97-99). In the early-seventeenth century, the fur trade served as the primary motivation for Dutch colonization of the Lower Hudson Valley. Interactions with the Dutch and participation in the fur trade resulted in rapid and dramatic changes in the economy, social relations, and material culture of local Delaware groups (Burrows and Wallace 1999:11-13; Goddard 1978).

#### 2.3.1 Contact and Colonial Periods

Contact Period settlements are recognized in the archeological record by small quantities of European manufactured goods, such as metal kettles, tools, projectile points, ornamental brass cones, glass beads, bottles, jugs, and cloth among larger quantities of Native American material culture and refuse (Cantwell and Wall 2001:122-123). Within New York City, close to eighty Lenape habitation sites have been documented, along with the locations of agricultural fields and a network of trails that connected the individual settlements (Burrows and Wallace 1999:6). On Manhattan, Late Woodland and Contact Period Native American settlements were mostly clustered at the southern and northern ends of the island. These settlements were connected by a trail (or network of trails) that ran along the upland spine of the island from Battery Park to Inwood (Burrows and Wallace 1995:6; Hornberger 1994:17).

The government of Holland formally established the colony of New Netherlands in 1614, claiming exclusive rights to trade on all lands between the Connecticut and Delaware Rivers. The seat of government for this new colony was at New Amsterdam, a small Dutch fort located in Lower Manhattan. In 1621 the charter for the colony was transferred to the Dutch West India Company, an armed mercantile association formed to serve as the agents of Dutch colonialism in the New World. Dutch colonists began to settle in increasing numbers at New Amsterdam in 1624 (Burrows and Wallace 1999:19-21). Throughout the New Amsterdam colony, the growth of the European population and encroachment upon Native American lands lead to increasing tensions between the two groups. The introduction of European diseases in the early-seventeenth century resulted in the decimation of Native American populations. These losses were compounded by casualties in wars both among Native groups and with the colonists (Brasser 1978; Goddard 1978).
The Dutch West India Company surrendered the New Netherlands colony to the English in 1664. Throughout the seventeenth and eighteenth centuries, urban development and settlement expansion was largely confined to Lower Manhattan (Burrows and Wallace 1999:206; Homberger 1994:41-47). Those areas in Manhattan north of Houston Street were primarily occupied by rural farms and remained sparsely settled into the early-nineteenth century (Homberger 1994:69; Winslow 1995:538).

2.3.2 THE NINETEENTH AND TWENTIETH CENTURIES

Proposed Shafts 25B, 28B, and 29B are located near the west (Hudson River) shoreline of Manhattan in the neighborhoods of Clinton (Hell’s Kitchen), Greenwich Village, and Tribeca. Each of these neighborhoods experienced different phases of residential and commercial development as the city spread northward during the nineteenth century. In the eighteenth and nineteenth centuries, the coastline and landscape of the West Side was extensively altered by episodes of filling and pier construction (HCI 1983:101-102,262). Eleventh Avenue (north of 23rd Street) marked the western shoreline of Manhattan until the 1870s. The present shoreline, and all areas west of Eleventh Avenue consist of “made land” that has been formed by filling and grading activities in the late-nineteenth and twentieth centuries (Cantwell and Wall 2001:224).

The neighborhood now known as Tribeca was part of a large land grant made by Queen Anne to Trinity Church in 1705. Through the end of the eighteenth century, this area was part of the Lipsenard Meadows—a broad tract of salt marsh and pasture located where the Kalch Hoek (i.e., the western outlet of the Collect Pond, now Canal Street) drained into the Hudson River (Hill and Waring 1879; Gold 1995). Trinity Church sponsored much of the early land filling in the area, and by the 1820s the former marshland was a fashionable and wealthy residential district. Proximity to the Hudson River and the construction of railroads and other infrastructure along the West Side encouraged the gradual transformation of the neighborhood to a commercial district.

Greenwich Village has historically maintained a unique character distinct from the rest of the city. During the seventeenth and eighteenth centuries, Dutch (and later English) colonists and freed black slaves established farms in this rural area. Greenwich Village retained its pastoral, suburban character through the early part of the nineteenth century. Outbreaks of epidemic diseases in the city resulted in mass emigrations to the Village, which fueled development. Between the 1820s and 1840s, speculators subdivided larger farms, rerouted the Minetta Brook, filled swamps, and leveled hills to construct blocks of row houses (Ramirez 1995). Throughout the nineteenth century, the western portion of the neighborhood adjacent to the Hudson River was largely a commercial district populated by breweries, warehouses, coal yards, and lumberyards.

Hell’s Kitchen was not intensely developed until after the 1851, when the New York Central & Hudson River Railroad (NYCHRR) was constructed along present-day Eleventh Avenue (Burrows and Wallace 1999:655). The neighborhood developed as an industrial area with rail yards, factories, warehouses, lumberyards, slaughterhouses, and gas works as well as residential tenements housing a growing impoverished immigrant population (Burrows and Wallace 1999:991; Winslow 1995). The Irish were the largest ethnic group in the neighborhood, along with Scots, Germans and African-Americans.
More detailed historical background information related to these neighborhoods is presented within the results of historical research associated with each of the proposed shaft sites (see Section 4).
3.0 RESEARCH METHODS

Primary and secondary sources were examined in order to document the environmental setting and history of the area, develop historic contexts for understanding potential cultural resources at each proposed shaft site, and assess the likelihood for each proposed shaft site to contain archeological resources. These sources included both written and cartographic documents relating to the past and present environmental conditions and human occupation of the region.

3.1 PREHISTORIC SENSITIVITY STUDY

In the early-twentieth-century, archeologists recorded the former locations of Native American sites in New York City (e.g., Bolton 1934; Skinner 1920). It was recognized at the time that many of these sites were being (or would be) destroyed by urban development and construction activities. These early references provide the best documentation of Native American settlements in Manhattan. Contemporary archeologists working in New York typically assume that historic and modern development, construction, and urban landscaping activities have destroyed any prehistoric sites that may have been located in the areas they investigate (Lenik 1992:20). Of the 17 major archeological data recovery projects undertaken in Manhattan in the 1980s, prehistoric materials were recovered during only four of these projects. For example, excavations at the seventeenth-century Augustine Heerman Warehouse on the East River (Grossman 1985, cited in Lenik 1992:22-24) recovered a large assemblage of Native American objects and Dutch trade goods dating to the Contact Period. In each case where archeologists identified Native American materials at these sites, all materials recovered were isolated finds recovered from areas of historic landfill or other disturbed contexts (Lenik 1992:24).

Sources and repositories reviewed by JMA to investigate the prehistoric archeological potential of the proposed shaft sites included:

- The site files of the New York State Museum (NYSM);
- The site files of the NYS Office of Parks, Recreation and Historic Preservation (OPRHP);
- The archeological reports bibliography of the New York City Landmarks Preservation Commission (NYC LPC 2003);
- Early-twentieth-century references concerning the archeology of New York City (e.g., Beauchamp 1900; Bolton 1920, 1922, 1934; Parker 1920; Skinner 1915, 1920);
- Previous cultural resources reports from other projects in the vicinity (e.g., HAA 1990; HCI 1983; HPI/LBG 2004; JMA 2001);
- And, regional syntheses of prehistory (e.g., Cantwell and Wall 2001; Funk 1976; Ritchie 1980; Snow 1980).

For each of the proposed shaft sites, JMA reviewed the available information concerning previously recorded Native American archeological sites in the vicinity, and examined nineteenth-century maps (e.g., Colton 1836; Viele 1865) that depict the pre-development topography of Manhattan. The 1865 Viele Sanitary & Topographical Map of the City and island of New York was drawn to identify former watercourses and wetlands to assist in planning sewer and sanitary facilities (Stokes 1918:777–778); accordingly, the map presents a detailed reconstruction of the pre-development topography and landscape.

Based on these sources, JMA evaluated the potential for Native American archeological sites to have once existed at each of the proposed shaft sites. This baseline potential was then re-
evaluated based on evidence for the extent of construction-related disturbance at each shaft site. Evidence for previous disturbance included both the results of historical and cartographic research that provided a record for construction episodes at each proposed shaft sites as well as a review of geo-technical boring logs prepared for the Project (Appendix A).

3.2 HISTORICAL RESEARCH

The goals of historical research conducted for each of the proposed shaft sites were to:

- Identify previous uses of each property;
- Document the size, location, construction date, descriptive characteristics, and demolition date of structures or other features that previously occupied the proposed shaft sites;
- Evaluate the likelihood that potentially informative archeological features associated with previous use and/or occupation of the lot may be present;
- And, evaluate the likelihood that potential archeological features may have remained undisturbed during nineteenth-and-twentieth-century episodes of construction, renovation, and/or demolition that have occurred at each shaft location.

For New York City, there is a wealth of cartographic and archival information detailing the development and occupation of blocks and lots throughout Manhattan. Archival sources and repositories that were examined for the project included:

- The New York Public Library, Maps Division and Local History and Genealogy Division;
- The City of New York Department of Records, Municipal Archives (DOR);
- The City of New York Department of Buildings (DOB);
- The City of New York Office of the City Register (OCR);
- The City of New York Department of Environmental Protection, Bureau of Sewer and Water Operations (DEP);
- The Library of Congress Geography and Maps Division;

More detailed research concerning the occupants of the lots, including Census and Directory reviews, was conducted as a second phase of research after the potential for archeological deposits to be present at each shaft location was established. Occupancy for each lot was only researched if a finite period could be established from when associated archeological deposits were likely to be present.
4.0 RESULTS

4.1 SHAFT 25B (BLOCK 1077, LOT 29)

Proposed Shaft 25B is located on Block 1077, Lot 29. Lot 29 fronts on Tenth Avenue (to the east) between 48th and 49th Streets, and is bounded by the Pennsylvania Central Railroad right-of-way to the west. Contemporary Lot 29 includes ten (10) Historical Lots, which are identified as lot numbers 28–37 in municipal records and on historical atlases (e.g., Robinson 1885). City records also identify the property as 705–719 Tenth Avenue and 507–513 West 48th Street (NYC DOB n.d., 2005; NYC OCR n.d., 2005). Within Lot 29, the proposed Shaft 25B is located in the southeast portion of the lot at the corner of Tenth Avenue and West 48th Street. Project plans depict the limits of disturbance associated with Shaft 25B (Figure 2) as an area extending 50 feet west (into the lot) from Tenth Avenue and 60 feet north from West 48th Street. The proposed shaft location falls within Historical Lots 29 and 30, and the southern portion of Historic Lot 31.

Lot 29 is currently an asphalt-paved, vacant lot (Plates 1–4). A chain link fence defines the southern, northern, and western perimeters of the property. The surface of the lot slopes gently to the northwest, which likely reflects the original topography of the area. The former Penn Central Railroad tracks (currently used by Amtrak) are located in a depressed open-cut located immediately west of the lot.

4.1.1 PREHISTORIC ARCHEOLOGICAL POTENTIAL, SHAFT 25B

Prior to the arrival of the Europeans, the vicinity of Shaft 25B area would have been an attractive locale for Native American occupation or resource-procurement activities. The 1865 Viele (Figure 5) and 1836 Colton (Figure 6) topographic maps depict the pre-development landscape in the vicinity of Block 1077 as a highland ridge with bedrock outcrops overlooking streams and broad, level areas descending to the Hudson. This type of setting would have attracted Native American people due to the proximity of streams and wetlands for hunting and fishing purposes. The level areas descending to the Hudson may have also been utilized for crop cultivation. The 1836 Colton map (Figure 6) depicts the area as open fields, orchards, hills and larger farms, with numerous small springs and tributaries that flow both north and south from the vicinity of Block 1077.

JMA did not identify any previously recorded Native American sites located in or near the proposed location of Shaft 25B. The nearest recorded archeological site is NYSM 4061, which is described as “traces of occupation” extending between (approximately) 42nd and 72nd Streets on the East Side (Harlem River shoreline) of Manhattan. Early-twentieth-century archeologists documented many more prehistoric archeological sites along the northern tip of the island, in the vicinity of Inwood. Previously recorded sites in this area include small campsites, shell middens, rockshelters, and burial grounds (Beachamp 1900:107; Bolton 1934:134-135; Parker 1922:626-628). Many of these sites are recorded in the OPRHP files as Sites A061.01.0114, A061.01.0116, A061.01.0117, A061.01.0119, A061.01.0121, A061.01.0123, A061.01.0532, A061.01.0533, and A061.01.0536. Other sites were recorded to the northeast along the Harlem River, including numerous shell middens and small campsites (Beachamp 1900:107; Bolton 1934:134; Parker 1922:626).

Geo-technical borings conducted in association with the Project (Appendix A) provide information concerning current subsurface soil stratigraphy at the proposed location of Shaft 25B.
Five borings were excavated at Shaft 25B; three of which were taken in the western portion of the proposed shaft site and two of which were taken within (or adjacent to the curb of) Tenth Avenue. All boring samples taken within the proposed shaft location encountered bedrock within 5 feet of the existing ground surface. Boring W48 St-W (located at the eastern edge of Lot 29, north of the proposed shaft site) documented fill material with brick, sand, and concrete (interpreted as building demolition and basement fill) to a depth of 11.3 feet underlain by bedrock. The results of the geo-technical investigation confirm the historical topography depicted for this location on the 1865 Viele map (Figure 5), which shows the pre-development landscape in this vicinity as hilly uplands with bedrock outcrops.

4.1.2 Lot History, Shaft 25B

Block 1077 is located within one of the numerous speculative real estate holdings acquired by John Jacob Astor during the early-nineteenth century (NYC DOR 1917); this property is variously referred to as the Eden Farm tract or Astor-Cutting tract. Astor significantly increased his family’s wealth by buying farmland and waterlots at low prices and holding onto the properties until the city's expansion extended into formerly rural or idle areas (Anon. 1930; Homberger 1994:66; Weiss 1995). Block 1077 was originally part of the Wolfert Webbers Upper Farm (ca. 1690s), and was included within Lots 1 and 3 of that property deeded to Medcef Eden in 1784 (NYC DOR 1917; Stokes 1928:171). The Eden Farm included the area between 42nd and 46th Street along Bloomingdale Road (Broadway) and the tract extending northwest to the Hudson River. Astor acquired this tract for $25,000 in 1803 by obtaining a one-third interest in an outstanding mortgage and foreclosing on the property (Anon. 1930; exploreNYC 2000).

Prior to the extension of the street grid in the early-nineteenth century, the nearest local thoroughfare was “Verdant Lane” (also called Feitner's Lane), which ran on a northwesterly course from Bloomingdale Road (later Broadway) and crossed Tenth Avenue along the northern border of Block 1077 - close to the present course of 49th Street (Stokes 1918:Plate 176, 1928:1011; Colton 1836)(Figure 6). The 1836 Colton map (Figure 6) depicts two structures located on the north side of Verdant Lane within the northern portion of Block 1077, Lot 29. The 1852 Dripps map (Figure 7) also depicts these two structures, but places the westernmost of the two structures further to the northwest, outside of the Astor property (and outside of Block 1077) and within the adjacent estate (the Frances Hendricks Tract, see below) to the northwest. The easternmost structure was located within the Astor-Cutting tract, in the northwestern corner of Lot 29 immediately south of the current course of 49th Street and immediately west of Tenth Avenue. According to the 1852 Dripps survey, this early-nineteenth-century building was located approximately 150 feet north of the proposed location for Shaft 25B (Figure 7).

The 1836 Colton (Figure 6) and 1852 Dripps (Figure 7) maps also depict a large farm or estate located on the north side of Verdant Lane, immediately west of Tenth Avenue and north of Block 1077. This estate was located within the Frances Hendricks property, deeded by Astor to John Wilkes and subsequently bought by Harman Hendricks ca. 1819. Hendricks passed away in 1838, leaving the property to his widows and children (NYC DOR 1917). The estate depicted on the Colton and Dripps surveys is likely the former Hendricks residence; and the westernmost structure described in the preceding paragraph was likely the gatehouse or servants quarters associated with the estate.

The Hendricks estate was demolished during the 1860s or 1870s (Figures 8–9) and subdivided into smaller lots as the Common Council’s grid plan for development replaced the earlier layout.
of rural roads such as Verdant Lane. During the 1860s, William Backhouse Astor developed most of the lots within the Astor-Cutting Tract. While tenements populated most of Hell’s Kitchen, Astor constructed brownstone townhouses in an attempt to create more refined areas within the neighborhood – examples of which survive at 412–414 West 47th Street (exploreNYC 2000).

Bureau of Sewer and Water records indicate that sewers were installed in the streets adjacent to Block 1077, Lot 29 in 1861 (NYC DEP n.d.), although the eastern portion of Block 1077 remained undeveloped until the 1880s (Dripps 1852; Bromley 1879; Galt & Hoy 1879) (Figures 7 and 8). The 1885 Robinson atlas (Figure 9) shows the subdivision of Historic Lots 28–37 within Block 1077 and depicts the structures built on each of these lots. These buildings that fronted along Tenth Avenue (Historic Lots 29–36) extended 50 feet in depth within 100-foot-deep lots. These structures are also depicted on the 1890 Sanborn and 1891 Bromley maps (Figure 10), which indicate that all of these structures were five-story, brick tenement buildings occupied by both stores (typically on the first floor) and apartments (on the upper floors). The 1890 NYC Police Census documents multiple households at each of these addresses; for instance, at least six families are listed for 581 West 48th Street (also 705 Tenth Avenue, or Historic Lot 29). The 1911 Sanborn atlas indicates that a “confe’c’y” (confectionary) occupied Lot 32, a Dryer and Cleaner occupied Lot 33, and a roofer occupied Lot 35. No structures or additions are depicted within the rear half of these lots through 1911.

The 1930 Sanborn atlas (Figure 11) depicts a single-story addition off the rear (west) wall of 705 Tenth Avenue (Historic Lot 29); the addition extended 50 feet to fill the entire rear portion of the lot. The rear yards of the other seven structures fronting on Tenth Avenue remained undeveloped. However, the rear yard of 719 Tenth Avenue (Historic Lot 36) was in use as a parking lot. The single-story addition in Historic Lot 29 is depicted in the ca. 1940 tax assessment photographs for Block 1077 and appears to have housed an unidentified commercial enterprise fronting on West 48th Street (NYC DOR 1940). The ca. 1940 photographs also identify storefronts along Tenth Avenue including a chemist (Historic Lot 29), butcher/bakery/grocery (Historic Lot 30), and “U.S. Tires” (Historic Lot 31).

The 1930 atlas also defines the right-of-way for the Penn Central Railroad through the middle of the block. The eight structures located within the right-of-way (Historic Lots 24–27 and 38–41) were subsequently demolished. The 1951 Sanborn atlas (Figure 12) indicates that the structures on Historic Lots 30-36 were demolished by this time, but that the tenement on Historic Lot 29 (including the single-story rear addition) was still standing. According to Department of Buildings records, this building was also demolished by 1961. Certificates of Occupancy (NYC DOB 2005) issued for Lot 29 indicate that the lot was occupied by a parking lot with single-story attendant’s booth (ca. 1961, 1971) and a gasoline service station and carwash (with buried gasoline tanks) at 707 Tenth Avenue (ca. 1962).

4.2 SHAFT 28B (BLOCK 581, LOT 45)

Proposed Shaft 28B is located within Lot 45 in the southwest corner of Block 581. Lot 45 fronts on Hudson Street (to the west) and extends the full block between West Houston Street (to the south) to Clarkson Street (to the north). A school defines the western perimeter of the property. Contemporary Lot 45 includes nine (9) Historical Lots, which are identified as lot numbers 45–52 and 83 in municipal records. These lot numbers correspond to 388-402 Hudson Street, 262 West Houston Street, and 22 Clarkson Street (NYC DOB n.d., 2005; NYC OCR n.d., 2005). Within
Lot 45, the proposed Shaft 28B is located in the southwest portion of the lot at the corner of Hudson and West Houston Streets. Project plans depict the limits of excavation associated with Shaft 28B (Figure 3) as an area extending 75 feet east from Hudson Street and 55 feet north from West Houston Street. Block 81, Lot 45 is currently a paved, level, vacant parking lot surrounded by a chain link fence (Plates 5–6).

4.2.1 Prehistoric Archeological Potential, Shaft 28B

The 1865 Viele map (Figure 13) depicts the pre-development landscape and topography in the vicinity of proposed Shaft 28B. Block 581 occupies what was once the top of a bluff located adjacent to and overlooking (to the south) the Minetta Brook and associated wetlands:

... between Charlton and West Houston Streets, lay a small, swampy tract, through which the ‘Manetta Water’ flowed to its outlet in the Hudson. Until demoralized by this near approach to the slothful stream in the marshy valley below, the brook was a brisk little affair, hurrying along in its well-defined channel, apparently as full of business as it was certainly full of trout... Indian, Dutch, and English boys caught them, and so did American boys who had the good – or bad luck to be born in the last century (Hill and Waring 1897:228).

This location would likely have been very attractive to Native American people because of the abundant natural resources in the immediate vicinity. The area would have been ideally suited for many economic activities including fishing in the Minetta Brook, collecting clams and oysters from the Hudson River estuaries, and planting food and tobacco crops within the fertile floodplain soils. Early-twentieth-century archeologists reported a Native American village site located in what is now Greenwich Village known as Sapokanikan (OPRHP Site A061.01.0502). Native Americans used this area for fishing, planting fields of crops and tobacco, and a landing place for canoes bringing goods over from New Jersey (Bolton 1920:240, 1922, 1934:133; Burrows and Wallace 1999:6; Skinner 1915:51). An important trail ran northeast from this area to Hell’s Gate Bay.

Geo-technical borings taken at the proposed location of Shaft 28B (Appendix A) provide information concerning subsurface soil stratigraphy at this location. Eleven borings were excavated in the vicinity of Shaft 28B; all of these borings were taken in the adjacent roadbeds of Hudson and West Houston Street, and therefore depict subsurface conditions in the areas immediately adjacent to (but not within) Lot 45. Eight of the boring logs record the presence of disturbed fill materials to depths between 15 and 19 feet underlain by glacial till. In three of the boring logs (27B-A, Houston-A, and soil testing well 28B-GEO-05), samples recovered from between 15 and 24 feet below the existing surface included peat and organic deposits or lenses in association with moist to wet fine silt to medium and coarse sands. These samples may indicate the presence of intact Holocene alluvial deposits associated with the Minetta Brook and adjacent wetlands, which may represent intact land surfaces in an area sensitive for prehistoric archeological remains.

JMA was contacted on January 12, 2005 to conduct monitoring at the proposed site of Shaft 28B. On January 13, 2005 JMA personnel monitored the excavation of a trench and the installation of shoring along the eastern perimeter of the limits of excavation for Shaft 28B. The shoring trench was excavated to variable depths between 4 and 9 feet below the ground surface; JMA observed sections of basement walls (with footings at approximately 9 feet below ground) within the trench. All soils observed within the trench consisted of demolition debris with brick fragments,
timbers, concrete, and asphalt fragments. These field observations confirm the depth of fill and debris reported in the logs for borings taken in the adjacent roadways (see above; Appendix A).

4.2.2 LOT HISTORY, SHAFT 28B

Hudson Street was extended north to Hamersley Street (now West Houston Street) in 1815 (Stokes 1928:1003). The 1836 Colton map indicates that Block 581 was developed soon after; however, the Colton map does not depict individual structures within the urbanized portions of the city. The 1852 Dripps survey (Figure 14) depicts the early layout of lots and structures within Block 581. In 1852, the proposed location of Shaft 28B was occupied by three small buildings in shallow (approximately 60-foot-deep) lots that fronted on Hudson Street and two small buildings also built within irregular, undersized lots that fronted on Hamersley (West Houston) Street. All five of these structures had vacant rear lots or backyard areas. Municipal sewers were installed in the adjacent streets in 1854 (NYC DEP n.d.). In the absence of later development and disturbances, it is very likely that historic shaft features (such as privies and cisterns) would have been located within the backyards associated with these five early-nineteenth-century structures.

By the end of the 1870s, the smaller structures built within undersized, irregular lots that were depicted on the 1852 survey (Figure 14) within the proposed location of Shaft 28B were demolished and replaced with a single, five-story commercial structure (Bromley 1879, 1891; Galt & Hoy 1879; Robinson 1885; Figures 15–17). The late-nineteenth-century maps identify the proposed location of Shaft 28B as Historic Lot 1345, although twentieth-century municipal records refer to Historical Lot 45. Regardless, the five-story building occupied almost the entirety (excluding a narrow alley in the northeast portion) of the consolidated lot that measured approximately 75 feet along Hudson Street by 100 feet along West Houston. The large commercial building is labeled as having been used for “Storage” (Bromley 1891; Figure 17). The 1895, 1904, and 1921 Sanborn atlases (Figure 18) indicate that the building was a single, five-story, brick structure that may have had separate street entrances at 388, 390, and 392 Hudson Street. 392 Hudson Street is identified as housing a “stock of carpets” on the 1904 Sanborn atlas (Figure 18), although it is unclear whether this function applies to the entire building.

Department of Buildings records include a demolition permit for Block 581, Lot 45 from 1938 (NYC DOB n.d.). A 1941 Certificate of Occupancy indicates that Lot 45 (including Historical Lots 45, 48–52, and 83) was in use as a parking lot (NYC DOB 2005). The 1951 Sanborn atlas (Figure 19) depicts Lot 45 as a vacant lot and documents the presence of the adjacent school. A 1960 Certificate of Occupancy documents the lot’s continued use for parking and indicates the presence of a small shed for an attendant (NYC DOB 2005).

Throughout the nineteenth century, historical maps depict the presence of the Trinity Church Cemetery (later St. John’s Cemetery) located on the block immediately north of Block 581 (Colton 1836; Dripps 1852; Bromley 1879, 1891; Galt & Hoy 1879; Robinson 1885; Figures 14–17). The cemetery was in use by Trinity Church parishes between 1799 and 1851, whose records indicate that approximately 10,000 people were buried within this one-acre cemetery. In the 1890s the City of New York annexed the cemetery for use as a park and playground; however, available records indicate that the bodies were not removed and that the graveyard was buried beneath several feet of fill (Inskeep 2000:159). The former cemetery is depicted on historical maps after 1895 as Hudson Park (Sanborn 1895, 1904, 1921, 1951; Figures 18–19).
4.3  Shaft 29B (Block 213, Lot 1)

Proposed Shaft 29B is located on Block 213, Lot 1. Block 213 is bounded by Hudson Street (west), Laight Street (north), Varick Street (east), and Ericsson Place (south). Lot 1 occupies the entirety of the block, and is identified as 21 Laight Street in city government records (NYC DOB 2005; NYC OCR 2005). Block 213 has always been a single property and was never subdivided into separate parcels. Certificates of Occupancy from the mid-twentieth century variously designate the property as 21 and 23 Laight Street, or 61, 67, and 69 Varick Street – however, all of these street addresses refer to the same, single property (NYC DOB 2005). Proposed Shaft 29B is located at the northwest corner of the block, approximately 41 feet south of the intersection of Hudson and Laight Streets. The limits of excavation associated with the shaft extend approximately 80 feet (north-to-south) along Hudson Street and 30 feet east into the lot (Figure 4). The proposed location for Shaft 29B is currently a traffic island bordering the circle of ramps at the exit of the Holland Tunnel (Plates 7-8).

4.3.1 Prehistoric Archeological Potential, Shaft 29B

Prior to the urban development of the area, the site of proposed Shaft 29B was within the Lipsenard Meadows – a broad tract of salt marsh and pasture located where the Kalch Hoek (i.e., the western outlet of the Collect Pond, now Canal Street) drained into the Hudson River (Hill and Waring 1879). The 1865 Viele topographic map (Figure 20) depicts the original extent of the marshland that stretched along Canal Street and from West Broadway to the Hudson between Duane and Broome Streets. Historical accounts describe the pre-development landscape in the vicinity of Block 213:

A less attractive location could hardly have been found. It was at the junction of the West Broadway and the Canal Street swamps, and the outlook was over a dreary waste of rushes and brambles, unshaded by a single large tree... (Hill and Waring 1879:222).

The nearest previously recorded Native American site in the vicinity of Shaft 29B is Shell Point (NYSM Site 4059), described as a village site located on a small upland overlooking a pond (the Collect Pond) near Canal Street (Beauchamp 1900:107; Parker 1922:630). The site was located farther inland in the vicinity of Broadway. Early-twentieth-century archeologists recorded numerous other habitation and shell midden sites that once existed in Lower Manhattan. These sites include shell mounds on the southern tip of the island (OPRHP Site A061.01.0508), and the village of Werpoes (OPRHP Site A061.01.0507) in the vicinity of Elm, Duane, and Worth Streets. The Native American name of the area was preserved in a 1651 Dutch land grant that referred to “the land called Werpoes” which included approximately 50 acres in Lower Manhattan. Another Contact Period village known as Rechtanck (A061.01.0509) was located at Corlears Hook and was the site of a Dutch massacre of Native Americans in 1643 (Bolton 1934:133).

Geo-technical borings taken at the proposed location of Shaft 29B provide information concerning subsurface soil stratigraphy at this location. All of the thirteen samples taken within or in the vicinity of proposed Shaft 29B document deposits of disturbed soils and fill associated with previous episodes of construction and demolition. The profiles recorded within the soil borings in this area consist of 10 to 15 feet of fill and demolition debris material overlying glacial drift or till material. For instance, boring log 25M (Appendix A) records the presence of modified glacial drift material probably used as artificial fill to depths of approximately 17 feet underlain by
glacial lakebed sediments. Soils that included identifiable traces of the pre-development marshlands in this area are not apparent in the boring logs.

4.3.2 Lot History, Shaft 29B

In the early-nineteenth century, Trinity Church built St. John's Chapel (ca. 1807) on the east side of Varick Street and invested in additional development in the area, which entailed filling and grading many of the adjacent marsh areas, including Block 213:

Having completed the chapel, the Vestry of Trinity turned their attention to the neighborhood, and laid out as a park the whole block bounded by Varick, Beach, Hudson, and Laight Streets, which was called Hudson Square or St. John's Park. It was carefully graded, planted, and fenced in (Hill and Waring 1879:222).

During the early-nineteenth century, Hudson Square/St. John's Park occupied Block 213 (Colton 1836; Dripps 1852; Viele 1865; Gold 1995; Stokes 1918:Plate 106-a; Figures 20-23). Hudson Square was a private park leased and maintained by the owners of the elegant brick row houses that faced the park. Historical accounts indicate that the square and immediately surrounding neighborhood were very fashionable in the early-to-mid-nineteenth century:

'Old Cisco', a former slave, who was made [Hudson Square's] keeper, cared for it with such fidelity that the locality soon became one of the most attractive parts of the city. Substantial brick houses arose around it, and the value of property in the vicinity rapidly increased... The gates of the Park were kept locked, to prevent the intrusion of strangers, but each resident of the square had his own key, and enjoyed its privileges with certainty that he would meet no objectionable person inside its limits (Hill and Waring 1879:222-223).

Dr. Dix describes Hudson Square at that time as one of the finest, if not the finest, in the city. It contained specimens of almost every American tree, with others of foreign sorts; and Dr. Francis, in 1857, said that the variety of trees there was greater than on any other ground of equal size in the known world (Stokes 1918:609).

Numerous other public squares and parks in Manhattan were previously used as burial grounds in the nineteenth-century (e.g., Washington Square, Bryant Park). Concern over the possibility of burials within Block 213 was perhaps heightened due to the association of the park with the early-nineteenth-century St. John's Chapel. JMA reviewed historical accounts and indices of New York cemeteries (e.g., Inskeep 2000; Stokes 1918). None of the records, maps, or secondary sources reviewed by JMA indicates that Hudson Square/St. John's Park (Block 213) was ever used as a burial ground. There are burials located at the "other" Hudson Park, coincidentally also referred to as St. John's Cemetery, located on Hudson and Clarkson Streets one block north of the proposed site for Shaft 28B (Inskeep 2000:159–160).

The neighborhood surrounding Hudson Square became increasingly commercial in character through the middle of the nineteenth century. After 1840, five- and six-story commercial buildings constructed with marble, sandstone, and cast iron facades came to dominate the neighborhood (Gold 1995). In the 1860s, Hudson Square was demolished in association with the construction of a railroad freight depot. According to historical accounts, this act seems to have finalized the transformation of the neighborhood:

The further history of that beautiful spot was a melancholy one. As time passed on and the character of the neighborhood changed, the owners of the property fronting on the Park were filled with the usual desire to sell for business purposes... Then followed a shocking scene: the felling of
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RESULTS

Facing this park lived the families of Alexander Hamilton, General Schuyler and General Morton, the Aymars, Drakes, Coits, Delafieldts, and others of equal fame; and here lived many of their descendants until the Hudson River Railroad Company tore down the protecting fence, invaded the sacred precincts with axe and shovel, and blotted St. John's Park out of existence with four acres of freight station. Fashion fled precipitately (Hill and Waring 1879:223).

The New York Central & Hudson River Railroad (NYCHRR) constructed a freight depot on the former site of St. John's Park in 1867 (Stokes 1918:975). The NYCHRR depot is depicted on an 1879 “bird’s eye” perspective map of Manhattan (Galt & Hoy 1879; Figure 24). This drawing depicts the freight depot as a large, three-story building that occupies all of Block 213, with a central, vacant courtyard. The same size and shape of the depot is depicted on the 1885 Robinson, 1891 Bromley, and the 1894, 1904, and 1922 Sanborn maps of Manhattan (Figures 25–28a).

The 1894 Sanborn atlas identifies the NYCHRR depot as a three-story “building of superior construction”, and includes an inset detail of the building's storage cellars, which encompassed the complete area of Block 213 (Figure 27). The 1905 and 1922 Sanborn maps provide additional detail. These maps show the arrangement of rail tracks and raised platforms on the first floor (street level) of the building (Figure 28). A detail plate of the structure (Figure 28) indicates that the basement of the building was 8.5 feet high, accessible only by elevator, with floors of planking overlying brick (Sanborn 1922). Department of Buildings records indicate that the foundation was built of stone with 28-inch-thick walls and the superstructure constructed of brick (NYC DOB n.d.).

The freight depot was demolished during the 1920s in association with the construction of the Holland Tunnel. The latest description of the depot within the Department of Buildings ‘Block and Lot Folder’ is dated 1923, although these records do not include an application for demolition (NYC DOB n.d.). The NYCHRR relocated their station and opened the St. John’s Park Freight Terminal, a three-story structure that covered three city blocks between Charlton and Clarkson Streets, in 1934. The new terminal was the end of the NYCHRR West Side line and served as the principal delivery station for dairy products in the city (FWP 1939:70).

Construction for the Holland Tunnel began in 1920 and was completed by 1927 (Gray and Hagen 1930; Shanor 1995). Due to concerns over traffic congestion, the exit and entrance ramps on the New York side of the Tunnel are widely separated. The eastbound exit ramp emerges in New York within Block 213, with a traffic circle of exit ramps allowing access to the adjacent surface streets (Figure 29). The approaches to the Tunnel (presumably including the exit ramps) were “built by the cut and cover method as usually employed in subway construction” (Gray and Hagen 1930:595).

Subsequent to the construction of the Tunnel exit ramp, the perimeters of the block continued to be used as traffic islands, with service stations and parking facilities. The ca. 1940 tax assessment photograph of Block 213 (NYC DOR 1940) depicts a large, single-story temporary structure located on the block. The structure is semi-circular in profile and apparently constructed of heavy fabric (possibly canvas) stretched over a frame. This temporary structure is likely the one-story, non-fireproof, “dining and recreational” building located at 25–57 Varick Street that is described in a 1943 Certificate of Occupancy for Block 213, Lot 1 (NYC DOB 2005).
The 1948 Certificate of Occupancy for Block 213, Lot 1 indicates that a single-story metal structure was located at 23–41 Laight Street, which was approved for use as a “garage for more than five motor vehicles” (NYC DOB 2005). The 1952 Certificate of Occupancy indicates that three single-story buildings were located on the lot, including a gasoline service station and two motor vehicle repair shops. The certificate also documents that a “grease pit” and “gasoline tank” were present, and that the lot continued to be used for parking (NYC DOB 2005). The locations of these service stations are depicted on the 1951 Sanborn map of Block 213 (Figure 30).
5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY AND CONCLUSIONS

5.1.1 ARCHEOLOGICAL SENSITIVITY EVALUATION, SHAFT 25B

Historic cartographic sources depict the pre-development topography of Block 1077 as an upland ridge location with bedrock outcrops. The 1836 Colton and 1852 Dripps maps depict an unidentified structure located on the north side of an early-nineteenth-century road (Verdant Lane) within the northern portion of Lot 29, immediately south of the current course of 49th Street and immediately west of Tenth Avenue. The early-nineteenth-century structure was located approximately 150 feet north of the proposed location for Shaft 25B. Urban development of Lot 29 (Historical Lots 28–37) did not occur until the 1880s, when five-story brick tenements were constructed along the lots fronting on Tenth Avenue. These tenements were 50-foot-deep structures within 100-foot-deep lots. Although the backyards of Historical Lots 30–36 remained undeveloped through the twentieth century, the construction date for these tenements post-date the (ca. 1861) installation of municipal sewers on the adjacent streets. Therefore, it is highly unlikely that backyard shaft features (e.g., privies or cisterns) are present in the associated backyard areas. Geo-technical boring logs document the presence of bedrock at depths ranging from 2 feet to 11 feet below the current ground surface (Appendix A). The only soils recorded consist of basement demolition debris/fill deposits overlying bedrock in one of the boring logs.

Proposed Shaft 25B is located completely within the building footprints of the five-story tenements that occupied Historical Lots 29–31. Recent geo-technical borings document the presence of bedrock within five feet of the existing ground surface within the proposed shaft site. Based on these factors, it is the opinion of JMA that there is very little likelihood that undisturbed archeological deposits are present within the proposed location of Shaft 25B.

5.1.2 ARCHEOLOGICAL SENSITIVITY EVALUATION, SHAFT 28B

Historic cartographic sources depict the pre-development landscape of Block 581 as a bluff located adjacent to and overlooking (to the south) the Minetta Brook and associated wetlands. This location would have been an attractive area for prehistoric habitation, and previous archeologists and historians recorded the presence of the Native American village of Saponikan within present-day Greenwich Village. The 1852 Dripps survey depicts three small buildings in shallow (approximately 60-foot-deep) lots that fronted on Hudson Street and two small buildings also built within irregular, undersized lots that fronted on West Houston Street within the proposed location of Shaft 28B. Municipal sewers were not installed in the adjacent streets until 1854, and in the absence of later development and disturbances, it is very likely that historic shaft features (such as privies and cisterns) would have been located within the backyards associated with these five early-nineteenth-century structures. By the end of the 1870s, these smaller structures were demolished and replaced with a single, five-story commercial structure that occupied almost the entirety (excluding a narrow alley in the northeast portion) of the consolidated lot. The limits of excavation for proposed Shaft 28B are located entirely within the building footprint for this later five-story structure. In the opinion of JMA, it is highly unlikely that potential earlier historic shaft features are intact within the basement area of the later five-story structure.
Geo-technical borings excavated in the streets adjacent to Shaft 28B document the presence of fill deposits to depths of approximately 15 feet. In three of the borings, these fill deposits were underlain by potentially intact strata of silts and sands containing samples of organic material and peat. These samples may indicate the presence of intact Holocene alluvial deposits associated with the Minetta Brook and adjacent wetlands. These deposits may represent intact land surfaces in an area sensitive for prehistoric archeological remains.

5.1.3 Archeological Sensitivity Evaluation, Shaft 29B

Prior to the urban development of the vicinity of Block 213, the proposed location of Shaft 29B was within a large wetland. Historical accounts refer to the filling and grading of the marsh in association with the early-nineteenth-century construction of Hudson Square or St. John’s Park. The private park was razed in the 1860s in association with the construction of the NYCHRR freight depot. The freight terminal was a massive three-story stone and cement structure with a basement that occupied the entirety of Block 213. The depot was demolished ca. 1920 in association with the construction of the eastbound exit ramps for the Holland Tunnel. According to historical accounts, the approaches to the tunnel were built via cut-and-cover methods. Geo-technical boring logs record the presence of disturbed fill deposits overlying glacial sediments, and do not indicate the presence of buried organic or wetland deposits.

Block 213 has experienced a dramatic sequence of disturbance episodes including the filling and grading of the marsh, razing of the park, construction and demolition of the freight depot, and excavation of the approaches for the Holland Tunnel. In the opinion of JMA, the cumulative effect of these episodes (and most significantly the excavations associated with the Holland Tunnel) preclude the possibility that intact archeological deposits are present at the proposed location of Shaft 29B.

5.2 Recommendations

Shaft 25B is located completely within the building footprints of the late-nineteenth-century, five-story tenements that formerly occupied Historical Lots 29–31. Recent geo-technical borings document the presence of bedrock within five feet of the existing ground surface within the proposed shaft site. Based on these factors, it is the opinion of JMA that there is very little likelihood that undisturbed archeological deposits are present within the proposed location of Shaft 25B. No additional archeological work is recommended for this location.

Shaft 28B is located on what was once a bluff overlooking the Minetta Brook, in the vicinity of a historically recorded Native American village. The limits of excavation associated with Shaft 28B are located within the building footprint of a late-nineteenth-century, five-story, commercial structure – the construction of which likely destroyed archeological deposits associated with previous historical-period occupation(s) of the lot. However, geo-technical boring logs document the presence of potentially intact alluvial and wetland soil horizons between 15 and 24 feet below the existing surface of the adjacent streets. These horizons are buried beneath deep deposits of fill. In the opinion of JMA, these buried soils have the potential to include intact archeological deposits associated with the Native American occupation of the area. JMA recommends a program of archeological monitoring during the excavation of the proposed shaft to determine whether intact soil horizons are present. Monitoring by professional archeologists should begin when construction/excavation reaches a depth of ten feet in any portion of the shaft site, and
should continue until sub-fill deposits have been exposed, examined, and (if necessary) sampled over the entire area of the proposed shaft site.

The vicinity of Shaft 29B has experienced dramatic episodes of disturbance throughout its history. In the opinion of JMA, the cumulative effect of each of these episodes (most significantly the excavations associated with the Holland Tunnel) preclude the possibility that intact archeological deposits are present at the proposed location of Shaft 29B. No additional archeological work is recommended for this location.
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Ramirez, Jan Seidler

Ritchie, William A.


Ritchie, William A. and Robert E. Funk

Robinson, E.

Sanborn Map Company

PHASE I A ARCHEOLOGICAL SENSITIVITY STUDY
NYCDEP WATER TUNNEL #3, SHAFTS 25B, 28B, AND 29B
NEW YORK, NEW YORK


Shanor, Rebecca R.

Skinner, Alanson


Snow, Dean R.

Stokes, I. N. Phelps

Tuck, James A.

Versaggi, Nina M.
1999  Regional Diversity within the Early Woodland of the Northeast. *Northeast Anthropology* 57: 45-56.

Viele, Egbert L.

Weiss, Marc A.

Winslow, George

Wolfe, Gerard R.
FIGURES
Figure 1. Detail of the Central Park, N.Y. and Brooklyn, N.Y. 7.5-minute USGS topographic quadrangles showing the proposed locations of the NYC Water Tunnel #3 Uptake Shafts 25B, 28B, and 29B.
Figure 2. Project plans showing the location of proposed Shaft 25B within Block 1077; photographic views are indicated by Plate Number.
Figure 3. Project plans showing the location of proposed Shaft 28B within Block 581; photographic views are indicated by Plate Number.
Figure 4. Project plans showing the location of proposed Shaft 29B within Block 213; photographic views are indicated by Plate Number.
Figure 5. Detail of the 1865 Viele Sanitary & Topographical Map of the City and Island of New York showing the pre-development topography in the vicinity of Block 1077 (Shaft 25B).
Figure 6. Detail of the 1836 Colton *Topographical Map of the City and County of New York* showing the vicinity of Block 1077 (Shaft 25B).
Figure 7. Detail of the 1852 Dripps Map of the City of New York showing the vicinity of Block 1077 (Shaft 25B).
Figure 8. Detail of the 1879 Galt & Hoy perspective drawing/"bird's eye" map showing the vicinity of Block 1077 (Shaft 25B).
Figure 9. Detail of the 1885 Robinson *Atlas of the City of New York* showing the vicinity of Block 1077 (Shaft 25B).
Figure 10. Detail of the 1890 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 1077 (Shaft 25B).
Figure 11. Detail of the 1930 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 1077 (Shaft 25B).
Figure 12. Detail of the 1951 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 1077 (Shaft 25B).
Figure 13. Detail of the 1865 Viele Sanitary & Topographical Map of the City and Island of New York showing the pre-development topography in the vicinity of Block 581 (Shaft 28B).
Figure 14. Detail of the 1852 Dripps Map of the City of New York showing the vicinity of Block 581 (Shaft 28B).
Figure 15. Detail of the 1879 Galt & Hoy perspective drawing/"bird's eye" map showing the vicinity of Block 581 (Shaft 28B).
Figure 16. Detail of the 1885 Robinson *Atlas of the City of New York* showing the vicinity of Block 581 (Shaft 28B).
Figure 17. Detail of the 1891 Bromley *Atlas of the City of New York* showing the vicinity of Block 581 (Shaft 28B).
Figure 18. Detail of the 1904 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 581 (Shaft 28B).
Figure 19. Detail of the 1951 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 581 (Shaft 28B).
Figure 20. Detail of the 1865 Viele Sanitary & Topographical Map of the City and Island of New York showing the pre-development topography in the vicinity of Block 213 (Shaft 29B).
Figure 21. Detail of the 1836 Colton *Topographical Map of the City and County of New York* showing the vicinity of Block 213 (Shaft 29B).
Figure 22. Detail of the 1852 Dripps Map of the City of New York showing the vicinity of Block 213 (Shaft 29B).
Figure 23. Early-nineteenth-century engraving of St. John's Chapel from within Hudson Square (Block 213) (Stokes 1918: Plate 106-a).
Figure 24. Detail of the 1879 Galt & Hoy perspective drawing/"bird's eye" map showing the vicinity of Block 213 (Shaft 29B).
Figure 25. Detail of the 1885 Robinson Atlas of the City of New York showing the vicinity of Block 213 (Shaft 29B).
Figure 26. Detail of the 1891 Bromley *Atlas of the City of New York* showing the vicinity of Block 213 (Shaft 29B).
Figure 27. Detail of the 1894 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 213 (Shaft 29B).
Figure 28. Detail of the 1922 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 213 (Shaft 29B).
Figure 1.—Plan and profile of the Holland Tunnel

Figure 29. Schematic plan and profile drawing of the Holland Tunnel (from Gray and Hagen 1930) showing the exit plaza at Block 213 (Shaft 29B).
Figure 30. Detail of the 1951 Sanborn Insurance Maps of the City of New York showing the vicinity of Block 213 (Shaft 29B).
PLATES
Plate 1. Block 1077, Lot 29 (proposed Shaft 25B) from the corner of Tenth Avenue and West 49th Street; view to the west.

Plate 2. Block 1077, Lot 29 (proposed Shaft 25B) from the corner of Tenth Avenue and West 49th Street; view to the northwest.
Plate 3. The proposed location of Shaft 25B; view to the northwest.

Plate 4. The proposed location of Shaft 25B; view to the southeast.
Plate 5. Block 581, Lot 45 (proposed Shaft 25B) from the corner of Hudson and West Houston Streets; view to the east.

Plate 6. The proposed location of Shaft 28B; view to the south.
Plate 7. The proposed location of Shaft 29B (Block 213); view to the southwest.

Plate 8. The proposed location of Shaft 29B (Block 213); view to the south.
APPENDIX A:

GEO-TECHNICAL BORING LOGS
SHAPT 25B

KEY TO SYMBOLS USED FOR BORINGS:
- Observation well
- Rock coring
- Boring number
- Boring contract
- Shaft location
- Surveying section

SCALE: AS BUILT
DATE: 04/02/93
PAGE 1 OF 1
## SHAFT 2B

<table>
<thead>
<tr>
<th>BORING NUMBER</th>
<th>CONTRACT</th>
<th>COORDINATES</th>
<th>ELEVATIONS</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>NORTH</td>
<td>EAST</td>
</tr>
<tr>
<td>SHAFT 25B</td>
<td>538C</td>
<td>278,356.549</td>
<td>594,188.684</td>
</tr>
<tr>
<td>24B-2A</td>
<td>C551</td>
<td>278,344.929</td>
<td>594,241.166</td>
</tr>
<tr>
<td>W48ST-A</td>
<td>C553</td>
<td>278,367.200</td>
<td>594,169.000</td>
</tr>
<tr>
<td>W48ST-B</td>
<td>C553</td>
<td>278,350.713</td>
<td>594,157.714</td>
</tr>
<tr>
<td>W48ST-C</td>
<td>C553</td>
<td>278,352.971</td>
<td>594,155.097</td>
</tr>
<tr>
<td>W48ST-W</td>
<td>BORE-1</td>
<td>278,378.773</td>
<td>594,244.534</td>
</tr>
</tbody>
</table>

### NOTES:
1. ELEVATIONS REFER TO DATUM USED BY USCGOS (KNOX 1928), MEAN SEA LEVEL AT SANDY HOOK, NEW JERSEY.
2. ALL COORDINATES ARE IN THE B.W.S. GRID SYSTEM UNLESS OTHERWISE NOTED.
3. ALL BORING COORDINATES WERE SUPPLIED BY THE DEP SURVEYING SECTION.

### LEGEND:
- D.S. ORIGINAL SURFACE
- T.O.R. TOP OF ROCK
- B.O.H. BOTTOM OF HOLE
**BORING NUMBER: 24B-2A**

**LOCATION:** West side of 10th Ave., at 67.5 ft. North of 48th St., Manhattan.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td>0 to 2.5</td>
<td>Demaged ash with some fine</td>
</tr>
<tr>
<td></td>
<td>2.5 to 10</td>
<td>to coarse rounded gravel, brown</td>
</tr>
<tr>
<td></td>
<td>10 to 15</td>
<td>sand and clay to some silt.</td>
</tr>
</tbody>
</table>

| Sample 2    | 0 to 2.5  | Weathered basaltic-basaltic schist  |
|             | 2.5 to 7.0| Weathered basaltic-basaltic schist  |

<table>
<thead>
<tr>
<th>Core Run 1</th>
<th>Depth (ft)</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 to 15</td>
<td>Fine to coarse grained-muscovite-basaltic schist</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Core Run 2</th>
<th>Depth (ft)</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 to 25</td>
<td>Fine to medium grained-muscovite-basaltic schist</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Core Run 3</th>
<th>Depth (ft)</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 to 35</td>
<td>Medium grained-muscovite-basaltic schist</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Core Run 4</th>
<th>Depth (ft)</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>35 to 45</td>
<td>Fine to medium grained-basaltic-muscovite schist</td>
</tr>
</tbody>
</table>

**NOTE:** All classifications and descriptions in this report are based on visual examination only.
## BORING NUMBER: W48 ST-A

### LOCATION:

In side property on NW corner of 10th Ave. and W48 St. (41.7 ft. north of W48th St. and 16 ft. west of 10th Ave.), Manhattan.

### JOB 495

**Date Bored**: 10/16/94  
**Date Completed**: 11/15/94

### Dr. Don George

**Under Contract of**:  
**Street Address**: 122 W 48th St.

### NOTATIONS:

- **Surface Elevation**: +40.00 ft.
- **Depth in Feet**: 5.00 ft.
- **Total Depth**: 49.00 ft.

### WET METHODS AND DESCRIPTIONS IN THIS LOG ARE BASED ON:

### VERTICAL EXAMINATIONS ONLY

### ASSESSMENT OF UNSTABLE ROCK:

**Depth**: 1.5 ft. **Elevation**: +38.45 ft.

### Rock Core Run No. 1

<table>
<thead>
<tr>
<th>Depth</th>
<th>8.00 to 18.00 ft.</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elev.</td>
<td>+32.98 to +24.98 ft.</td>
<td>15</td>
</tr>
<tr>
<td>Box 1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Spct:</td>
<td>broken and weathered medium to coarse grain argillite-biotite schist.</td>
<td></td>
</tr>
<tr>
<td>Sub.:</td>
<td>8.00 to 12.40'. ApEx: 12.40' to 16.00'.</td>
<td></td>
</tr>
<tr>
<td>Sub.:</td>
<td>8.00 to 12.40'. ApEx: 12.40' to 16.00'.</td>
<td></td>
</tr>
</tbody>
</table>

| Depth| 16.00 to 26.00 ft. | 25 |
| Elev.| +24.98 to +14.98 ft. | 20 |
| Box 1| 20 |
| Spct:| Subhorizontal sp. 20.30 (min.). |  |
| Sub.:| 30' cores r. 21.00' (24) Ribbon cores r. 20.20, 20.20'. |  |
| Sub.:| 80' healed r. 16.00' to 16.35'. |  |
| Spct:| Indeterminate. |  |
| Sp.:| 20'. |  |
| Fl.:| 0.4 |  |

### Rock Core Run No. 2

| Depth| 26.00 to 36.00 ft. | 100 |
| Elev.| +14.98 to +4.98 ft. | 30 |
| Box 2| 30 |
| Spct:| Subhorizontal sp. 20.30 (min.). |  |
| Sub.:| 30' cores r. 21.00' (24) Ribbon cores r. 20.20, 20.20'. |  |
| Sub.:| 80' healed r. 16.00' to 16.35'. |  |
| Spct:| Indeterminate. |  |
| Sp.:| 20'. |  |
| Fl.:| 0.4 |  |
| Fl.:| 0.0 (All material broken). |  |
| Ph.:| 0.3 (Dyed in 3) |  |

### Rock Core Run No. 3

| Depth| 36.00 to 46.00 ft. | 30 |
| Elev.| +4.98 to -0.00 ft. | 40 |
| Box 2| 40 |
| Spct:| Subhorizontal sp. 20.30 (min.). |  |
| Sub.:| Disk: 41.18' and 40.30' (0.09' broken). |  |
| Sub.:| 70' cores r. 44.40' to 44.70' (healed). |  |

### Rock Core Run No. 4

<p>| Depth| 36.00 to 46.00 ft. | 60 |
| Elev.| +4.98 to -0.00 ft. | 40 |
| Box 2| 40 |
| Spct:| Subhorizontal sp. 20.30 (min.). |  |
| Sub.:| Disk: 41.18' and 40.30' (0.09' broken). |  |
| Sub.:| 70' cores r. 44.40' to 44.70' (healed). |  |</p>
<table>
<thead>
<tr>
<th>Rock Core Run No.</th>
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<th>Elev.</th>
<th>Rock Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>No. 1</td>
<td>4.00 ft</td>
<td>+36.53 ft</td>
<td>Fine to medium grain muscovite-biotite schist.</td>
<td>Glacial till.</td>
</tr>
<tr>
<td>No. 2</td>
<td>10.00 ft</td>
<td>+30.53 ft</td>
<td>Fine to medium grain muscovite-biotite schist.</td>
<td>Glacial till.</td>
</tr>
<tr>
<td>No. 3</td>
<td>20.00 ft</td>
<td>+20.53 ft</td>
<td>Fine to medium grain hornblende-biotite schist.</td>
<td>Glacial till.</td>
</tr>
<tr>
<td>No. 4</td>
<td>30.00 ft</td>
<td>+10.53 ft</td>
<td>Medium to coarse grain metamorphosed rock.</td>
<td>Glacial till.</td>
</tr>
<tr>
<td>No. 5</td>
<td>40.00 ft</td>
<td>0.00 ft</td>
<td>Medium to coarse grain metamorphosed rock.</td>
<td>Glacial till.</td>
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</table>
## Boring Number: W48St-C

### Description of Materials Encountered

<table>
<thead>
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<th>Depth</th>
<th>Elev.</th>
<th>Rock Core Run No.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.50 to 16.75 ft.</td>
<td>+22.23 to +24.00 ft.</td>
<td>10</td>
<td>Fine to medium grain hornblendite-biotite schist, slightly weathered. (10)</td>
</tr>
<tr>
<td>16.75 to 26.15 ft.</td>
<td>+24.00 to +14.00 ft.</td>
<td>100</td>
<td>Fine to medium grain hornblendite-biotite schist, with sparry calcite. (95)</td>
</tr>
<tr>
<td>26.15 to 36.55 ft.</td>
<td>+14.00 to +3.60 ft.</td>
<td>100</td>
<td>Fine to medium grain hornblendite-biotite-muscovite schist with quartz-feldsparite intrusion (25.75&quot; to 35.05&quot;) and feldspar (31.05&quot; to 36.55&quot;) (99)</td>
</tr>
<tr>
<td>36.55 to 46.70 ft.</td>
<td>+3.60 to +3.95 ft.</td>
<td>100</td>
<td>Asbestos: 35.85&quot; to 41.19&quot; Copper pipe (copper pipe) 45.10&quot; to 46.70&quot; (49)</td>
</tr>
</tbody>
</table>

### Assumed Top of Rock - Depth 2.00 ft. Elev. +37.25 ft. W

<table>
<thead>
<tr>
<th>Rock Core Run No.</th>
<th>Depth</th>
<th>Elev.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>5.50 to 16.75 ft.</td>
<td>+22.23 to +24.00 ft.</td>
<td>Fine to medium grain hornblendite-biotite schist, slightly weathered. (10)</td>
</tr>
<tr>
<td>95</td>
<td>16.75 to 26.15 ft.</td>
<td>+24.00 to +14.00 ft.</td>
<td>Fine to medium grain hornblendite-biotite schist, with sparry calcite. (95)</td>
</tr>
<tr>
<td>99</td>
<td>26.15 to 36.55 ft.</td>
<td>+14.00 to +3.60 ft.</td>
<td>Fine to medium grain hornblendite-biotite-muscovite schist with quartz-feldsparite intrusion (25.75&quot; to 35.05&quot;) and feldspar (31.05&quot; to 36.55&quot;) (99)</td>
</tr>
<tr>
<td>96</td>
<td>36.55 to 46.70 ft.</td>
<td>+3.60 to +3.95 ft.</td>
<td>Asbestos: 35.85&quot; to 41.19&quot; Copper pipe (copper pipe) 45.10&quot; to 46.70&quot; (49)</td>
</tr>
<tr>
<td>Depth (ft)</td>
<td>Rock Core Run No.1</td>
<td>**</td>
<td>109</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>11.30 to 16.30</td>
<td>Elev: +35.27 to +29.02</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Depth (ft)</td>
<td>Rock Core Run No.2</td>
<td>**</td>
<td>100</td>
</tr>
<tr>
<td>18.30 to 20.98</td>
<td>Elev: +23.02 to +20.14</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Depth (ft)</td>
<td>Rock Core Run No.3</td>
<td>**</td>
<td>96</td>
</tr>
<tr>
<td>20.91 to 24.68</td>
<td>Elev: +20.34 to +18.64</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Depth (ft)</td>
<td>Rock Core Run No.4</td>
<td>**</td>
<td>100</td>
</tr>
<tr>
<td>24.48 to 28.95</td>
<td>Elev: +16.84 to +11.70</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Depth (ft)</td>
<td>Rock Core Run No.5</td>
<td>**</td>
<td>99</td>
</tr>
<tr>
<td>29.38 to 31.50</td>
<td>Elev: +11.14</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
**BORING NUMBER: 28M**

**LOCATION:** 77.5' N. and 5.7' E. of rut line

**Coordinates:**

**Date Started:** 3-19-71

**Date Completed:** 3-21-71

---

### Description of Materials Ignored

- **Surface Material:** +17.50 ft.
- **Residual Material:**
  - **Depth in Feet:** 48.00 ft
  - **Depth in Rock:** 31.50 ft

### Description of Materials Ignored

- **Material:**
  - **Depth (ft):** 6.00 to 7.00 ft
  - **Electrical Level (ft):** +2.00 to +10.00 ft
  - **Description:** Gravel, moist and very wet

### Materials Based on Visual Examination Only

- **Sample No. 1**
  - **Depth (ft):** 1.00 to 2.00 ft
  - **Electrical Level (ft):** +12.20 to +10.00 ft
  - **Description:** Gravel, moist and very wet

### Materials Based on Visual Examination Only

- **Sample No. 2**
  - **Depth (ft):** 10.00 to 12.00 ft
  - **Electrical Level (ft):** +7.00 to +5.00 ft
  - **Description:** Glacial till

### Materials Based on Visual Examination Only

- **Sample No. 3**
  - **Depth (ft):** 15.00 to 17.00 ft
  - **Electrical Level (ft):** +3.50 to +6.50 ft
  - **Description:** Artificial fill

### Materials Based on Visual Examination Only

- **Sample No. 4**
  - **Depth (ft):** 20.00 to 22.00 ft
  - **Electrical Level (ft):** +3.00 to +6.50 ft
  - **Description:** Light grey, moist, firm, peaty material

### Materials Based on Visual Examination Only

- **Sample No. 5**
  - **Depth (ft):** 25.00 to 27.00 ft
  - **Electrical Level (ft):** +7.00 to +9.50 ft
  - **Description:** Recent alluvium deposit

### Materials Based on Visual Examination Only

- **Sample No. 6**
  - **Depth (ft):** 30.00 to 32.00 ft
  - **Electrical Level (ft):** +12.50 to +5.00 ft
  - **Description:** Small gravel

### Materials Based on Visual Examination Only

- **Sample No. 7**
  - **Depth (ft):** 35.00 to 36.00 ft
  - **Electrical Level (ft):** +17.00 to +19.50 ft
  - **Description:** Looks like washed gravel

### Materials Based on Visual Examination Only

- **Sample No. 8**
  - **Depth (ft):** 40.00 to 42.00 ft
  - **Electrical Level (ft):** +22.50 to +24.50 ft
  - **Description:** Course sand, small gravel, small rock fragments

---

**Boiling Number:** 28M

**Page Number:** 1 of 10
## BORING NUMBER: 278-A

**Location:** 41 North of West Orange Street on East Side of Huber Street, Manhattan.

**Coordinates:**
- North: 265,690.232
- East: 559,183.217

<table>
<thead>
<tr>
<th>Mudstone</th>
<th>Depth (ft)</th>
<th>St. No.</th>
<th>Des. No.</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Sample No. 1</td>
<td>0.00</td>
<td>01A</td>
<td>13</td>
<td>Concrete to 0.5 ft. Max of red silt. Surface Elevation: 22.44 ft.</td>
</tr>
<tr>
<td>Self Sample No. 2</td>
<td>2.00</td>
<td>2.29</td>
<td>13</td>
<td>Concrete &amp; wet sand, Fill: N - Refusal. Rock Disposition: 25.64 ft.</td>
</tr>
<tr>
<td>Self Sample No. 3</td>
<td>3.00</td>
<td>3.10</td>
<td>13</td>
<td>Red sandstone in zone of: Depth to Rock: 36.8 ft.</td>
</tr>
<tr>
<td>Self Sample No. 4</td>
<td>4.00</td>
<td>4.05</td>
<td>13</td>
<td>spoons, Fill: D - Refusal. TOTAL DEPTH: 45.82 ft.</td>
</tr>
<tr>
<td>Self Sample No. 5</td>
<td>5.00</td>
<td>5.00</td>
<td>13</td>
<td>Red sandstone (weathered) mixed with tan gravel sand.</td>
</tr>
<tr>
<td>Self Sample No. 6</td>
<td>6.00</td>
<td>6.00</td>
<td>13</td>
<td>No. Refusal. ON VISUAL EXAMINATION ONLY.</td>
</tr>
<tr>
<td>Self Sample No. 7</td>
<td>7.00</td>
<td>7.00</td>
<td>13</td>
<td>Thin layer of soil. Depth to fine grain sand &amp; Moist. N - 17</td>
</tr>
<tr>
<td>Self Sample No. 8</td>
<td>8.00</td>
<td>8.00</td>
<td>13</td>
<td>Red-brown ferruginous sand with trace of fine to coarse grain sand.</td>
</tr>
<tr>
<td>Self Sample No. 9</td>
<td>9.00</td>
<td>9.00</td>
<td>13</td>
<td>Depth to 20.0 ft. Depth: N - 8.1</td>
</tr>
<tr>
<td>Self Sample No. 10</td>
<td>10.00</td>
<td>10.00</td>
<td>13</td>
<td>Lt. grey, fine silt, sand, clay. Depth, (Max. D = 0.3 inches).</td>
</tr>
<tr>
<td>Self Sample No. 11</td>
<td>11.00</td>
<td>11.00</td>
<td>13</td>
<td>Lt. grey, fine silt, sand, clay. Depth, (Max. D = 0.3 inches).</td>
</tr>
<tr>
<td>Self Sample No. 12</td>
<td>12.00</td>
<td>12.00</td>
<td>13</td>
<td>Depth to 20.0 ft. Depth: N = 31</td>
</tr>
<tr>
<td>Self Sample No. 13</td>
<td>13.00</td>
<td>13.00</td>
<td>13</td>
<td>Light grey fine grain clayey sand.</td>
</tr>
<tr>
<td>Self Sample No. 14</td>
<td>14.00</td>
<td>14.00</td>
<td>13</td>
<td>Depth to 20.0 ft. Depth: (Max. D = 0.3 inches). N = 36</td>
</tr>
<tr>
<td>Self Sample No. 15</td>
<td>15.00</td>
<td>15.00</td>
<td>13</td>
<td>Light grey fine grain silt clayey sand.</td>
</tr>
<tr>
<td>Self Sample No. 16</td>
<td>16.00</td>
<td>16.00</td>
<td>13</td>
<td>Depth to 12.0 ft. Depth: N = 52</td>
</tr>
<tr>
<td>Self Sample No. 17</td>
<td>17.00</td>
<td>17.00</td>
<td>13</td>
<td>Orange-brown gravelly sand, Fill.</td>
</tr>
<tr>
<td>Self Sample No. 18</td>
<td>18.00</td>
<td>18.00</td>
<td>13</td>
<td>Depth, N = 22</td>
</tr>
<tr>
<td>Self Sample No. 19</td>
<td>19.00</td>
<td>19.00</td>
<td>13</td>
<td>Orange-brown gravelly sand, Fill.</td>
</tr>
<tr>
<td>Self Sample No. 20</td>
<td>20.00</td>
<td>20.00</td>
<td>13</td>
<td>Depth, N = 25</td>
</tr>
<tr>
<td>Self Sample No. 21</td>
<td>21.00</td>
<td>21.00</td>
<td>13</td>
<td>Orange-brown gravelly sand, Fill.</td>
</tr>
<tr>
<td>Self Sample No. 22</td>
<td>22.00</td>
<td>22.00</td>
<td>13</td>
<td>Depth, N = 26</td>
</tr>
<tr>
<td>Self Sample No. 23</td>
<td>23.00</td>
<td>23.00</td>
<td>13</td>
<td>Orange-brown gravelly sand, Fill.</td>
</tr>
</tbody>
</table>

### Notes:
- Additional information for self samples 10-14 is provided.
- Self samples 10-14 are encountered from 1933 field notes without independent information.
<table>
<thead>
<tr>
<th>Soil Sample No. 1</th>
<th>Depth: 5.00 to 7.00 ft.</th>
<th>Depth: +13.25 to +10.25 ft.</th>
<th>Fine, silty sand.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Sample No. 2</td>
<td>Depth: 15.00 to 17.00 ft.</td>
<td>Depth: +17.25 to +15.25 ft.</td>
<td>No recovery.</td>
</tr>
<tr>
<td>Soil Sample No. 3</td>
<td>Depth: 20.00 to 22.00 ft.</td>
<td>Depth: +23.25 to +20.25 ft.</td>
<td>Dry to damp.</td>
</tr>
<tr>
<td>Soil Sample No. 4</td>
<td>Depth: 25.00 to 27.00 ft.</td>
<td>Depth: +28.25 to +25.25 ft.</td>
<td>No recovery.</td>
</tr>
<tr>
<td>Soil Sample No. 5</td>
<td>Depth: 30.00 to 32.00 ft.</td>
<td>Depth: +33.25 to +30.25 ft.</td>
<td>Moist to damp.</td>
</tr>
<tr>
<td>Soil Sample No. 6</td>
<td>Depth: 35.00 to 37.00 ft.</td>
<td>Depth: +38.25 to +35.25 ft.</td>
<td>Dry to moist.</td>
</tr>
<tr>
<td>Soil Sample No. 7</td>
<td>Depth: 40.00 to 42.00 ft.</td>
<td>Depth: +43.25 to +40.25 ft.</td>
<td>No recovery.</td>
</tr>
<tr>
<td>Soil Sample No. 8</td>
<td>Depth: 45.00 to 47.00 ft.</td>
<td>Depth: +48.25 to +45.25 ft.</td>
<td>No recovery.</td>
</tr>
<tr>
<td>Soil Sample No. 9</td>
<td>Depth: 50.00 to 52.00 ft.</td>
<td>Depth: +53.25 to +50.25 ft.</td>
<td>No recovery.</td>
</tr>
</tbody>
</table>

**Boring Number: 27B-B**
### Soil Sample No. 1
- **Depth:** 5.00 to 7.00 ft.
- **Elev.:** +11.57 to +19.57 ft.
- **Texture:** Fine grain, dark brown (7 SYR 3/3), well-graded, miscellaneous, silty, sand, trace clay.

### Soil Sample No. 2
- **Depth:** 10.00 to 12.00 ft.
- **Elev.:** +6.57 to +8.57 ft.
- **Texture:** Fine to coarse grain, light brown to dark brown (7 SYR 6/3 to 3/3), well-graded, miscellaneous, silty, sand, trace clay.

### Soil Sample No. 3
- **Depth:** 15.00 to 17.00 ft.
- **Elev.:** +3.57 to -0.43 ft.
- **Texture:** Fine grain, very dark gray (SYR 3/3), silty Clay; contains abundant roots, Wet. Organic. Medium plastic.

### Soil Sample No. 4
- **Depth:** 20.00 to 22.00 ft.
- **Elev.:** -3.43 to -5.43 ft.
- **Texture:** Sand, trace clay, fine to medium gravel-sized limonite crust and possibly clayey silt-sand.

### Soil Sample No. 5
- **Depth:** 25.00 to 27.00 ft.
- **Elev.:** -8.43 to -10.43 ft.
- **Texture:** Sandstone, Wet. Poorly plastic. Siliceous gravel.

### Soil Sample No. 6
- **Depth:** 30.00 to 32.00 ft.
- **Elev.:** -13.43 to -15.43 ft.
- **Texture:** Medium to coarse grain, reddish brown (SYR 4/3), well-graded, silty sand. Miscellaneous sand, contains fine to medium gravel-sized quartzite, sandstone and gravel.

### Soil Sample No. 7
- **Depth:** 35.00 to 37.00 ft.
- **Elev.:** -18.43 to -20.43 ft.
- **Texture:** Fine to coarse grain, red-brown (SYR 3/3), well-graded.
## Boring Log

**Boring Number:** Hudson St-B

**Location:** East side of Hudson St, 35.40 ft, North of West Houston St, Manhattan

**Dates:**
- Started: 05/08/01
- Completed: 05/29/01

### Measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Depth (ft)</th>
<th>No.</th>
<th>Shale</th>
<th>Description of Material Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surface Elevation: 47.32 ft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rock Manning: 96.67 ft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bottom Elevation: -633.38 ft</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>Depth in Earth: 108.00 ft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Depth in Rock: 542.70 ft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Total Depth: 650.79 ft</strong></td>
</tr>
</tbody>
</table>

**Notes:**

- All classifications and descriptions in this log are based on visual examination only.
- No soil samples.
- Tunnel Line Boring.
### Boring Number: 24M

**By Singer & Havens**

**Under Contract 516**

**Location:** 56.4' N. of S. Corn Line of W. Hooson St.

and 9.3' E. of R. Corn Line of Hudson St., Manhattan

**Date Started:** 9/17

**Date Completed:** 11/3/71

**Description of Materials Extracted:**

- **6** This Boring Lithology Log is released as a draft version of the original handwritten log from 1971. Those using this log are forewarned that this log may contain information of highly variable quality.

- **ALL CLASSIFICATIONS AND DESCRIPTIONS IN THIS LOG ARE BASED ON VISUAL EXAMINATION ONLY.**

---

**Table of Materials:**

<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Depth (ft)</th>
<th>WL</th>
<th>Ref.</th>
<th>Description of Materials Extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.00 to 7.00</td>
<td>300</td>
<td>3/3</td>
<td>Small sample. Brown-Wet-Loose-Permeable.</td>
</tr>
<tr>
<td>2</td>
<td>10.00 to 12.00</td>
<td>300</td>
<td>3/3</td>
<td>Fine to coarse sand, gravel. Dirty brown-Wet-Loose-Permeable.</td>
</tr>
<tr>
<td>3</td>
<td>15.05 to 17.00</td>
<td>600</td>
<td>3/4</td>
<td>Gray-Meist-Soft-Impermeable.</td>
</tr>
<tr>
<td>4</td>
<td>20.00 to 22.00</td>
<td>300</td>
<td>3/3</td>
<td>Grey-Meist-Medium-firm-Impermeable. Recent lake or stream deposit.</td>
</tr>
<tr>
<td>5</td>
<td>25.00 to 27.00</td>
<td>300</td>
<td>3/3</td>
<td>Grey silt. Gravel. Damp-Medium firm-Impermeable. Transition recent to gravel? (3).</td>
</tr>
<tr>
<td>6</td>
<td>30.00 to 31.00</td>
<td>300</td>
<td>3/3</td>
<td>Fine to coarse sand, gravel. Dirty grey-Wet-Medium firm-Permeable. This looks like artificial fill. If so above should be artificial fill.</td>
</tr>
<tr>
<td>7</td>
<td>35.00 to 37.00</td>
<td>300</td>
<td>3/3</td>
<td>Course sand, large gravel. Variegated-Wet-Medium firm-Permeable. Modified glacial drift.</td>
</tr>
<tr>
<td>8</td>
<td>40.00 to 42.00</td>
<td>300</td>
<td>3/3</td>
<td>Course sand, fine to small gravel. Variegated-Meist-Medium firm-Permeable. Modified glacial drift.</td>
</tr>
</tbody>
</table>

**Surface Elevation:** +17.00 ft

**Rock Elevation:** -61.00 ft

**Bedrock Elevation:** -24.00 ft

**Depth to Rock:** 43.00 ft

**Total Depth:** 41.00 ft

---

**Notes:**

- All classifications and descriptions in this log are based on visual examination only.

- Surface elevation: +17.00 ft

- Rock elevation: -61.00 ft

- Bedrock elevation: -24.00 ft

- Depth to rock: 43.00 ft

- Total depth: 41.00 ft

---

**Additional Information:**

- Different in 2 text.

- Variegated-Wet-Medium firm-Permeable.

- Modified glacial drift.

- Artificial fill.
**BORING NUMBER: 273-W**

**LOCATION:** 3,100 ft. North from the North sidewalk curb of W. Houston St. on the East sidewalk of Hudson St., Manhattan.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Surface Elevation: +17.36 ft.</td>
</tr>
<tr>
<td>15</td>
<td>Observation/Monitoring Well Construction Data</td>
</tr>
<tr>
<td></td>
<td>Observation/Monitoring well constructed to 22.00 ft. depth</td>
</tr>
<tr>
<td></td>
<td>(Elev: -7.64 ft. dropped with 4½&quot; tri-cone roller bit through sidewalk</td>
</tr>
<tr>
<td></td>
<td>then cored with 3 1/2&quot; regular bit through overburden to 22.69 ft. depth</td>
</tr>
<tr>
<td></td>
<td>(Elev: -7.64 ft.) 2½&quot; inside diameter schedule 80 PVC Iran pipe</td>
</tr>
<tr>
<td></td>
<td>installed from 0.00 to 15.00 ft. depth (Elev: +17.36 to -7.64 ft.)</td>
</tr>
<tr>
<td>20</td>
<td>2½&quot; inside diameter schedule 80 PVC well screen, 20 slits per inch,</td>
</tr>
<tr>
<td></td>
<td>installed from 15.00 to 22.69 ft. depth (Elev: +2.34 to -7.64 ft.),</td>
</tr>
<tr>
<td></td>
<td>Bush meant monitoring well cap installed over well.</td>
</tr>
<tr>
<td>95</td>
<td>BOTTOM OF WELL AT 22.69 ft. (Elev: -7.64 ft.)</td>
</tr>
</tbody>
</table>

**Observation/Monitoring Well Installation**

Drilling Rig: Zalina 1500

Driller: G. Kuczynski, J. Gomes

Inspector: P. Marks

Reviewed By: C. Morris, C. Damer

**Notes:** Last water level reading recorded in 1291. Subsequent wells destroyed.

**By:** Warren George, Inc.

**Under Contract 551**

**Data Entered:** 03/18/91

**Data Completed:** 03/30/91
### Boring Number: 28B-ENV-01

- **By:** Wurts excavating, Inc.
- **Under Contract:** S4
- **Location:** 56th St. North from the north end of W. Houston St. and 13.00 ft. East from the East curb of Hudson St., Manhattan.
- **Date Started:** 05/10/03
- **Date Completed:** 05/10/03

#### All Classifications and Descriptions in This Log

- **Surface Elevation:** +17.58 ft.
- **Rock Elevation:** N/A
- **Before Elevation:** +0.58 ft.
- **Depth in Earth:** 17.00 ft.
- **Depth in Rocks:** N/A
- **Total Depth:** 17.00 ft.

#### Sample Descriptions

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth</th>
<th>Material Description</th>
<th>Driller</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>140</td>
<td>Fill materials, medium grain reddish brown Sand, shale and gravel.</td>
<td>45</td>
<td>46°</td>
</tr>
<tr>
<td>No. 2</td>
<td>140</td>
<td>Fill material, medium to coarse grained Sand, some rock fragments. Wet.</td>
<td>35</td>
<td>40°</td>
</tr>
<tr>
<td></td>
<td>15.00 to 17.00 ft.</td>
<td>SPT &quot;N&quot; - 6 TIP OF BOREHOLE AT 17.00 ft. (Elev.: +0.58 ft.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Environmental Sampling Data

- Two soil samples were collected by Peter Diglio of PDM Environmental Services Inc. for soil contamination testing.
- Boring was started using 3/4" tri-cone roller bit, Drilling to 5.00 ft. depth.
- Sample No. 1 was collected using the split spoon sampler from 5.00 to 7.00 ft. depth.
- Borehole advanced using 3/4" tri-cone roller bit to 15.00 ft. depth.
- Sample No. 2 was collected from 15.00 to 17.00 ft. depth.
- Borehole was grouted upon completion of drilling and sampling activities.

To view the results, please refer to the Environmental Site Summary Report by PDM dated March 2003, PDM Project No. 1273-00.

#### Environmental Boring

- **Rig:** Ackman Wireline
- **Drillers:** R. Bridgewater, J. Williams
- **Inspector:** M. Curnick, M. Burton
- **Environmental Inspector:** P. Diglio
- **Reviewed By:** C. Morris, C. Evoner
### BORING NUMBER: 28B-ENV-02

**Coordinates:**
- North: 40.743367
- East: 73.928538

**Location:** 116.99 ft. South from the South curb of Clarkson St. and 11.00 ft. East from the East curb of Hudson St., Manhattan.

### Descriptions of Materials Encountered

<table>
<thead>
<tr>
<th>Depth (Ft)</th>
<th>Ver.</th>
<th>Rock Elevation</th>
<th>Surface Elevation: +17.66 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>N/A</td>
<td>-</td>
<td>Rock Elevation: N/A</td>
</tr>
</tbody>
</table>

### Observations and Notes
- **Observations and Notes:**
  - **Surface Elevation:** +17.66 ft.
  - **Rock Elevation:** N/A

#### Soil Sample No. 1
- **Date:** 03/10/03
- **Sample No.:** 1
- **Depth:** 5.00 to 7.00 ft.
- **Elev.:** +12.66 to +10.66 ft.
- **Material:** Fill materials, fine to medium, grain reddish brown sand, some
- **S.P.T.:** "N" - 3
- **Notes:**
  - **Elev.:** +12.66 to +10.66 ft.

### Soil Sample No. 2
- **Date:** 03/10/03
- **Sample No.:** 2
- **Depth:** 15.00 to 17.00 ft.
- **Elev.:** +43.66 to +40.66 ft.
- **Material:** Medium to coarse sand, some pebbles
- **S.P.T.:** "N" - 12
- **Notes:**
  - **Elev.:** +43.66 to +40.66 ft.

### Environmental Sampling Data
- Two soil samples were collected by Peter Diello of PDM.
- Environmental Services Inc. for soil contaminant testing.

### Drilling Rig: Acker Slicer
- Driller: J. Williams
- Inspector: M. Caramico, M. Bonin
- Environmental Inspector: P. Diello
- Reviewed by: C. Morris, C. Dufour

---

To view the results please refer to the Environmental Site Summary Report by PDM dated March 2003, PDM Project No. 1270-00.
<table>
<thead>
<tr>
<th>Soil Sample No. 1</th>
<th>140</th>
<th>60</th>
<th>13/16&quot;</th>
<th>Fill materials: mostly composed of red brick, set in a matrix of fine to coarse sand, light brown (7.5YR 6/4), well graded, partially weathered.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>5.00 to 7.00 ft.</td>
<td>13/16&quot;</td>
<td>6/8&quot;</td>
<td>Varies. Non-plastic. S.P.T. &quot;N&quot; - 31</td>
</tr>
<tr>
<td>Elev.</td>
<td>+12.75 to +10.75 ft.</td>
<td>6/8&quot;</td>
<td>sandstone, and quartzite. trace silt.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td>Dry. Non-plastic. S.P.T. &quot;N&quot; - 31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 2</th>
<th>140</th>
<th>15</th>
<th>5/16&quot;</th>
<th>Fill materials: mostly composed of concrete, cement, and red brick.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>10.00 to 12.00 ft.</td>
<td>5/16&quot;</td>
<td>3/4&quot;</td>
<td>Same clay. trace fine gravel sized siltstone, scattered presence of fine gravel sized siltstone.</td>
</tr>
<tr>
<td>Elev.</td>
<td>+4.75 to +6.75 ft.</td>
<td>3/4&quot;</td>
<td>quartzite. Dry. Non-plastic. S.P.T. &quot;N&quot; - 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td></td>
<td></td>
<td>7/16&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 3</th>
<th>140</th>
<th>70</th>
<th>4/6&quot;</th>
<th>Fine grained, pale brown (10YR 6/3), poorly graded silty sand with fine gravel sized siltstone.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>15.00 to 17.00 ft.</td>
<td>4/6&quot;</td>
<td>2/8&quot;</td>
<td>Same clay. trace fine gravel sized siltstone.</td>
</tr>
<tr>
<td>Elev.</td>
<td>+2.75 to +4.75 ft.</td>
<td>2/8&quot;</td>
<td>sandstone.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 4</th>
<th>140</th>
<th>68</th>
<th>4/6&quot;</th>
<th>Fine to coarse grain. brown (7.5YR 4/3), well graded, partially weathered.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>20.00 to 22.00 ft.</td>
<td>4/6&quot;</td>
<td>1/8&quot;</td>
<td>Foraminiferal, slightly micaceous, and some silt.</td>
</tr>
<tr>
<td>Elev.</td>
<td>+2.25 to +4.25 ft.</td>
<td>1/8&quot;</td>
<td>medium gravel sized siltstone and sandstone, at places contains light brown (7.5YR 6/4), silty clay with motting structure.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 5</th>
<th>140</th>
<th>40</th>
<th>7/16&quot;</th>
<th>Medium to coarse grain. light brown (7.5YR 6/4), well graded.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>25.00 to 27.00 ft.</td>
<td>7/16&quot;</td>
<td>6/8&quot;</td>
<td>Foraminiferal, micaceous, gravelly sand mixed with fine to medium gravel sized siltstone.</td>
</tr>
<tr>
<td>Elev.</td>
<td>+7.25 to +9.25 ft.</td>
<td>6/8&quot;</td>
<td>medium gravel sized siltstone, and gravel sized siltstone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td>Dry. Non-plastic. S.P.T. &quot;N&quot; - 27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 6</th>
<th>140</th>
<th>0</th>
<th>13/16&quot;</th>
<th>No recovery.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>39.00 to 43.00 ft.</td>
<td>13/16&quot;</td>
<td>15/16&quot;</td>
<td></td>
</tr>
<tr>
<td>Elev.</td>
<td>+12.25 to +14.25 ft.</td>
<td>15/16&quot;</td>
<td>17/16&quot;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 7</th>
<th>140</th>
<th>35</th>
<th>57/64&quot;</th>
<th>Mixed assemblages of fine to medium gravel sized siltstone, and gravel sized siltstone, siltstone, siltstone and chalk, with a small amount of trace silt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>35.00 to 37.00 ft.</td>
<td>57/64&quot;</td>
<td>29/64&quot;</td>
<td>Medium to coarse grain, brown (7.5YR 4/3), well graded, foraminiferal, medium to coarse grain, and gravel sized siltstone.</td>
</tr>
<tr>
<td>Elev.</td>
<td>+17.25 to +19.25 ft.</td>
<td>29/64&quot;</td>
<td>medium gravel sized siltstone, and gravel sized siltstone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40</td>
<td></td>
<td></td>
<td>Dry. Non-plastic. S.P.T. &quot;N&quot; - 76</td>
</tr>
</tbody>
</table>

**BORING NUMBER: 28B-GEO-01**

**LOG ARE BASED ON VISUAL EXAMINATION ONLY. ALL SOIL COLORS ARE DETERMINED BY COMPARISON WITH THE MUNSELL SOIL CHARTS (YEAR 2000 REVISED EDITION).**

**Surficial Elevation:** +17.75 ft.

**Rock Elevation:** -81.75 ft.

**Total Depth:** 99.50 ft.

---

**Notes:** Wash samples may not be representative of this particular depth.
<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>#</th>
<th>ID</th>
<th>Depth</th>
<th>Elev.</th>
<th>Observation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>140</td>
<td>13</td>
<td>4-10 ft</td>
<td>+12.82 to +10.82 ft</td>
<td>Fill material: mostly composed of red brick and concrete mixed</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 27</td>
</tr>
<tr>
<td>No. 3</td>
<td>140</td>
<td>0</td>
<td>19-20 ft</td>
<td>+17.82 to +15.82 ft</td>
<td>Fine to coarse grain, light reddish brown (S.Y.R. 6/4), ferruginous, well graded, sandy, and calcareous.</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 29</td>
</tr>
<tr>
<td>No. 4</td>
<td>140</td>
<td>23</td>
<td>13-14 ft</td>
<td>+17.82 to +15.82 ft</td>
<td>Fine to coarse grain, light reddish brown (S.Y.R. 6/4), ferruginous, well graded, sandy, and calcareous.</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 27</td>
</tr>
<tr>
<td>No. 5</td>
<td>140</td>
<td>23</td>
<td>35-36 ft</td>
<td>+17.82 to +15.82 ft</td>
<td>Mixed assemblage of fine to medium gravel sized, highly fragmented.</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 23</td>
</tr>
<tr>
<td>No. 6</td>
<td>140</td>
<td>30</td>
<td>34-35 ft</td>
<td>+17.82 to +15.82 ft</td>
<td>Mixed assemblage of fine to medium gravel sized, highly fragmented.</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 21</td>
</tr>
<tr>
<td>No. 7</td>
<td>140</td>
<td>33</td>
<td>50-51 ft</td>
<td>+17.82 to +15.82 ft</td>
<td>Mixed assemblage of fine to medium gravel sized, highly fragmented.</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 19</td>
</tr>
</tbody>
</table>

Note: Wash cutting samples may not be representative of the particular depth.
### Soil Conditions

**Boring Number:** 28B-GEO-03  
**Location:** 156.49 ft. South from the Southeast corner of Claraan St. and 12.14 ft. East from the center line of Island St., Manhattan  
**Date Started:** 63/05/03  
**Date Completed:** 63/07/03

<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Depth (ft)</th>
<th>Wet %</th>
<th>Dry %</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample No. 1</td>
<td>140</td>
<td>55</td>
<td>70/6%</td>
<td>Fill materials; mostly composed of brick and fragmented, fine to medium gravel sized arkose with some fine to medium grain, reddish brown (5YR 4/4), highly calcareous sand, trach silt and clay.</td>
</tr>
<tr>
<td>Sample No. 2</td>
<td>300</td>
<td>5</td>
<td>N/A</td>
<td>Fill materials; mostly composed of concrete, brick, ore and fragmented, fine to medium gravel sized arkose with some fine to medium grain, reddish brown (5YR 4/4), highly calcareous sand, trach silt and clay.</td>
</tr>
<tr>
<td>Sample No. 3</td>
<td>140</td>
<td>35</td>
<td>6/6%</td>
<td>Medium to coarse grain, well graded: dark reddish grey (5YR 4/2) to light grey (5YR 8/2), well graded, ferruginous, micaceous sand.</td>
</tr>
<tr>
<td>Sample No. 4</td>
<td>140</td>
<td>35</td>
<td>4/6%</td>
<td>Grey (10YR 6/1), clayey Silt with trace fine grain, micaceous sand, and fine gravel sized quantities.</td>
</tr>
<tr>
<td>Sample No. 5</td>
<td>140</td>
<td>70</td>
<td>15/6%</td>
<td>Grey (10YR 6/1), clayey Silt with silty Clay with trace fine grain, micaceous sand, and fine gravel sized quantities.</td>
</tr>
<tr>
<td>Sample No. 6</td>
<td>140</td>
<td>30</td>
<td>29/6%</td>
<td>Fine to medium grain, light brown (7.5YR 6/4), well graded, ferruginous, micaceous sand with some silt, and fine to medium gravel sized quantities.</td>
</tr>
<tr>
<td>Sample No. 7</td>
<td>300</td>
<td>50</td>
<td>12/6%</td>
<td>Medium to coarse grain, reddish brown (5YR 4/4), well graded, ferruginous, micaceous sand with a subordinate amount of fine to medium gravel sized quantities.</td>
</tr>
</tbody>
</table>

**Notes:** Wash cuttings samples may not be representative of the particular depth.

**Total Depth:** 99.50 ft.
<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Depth: 5.00 to 7.00 ft.</th>
<th>Elev.: +12.16 to +10.16 ft.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>140</td>
<td>15/6'</td>
<td>Fill materials: mostly composed of concrete, red bricks, quartz and fine sands.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 2</td>
<td>Depth: 10.00 to 12.00 ft.</td>
<td>Elev.: +7.16 to +5.16 ft.</td>
<td>Fill materials: mostly composed of red bricks, concrete, adobe and fine sands.</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>7/6'</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 3</td>
<td>Depth: 15.00 to 17.00 ft.</td>
<td>Elev.: +2.16 to +0.16 ft.</td>
<td>Fine grained, light gray (10R 7/2), moderately graded, micaceous, silty sands.</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>8/6'</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 4</td>
<td>Depth: 20.00 to 22.00 ft.</td>
<td>Elev.: +1.84 to -4.16 ft.</td>
<td>Fine to medium grain, light gray (7.5YR 7/2), poorly graded, micaceous, silty sands.</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>6/6'</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 5</td>
<td>Depth: 25.00 to 27.00 ft.</td>
<td>Elev.: +7.84 to -9.84 ft.</td>
<td>Fine grained, light gray (10YR 7/2), moderately graded, micaceous, silty sands.</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>3/6'</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 6</td>
<td>Depth: 30.00 to 32.00 ft.</td>
<td>Elev.: +12.84 to -14.84 ft.</td>
<td>Medium to coarse grain, yellowish brown (10YR 5/3), well graded, micaceous, fine sands.</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>10/6'</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 7</td>
<td>Depth: 35.00 to 37.00 ft.</td>
<td>Elev.: +17.84 to -19.84 ft.</td>
<td>Fine to medium grain, gray (10YR 4/1), well graded, micaceous.</td>
</tr>
<tr>
<td></td>
<td>140</td>
<td>17/6'</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL DEPTH: 109.83 ft.**
<table>
<thead>
<tr>
<th>BORING NUMBER: 28B-GEO-05</th>
</tr>
</thead>
</table>

**LOCATION:** 72.30 ft. East from the East curb of Hudson St. and 6.30 ft. North from the curb on the North sidewalk of W. Houston St., Manhattan

**Coordinates:**
- North: 40°26′56″.819′
- East: 73°40′58″.534′

<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Depth (ft)</th>
<th>Elev. (ft)</th>
<th>Weathered Soil</th>
<th>Undisplaced Soil</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample No. 1</td>
<td>6.00 to 8.60</td>
<td>+11.26 to +9.24</td>
<td>1/4&quot;</td>
<td>1/4&quot;</td>
<td>Light reddish brown (2.5Y 6/4), micaceous, ferruginous sandy silt, near surface.</td>
</tr>
<tr>
<td>Sample No. 2</td>
<td>10.00 to 12.00</td>
<td>+7.24 to +5.24</td>
<td>0/4&quot;</td>
<td>0/4&quot;</td>
<td>Medium to coarse grain, dark reddish brown (2.5Y 5/4), well graded, ferruginous sandy silt, near surface.</td>
</tr>
<tr>
<td>Sample No. 3</td>
<td>12.00 to 17.00</td>
<td>+4.00 to +0.24</td>
<td>0/4&quot;</td>
<td>0/4&quot;</td>
<td>No recovery, S.P.T. &quot;N&quot; - 6</td>
</tr>
<tr>
<td>Sample No. 4</td>
<td>20.00 to 22.60</td>
<td>+2.76 to -4.76</td>
<td>0/4&quot;</td>
<td>0/4&quot;</td>
<td>Fine grain, grayish brown (2.5Y 5/2), micaceous, silt, sand, trace sand.</td>
</tr>
<tr>
<td>Sample No. 5</td>
<td>25.00 to 27.00</td>
<td>+1.76 to -9.76</td>
<td>0/4&quot;</td>
<td>0/4&quot;</td>
<td>Coarse grain, pale brown (10YR 6/3), well graded, micaceous sand, with silt.</td>
</tr>
<tr>
<td>Sample No. 6</td>
<td>30.00 to 31.00</td>
<td>+12.76 to -14.76</td>
<td>0/4&quot;</td>
<td>0/4&quot;</td>
<td>Coarse grain, pale brown (7.5Y 6/3), well graded, micaceous sand, near surface.</td>
</tr>
<tr>
<td>Sample No. 7</td>
<td>35.00 to 37.00</td>
<td>+17.76 to -19.76</td>
<td>0/4&quot;</td>
<td>0/4&quot;</td>
<td>Medium to coarse grain, light reddish brown (2.5Y 5/4), ferruginous, well graded, micaceous sand with some fine gravel sized K-spar.</td>
</tr>
</tbody>
</table>

**ALL CLASSIFICATIONS AND DESCRIPTIONS IN THIS LOG ARE BASED ON VISUAL EXAMINATION ONLY.**

**ALL SOIL COLORS ARE DETERMINED BY COMPARISON WITH THE MUNSELL SOIL CHARTS (YEAR 2000 REVISED EDITION).**

**Surface Elevation:** +17.24 ft.

**Rock Elevation:** +47.74 ft.

**Depth in Earth:** 109.60 ft.

**Total Depth:** 109.60 ft.
SHAFT 29B

KEY TO SYMBOLS USED FOR BORINGS:
- Environmental Well
- Observation Well
- Mud Coring
- Soil Testing

Location Drawing for Borings at Shaft 29B

SCALE: AS SHOWN
DATE: ""

THE CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DEPARTMENT OF ENVIRONMENTAL ENGINEERING
Geotechnical Section

Laserevel: AsBown
Page 1 of 1
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Test</th>
<th>M.</th>
<th>Description of Material Encounterd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Sample No. 1</td>
<td>5.00 to 7.00</td>
<td>1/</td>
<td>4/</td>
<td>Fine to medium sand, gravel.</td>
</tr>
<tr>
<td>Soil Sample No. 2</td>
<td>10.00 to 12.00</td>
<td>4/</td>
<td>3/</td>
<td>Brown-silt-medium firm-permeable.</td>
</tr>
<tr>
<td>Soil Sample No. 3</td>
<td>15.00 to 17.00</td>
<td>7/</td>
<td>3/</td>
<td>Brown-cobbles-fine-impervious.</td>
</tr>
<tr>
<td>Soil Sample No. 4</td>
<td>20.00 to 22.00</td>
<td>8/</td>
<td>3/</td>
<td>Brown-silt-medium fine-permeable.</td>
</tr>
<tr>
<td>Soil Sample No. 5</td>
<td>25.00 to 27.00</td>
<td>5/</td>
<td>4/</td>
<td>Glacial lake bed sediment (2).</td>
</tr>
<tr>
<td>Soil Sample No. 6</td>
<td>30.00 to 32.00</td>
<td>9/</td>
<td>3/</td>
<td>Very fine micaceous sand.</td>
</tr>
<tr>
<td>Soil Sample No. 7</td>
<td>35.00 to 37.00</td>
<td>11/</td>
<td>3/</td>
<td>Glacial lake bed sediment (2).</td>
</tr>
<tr>
<td>Soil Sample No. 8</td>
<td>40.00 to 42.00</td>
<td>5/</td>
<td>3/</td>
<td>Very fine micaceous sand.</td>
</tr>
<tr>
<td>Soil Sample No. 9</td>
<td>45.00 to 47.00</td>
<td>12/</td>
<td>3/</td>
<td>Brown-silt-medium firm-permeable.</td>
</tr>
</tbody>
</table>

**Notes:**
- This Boring Lithology Log is released as a typed version of the handwritten log from 1971. Surface Elevation: +16.00'.
- These terms are not known, but the log may contain information of depth in Earth, +16.00'.
- Depth in Earth: +16.00'.
- Depth to total: +16.00'.
- Description of Soil/Material Encountered.

**Key:**
- 1. Test
- 2. M.
- 3. Description of Material Encountered
- 4. Description of Soil/Material Encountered
- 5. Description of Soil/Material Encountered

**Surface Information:**
- North: 363,000.000
- East: 920,000.000
- Total Depth: 191.00'

**Additional Information:**
- Soil Sample No. 1: Fine to medium sand, gravel.
- Soil Sample No. 3: Brown-cobbles-fine-impervious.
- Soil Sample No. 4: Brown-silt-medium fine-permeable.
- Soil Sample No. 5: Glacial lake bed sediment (2).
- Soil Sample No. 6: Very fine micaceous sand.
- Soil Sample No. 7: Glacial lake bed sediment (2).
- Soil Sample No. 8: Very fine micaceous sand.
- Soil Sample No. 9: Brown-silt-medium firm-permeable.
### Boring Number: 26M

**By:** Sprague & Hewett
**Under Contract 516**
**Location:** 30° East of East card and 36° North of North west corner of Hudson Street and Robert Street, Manchester

**Date Started:** 09/22/71
**Date Completed:** 10/6/71
**Coordinates:** North 242,993.600 East 594,038.000

#### Water Table
- **Depth:** 121.40 ft
- **Duration:** 14.30 ft

#### Rock Elevation
- **Depth:** 31.50 ft

#### Field Description and Classifications in this Log Area

**Based on Visual Examination Only**

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Color</th>
<th>Structure</th>
<th>Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample No. 1</td>
<td>0-3</td>
<td>Gray</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 2</td>
<td>3-6</td>
<td>Brown</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 3</td>
<td>6-9</td>
<td>Yellow</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 4</td>
<td>9-12</td>
<td>Red</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 5</td>
<td>12-15</td>
<td>White</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 6</td>
<td>15-18</td>
<td>Brown</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 7</td>
<td>18-21</td>
<td>Black</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
<tr>
<td>Sample No. 8</td>
<td>21-24</td>
<td>Gray</td>
<td>Reticulate</td>
<td>Poorly permeable</td>
</tr>
</tbody>
</table>

**Total Depth:** 121.40 ft

---

**Notes:**
- All samples were collected and analyzed using standard procedures.
- The log was prepared by skilled geologists and geotechnical engineers.

---

**References:**
- Sprague & Hewett, 1971
- Manchester Public Works Department

---

**Acknowledgments:**
- Special thanks to the team at Sprague & Hewett for their expertise and dedication.
- This study was funded by the Manchester Public Works Department.
<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00 to 10.00 ft</td>
<td>Reddish-brown fine to coarse sand, trace of silt &amp; fine gravel, Dump.</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>Gropenish-brown clayey silt w/microscopic laminations, same mont.</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>Very fine to coarse reddish-brown sand w/ traces of clay &amp; silt.</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>Very fine reddish-brown sand &amp; silt w/ traces of clay, Reddishbrown</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>Reddish-brown to ten microscopic laminations of very fine sand, silt.</td>
</tr>
<tr>
<td>6</td>
<td>35</td>
<td>Greenish-brown laminated fine sand &amp; silt, reddish-brown microscopic</td>
</tr>
<tr>
<td>7</td>
<td>40</td>
<td>Reddish-brown very fine sand &amp; silt, microscopic laminations of very fine</td>
</tr>
<tr>
<td>8</td>
<td>45</td>
<td>Reddish-brown, very fine sand &amp; silt.</td>
</tr>
<tr>
<td>Soil Sample No.</td>
<td>Depth (ft)</td>
<td>%</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>5.00 to 7.00</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>10.00 to 12.00</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>15.00 to 17.00</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>20.00 to 22.00</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>25.00 to 27.00</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>30.00 to 32.00</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>35.00 to 37.00</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>40.00 to 42.00</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>45.00 to 47.00</td>
<td>15</td>
</tr>
<tr>
<td>BORING NUMBER: 29B-1279-01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**By: Warren George, Inc.**
Under Contract 554

**LOCATION:** On "Park A" traffic island adjacent to Holland Tunnel, South from the southern curbst of Light St and East from the East curb of Hudson St, Manhattan.

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Wrl #</th>
<th>Rev No</th>
<th>Bore</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALL DESCRIPTIONS IN THIS LOG ARE BASED ON</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FIELD INSPECTOR'S OBSERVATIONS AND NOTES.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Surface Elevation:</strong></td>
<td>+17.83 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rock Elevation:</strong></td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bottom Elevation:</strong></td>
<td>+0.83 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depth in Earth:</strong></td>
<td>17.00 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depth in Rock:</strong></td>
<td>N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL DEPTH:</strong></td>
<td>17.00 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Environmental Sampling Data**

Soil Sample No. 1

- Depth: 2.00 to 4.00 ft.
- Elev.: +15.83 to +13.83 ft.
- Two soil samples were collected by Peter Diglio
- of PDM Environmental Services Inc. for soil contaminant testing

Boring was started using a 3/4" tri-cone roller bit, drilling to 2.00 ft depth.

Sample No. 1 was collected using the split spoon sampler from 2.00 to 4.00 ft. depth. Borehole was again advanced using 3/4" roller bit roller bit to 15.00 ft. depth (approximate depth to water table).

Sample No. 2 was collected from 15.00 to 17.00 ft. depth.

Borehole was backfilled and grouted upon completion of drilling and sampling activities.

To view the results please refer to the Environmental Site Summary Report by PDM dated April 2003, PDM Project No. 1279-00.

**Environmental Boring**

Drilling Rig: Aker Mayhew 300

Drillers: R.J. Gregory, N. Burgess

Inspector: B. Bowman

Environmental Inspector: P. Diglio

Reviewed By: C. Morris, C. Decker
## Environmental Sampling Data

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth</th>
<th>Elev.</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>140</td>
<td>15.76</td>
<td>Split spoon</td>
</tr>
<tr>
<td>No. 2</td>
<td>140</td>
<td>3.75</td>
<td>Drill core</td>
</tr>
</tbody>
</table>

1. **Soil Sample No. 1**: Two soil samples were collected by Peter Diglio. Depth: 2.00 to 4.00 ft.
2. **Soil Sample No. 2**: Sample No. 2 was collected from 15.00 to 17.00 ft. depth.

**Boring**

Boring was started using 3½” tri-cone roller bit. Drilling to 2.00 ft. depth.

**Sample No. 1**

- Sample No. 1 was collected using the split spoon method from 2.00 to 4.00 ft. depth. Borehole was again advanced using 3½” tri-cone roller bit to 15.00 ft. depth (appreciable depth to water table).

**Sample No. 2**

- Sample No. 2 was collected from 15.00 to 17.00 ft. depth.

**Drilling Procedure**

- Drilling Rig: Mayhow 500
- Drillers: R.J. Gregory, N. Burgar
- Inspector: B. Bowman
- Environmental Inspector: P. Diglio

**Borehole End**

- **End of Borehole at 17.00 ft. (Elev.: +1.76 ft.).**
<table>
<thead>
<tr>
<th>BORING NUMBER: 29B-ENV-01</th>
<th>LOCATION: On East side of Hudson St. 33.80 ft. East, from the East curb of Hudson St. and 10.61 ft. South from the South curb of East St., Manhattan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample No. 1</td>
<td>140</td>
</tr>
<tr>
<td>Depth: 5.00 to 7.00 ft.</td>
<td>Elevation: 11.56 to 9.58 ft.</td>
</tr>
<tr>
<td>Sample No. 2</td>
<td>140</td>
</tr>
<tr>
<td>Depth: 15.00 to 17.00 ft.</td>
<td>Elevation: -1.58 to -0.42 ft.</td>
</tr>
</tbody>
</table>

Environmental Drilling

Drilling Rig: Acker Drilling
Drillers: R. Bridge, A. Feliciano
Inspector: M. Barton, M. Carneaux
Environmental Inspector: F. Diglio
Reviewed By: C. Morris, C. Degr"
By: Warren Gentry, Inc.
Under Contract 554

LOCATION: On the East sidewalk of Hudson St., 12.00 ft.
from South curb of Leight St., Manhattan.

<table>
<thead>
<tr>
<th>Soil Sample No. 1</th>
<th>140</th>
<th>N/A</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth: 5.00 to 7.25 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elev.: +11.27 to +2.27 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two soil samples were collected by Peter Diglio of PDM Environmental Services Inc. for soil contamination testing.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Soil Sample No. 2</th>
<th>140</th>
<th>N/A</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth: 15.00 to 17.00 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elev.: +2.07 to -0.07 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>END OF BOREHOLE AT 17.00 ft. (Elev.: +0.07 ft.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Environmental Boring

Drilling Rig: Aker Winch

Drillers: R. Bridgey, A. Felicato

Inspector: M. Bouton, M. Canicapa

Reviewed By: C. Morris, C. Delator

TOTAL DEPTH: 17.00 ft.

Environmental Sampling Data

Sample No. 1 was collected using the split spoon sampler from 5.00 to 7.00 ft. depth. Borehole was advanced using 3-½ tri-cone roller bit to 15.00 ft. depth (approximate depth to water table).

Sample No. 2 was collected from 15.00 to 17.00 ft. depth. Borehole was grouted upon completion of drilling and sampling activities.

To view the results please refer to the Environmental Site Survey Report by PDM dated March 2003, PDM Project No. 1271-00.
<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Depth (ft)</th>
<th>Moisture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>140-150</td>
<td>Moist</td>
<td>SPT &quot;N&quot; - N/A</td>
</tr>
</tbody>
</table>

**Environmental Sampling Data**

Five soil samples were collected by Karen Schwartz of Langum Engineering and Environmental Services Inc. for soil contaminant testing. Borehole was backfilled and grouted upon completion of drilling and sampling activities. To view the results please refer to Langum Engineering Environmental Report dated May 7, 2014, Sample B-2.

**Environmental Boring**

Drilling Rig: CME 45
Drillers: R. Doller, C. Tully, R. Malyukov
Inspector: M. Yang
Environmental Inspector: K. Schwartz
Reviewed By: C. Morris, C. Dozier
### BORING NUMBER: 29B-ENV-04

**Location:** On traffic island adjacent to Holland Tunnel, 720 ft. East from the East curb of Hudson St. and 500 ft. South from the South curb of Laight St., Manhattan

**Date Started:** 01/23/04  
**Date Completed:** 1/23/04

---

#### ALL CLASSIFICATIONS AND DESCRIPTIONS IN THIS LOG ARE BASED ON FIELD INSPECTOR'S OBSERVATIONS AND NOTES:

**Note:** S.P.T. "N" was not determined due to the blow counts obtained with 3" split spoon sampler.

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Depth (ft)</th>
<th>Wet</th>
<th>Bone</th>
<th>Description of Materials Encountered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Sample No. 1</td>
<td>0.00 to 2.00 ft.</td>
<td>140</td>
<td>96</td>
<td>22/6</td>
</tr>
<tr>
<td>Soil Sample No. 2</td>
<td>2.00 to 4.00 ft.</td>
<td>140</td>
<td>75</td>
<td>15/6</td>
</tr>
<tr>
<td>Elev.: +15.49 to +13.49 ft.</td>
<td>5</td>
<td>19/6</td>
<td>Moist, S.P.T. &quot;N&quot; - N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8/6</td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 3</td>
<td>9.00 to 11.00 ft.</td>
<td>140</td>
<td>83</td>
<td>26/6</td>
</tr>
<tr>
<td>Elev.: +8.49 to +6.49 ft.</td>
<td>36</td>
<td>Moist, S.P.T. &quot;N&quot; - N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5/6</td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 4</td>
<td>14.00 to 16.00 ft.</td>
<td>140</td>
<td>83</td>
<td>4/6</td>
</tr>
<tr>
<td>Elev.: +14.49 to +12.49 ft.</td>
<td>3/6</td>
<td>Moist, S.P.T. &quot;N&quot; - N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elev.: +12.49 to +10.51 ft.</td>
<td>11/6</td>
<td>END OF BOREHOLE AT 18.00 ft. (Elev.: -0.51 ft.).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 1 (cont.)</td>
<td>17.00 to 18.00 ft.</td>
<td>11/6</td>
<td>Dry, S.P.T. &quot;N&quot; - N/A</td>
<td></td>
</tr>
<tr>
<td>Elev.: +17.49 to +15.49 ft.</td>
<td>14/6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Sample No. 6</td>
<td>2/6</td>
<td>Moist, S.P.T. &quot;N&quot; - N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elev.: +15.49 to +13.49 ft.</td>
<td>8/6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Environmental Sampling Data:**

Five soil samples were collected by Karen Schwartz of Langan Engineering and Environmental Services Inc. for soil contaminant testing.

Borehole was backfilled and grouted upon completion of drilling and sampling activities. To view the results please refer to Langan Engineering Environmental Report dated May 7, 2004, Sample B-1.

---

**Environmental Boring**

**Drilling Rig:** CME 42  
**Drillers:** D. Dellar, C. Tolly, R. Malyskov  
**Inspector:** M. Yang  
**Environmental Inspector:** K. Schwartz  
**Reviewed By:** C. Morris, C. Dover
**BORING NUMBER:** 29B-GEO-01

**LOCATION:** 30.77 ft. South from the North end of P.A. fence and 1.20 ft. East from the curb on East side walk of: Hudson St., Manhattan

<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>Depth (ft)</th>
<th>Wet</th>
<th>Rec</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL CLASSIFICATIONS AND DESCRIPTIONS IN THIS REPORT ARE BASED ON VISUAL EXAMINATION ONLY.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL SOIL COLORS ARE DETERMINED BY COMPARISON WITH THE MUNSELL SOIL CHARTS (YEAR 2000 REVISED EDITION).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOG ARE BASED ON VISUAL EXAMINATION ONLY.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPARISON WITH THE MUNSSELL SOIL CHARTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOT. DEPTH:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Surface Elev.:** 14.65 ft.

**Rock Elev.:** 76.45 ft.

**Bottom Elev.:** 76.95 ft.

**Depth in Earth:** 93.00 ft.

**Depth in Rock:** 0.50 ft.

**TOTAL DEPTH:** 93.50 ft.

Note: Wash cutting samples may not be representative of the particular depth.

### Soil Sample No. 1
- **Depth:** 5.00 to 7.00 ft.
- **Elev.:** +11.55 to +9.55 ft.
- **Description:** Coarse grain, dark reddish brown (5YR 3/4), poorly graded.

### Soil Sample No. 2
- **Depth:** 10.00 to 12.00 ft.
- **Elev.:** +6.55 to +4.55 ft.
- **Description:** Fines to coarse grain, dark reddish brown (5YR 3/4), well graded.

### Soil Sample No. 3
- **Depth:** 15.00 to 17.00 ft.
- **Elev.:** +1.55 to +0.55 ft.
- **Description:** Moist, Non-plastic, S.P.T. "N" = 7

### Soil Sample No. 4
- **Depth:** 20.00 to 22.00 ft.
- **Elev.:** -3.45 to -5.45 ft.
- **Description:** Clay, Moist, Low plastic, S.P.T. "N" = 24

### Soil Sample No. 5
- **Depth:** 25.00 to 27.00 ft.
- **Elev.:** -8.45 to -10.45 ft.
- **Description:** Moist, Non-plastic, S.P.T. "N" = 34

### Soil Sample No. 6
- **Depth:** 30.00 to 32.00 ft.
- **Elev.:** -13.45 to -15.45 ft.
- **Description:** Moist, Non-plastic, S.P.T. "N" = 46

### Soil Sample No. 7
- **Depth:** 35.00 to 37.00 ft.
- **Elev.:** -18.45 to -20.45 ft.
- **Description:** Fine to medium grain, dusky red (10R 3/4), poorly graded, ferralginous.

### Soil Sample No. 8
- **Depth:** 40.00 to 42.00 ft.
- **Elev.:** -23.45 to -25.45 ft.
- **Description:** Fine to medium grain, dusky brown (7.5YR 4/3), poorly graded.

### Soil Sample No. 9
- **Depth:** 45.00 to 47.00 ft.
- **Elev.:** -28.45 to -30.45 ft.
- **Description:** Fine to medium grain, red (10R 3/4), poorly graded, ferralginous.
**BORING NUMBER:** 29B-GEO-02  |  **Job:** 495

**LOCATION:** 67.39 ft. South from the North end of P.A.  
**Date Started:** 02/01/03  
**Date Completed:** 02/14/03

<table>
<thead>
<tr>
<th>Soil Sample No.</th>
<th>Depth (ft)</th>
<th>WT %</th>
<th>Description of Material Encountered</th>
</tr>
</thead>
</table>
| Soil Sample No. 1 | 140-160 | 41 | Fine to coarse grain, reddish brown (5YR 5/4), well graded,  
| Depth: 5.00 to 7.00 ft. | 5/8" | Arenaceous Sand with some fill materials; mostly composed of pebbles, fine to medium gravel sized sandstone, chert, quartz, and chert; trace silts.  
| Elev.: +/-1.02 to +0.62 ft. | 5/8" |  
| Soil Sample No. 2 | 140-160 | 60 | Medium to coarse grain, reddish brown (5YR 5/2), well graded,  
| Depth: 10.00 to 12.00 ft. | 6/8" | Arenaceous, arenaceous Sand mixed with fine to medium gravel sized materials.  
| Elev.: +/-2.02 to +0.62 ft. | 5/8" |  
| Soil Sample No. 3 | 140-160 | N/A | Mixed assemblages of fine to medium gravel sized, highly fragmented,  
| Depth: 15.00 to 17.00 ft. | 10/6" | Medium to coarse grain, poorly sorted, variable shaped quartzite, sandstone, chert, siltstone, and fill materials.  
| Elev.: +/-1.62 to -0.38 ft. | 8/8" |  
| Soil Sample No. 4 | 140-160 | 0 | No recovery,  
| Depth: 20.00 to 22.00 ft. | 20/6" |  
| Elev.: -3.38 to -5.38 ft. | 20/6" |  
| Soil Sample No. 5 | 140-160 | 60 | Fine to medium grain, light reddish brown (5YR 6/3), well graded,  
| Depth: 25.00 to 27.00 ft. | 10/6" | Arenaceous, arenaceous Sand with some fill materials; mostly composed of medium gravel sized quartzite and granite.  
| Elev.: -3.38 to -10.38 ft. | 10/6" |  
| Soil Sample No. 6 | 140-160 | 85 | Fine to medium grain, yellowish red (5YR 4/3), well graded,  
| Depth: 30.00 to 32.00 ft. | 13/6" | Arenaceous, arenaceous Sand with some fill materials; trace clay, and fine to medium gravel sized quartzite, sandstone, and banded consolidation.  
| Elev.: -13.38 to -15.38 ft. | 13/6" |  
| Soil Sample No. 7 | 140-160 | 100 | Fine grain, light reddish brown (2.5YR 6/4), poorly graded,  
| Depth: 35.00 to 37.00 ft. | 12/6" | Arenaceous, arenaceous Silty Sand with some fill materials; trace fine gravel.  
| Elev.: -18.38 to -20.38 ft. | 15/6" |  

**TOTAL DEPTH:** 58.80 ft.  

**Note:** Wash cutting samples may not be representative of the particular depth.
### BORING NUMBER: 29B-GEO-03/W

**LOCATION:** 102.45 ft. South from the North end of P.A. face and 13.30 ft. East from the curb on East sidewalk of Museum St, Manhattan.

<table>
<thead>
<tr>
<th>Soil Sample Number</th>
<th>Depth (ft)</th>
<th>Cut No.</th>
<th>Core No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Sample No. 1</strong></td>
<td>140-25</td>
<td>1/6&quot;</td>
<td>Fine to medium grain, brown (7.5YR 3/4), well graded, ferruginous.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 5.00 to 7.00 ft.</td>
<td>4/6&quot;</td>
<td>micaceous Sand with some clayey silt and fine to medium gravel sized.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +11.83 to +9.18 ft.</td>
<td>5/4&quot;</td>
<td>quartz, feldspar, and sandstone.</td>
<td></td>
</tr>
<tr>
<td><strong>Soil Sample No. 2</strong></td>
<td>140-25</td>
<td>18/6&quot;</td>
<td>Fill materials; mostly composed of concrete and red brick, and fine to medium sand.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 10.00 to 12.00 ft.</td>
<td>13/6&quot;</td>
<td>medium gravel sized quartz, feldspar, and other fragments.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +6.88 to +5.12 ft.</td>
<td>14/6&quot;</td>
<td>with trace till. Note: S.P.T. &quot;N&quot; was not determined due to the blow counts obtained with a 3&quot; split spoon sampler.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10/6&quot;</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil Sample No. 3</strong></td>
<td>140-20</td>
<td>13/6&quot;</td>
<td>Fine grained, yellowish brown (7.5YR 4/2), poorly graded, ferruginous.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 15.00 to 17.00 ft.</td>
<td>16/6&quot;</td>
<td>slightly calcareous and slightly micaceous silt. Sand with some clayey silt.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +1.85 to -0.15 ft.</td>
<td>14/6&quot;</td>
<td>silt. Trace fine to medium gravel sized sandstone, anode, and gravel.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>36/6&quot;</td>
<td>Weak magnetic susceptibility has been noted in the sample. Note: S.P.T. &quot;N&quot; was not determined due to the blow counts obtained. Cont. on page 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil Sample No. 4</strong></td>
<td>140-65</td>
<td>11/6&quot;</td>
<td>Fine to medium grain, reddish brown (5YR 4/4), poorly graded.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 20.00 to 22.00 ft.</td>
<td>10/6&quot;</td>
<td>ferruginous, highly micaceous Sand with trace silt. Moderate magnetic susceptibility has been noted in the sample.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +3.15 to -5.15 ft.</td>
<td>10/6&quot;</td>
<td>Moist. Non-plastic. S.P.T. &quot;N&quot; - 20</td>
<td></td>
</tr>
<tr>
<td><strong>Soil Sample No. 5</strong></td>
<td>140-60</td>
<td>4/6&quot;</td>
<td>Fine grain, reddish brown (5YR 4/4), poorly graded, ferruginous.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 25.00 to 27.00 ft.</td>
<td>4/6&quot;</td>
<td>highly micaceous silt. Sand with a subordinate amount of clayey silt.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +8.15 to -10.15 ft.</td>
<td>16/6&quot;</td>
<td>Weak magnetic susceptibility has been noted in the sample.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19/6&quot;</td>
<td>Moist. Low plastic. S.P.T. &quot;N&quot; - 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil Sample No. 6</strong></td>
<td>140-56</td>
<td>23/6&quot;</td>
<td>Fine grain, reddish brown (5YR 4/3), poorly graded, ferruginous.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 30.00 to 32.00 ft.</td>
<td>19/6&quot;</td>
<td>micaceous Sand with some clayey silt. Trace fine to medium gravel sized.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +13.15 to -15.15 ft.</td>
<td>20/5&quot;</td>
<td>sized, ferruginous hornblende gneiss. Weak magnetic susceptibility has been noted in the sample.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30/6&quot;</td>
<td>Moist. Low plastic. S.P.T. &quot;N&quot; - 39</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soil Sample No. 7</strong></td>
<td>140-100</td>
<td>11/6&quot;</td>
<td>Fine grain, reddish brown (5YR 4/4), poorly graded, ferruginous.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depth: 35.00 to 37.00 ft.</td>
<td>11/6&quot;</td>
<td>highly micaceous silt. Sand with clayey silt. Trace fine gravel sized.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Elev.: +18.15 to -20.15 ft.</td>
<td>14/6&quot;</td>
<td>quartz and feldspar. Weak magnetic susceptibility has been noted in the sample. Moist. Low plastic. S.P.T. &quot;N&quot; - 27</td>
<td></td>
</tr>
</tbody>
</table>

Note: Wet's cutting samples may not be representative of the particular depth.
<table>
<thead>
<tr>
<th>BORING NUMBER: Holland-W</th>
<th>LOCATION: Holland Tunnel Ent.Ramp, East of Dutch St, and East of Hudson St, Manhattan.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinate: N38 42'26.46&quot;</td>
<td>East: 73° 47' 33.28&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth</th>
<th>Rem.</th>
<th>Dia.</th>
<th>Description of Borehole Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td>Surface Elevation: +17.58 ft.</td>
</tr>
<tr>
<td>0.6</td>
<td></td>
<td></td>
<td>Rock Elevation: N/A.</td>
</tr>
<tr>
<td>1.6</td>
<td></td>
<td></td>
<td>Bottom Elevation: 3.42 ft.</td>
</tr>
<tr>
<td>11.08</td>
<td></td>
<td></td>
<td>Depth in Earth: 11.08 ft.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Depth in Rock: N/A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TOTAL DEPTH: 11.08 ft.</td>
</tr>
</tbody>
</table>

**Notes:**
- No unusual well conditions or settling conditions.

- Observation/Monitoring Well Construction Data

  Observation/Monitoring well constructed to 21.00 ft. depth
  
  - (Rem. = 3.42 ft. Bore with 1 7/8" of-cast iron bit (push condition from 0.00 ft. to 3.00 ft. depth) (Rem. = +17.58 to +4.42 ft.).
  
  - 2 5/8" inside diameter schedule 40 PVC pipe
    
    - Installed from 0.00 to 11.00 ft. depth (Rem. = +17.58 to +36.58 ft.).
  
  - 2 5/8" inside diameter schedule 40 PVC well screen, 22 slots per inch,
    
    - Installed from 11.00 to 21.00 ft. depth (Rem. = +4.42 to +36.42 ft.).
  
  - Holes backfilled with 3" of grout from 0.00 to 21.00 ft. depth
    
    - (Rem. = +36.58 to +36.42 ft.), Demising slab from 0.00 to 21.00 ft. depth
  
  - (Rem. = +17.58 to +36.58 ft.).

- Plugs are in monitoring well not installed over well.

- Observation/Monitoring Well Installation

  - Driller: R. Gregory
  
  - Inspector: P. Meeks

- Reviewed by: C. Morris, C. Banner