FINAL REPORT:
PHASE 1B ARCHAEOLOGICAL INVESTIGATION FOR THE RANDALL'S ISLAND SPORTS FIELD DEVELOPMENT PROJECT

Prepared for:

Randall's Island Park Alliance, Inc.
24 West 61st Street, 4th Floor
New York, NY 10023

Assembled by:

Joseph Schuldenrein, Ph.D
Principal Investigator

Contributions by:

Michael Aiuvalasit, M.A.
Suanna Selby Crowley, Ph.D.
Johnathan Garland, M.Sc.
Andrew Nesheim, M.A.
Mark A. Smith, Ph.D.

Geoarcheology Research Associates
92 Main Street
Suite 207
Yonkers, NY 10701

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Management Summary

This report details the results of historical background research and subsurface archaeological investigations for the Randall's Island Sports Field Development, located in Randall's Island, New York, New York. A previous Phase IA study recommended subsurface testing at five proposed athletic field areas. The fields are located across the southern half of Randall's Island, formerly known as Wards Island before the narrow straight between the two islands was filled in. The five areas that were investigated included: Hell's Gate, Central Fields, Sunken Garden, Wards Meadow, and East River. Phased cultural resource investigations for this project were undertaken and concurrent with the construction of the sports fields. Accordingly, there were restrictions on project area access as well as logistical constraints on the approaches and methods of subsurface investigation. Alternative investigative strategies were devised in consultation with the Landmarks Preservation Commission of New York City (LPC). Initial field work centered on the examination of backdirt piles in areas where construction had already occurred. Field relations coupled with examinations of historic fills and natural sediments led to a systematic program design for Geoprobe-based subsurface testing. Test transects were positioned along alignments traversing the fields scheduled for impact. Three (3) radiocarbon samples were collected to date key buried landform components. The dates confirmed the Late Pleistocene age of much of the substrate underlying the impact areas. All of the areas with the exception of the East River Fields and a portion of Wards Meadow were subject to subsurface testing. These latter areas could not be tested since artificial turf fields had already been constructed. Current plans call for supplementary testing of these remaining areas when large scale maintenance activities are planned.

The present subsurface investigations coupled with historic research facilitated an evaluation of the potential for buried archeological deposits. A major focus of the present effort was identifying the location of New York City's cemetery for the indigent – a well-documented, mid-19th century Potter's Field – within the project area. While historic records converge on the location of that Potter's Field in the vicinity of Hell's Gate Field, several sources indicate that significant numbers of burials were subsequently re-interred at Hart's Island in the late 19th century. No human remains or geoarchaeological indications of mass burials were recovered over the course of the present testing at Hell's Gate Field or other properties. Evidence for the brick foundations of the Inebriate Asylum, dated to the late 1860's, were recovered in probes at Hell's Gate Field. Buried historical surfaces across the project areas were also recognized. However, identified buried surfaces were clearly underlain by disturbance fills. While no surfaces of apparent prehistoric age were identified, evidence of Late Holocene estuarine marshes was present. The broad and deep extent of recent and historic disturbance and the thin and diffuse strata of Holocene age precluded the presence of substantial archaeological resources. Cultural sensitivity and soil-stratigraphic matrices were developed to structure the findings. These serve as a heuristic device for future cultural resource investigations in Randall's Island. No further field-work is warranted, except for potential subsurface testing of the East River fields and southwestern Wards Meadow, coincident with future maintenance scheduling.

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1. Introduction and Objectives

A Phase IB cultural resources study was conducted by Geoarcheology Research Associates, Inc. (GRA), under contract to the Randall's Island Park Alliance, Inc. (RIPA), Wards Island. The summary is part of a wider investigation of five separate locations on Wards Island: East River Fields, Wards Meadow Fields, Central Fields, Sunken Garden Fields and Hell's Gate Fields (Figure 1). Previously a Phase IA report had been prepared for all the areas of study examined by GRA (Schuldenrein et al. 2008).

A proposal and scope of work for a Phase IB archaeological assessment of the areas was submitted by GRA to the New York City Landmarks Preservation Commission (LPC) in October 2008. The scope of work, approved by the LPC on 16 October 2008 (24708_FSO_ALS_10162008), proposed that testing for buried archaeological resources would be undertaken in two separately staged field phases. The first phase involved backhoe and auger testing of existing spoil piles that had accumulated along the peripheries of each of five parcels. The second phase would utilize a geoprobe to conduct a series of subsurface probes aligned on transects across each of the parcels. Results of these field efforts would be analyzed to determine the past and present integrity of the parcels and to assess the age, degree, and extent of historic and/or recent disturbance.

Of the five areas, Hell's Gate Fields was the only parcel that was not subject to previous disturbance by RIPA. As a result, it was decided, in consultation with LPC and the RIPA, to commence the second stage of field investigations at this location. Further work was conducted later at the Sunken Garden, Central and Wards Meadow Fields. No subsurface investigations were undertaken at the East River Fields as construction of the artificial fields was completed before cultural resource investigations were undertaken. A Management Summary of the results of the Hell's Gate Fields geoarchaeological investigations was submitted to LPC and it was determined that future construction work was not likely to adversely impact cultural resources at that location. Further, it was noted that final approval of the project was contingent on submittal and review of a comprehensive report covering all five tracts (24708_FSO_ALS_10162008; 26 January 2009).

A contract covering report preparation was finalized between GRA and RISF on 18 January 2012. A detailed timeline of the events leading up to the issuance of this report is presented at the end of this Introduction.

This comprehensive report summarizes the results of the subsurface investigations on the five parcels constituting the project area. On this basis, GRA has developed a model for understanding the stratigraphy of Randall's Island as a precursor to predicting archaeological potential. The scale of that potential is inductive and projects the structure of investigated sequences to a broader, island-wide model of landscape history and archaeological preservation based on prehistoric and historic landform relations and GIS modeling.

The narrative of this document begins with a detailed overview of the geological setting inclusive of discussions on landfilling, modern topography and land use (Chapter

2). The historic development of the project area is then presented from the prehistoric, through mid-19th century and modern eras (Chapter 3) and is succeeded by a detailed account of the investigative methodology and results of the field effort (Chapter 4). In general, the methodology was designed to test for the presence vs. absence of intact subsurface deposits, to distinguish fill sequences and to establish the depositional origins of pristine landscape elements if, indeed, these were present. Synthetic interpretations follow, culminating in a time-transgressive GIS-based reconstruction of landform history (Chapter 5). A concluding section (Chapter 6) presents a summary statement and offers recommendations bearing on significance determinations.

1.1 Timeline

09 September 2008.	Initial site visit.
05 October 2008.	Phase 1a report submitted.
09 October 2008.	LPC approval of Phase 1a report (24708_FSO_ALS_10092008).
15 October 2008.	SOW for Phase 1b submitted
16 October 2008.	LPC approval SOW (24708_FSO_ALS_10162008).
12 November 2008.	Spoil pile investigation: profiles.
13 November 2008.	Auger tests in Wards Meadow spoil pile. Road cut profile descriptions.
13 November 2008.	Report letter on spoil piles submitted.
14 November 2008.	LPC concurs with report letter (24708_FSO_ALS_11142008).
24 November 2008.	Geoprobe testing: Hell's Gate.
28 November 2008.	Second site visit to decide new placements for Geoprobes.
01 December 2008.	Revised locations submitted to LPC.
02 December 2008.	LPC concurs with new locations except East River Fields (24708_FSO_ALS_12022008)
09 December 2008.	Geoprobe testing: Sunken Garden, Central Fields.
12 December 2008.	Geoprobe testing: Central Fields, Wards Meadow
23 January 2009.	Hell's Gate management summary submitted.
28 January 2009.	LPC concurs with Hell's Gate management summary (24708_FSO_ALS_01282009).
12 January 2012.	RISF and GRA sign contract for resumption of Phase 1B report preparation
15 March 2012.	Submittal of Phase 1B report to client and LPC

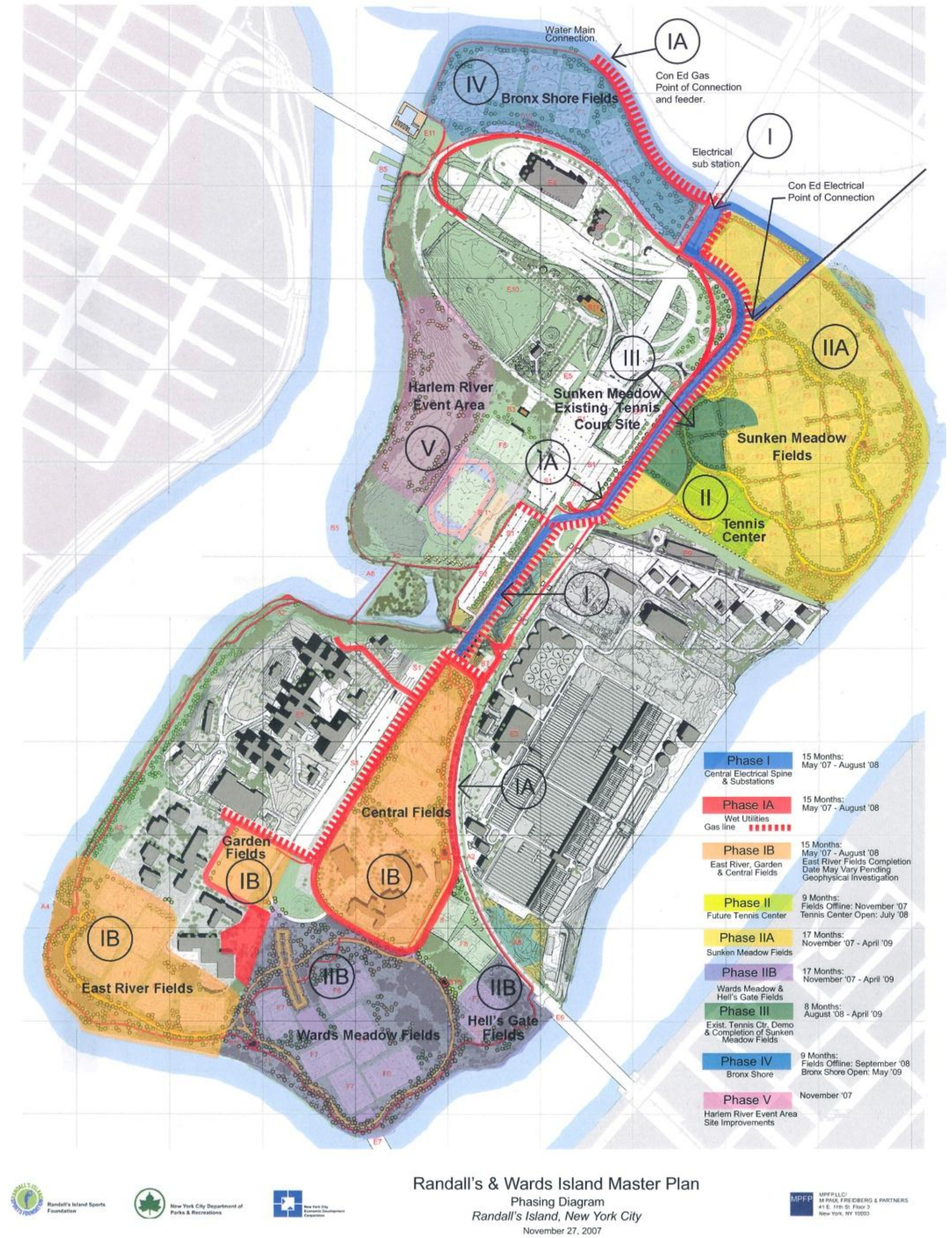

Figure 1. Randall's Island Park Alliance Master Plan.

2. Environmental Setting

2.1 Geological Setting, Landfill and Modern Topography

Randall's Island is located east of Manhattan, south of the Bronx and west of Queens. The island is part of the borough of Manhattan. It once consisted of two separate islands, Randall's Island to the north and Wards Island to the south; these islands were separated until the mid 20th century, when the tidal wetlands and marshes known as Little Hell Gate were infilled, as part of efforts by the City Parks Department to expand parkland between the islands (see HPI 2000). The island is bound by the Harlem River to the west, Bronx Kills to the north, the East River to the east and south, with Hell Gate formed at the confluence of the Harlem and East Rivers. All field investigations took place on the former Wards Island, which was the southernmost of the two islands.

Randall's Island has been described as originally largely swamp with granite hills (Richmond 1872:562). During the 19th century, when various charitable institutions were constructed, orchards and farms thrived across the island. Topographic maps show a ridge running parallel to the northern end of the island. The RFK (Triborough) Bridge now runs roughly along this feature. Marshland was situated northwest of the ridge as well as at the southeastern end of the island, where a stream drained into the Little Hell Gate. In the mid-19th century, the southern tip of the island contained orchards.

Mid-19th century maps illustrate the original pre-industrial topography of Wards Island. The earliest map to present the island in significant detail is the 1851 coastal survey chart which depicts the island's physiographic features in considerable detail. These features included a cluster of four, small, steep-sided hills (glacial kames) in the island's center and a steep ridge which stood on the east side of the island (Figure 2). The bluff of the latter overlooking the river is labeled "Negro Pt. Bluff." "Negro Point" is the southeastern corner of the island which consisted of an outcrop above the salt marshes characteristic of the area. The landform has only recently been renamed Scylla Point by the New York Park Commission (Baard 2001). This particular feature is more clearly visible on a map dated 1871, which appears to be a version of the 1851 coastal survey map.

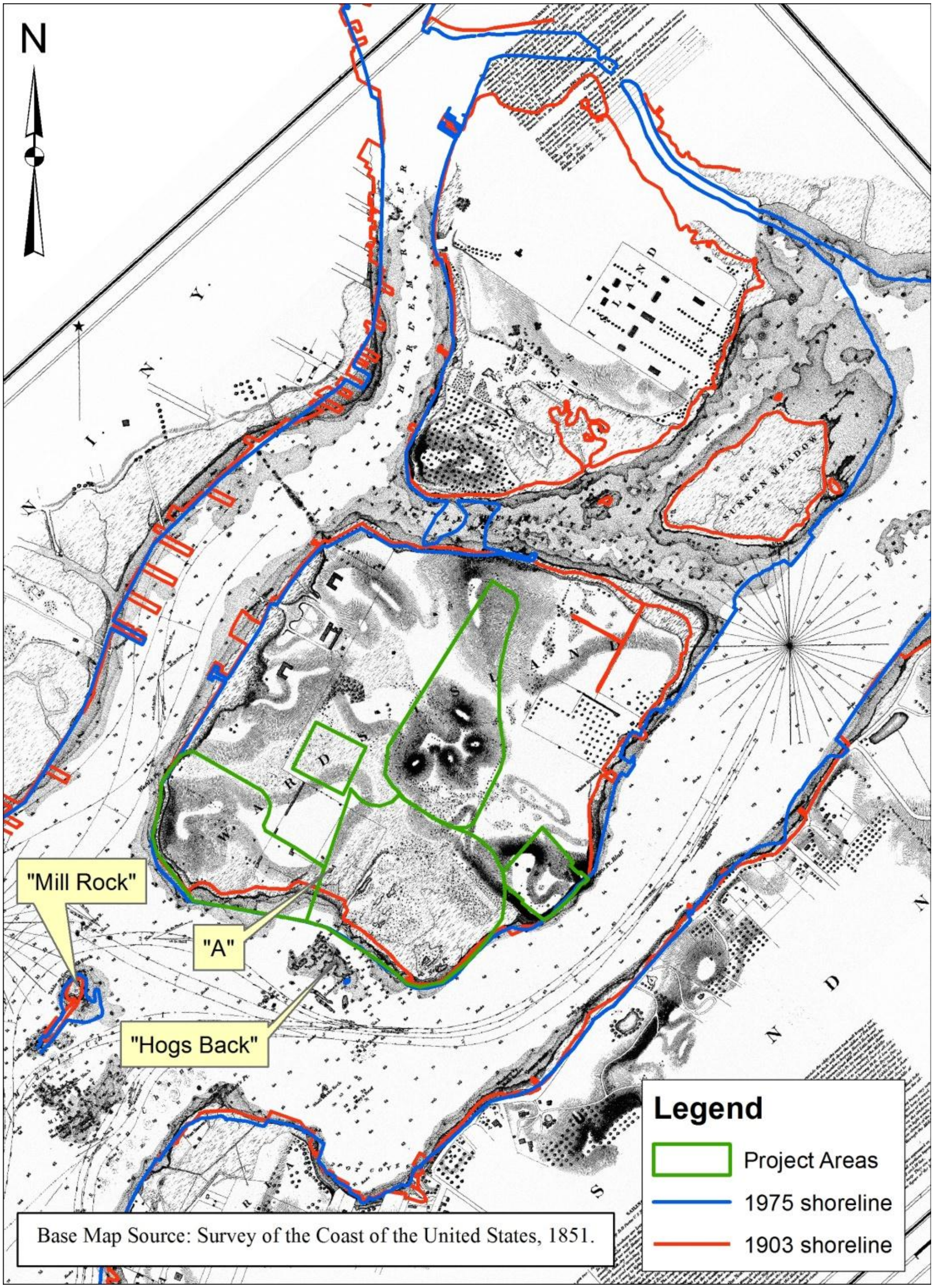

Figure 2. 1851 Coastal Survey map of Wards Island.

Randall's and Wards Islands have experienced extensive modifications and disturbances during historic periods. The expected stratigraphy of the project area is based on a review of bedrock geological mapping, surficial geology maps and historical research. The bedrock of Wards Island is characterized by four components (Figure 3). The majority of the island is underlain by Manhattan Schist (Єm), a grey layered sillimanite-muscovite-biotite-kyanite schist inner-layed with layered tourmaline-garnet-plagioclase-biotite-quartz schist and gneiss with black amphibolites layers (Baskerville 1992). A band of Inwood marble (OЄi), a white or blue-gray calcitic dolomite, runs through the Wards Meadow property and edge of Central Fields. The eastern edge of the island is dominated by two members of Fordham Gneiss (Yfa and Yfb). Member A features a muscovite-biotite-plagioclase-microcline-quartz gneiss. It is pinkish to gray in color with black bands of biotite. Member B is characterized by black and white banded gneiss. The black bands are comprised of quartz, plagioclase and biotite, while the white bands consist of garnet, quartz, plagioclase, muscovite and microline (see Figure 3).

The surficial geology of Randall's and Wards Island's is mapped entirely as fill (Cadwell 1991); however, before historical manipulation the islands were blanketed by glacial till which, where intact in the region, consists of heterolithic gravels, sands and clays glacially deposited during the Pleistocene. The surface soils of the project area are mapped as the Inwood-Laguardia-Ebbets complex of deep debris and rubble mixed with natural soil. The matrix is dominated by coarse fragments of rubble and gravels (New York City Soil Survey Staff 2005).

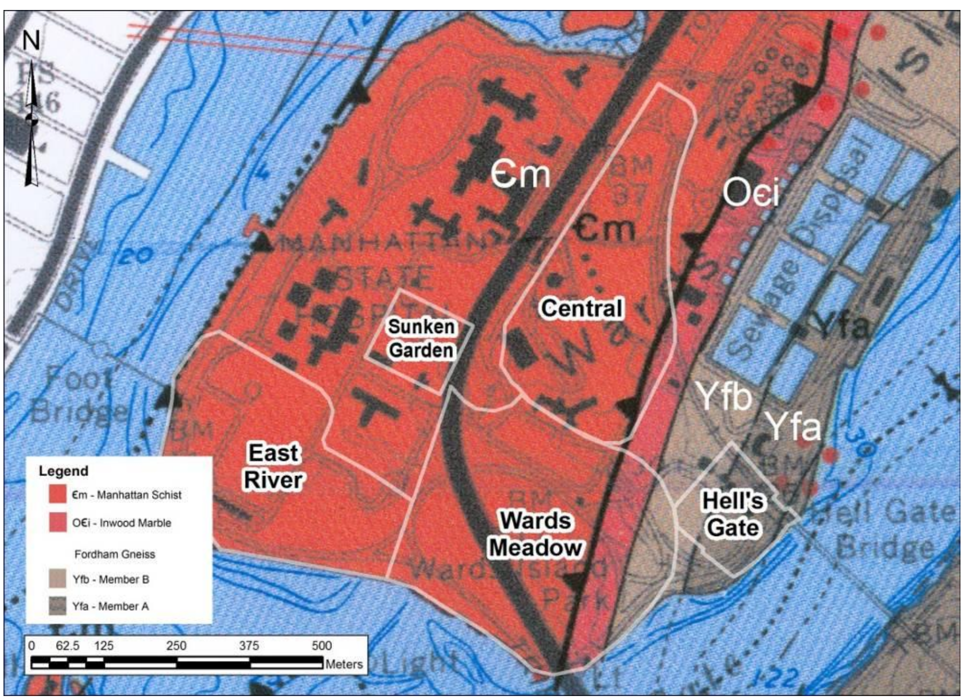

Figure 3. Bedrock map of Wards Island (Baskerville 1994).

2.2 Land Reclamation and Land Fill

Since the mid-19th century, episodes of land reclamation on Randall's and Wards Island have greatly altered the islands' early landscapes. Mid-19th century accounts of land purchase agreements (e.g., see Commissioners of Public Charities and Correction early purchases cited below), clearly demonstrate that the "water land" was considered integral to property values across Wards Island. Frequent reference is made to lots which could easily be reclaimed from the river or low-lying wetlands. In 1862, it was reported in the New York Times that 16 acres of "miasmatic swamp" were drained and cleared of "useless thickets", adding sixty five acres of land to the farm used to support the facilities on the island (NYT 1862).

In 1938, large scale efforts were implemented to infill the waterways that separated the islands both from each other and from the Bronx. Near-shore landfills narrowed the east branch of the East River. Two seawalls were initially extended northward from the northeast point of Wards Island and from a point near the Hell Gate Bridge. These seawalls were eventually constructed to encircle Sunken Meadow and formed the boundary of the landfill. At that time, Sunken Meadow was not inhabited. The most recent episode of localized land filling took place in the 1990's, reclaiming the swampy area between the RFK (Triborough) and the Hell Gate Bridges, where a footbridge once existed (Gary Guttman, personal communication, Jan. 28, 2001). Today, only a narrow inlet remains of the Little Hell Gate channel.

Currently Randall's Island, Wards Island, and Sunken Meadow form a single landmass approximately 530 acres in size. Prior to infilling, Randall's Island consisted of approximately 145 acres and Wards Island totaled nearly 240 acres. A third island called Sunken Meadow, immediately east of Randall's Island, extended for over 20 acres (see Figure 2). The waterway which once separated Randall's from Wards Island was called Little Hell Gate. To the north the Bronx Kills separated Randall's Island from the Bronx. Today, only a narrow channel remains of the Bronx Kills, although the waterway was once nearly as wide as the East River at 125th Street. The extent of the "made land" can be seen in Figure 2 which depicts the changing shoreline. The East River flows around the eastern side of the island and the Harlem River to the west. The treacherous waters southwest of Wards Island are called Hell Gate. The 1851 USCS map (Figure 2) identifies the many rocks that made the Hell Gate dangerous. It has been estimated that one out of ten ships trying to transverse the area ran aground in the 1850s, totaling 1000 ships a year (U.S. Army Corps of Engineers n/d:2).

2.3 Modern Landscape

The dominant structures on Randall's and Wards Island are the RFK (Triborough) and Hell Gate Bridge. Opened in 1938, the RFK Bridge runs from Manhattan to Randall's Island in a line approximately parallel to the northern side of the island. It then turns, north to the Bronx, and south to the end of Wards Island. From there the bridge runs southeast across the Hell Gate into Queens. Parallel to the RFK Bridge, is the Hell Gate Bridge which crosses Randall's Island from the Bronx and then diverges from the RFK to cross Hell Gate. A footbridge also once spanned Little Hell Gate between the RFK and Hell Gate bridges. Other structures on Randall's Island include the offices and shops of the Triborough Bridge and Tunnel Authority and Icahn Stadium. The pavilions of the Manhattan State Psychiatric Center dominate the northwestern quarter of Wards Island. The Municipal Sewage Disposal Plant (one of the three largest in the world at the time of its construction) put into operation by the Department of Sanitation in October 1937, dominates the eastern part of the island complex. Large tracts of both islands are vacant and are either undeveloped or used as recreational parkland.

Subsurface probes have furnished limited information on the natural and historic landscape and development of the island. A soil boring taken near the Manhattan Toll Plaza at the north of Randall's Island in conjunction with the RFK Bridge Rehabilitation Project recorded a surface elevation of 15', the top 5' consisting of miscellaneous fill. Below this was brown silt with traces of clay and little to some fine sand with traces of gravel--a typically lacustrine deposit. Other borings from the northern end of Randall's Island in the area now used for playing fields penetrated fills varying in depth from 13' to 29'.

3. Historic Background

3.1 Wards Island from the Prehistoric Period to the Mid-19th Century

Randall's and Wards Island are centrally located within a region known for its extensive Native American use and occupation. Historic records indicate that local prehistoric groups utilized the islands within waterways for the purpose of transit. Native Americans were familiar with traversing Hell Gate channel, which is known for its shifting tidal conditions and tumultuous maritime landscape; sources indicate that channel did not impose a barrier to Native Americans who were willing to traverse the passages in dugout canoes, as recorded by Rev. Chas Wooly in 1678 (Rutsch and Porter 1980: 10).

Previous research by Robert S. Grumet and Reginald Bohon indicates that Native American settlement nearest to the islands was a habitation area, or campsite, along the shorelines of the Harlem River. This site is located between East 119th and 122nd Streets about 1,300 feet west northwest of the Randall's Island. The site was first recognized in 1855 after "numerous shells, flakes and weapons" were found between East 120th and 121st Streets. Historian Richard Bolton determined that it was a "native site of some importance...a place of landing and trade, or perhaps a fishing-place," because it was the nearest point by canoe to the Bronx (HPI 2000). Bohon recorded a major Native American trail cutting diagonally eastward through the present Manhattan street grid, linking the shore and campsite area with the main trail running through the center of Manhattan Island. The trail and the settlement were located on a broad area of level land (later to become the Dutch town of Nieuw Haarlem) known to local Native Americans as *Conykeekst,* probably meaning "little narrow tract." Bohon speculated that the place name referred to the area's lack of sheltering high ground, which was not likely to have been occupied during the winter months (HPI 2000; Grumet 1981:9).

To the south of the town of *Nieuw Haarlem,* archaeologist Arthur C. Parker recorded the presence of a prehistoric village site (ACP-NYRK no#) at about East 110th Street and the East River, about 2,000 feet west of southern Randall's Island (Parker 1920:627). While no other sources make reference to this specific site, Grumet (1981:68) does record the presence of Native American planting fields in that area and a village locus is perhaps represented on the 1981 Grumet map, south on 118th street at the fork of two trails (see HPI 2000, Figure 3).

Earlier archaeological studies demonstrate that there was a high Native American presence in the County of the Bronx adjacent to north of Randall's Island and separated by the narrow Bronx Kill. The Native American village known as *Ranachqua* is located 2,600 feet north of the Little Hell Gate near Cypress Avenue south of East 132nd Street (HPI 2000). "Food pits and Indian implements" have been previously located at this site (HPI 2000). Historian Robert Bolton reported in 1881 that "within a few years several Indian tumuli have been accidentally opened in the vicinity ... and found to contain large-sized skeletons of the Aborigines" (HPI 2000). The name *Ranachqua* has been defined in various sources as "the end place," "stop" or "point," which may be related to its physical location on the shore at the end of a trail (HPI 2000). This trail ran northeast-southwest and in its southern sections approximates Cypress Avenue (HPI 2000). Despite the existence of the village, the name *Ranachqua* was often used to refer to the part of the southwestern Bronx which juts out between the Harlem and East Rivers (Grumet 1981:43; HPI 2000; Broadhead 1853:43).

To date, there have been no archaeological finds on Randall's or Wards Island dating to the prehistoric period (Bergoffen 2001; Schuldenrein et al. 2008, 2011). According to an existing map of inventoried prehistoric archaeological sites in New York, compiled by the Office of Parks, Recreation and Historic Preservation (OPRHP), there is no record of prehistoric sites on either Randall's or Wards Islands. However, as mentioned, both Randall's and Wards Island are situated in areas where extensive prehistoric activity took place.

Site files from the New York State Museum, the New York State Office of Parks and Recreation, Division of Historic Preservation indicate that while the region surrounding Randall's and Wards Islands has archaeological sites containing prehistoric artifacts, the islands themselves were largely unoccupied around the time of European contact.

Historical Perspectives Inc. undertook a comprehensive background study within one mile of the project area (HPI 2000: 11) and documented the following prehistoric sites in close proximity to the islands:

NYSM#4064
This a campsite identified by Parker (ACP-NYRK no#) on the Manhattan shore of the Harlem River in the vicinity of the approaches to the RFK (Triborough) Bridge, about 1,000 feet (0.3 km) northwest of Randall's Island (Block 1819, Lot 203).

NYSM#5475; OPRHP #A005-01-0027, #A005-01-0031
This is a village site (previously referenced), identified by Reginald Bolton as Ranachqua. The NYSM and OPRHP locate the site(s) more generally than does Bolton, in a broad area south of 133rd Street. It extends as far west as the Bruckner Expressway, about 2,600 feet (0.8 km) northwest of Randall's Island (Block 1819, Lot 203).

NYSM#7248
Traces of occupation (small numbers of artifacts) were recorded approximately 1.0 miles (1.6 km) west of Block 1819, Lot 203 on the Manhattan shore of the Harlem River near Park Avenue.

NYSM#4539 (ACP Quos 00#)
Here, shell and kitchen middens (refuse heaps) were concentrated along the East River shore, in what is now Ralph Demarco Park (north of Astoria Park), in the Ditmars area of northwestern Queens, about 3,000 feet (0.9 km) southeast of Randall's Island (Block 1819, Lot 203) (Parker 1920: 672).

These sites are clustered along the shores of major waterways, the Harlem, Bronx and East Rivers, and surround both islands in all directions. At of the above sites, there were shellfish beds which might have been exploited in conjunction with marshland resources and small freshwater creeks. The northern and southeastern sections of Randall's Island as well as the southeastern sections of Wards Island show a similar distribution of ecological resources. Although there were no freshwater creeks on the island, early maps indicate the existence of at least two small ponds, which may have served as fresh water sources. These may also have constituted poorly-drained wetlands along the northern and western coastlines of both Randall's and Wards Island (HPI 2000).

Since its sale to the Dutch Governor in 1637, the island's name has reflected its various landholders or tenants. The Mayrechkeniockkingh Indian Chiefs, Seyseys and Numers, sold Wards Island, which they called *Tekenas*, to Wouter Van Twiller in 1637 (New York City Board of Education 1968:7). The translation of *Tekenas* is uncertain. Several meanings are possible including forest, uninhabited track, and wild land (American Scenic and Historic Preservation Society 1923:33-34).[1]

Twiller used Wards Island only to graze livestock and did not reside there. His cowherd was the Danish farmer Barent Jansen Blom who earned the nickname Groot Barent or Great Barent. The first European names of both Randall's and Wards Islands were based on this man's name: Great Barent Island for Wards; Little Barent Island for Randall's. Those names were corrupted to Great and Little Barnes or Barn Island(s), and in the 1730 Montgomerie Charter, Wards Island appeared as Great Barn Island (American Scenic and Historic Preservation Society 1923:33; Hoffman 1919:148).

The English confiscated Wards Island from the Dutch States General and in 1664 awarded it, along with Randall's Island, to Thomas Delavall of Harlem (d. 1682), a collector of customs (Smith 1962:100; Valentine 1855:493). Thomas Delavall left his land to his son-in-law William Dervall. In 1687, Thomas Parcell bought Wards Island and it remained in his family for 75 years. It was also then called Parcell's Island (Greenhouse Consultants 1994:27).[2] In 1872 an arched stone vault with the remains of four individuals was uncovered by workers excavating near the Immigrant Refuge Chaplain's Quarters (NYT 1874). The one surviving coffin was reported to have a heart and inscription, both delineated by silver nails. The inscription read, "I. R. Age 37 6, Obt. Aug 23: 1737." If correctly interpreted, this vault therefore would date to the period when the Parcells owned the island. These graves were likely to be the remains of a familial grave site. The workers subsequently closed the tombs and left gravesite *in situ*.

In 1767, Thomas Bohanna purchased land on Wards Island and briefly gave his name to the island. The Bohanna property, comprising 140 acres, was sold to Benjamin Hildreth in 1772, who sold it to William Lownds in 1785. The other half of the island was purchased by John William Pinfold.[3] During the Revolutionary War, Wards Island

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[1] The author cites Beauchamp (1907) for the translation of the Indian names. The historical summary in this section is largely taken from this source. See also Grumet (1981:56).

[2] An earlier study is cited (available at LPC or the Municipal Reference Library) by Rutsch and Porter (1980).

[3] A classified advertisement offers the "...southern half of Great Barn Island, commonly called Bohanna's Island, to be sold at Public Auction on the 20th Day of November next... at the Merchants Coffee House (...) 140 acres... several convenient buildings on it," also wood, an orchard, and "many fruit trees" (*The*

was occupied by British troops who used it as an army base (American Scenic and Historic Preservation Society 1923:34). Both islands were contested during the conflict and passed from control of the Continental Army—George Washington established a smallpox quarantine on Randall's Island in the spring of 1776— to British Forces, who drove the Americans out in September of that year.

In 1806, Captain William Lowndes' estate was sold to Jasper Ward. It consisted of "half the Island situated at Hell Gate ...150 acres ... [a] large dwelling… [a] valuable building stone quarry, of the best kind of hard blue stone ... a wharf and creek near the house" (Kelby). Pinfold's half was purchased first by John Molenaar, then by Jasper's brother Bartholomew Ward. Since that time, the island has been named after these owners.

The Wards sold parcels to a number of individuals and attempted to develop a farming community on the island. This effort was less than successful, and in 1811 the Wards turned their attention to the construction and running of a cotton mill. They also, with Phillip Milledoer, built the first bridge "Wards Bridge" connecting the island to 114th Street in Harlem. The bridge was subsequently destroyed by a storm in 1821 and became a significant obstacle to navigation. Work commenced in 1858 to remove the pilings (Gillmore 1874:172). In 1874, it was reported that the project was "costing the Government a good deal of trouble to remove its remains" and that engineers "for some time back" had been working to remove its beams and abutments (NYT 1874). The 300-foot long three story cotton mill was located on the west side of the island and was marked on a number of maps. As a business venture, it was largely unsuccessful due to the War of 1812 which isolated New York from both markets and suppliers (Anonymous 1893:1).

Following the acquisition of Randall's Island and Sunken Meadow from the heirs of John Randel in 1835[4], New York City began to purchase large tracts of Wards Island by a series of conveyances from 1851-52 (American Scenic and Historic Preservation Society 1923:34). The last private lots on the island were sold to the city in 1883 (NYT 1883).

New York Journal, Oct. 30, 1772; collected in Kelby, W., Notes on Wards Island, MSS notes, New York Historical Society). Greenhouse (1994:27) states that Bohanna sold 140 acres on the northern half of the island in 1772. See also American Scenic (1923:33).

[4] The article gives "John Randall" as the name of the purchaser. In Seitz and Miller (1996:164) it is Jonathan Randel, in Smith (1962:101) Jonathan Randall.

3.2 History of Wards Island from the Mid-19th Century to the Present

The institutions built on Wards Islands during the second half of the 19th century are briefly described in this section. The potter's field, which existed during the mid 19th century, is treated separately below.[5] Throughout the 19th century two governmental agencies were responsible for the various institutions: the Commissioners of Emigration (a state agency) and the Commissioners of Public Charities and Correction (a city agency).

3.2.1 Commissioners of Emigration

The first public institution to be erected on Wards Island was created by the Commissioners of Emigration. This body, formed in 1847, consisted of six citizens appointed by the Governor and ex-officio, the mayors of New York and Brooklyn as well as the Presidents of the German Society and the Irish Emigrant Society (Richmond 1872:551). Their purpose was to create an institution to receive immigrants landing at New York. In 1855 they leased Caste Garden to be the primary landing depot in the city. Arrangements were also made to support sick and destitute immigrants with an Emigrant Fund subsidized by an individual two dollar landing fee. The Commissioners leased part of Wards Island in 1848 and then purchased 121 acres "including the whole of the water front to New York City" on the western side of the island. This location, near "Paupers Dock," was where the buildings of the **State Emigrant Refuge and Hospital** were later situated (Richmond 1872:552). The 1852 Serrell map indicates that the Commissioners of Emigration further owned four lots (28-31) at the southeastern end of the island. By 1875, when the Bromley map was published, those lots had been transferred to the City (see Figure 4).[6]

The first structures to be built were the State Emigrant Hospital (soon renamed the Verplanck Hospital) a two-story building with five wings, and the three-story Refuge for destitute immigrants. Both were formally opened on July 10th, 1866 (NYT 1866). Other buildings subsequently constructed included a nursery, an insane asylum, Protestant and Roman Catholic chapels, various barracks and residences for the physicians and superintendent (Richmond 1872:554-556).[7] Before 1874, immigrants who died were placed in the potter's field, but after the Wards Island potter's field closed, the complex contained its own cemetery (Board of Health 1874:408).

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[5] The cemeteries are mentioned, without further details, in several places including Smith (1962:102);("Toward North Brother Island," N/A 1978).

[6] This is probably referred to when Mayor Tiemann states that, "we bought 69 acres; then we traded with the House of Refuge people for some that they had." (NYT 1858).

[7] The 1851 USC & GS map (Figure 2) shows three structures on the west side of the island. It is uncertain whether these were already part of the institution because they are not labeled and do not correspond to the plans of the later buildings seen on the 1860 Valentine's Manual map or on the 1885 Robinson map. Four of the rectangular buildings on the 1860 Valentine's map shown at the northern end of the eastern row may correspond to the hospital Wards shown on the 1885 Robinson map.

In 1869, a committee from the Commissioners of Immigration asked for plans to be submitted for a new insane asylum to be built on the island (NYT 1869). Built to replace the old asylum which was being used to house "consumptive" patients, the structure was located at the southwest corner of the island away from the other immigration buildings (Figure 5) (NYT 1874).

The complex was used as a secondary immigration station until Ellis Island was opened in 1892, after which the buildings were taken over by the New York City Asylum for the Insane (New York City Guide 1939:425-426). In 1896, the New York State Department of mental hygiene assumed control of the compound and changed its name to the Manhattan State Hospital. By 1943, however, the eighty buildings that formed the center were abandoned; the original buildings of the complex no longer existed. Various institutions discussed in this section can be seen on the 1887 USC&GS map.

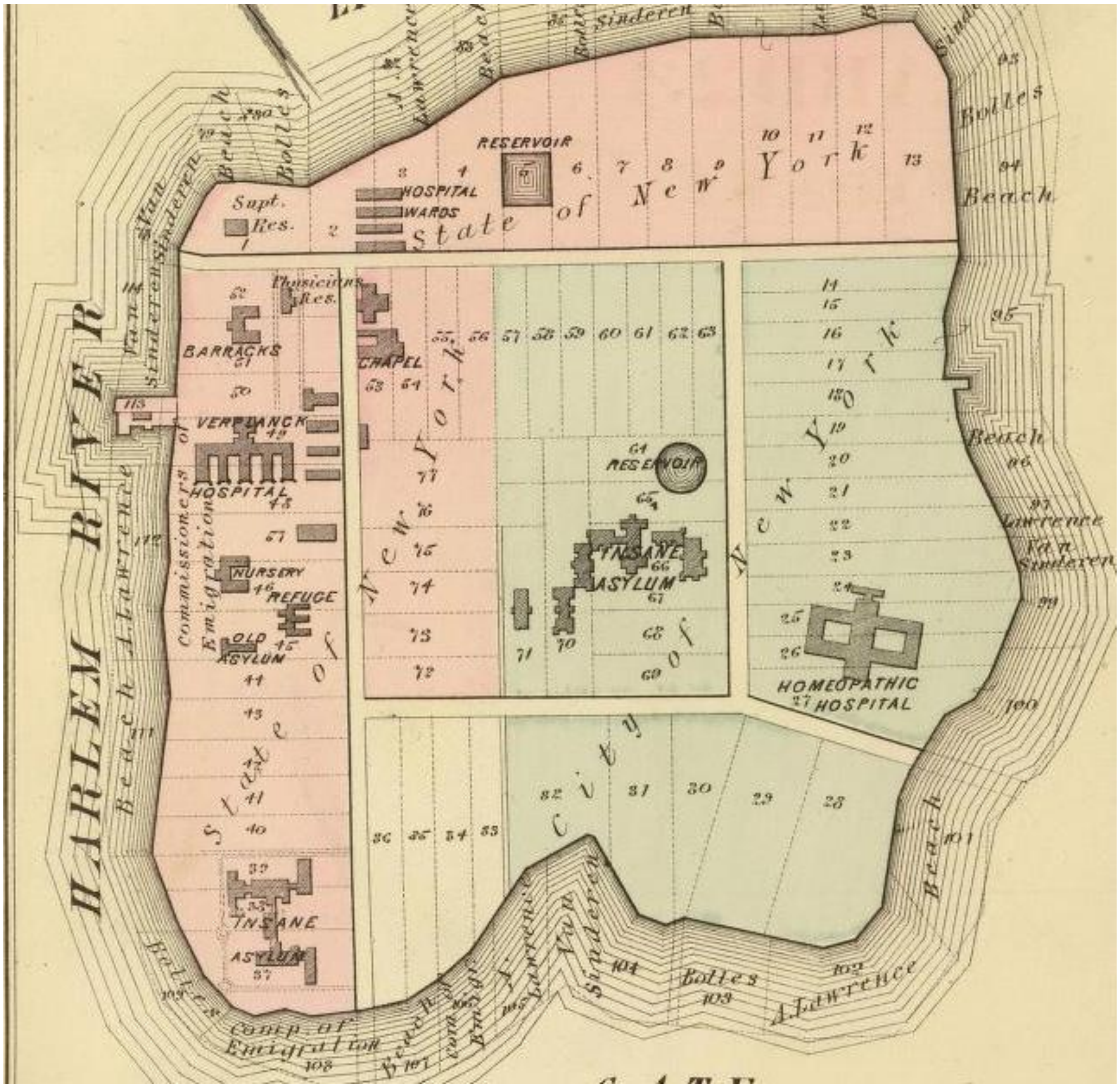


Figure 4. Bromley 1875 map of Wards Island.

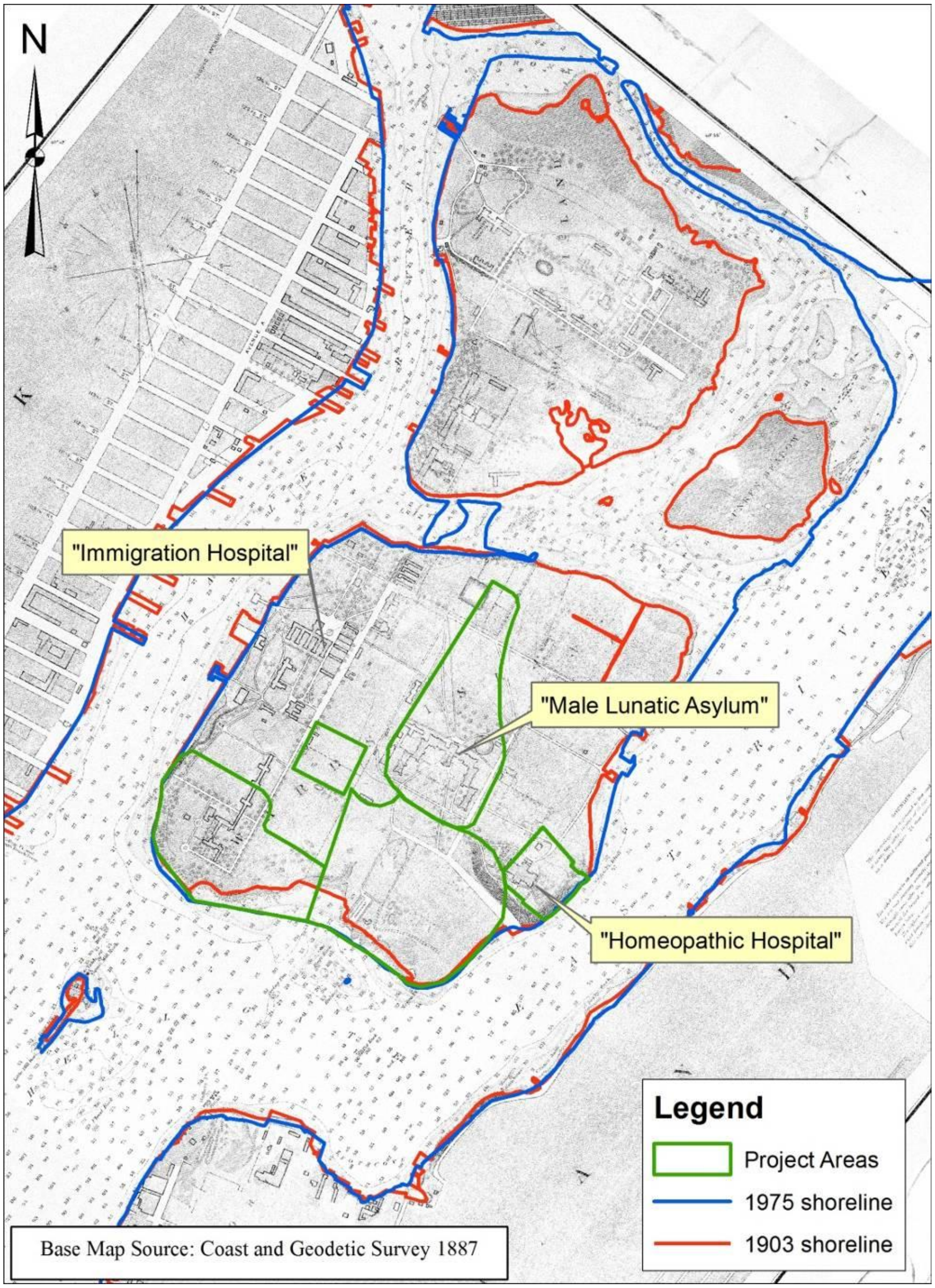


Figure 5. 1887 Coastal Survey map of Wards Island.

3.2.2 Commissioners of Public Charities and Correction

In 1852, the City of New York purchased sixty nine acres of land on Wards Island (along with water rights for 30 additional acres) from a Mr. Lawrence “to be used as a City Cemetery, in lieu of the ‘Old Potter’s Field’ on Randall’s Island” (Bard and Oakley 1853:1259). In December of that year, the Board of Aldermen’s Finance Committee recommended purchasing the lots owned by a Mr. McCotter (Lots 7, 8, 22, 23, 61, 62 and 63 on Figure X). The properties equaled 18 acres of land and McCotter’s ¼ claim of undivided water rights to the whole island (estimated to be 22 acres) (Bard and Oakley 1853:1260). There was considerable debate on the fair price and the definition of water rights, resulting in litigation that continued into the 1860s (see NYT 1854, 1862). In addition to the Wards Island potter’s field, the Commissioners of Public Charities and Correction used their Wards Island properties as the location for an Inebriate Asylum.

3.2.3 Inebriate Asylum

In 1854, the New York Legislature chartered the State Inebriate Asylum in Binghamton, which was considered a great success (Richmond 1872:558). In 1862, the Commissioners of Charities and Corrections recommended that a similar institution be created in New York City, and in 1864, the City Legislature passed an act authorizing its establishment. The Commissioners expressed the expectation that the organization would serve a social need:

> We hope, by means of this asylum, to effect the restoration to usefulness of a large class of persons who, through excessive indulgence, have been rendered useless to society and have brought sorrow and disgrace upon those with whom they are connected (Commissioners of Public Charities and Corrections 1865).

Construction of the main three-story building was begun in 1866 and formally opened in July 1868 and was described as “one of our best public buildings” (Richmond 1872:558). In 1869, after the closing of the Soldiers home in Albany, the Commissioners allotted part of the building to the displaced veterans. In 1875, however, it was decided that any veteran with a pension of over $18 a month had sufficient funds to support themselves, hence the population on Wards Island greatly diminished in the following years and the housing space of former veterans was partially filled with overflow from the Insane Asylum. After petition from doctors and other interested parties in the City, the Commissioners decided that the building was spacious enough to accommodate a Homeopathic Hospital. The facility was formally opened on September 10th, 1875 (NYT 1875). While the Homeopathic Hospital eventually came to monopolize the physical facility at least until 1880, the three institutions (the Inebriate Asylum, the Soldiers Retreat and the Homeopathic Hospital) coexisted on the island (NYT 1880).

3.2.4 Male Lunatic Asylum

The first building phase of the hospital identified as the Male Lunatic Asylum was completed in 1872. Built "a few hundred yards west" of the Inebriate Asylum, the edifice was a "three-story English gothic, with mansard roof, constructed of brick and Ohio free-stone" (Richmond 1872:547). The facility was built on the terrain where post-glacial features (such as kames), shown on the 1851 map, had been leveled. Its once massive structures contained thousands of patients after 1896, when it was taken over by the State of New York and became part of the Manhattan State Hospital for the insane. By 1899, it was the world's largest mental institution, with 4393 patients (Seitz and Miller 1996:166). In 1926, the population was approximately 7000, but by 1930 many of the buildings had deteriorated and become unsafe. It was suggested that they be demolished and the area converted for recreational purposes. Most of the buildings were torn down in the 1950s. None of the older buildings survived. The Mabon Building, which still stands, was erected sometime between 1910 and 1920, directly south of the State Hospital, and contemporaneous with the later occupation of that building.

Two burials discovered in the former front garden of the asylum most likely predate it. They were found during the excavation of a trench approximately 6 feet wide and 8 feet deep, intended for two 24-inch pipes running side-by-side from the power plant of the Manhattan Psychiatric Center to Building 102 of the center (W. Camargo, personal communication, Feb. 21 2001). The burials contained no chronologically diagnostic finds. Greenhouse (1994) suggested that they date to the mid 19th century, and the individuals were likely from the Emigrant Refuge, or the Inebriate Asylum, or perhaps from the old Insane Asylum (associated with the Emigrant Refuge) (Greenhouse Consultants 1994:29). They probably do not belong to the period between ca.1850 and 1868, since during those years there was a potter's field on Wards Island where they could have been interred in individually-marked graves. Riis reported that in 1891, the City allocated $50 for funeral expenses for honorably discharged military personnel, but a "decent funeral" cost double that amount (Riis 1891:45). The potter's fields on Wards and Randall's Islands were used both for the interment of the anonymous dead and for those who could not afford a better final resting place. This applied particularly to residents of the island's many institutions.

A third burial was discovered while digging to repair a water main break behind the Mabon Building in 1995. W. Camargo, the plant superintendent of the Manhattan Psychiatric Center, stated that he saw only a skull and that it was "thrown back in the hold" (personal communication, Feb. 21 2001). The Police Department's Street Crimes Unit determined that investigation was not warranted because the remains were not recent; no further investigations were performed.

In the 1920s to 1930s, land was also set aside for the sewer plant and a right-of-way was laid out for the RFK (Triborough) Bridge (begun in 1929) (New York City Department of Parks 1953). In 1935, four hundred patients in the House of Refuge were moved. The plan was to demolish that building as well as eighty-seven other large and small structures by the end of 1936 (New York City Department of Parks 1935). In 1938, the Works Progress Administration (WPA) began to develop 38 acres at the southern end of Wards Island for parkland and the old civil war dormitories were destroyed. But in 1943, the Manhattan State Hospital ignored a mandate demanding the shutdown of that facility, and in 1954 a $350-million bond fund added three new buildings to the hospital. In 1979, the Manhattan State Hospital was reconsolidated into the Manhattan Psychiatric Center and it was renovated in 1988. In the same year the City opened a "temporary" emergency shelter for 200 homeless men, which later became known as the Charles Gay Homeless Shelter. It is still operational, housing over 500 individuals.

3.3 The Potter's Field

This section traces the history of potter's fields in New York and presents the available evidence on the possible locations of the Wards Island potter's field. The potter's field was the burial place of last resort for the poor, the unknown and the unclaimed dead. Riis observed: "The Potter's Field stands for utter, hopeless surrender. The last the poor will let go, however miserable their lot in life, is the hope of a decent burial" (Riis 1891:224). The custom of providing a place to bury the poor or friendless is ancient. A potter's field is mentioned in St. Matthew 27: l-10. Because it was unclean to keep Judas' "blood money" in the temple, the chief priests took the thirty pieces of silver that the repentant apostle had cast down and used the funds to purchase a potter's field as a burial site for strangers, or foreigners.

In Colonial New York, middle class, white Christians were buried in their churchyards. But African slaves and freedmen, indigent whites, and in some cases Jews, buried their dead on the outskirts of the town near the potters' workshops and tan yards. During the Revolutionary War, prisoners were buried in the area now occupied by City Hall Park, where the almshouse was then located.

In 1796, the City purchased its first potter's field at the junction of the Albany and Greenwich Roads, and hired a keeper at six shillings a day (Macatamney 1909:124). But in 1800, city authorities decided that it was too near the public roads, and a new site in the area of present-day Washington Square was selected. The Washington Square site was used until 1823, by which time the City had grown into that neighborhood, and a new location was established at 5th Avenue between 40th and 42nd Street, the current Bryant Park (Lossing 1884; New York City Department of Correction 1967).[8] The burial plot, however, was transformed in 1842 into the Murray Hill distributing reservoir (fed by the new Croton Aqueduct) and the human remains were moved to 4th Avenue and 49th Street. No permanent rest would be given here, because the potter's field was later given over for a woman's hospital. The disinterment of remains for reburial at Randall's and Wards Islands was conducted throughout the 1850s to the consternation of city residents (Bahde 2006).

As early as 1835, one Jacob Lorillard petitioned the Council to move the potter's field to Randall's Island, which the city had purchased for this purpose (Klips 1980:542). But the Board of Assistants' Lands and Places Committee had settled on Randall's Island for

[8] See the report to the Board of Aldermen (1842:524-525), which pleads for the relocation of the burial ground whose "excessively offensive" effluvia were noticeable for several hundred feet around.

the location of an almshouse—opened in 1845—and did not want the potter's field to be situated there. Finally, in 1843, following eight years of indecision, the plan for a graveyard on Randall's Island passed the Council (Klips 1980:543-544, 547). The potter's field on Randall's Island remained in use at least until 1850 (Alms House Governors 1850:15).

The Manhattan 4th Avenue potter's field was still being used during the early 1840s, though the Randall's Island burial ground had opened. This would have reduced the number of interments on Manhattan. The continued use of the Manhattan burial ground is evidenced by two requests to the Board of Aldermen, one in January 1843, to remove a fence on the north side of the 4th Avenue potter's field and a second, at the end of 1844, to continue using the old potter's field during the winter (New York City Board of Aldermen 1842-1843:284, 1844-1845:54).

Contemporary documents indicated that the potter's field on Randall's Island was located south of the nurseries (Alms House Governors 1850:15). In 1850, the Alms House Governors reported that 1360 interments had been made in the potter's field between June 15 and December 31 (Alms House Governors 1850:3). The 1850 report also stated that the field was not large enough, and not actually suitable for burial:

> [The] field is upon rock, below the surface, so that the decomposition of human remains there interred, and the effluvia resulting from it, will not sink in the ground, but the latter will exhale and taint the atmosphere. Its proximity therefore to the Nurseries... is objectionable, and at certain seasons dangerous (Alms House Governors 1850:15) .

The dangerous season was summer. The "emanations from this spot vitiate the atmosphere in its immediate vicinity, and the prevailing southerly winds of the summer season waft the pestilential exhalations directly over the plot covered by the nursery buildings" (Alms House Commissioner 1849:23-24).

The warden of Randall's Island reported that of the "great number" of pits dug in 1849, six remained, and each could hold 120 bodies. These burial pits must have been smaller than the ones on Wards Island (below) and consequently, the Randall's Island potter's field would have contained more pits. The potter's field was in use for approximately seven years. In 1850, the rate of burial was around seventy individuals per week. This includes an elevated summer mortality rate, since the annualized number of 3,640 is rather high; over a seven year period, the number of interments would have been greater than 25,300. A more realistic figure is around 21,000. If each burial pit contained 120 bodies, at least 130 pits would have been required for the seven year period.

The location of the Randall's Island potter's field, like that of Wards Island, is not indicated on historic maps or plans for the period. The only area large enough to serve as a potter's field on Randall's Island, that is also relatively undisturbed, is at the southern tip, south/southwest of the Stadium.

The burial ground on Wards Island, which succeeded that on Randall's, most likely does not predate 1851, since the Corporation of New York only began acquiring land there in that year (Hoffman 1862:148). The Island was chosen as it was the "only locality appropriate for the purpose desired; the depth of its soil, its being free from rock, its isolated and secluded position, its convieniency of access…" (Bard and Oakley

1853:1259-1260). The old Randall's Island potter's field was generally considered inadequate being described in the press as a "disgrace to the city" (NYT 1854).

While there a number of descriptions of the potter's field, few of them isolate its location on the island. One of them is a report from the Metropolitan Board of Health which, in describing it as a vector for a cholera outbreak at the Emigrant Hospital, states the field "occupies the southern and low-lying extremity of the island." (Board of Health 1867:181, 252).

The best description of both the cemetery itself and its location is provided by an 1855 New York Times article that describes a visit to the site is some considerable detail (see Appendix A). The anonymous writer traveled in an open rowboat from the ferry pier at the foot of 116th Street in Manhattan to "Wards Island Hospital wharf" and then proceeded to walk southward to "the end of the Island." He met up with the "guardian" of the potter's field at a house described as being located a few rods (one rod is equal to 16.5 feet) from the shore with the Hog's Back in front and "a little to the left" and Mill Rock to the right when looking out over the water. To one side was an orchard and to the other "a little cove." Following a "crooked, right-angled path", the reporter and his guide traveled a quarter mile to the potter's field. Along the way, they stopped at the "old house on Great Barn Island." A structure with the same identification is labeled "A" on the 1851 USGS map (Figure 2). Eventually, a slight rise led to the gate of the burial field. The burial ground was a few rods northwest of the shoreline near "an abrupt wood crowned bank" overlooking Long Island. A hill, with a steeper stretch near the shore shown on the 1851 USGS map, may represent the features described in the article.

The burial process was summarized as follows: The human remains, in coffins, were rowed to a landing house "on the shore of the cove spoken of as hollowing the south end of Wards Island." This is the cove in the center of the southern side of the island. The bodies were then taken by road to a "large receiving vault at the western hill end of the cemetery" where they could be preserved in airtight chambers for a few days in case anyone came to identify and claim them.

The two acres of the potter's field were enclosed by a "tight board fence."[9] In one corner of the field, graded about four feet higher than the surrounding land, were three trenches measuring three hundred feet long by eighteen feet wide and fifteen feet deep. Note that this depth is more than twice that normally used for individual interments. A fourth had just been dug a few weeks before (NYT 1855). The burials were placed three coffins end-to-end across the trench, and layered up to within two feet of the surface. When the trench was filled, the earth from a new trench was used to cover the old, which further raised the level. As soon as the mound had settled, it was turfed and planted with "cedars, willows and other appropriate trees" (NYT 1855). In 1858, the pits still only occupied an area 400 feet square (NYT 1858). These would be enough, according to Mayor Tiemann, "to last for another 25 years".

The Wards Island trenches contained the burials of some 16,000 people, according to the anonymous reporter. They noted that the average number of burials per day was eighteen, or one hundred twenty-five per week, for a total of 6,570 in a year. However,

[9] The year before, 1854, a New York Times journalist reported that the enclosed area was "no more than half an acre"(NYT 1854).

this must represent the higher mortality rate of the summer months, resulting from epidemics. A third of the dead were sent to the burial ground by the Commissioners of Emigration, and were buried by the Governors of the Almshouse at a cost of fifty cents per burial.[10]

The total number of burials in potter's field in 1859 was 2,278, 2,383 in 1860 (Commissioners of Public Charities and Corrections 1861:65), 1,946 in 1864 (NYT 1866) and 2,828 in 1867 (Commissioners of Public Charities and Corrections 1868:435). In the latter year, 2,378 of the individuals were sent to the cemetery from the City and 450 from the State Emigrant Refuge and Hospital on the island itself. Only 13 bodies were claimed by and delivered to relatives. In 1857, the Corporation of New York added to the number of burials on Wards Island by transferring the remains of some 100,000 individuals from the old Manhattan potter's fields discussed above (Lossing 1884:668).

Because the trenches were mass burials and the individuals unknown, they were not identified with grave markers; "...no marble tablets and that earthly oblivion which the storied urn averts but a few brief years falls at once upon the sleepers"(NYT 1866).

However, there also were individual burials and these may have been marked. The Governors of the Almshouse fenced off a one acre plot on the west side of the potter's field for the "Randall's Island boys" residing in the Boys House of Refuge, opened on that island in 1854. And the 1855 New York Times reporter mentions that residents of the Almshouse might request that their friends be buried "in another part of the yard, and a headstone...or a board with the name and age painted on it... mark the spot." There were already "many such single graves." In sum, given the number of years in use, the burial practices and the mortality rate, the area occupied by the potter's field on Wards Island may have covered a smaller area than the cemetery on Randall's Island. In 1868, at the end of the cemetery's employment, it was described as consisting of "two large plots of ground" with one being consecrated by the Catholic Church and the other by the Protestant Episcopal Churches (Commissioners of Public Charities and Corrections 1868:29). Individuals were laid to rest in the plot designated for their religion and with the service being presided over by the appropriate cleric.

By the end of the 1860's Wards Island was increasingly viewed as an inappropriate location for the city cemetery. In 1868, the Commissioners of Public Charities and Correction reiterated the request to purchase land elsewhere due to "the increase of the population on the adjacent shores of the East river, and by the further erection of public buildings in close proximity to the Cemetery" (1868:29). In 1869, the Commissioners purchased property on Hart's Island for that purpose (NYT 1869). To date the potter's field on Hart's Island is still in use.

[10] By 1967, the price of an adult burial on Hart's Island had risen to $75 (New York City Department of Correction 1967:8).

3.4 Sensitivity Index

In a May 27, 2008 statement, LPC determined that the proposed action might infringe on areas potentially sensitive for human burials and historic archeological remains from colonial occupation and 19th century institutions. Consequently, this Phase IA archaeological assessment report was prepared by GRA for the proposed action (Schuldenrein, et al. 2008). Research was focused on the field areas that make up Randall's Island South (formerly Wards Island), consistent with the locations of the fields identified above. Each of the fields was assessed for its potential proximity to the presumed location of the 19th century potter's field, and a matrix was prepared to summarize low, medium, and high probability for the tracts included in that assessment. Further, a more general archaeological sensitivity evaluation was based on factors including previous construction and land use. The combined data for historic structures and the presumed whereabouts of the potter's field appear in the matrix in Table 1 and is central to the development of the probability map (Figure 6). These data were assembled with a view toward the sequence of disturbance on the island before that of the current project.

GRA's probability assessment for the project area indicated the following:

East River Fields was a medium to high probability area. While expansive construction over the area likely prohibited later use of the field as a burial site, construction debris from the buildings that occupied the site for a century would be expected to have left historic material remains. Therefore, it is possible that East River Fields may have construction debris mixed in with the fill.

Wards Meadow Fields, deemed low probability, is a low-lying area that was predominantly swampy throughout its earlier history. This location does not conform to the 1855 Times article description of the potter's field, but is tangentially referred to by the author. There was no agricultural development of the location and no significant construction before the early 1920's. Development of the area expanded with the construction of the supports for the RFK (Triborough) Bridge in the 1930's.

Hell's Gate Fields was determined to be a high probability area based on its elevation and similarity to the description in the 1855 Times article of the potter's field. The construction of the Inebriate Asylum (later Homeopathic Hospital), a multi-story building, on the western side of the field required that the central portion of the area be filled. Therefore, there is an additional potential for historical material in the area next to the former structure.

Central Fields, determined to be of medium probability, is elevated and was perhaps suitable for the potter's field site, though based upon the 1855 description it is likely too far inland. The area at the south end of the parcel has undergone substantial earlier construction and demolition in conjunction with modifications to the psychiatric hospital. Previously recovered human skeletal remains were attributable to the asylum garden at this location. However, this southern area is not included in the current project. The northern section of Central Fields was extensively plowed and subsequently planted with trees. This northern section is less likely to have been disturbed until the construction of the RFK (Triborough) Bridge. Therefore, there may be intact deposits from the period during which this area was leveled for institutional use.

Sunken Garden Fields was determined to be a medium probability area. This location was only moderately altered as a result of prior construction, making it likely to preserve earlier deposits.

Table 1.

RANDALL'S ISLAND SPORTS FIELDS PROJECT

PROPERTY	FIELD NUMBERS	HISTORICAL BACKGROUND	ARCHEOLOGICAL SENSITIVITY (LPC Comments 5/27/08)	CONSTRUCTION STATUS	EXCAVATION TO BE COMPLETED	ARCHEOLOGICAL SENSITIVITY BASED UPON HISTORICAL RECORDS	RECOMMENDATION
EAST RIVER FIELDS	80 thru 85	structure* shown on 1887 map (not named)	Potential for recovery of human burials and remains from colonial occupation and 19th century hospital	Fields 100% complete	0%	extensive and expanded construction in the area, medium to high probability of historical material	Spoil pile testing and Geoprobe cores
WARDS MEADOW FIELDS	70 thru 75	swampy area; light construction first appears in 1920's	Potential for recovery of human burials and remains from colonial occupation and 19th century hospital	Fields 100% complete	0%	very little prior construction, low probability of human burials and historical materials	Spoil pile testing and Geoprobe cores
HELL'S GATE FIELDS	62 and 63	structure* shown on 1887 map (opened in 1868 it became the Homeopathic Hospital which stood until the mid-1900s)	Potential for recovery of human burials and remains from colonial occupation and 19th century hospital	Field work on hold	60% - utilities trench	elevated area supported a large structure with basement for nearly a century, high probability of historical material and burials	Spoil pile testing and Geoprobe cores
CENTRAL FIELDS	50 thru 54	1851 map shows area with four small hillocks (kames) subsequently leveled, Mental Hospital at southern end from 1880's till present	Potential for recovery of human burials and remains from 19th century hospital	Fields 80% complete	0% - sod not in place	elevated landform leveled between 1851 and 1887, partly planted, part under buildings, medium probability of historical material	Spoil pile testing and Geoprobe cores
SUNKEN GARDEN FIELDS	90 and 91	structure* shown on 1924 map and is shown on 2007 demolition drawing	Potential for recovery of human burials and remains from colonial occupation and 19th century hospital	Fields 80% complete	0% - sod not in place	elevated landform with small construction footprint, medium probability of historical material	Spoil pile testing and Geoprobe cores

*NOTE: All brick and stone structures include a fully excavated basement

Table 1. Archaeological Sensitivity Matrix.

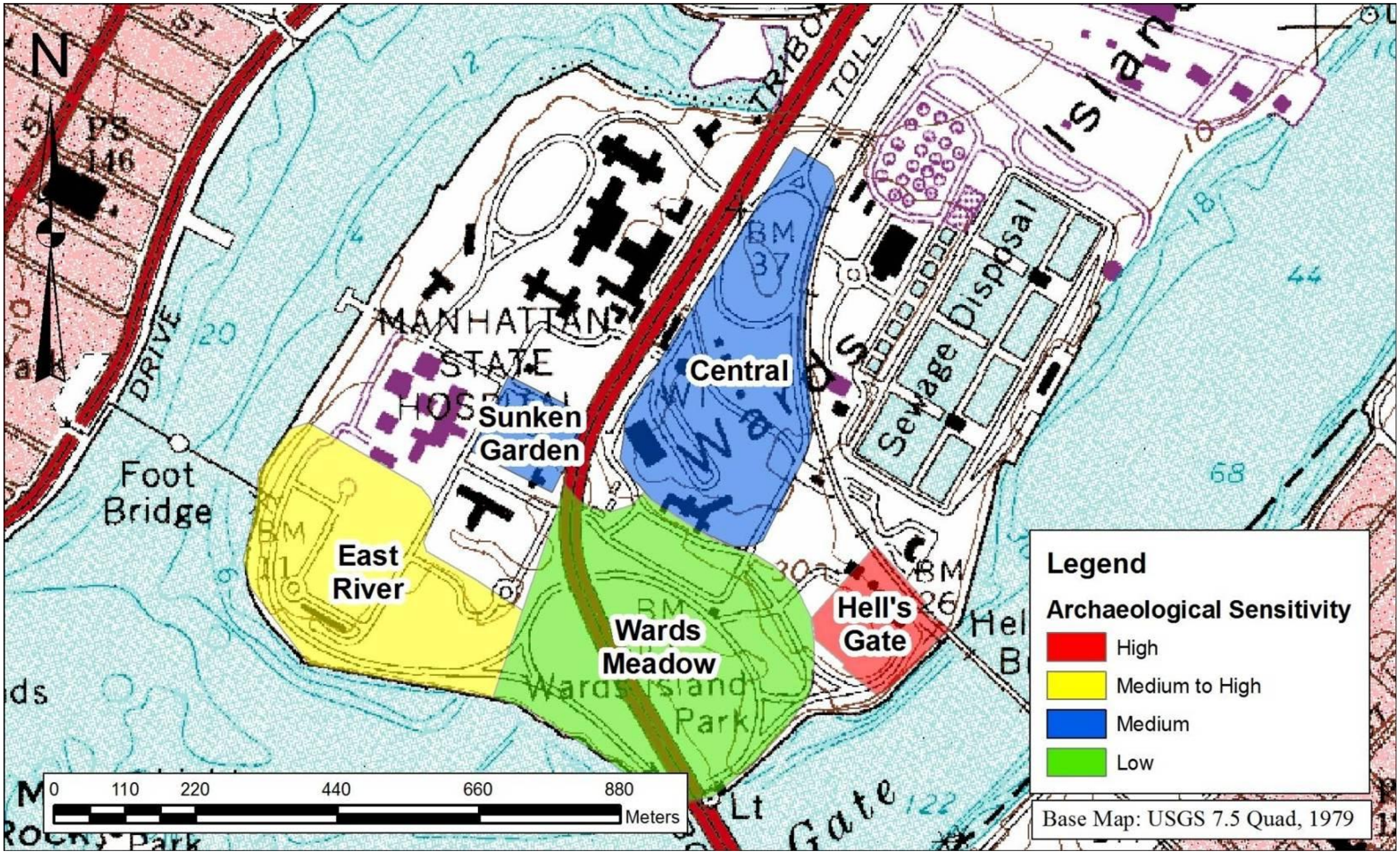


Figure 6. Archaeological sensitivity map developed for Phase IA report.

4. Results of Archaeological Testing

A Scope of Work for a Phase IB archaeological assessment of the areas was submitted by GRA to the New York City Landmarks Preservation Commission (LPC) in October 2008. The scope of work that was approved by LPC on 10 October 2008 (24708_FSO_ALS_10162008), proposed that testing for buried archaeological resources would be undertaken in two separately staged field phases. The first would involve backhoe and auger testing of existing spoil piles that had accumulated along the peripheries of each of five parcels. The second was to utilize a geoprobe to conduct a series of subsurface probes aligned on transects spanning each of the parcels.

Fieldwork was performed on all parcels approved by the RISF between November and December 2008. At the time of this investigation authorization for subsurface testing at the East River Fields and the southwestern quadrant of Wards Meadow had not been granted by the client because of construction activities at these tracts.

4.1 Spoil Piles Testing

Testing of the spoil piles associated with RISF landscaping activities was undertaken on November 12-13, 2008. Objectives of the study were to characterize the matrix and composition of the soils and sediments within the piles; to determine their origins and antiquity; to search for artifacts or evidence of disturbance of potential historically significant deposits; and to identify episodes of spoil pile accumulation.

A total of four (4) spoil piles on Wards Island were investigated (Figure 7). One spoil pile was reported to contain a combination of sediments from the East River and Wards Meadow locations; a second consisted of topsoil from Hell's Gate; a third included construction fill from Sunken Meadow; and a fourth, smaller pile was unidentified and located on Wards Meadow. A backhoe was utilized to create vertical exposures in each spoil pile after which profiles were drawn and descriptions made.

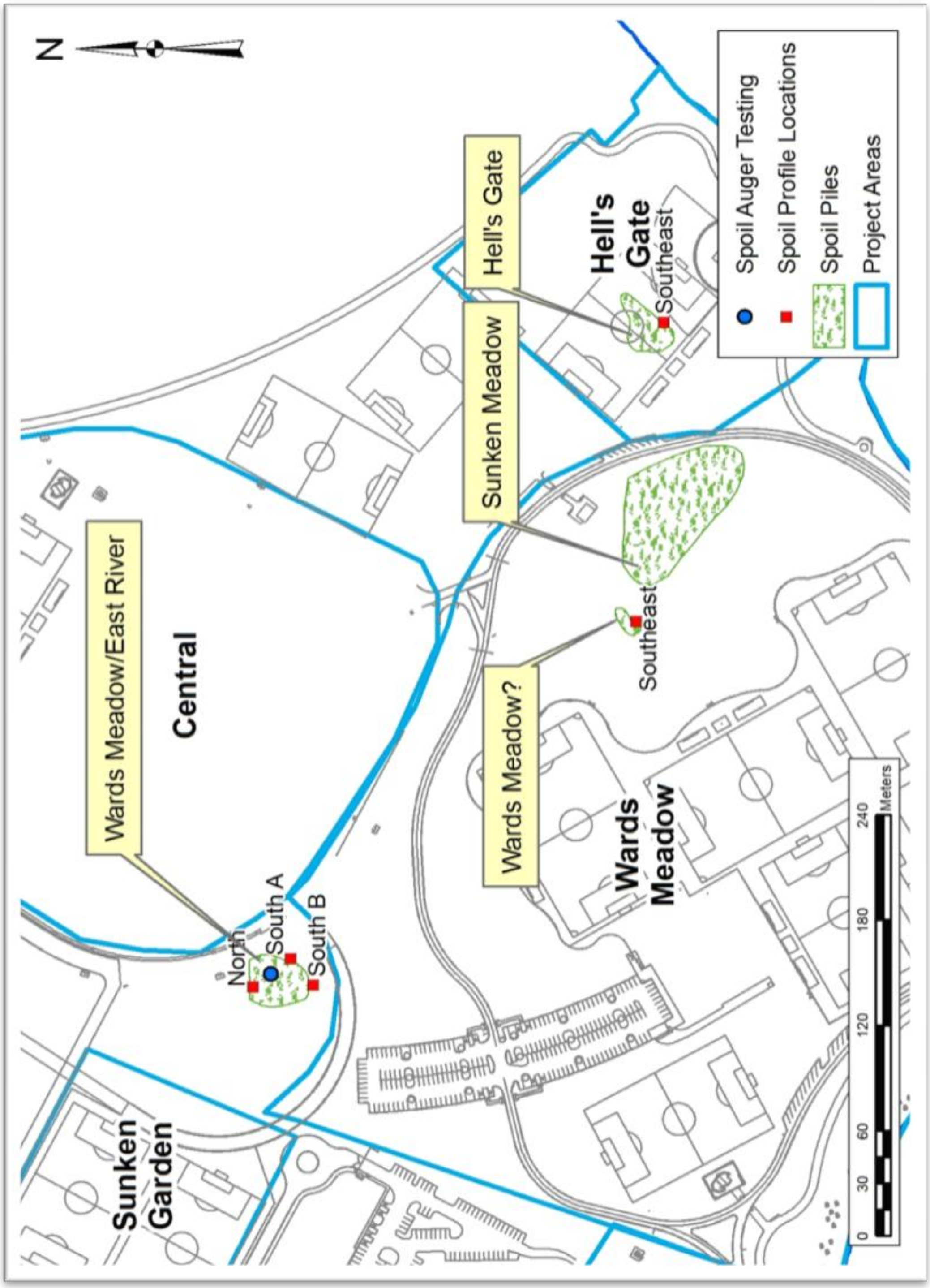


Figure 7. Locations of spoil piles investigated.

4.1.1 East River and Wards Meadow Spoil Pile

It was determined that the East River/Wards Meadow spoil pile was more likely to contain cultural material of interest than the others due to the heterogeneous composition of the latter's matrix (see below). Therefore, the bulk of the field effort was directed at this locality. Three (3) profiles were examined and the inspections were supplemented by the excavation of two auger tests. The northern end of the spoil pile had been removed prior to the investigations, which exposed a large profile that was subsequently exposed and recorded (Figure 8 and Figure 9).

Figure 8. Spoil pile from East River and Wards Meadow landscaping, view to the south/south-east.

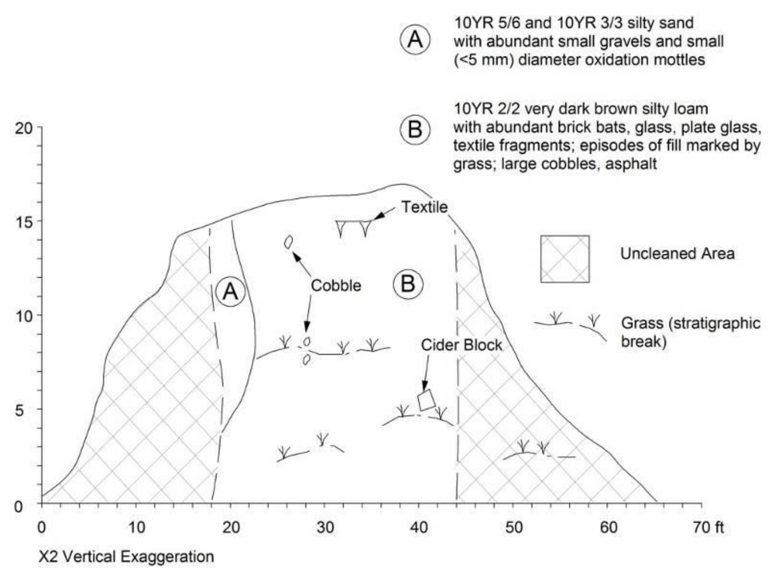


Figure 9. Northwest profile of spoil pile from East River and Wards Meadow.

Sediment composition was generally homogeneous (dominated by silt to silty clay loam) and featured variable components of poorly sorted gravels and cobbles. Historic stratification was marked by discrete fills featuring matted grass lenses. Cultural material consisted of brick bats, scraps of cloth, a cinder block and variably crushed and broken distributions of plate and bottle glass. A lighter colored sandy deposit was noted on the eastern side of the profile and is marked (A) in Figure 9.

Two profiles were recorded at the southern end of the spoil pile (Figure 10 and Figure 11). A representative photo is shown in Figure 12.

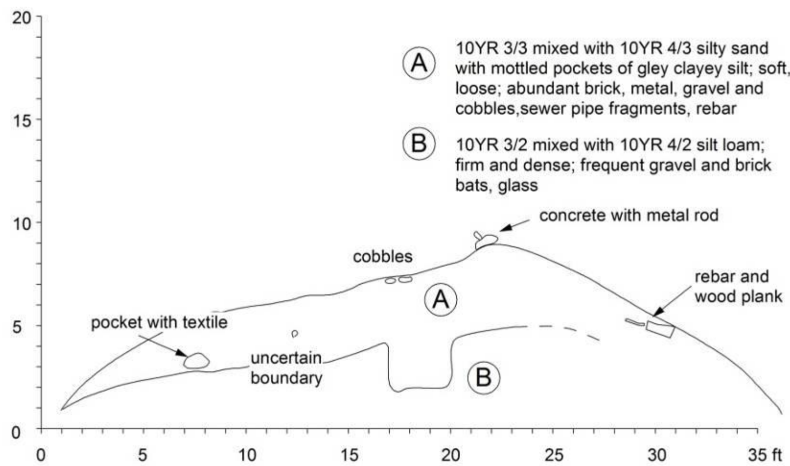


Figure 10. South profile A of spoil pile from East River and Wards Meadow

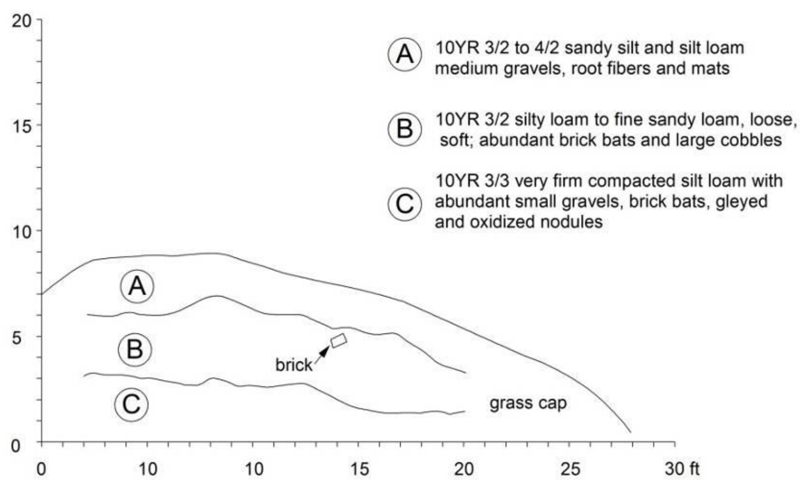


Figure 11. South Profile B of spoil pile from East River and Wards Meadow

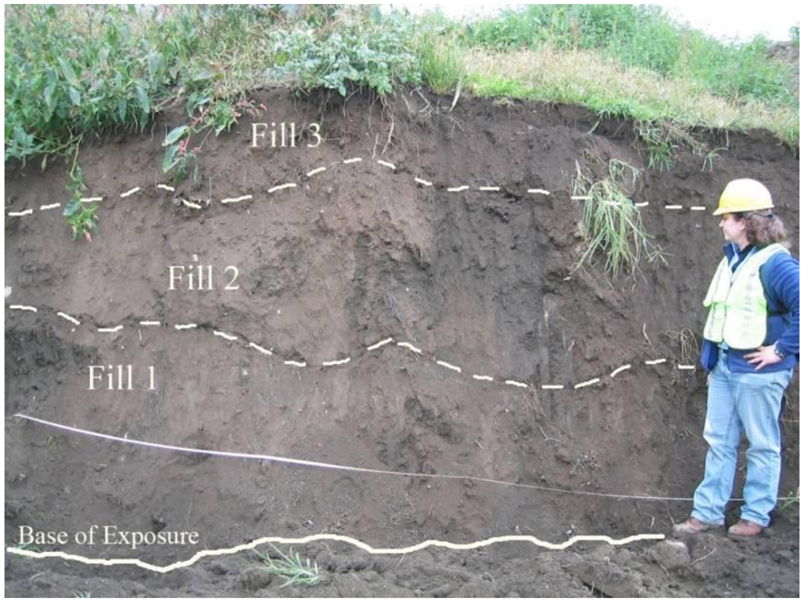


Figure 12. South Profile B of spoil pile from East River and Wards Meadow.

At south profile B, three major episodes of deposition were clearly demarcated by layers of matted vegetation as well as by a subtle change in sediment matrix composition, color, and texture. Sediment composition within each stratum was generally homogeneous (silt to silty clay loam) and featured significant quantities of poorly sorted gravels and cobbles. The lowest stratum contained gleyed and oxidized nodules, indicative of periodic waterlogging. Cultural material was found in all strata and was generally comprised of brick bats, scraps of cloth, and small quantities of plate and bottle glass. No artifacts of identifiably pre-modern attribution were found and the context attested to considerable, episodic, and extensive reworking. Matrix composition and artifact distributions were consistent with fill activity attendant to landscape reclamation and terrain modification.

Two hand augers were dug at the apex of the spoil pile. The first terminated at a rock impasse at 1.5m and the second at .57m. In both cases, the first .3m of matrix was 10YR 4/2 silt loam. A lower stratum consisted of a 10YR 3/1 gravelly sandy loam with roots, grass, and modern domestic and construction trash (e.g., bottle cap, plastic, etc.).

4.1.2 Hell's Gate Spoil Pile

The spoil pile on the Hell's Gate property was comprised of topsoil scraped from the immediate vicinity (Figure 13). The matrix was uniform, friable, loose and texturally homogeneous from top to bottom. Minimal quantities of cultural material were observed within the pile, and were limited to a few pieces of green bottle glass and some bottle caps. Horizontally differentiated episodes of deposition were noted (Figure 14).

Figure 13. Spoil pile at Hell's Gate. View to the west.

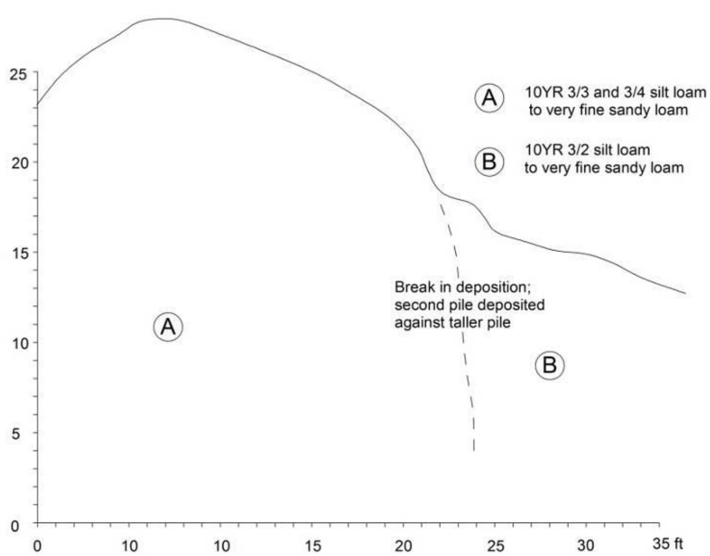


Figure 14. East profile of spoil pile at Hell's Gate.

4.1.3 Wards Meadow Spoil Pile

A small spoil pile was located on the Wards Meadow property (Figure 15 and Figure 16). Covered by extensive vegetation, the matrix was similar to that of the Hell's Gate pile. As elsewhere, homogeneous matrices were dominant, and the source matrix was topsoil scraped from the immediate environs. No cultural material was retrieved.

Figure 15. Spoil pile at Wards Meadow. View to the south.

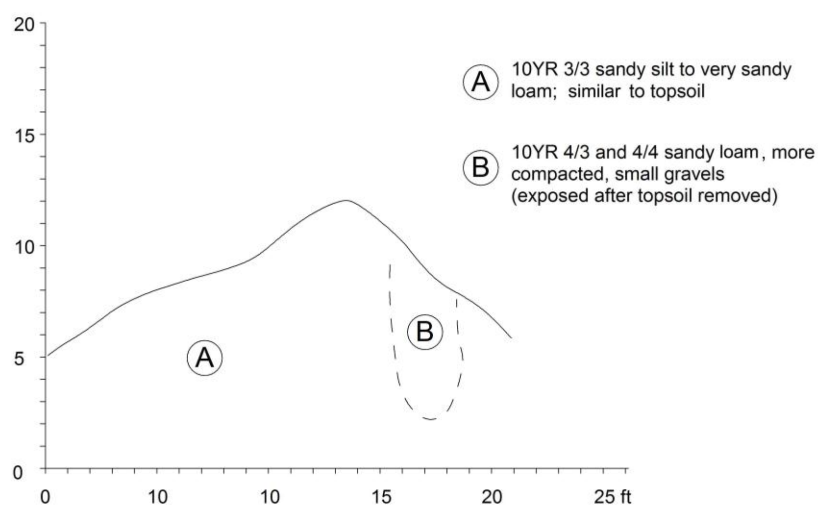


Figure 16. North profile of spoil pile at Wards Meadow.

4.1.4 Sunken Garden Spoil Pile

The largest spoil pile investigated occupied the edge of the Wards Meadow property (Figure 17), but the fill was transported from the Sunken Garden tract. Sunken Garden is "made land" first created in the 1930. Expectations were low for recovery of cultural materials. The fill was primarily construction debris with abundant concrete rubble, re-bar sections, broken bricks and asphalt slabs. Some bedrock schist fragments were also noted in the 2.5 YR 3/3 sandy loam matrix.

Figure 17. Spoil pile on northern edge of Wards Meadow. View to the north.

4.1.5 Conclusions on Spoil Piles

On the basis of infield observations—specifically spoil pile sampling, profiled exposures and limited augering through accessible spoil hillocks—it was concluded that these recently-created mounds did not contain significant cultural remains, either culturally or contextually. It was determined that the spoil piles could be remobilized as secondary fill material to recontour the landscape without adverse impact to cultural resources. LPC concurred with these conclusions (24708_FSO_ALS_11142008) and the spoil piles were subsequently removed and redistributed across the terrain.

4.2 Geoprobe Methodology

The geoprobe subsurface recovery strategy involves the sequential extraction of segmented cores housed in plastic sleeves in continuous 4 ft lengths. Core segments measure 1 ¾ inches in diameter. A Geoprobe™ coring device extracted the cores (Figure 18). Probing ceased when the core encountered obstructions of either bedrock or resistant gravels. All of the core sleeves were sealed in the field and transported to GRA's lab facilities where they were subsequently split, described and sampled (see Figure 19). The cores were described using standardized pedo- and litho-stratigraphic terminology (ISSC 1994; USDA 1994). After stratigraphic descriptions were completed, core matrices were passed through ¼ inch wire mesh for artifact recovery. Samples of historic materials as well as organic sediment matrices for radiometric analysis were collected.

Figure 18. Geoprobe equipment at Hell's Gate.

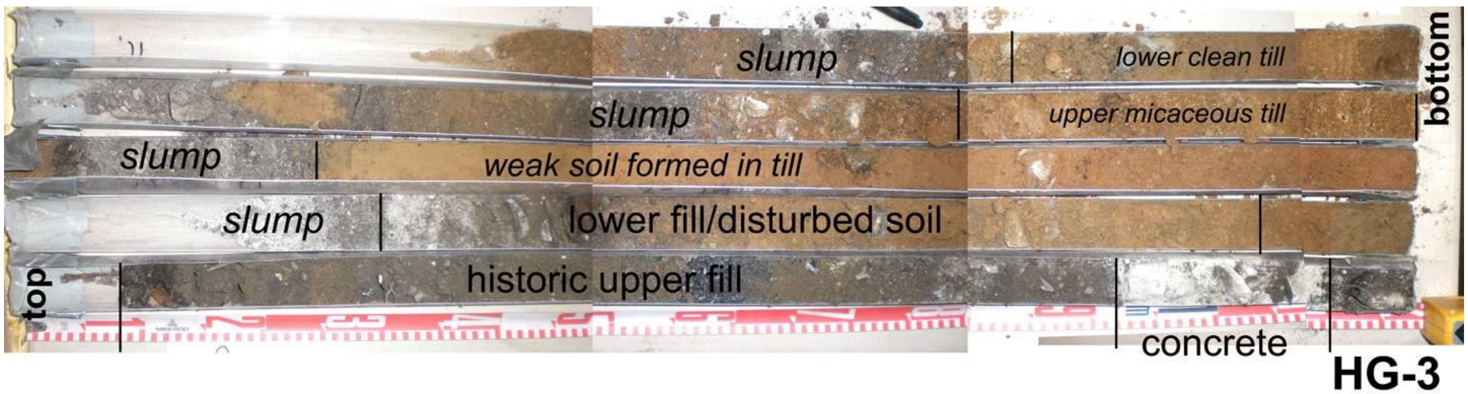


Figure 19. HG-3 presented as an example of a split core. "Slump" refers to sediment derived from upper portion of core during excavation and does not represent in situ material

4.2.1 Hell’s Gate Observations

The earliest detailed landscape depiction of the project area is the Coastal Survey map of 1851 (Figure 20). That projection depicts the project area as an upland U-shaped level ridgetop with a swale in the center of the “U” that was bound by another ridge to the north trending to a crest along the East River, labeled “Negro Point” in 1851 and 1887 maps. By 1887, the local landscape had been drastically reworked (Figure 21). The swale had been in-filled, and a hospital and grounds were built on the property. Subsequent construction of the New York Connecting Railroad Bridge (now known as Hell’s Gate Bridge) in 1917 and the removal of the hospital would also have impacted the project area.

The archaeological sensitivity of Hell’s Gate Fields primarily relates to two historically known institutions associated with the New York Commissioners of Public Charities and Corrections: a hospital and an indigent burial ground (i.e. potter’s field). The Hell’s Gate Fields area is the highest point on Wards Island. Upon this elevation an Inebriate Asylum with accommodations for 350 individuals was built between 1866 and 1868. The multi-story building also briefly housed Civil War Veterans before being converted into the country’s first Homeopathic Charity Hospital in 1875. It was finally demolished during Robert Moses’ infrastructure projects in the 1950s. In addition to potential archaeological features related to this institution, the Phase IA report concluded that the location may have been the site of the Wards Island potter’s field based on its similarity to the latter as described in the 1855 New York Times article described above (see page 21).

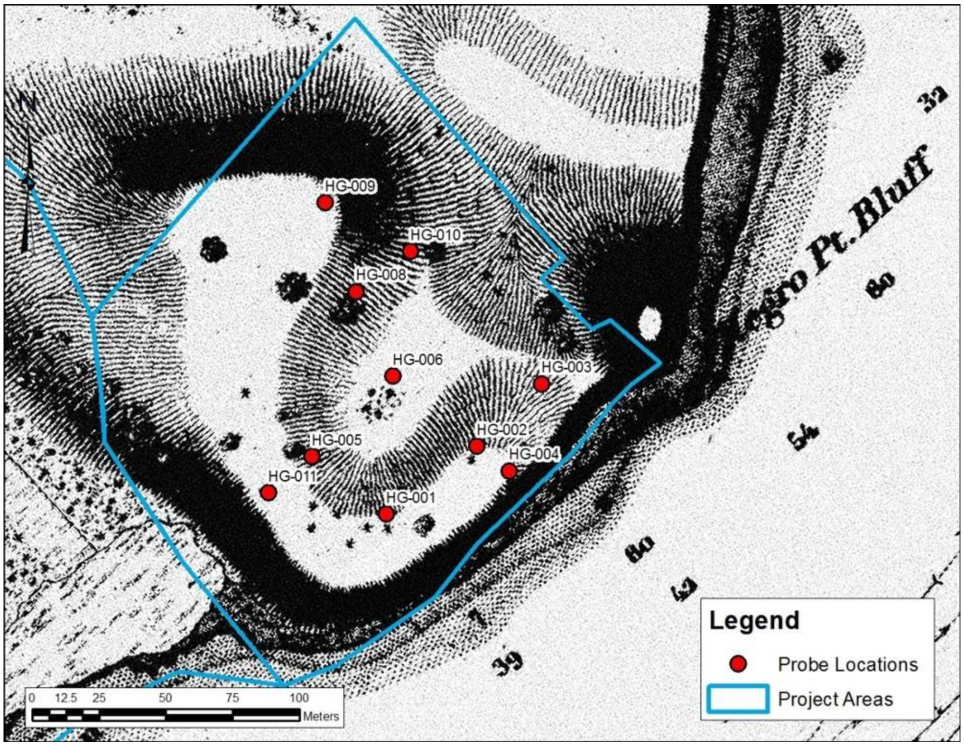


Figure 20. Hell's Gate probe locations superimposed on 1851 map (Survey of the Coast of the United States, 1851).

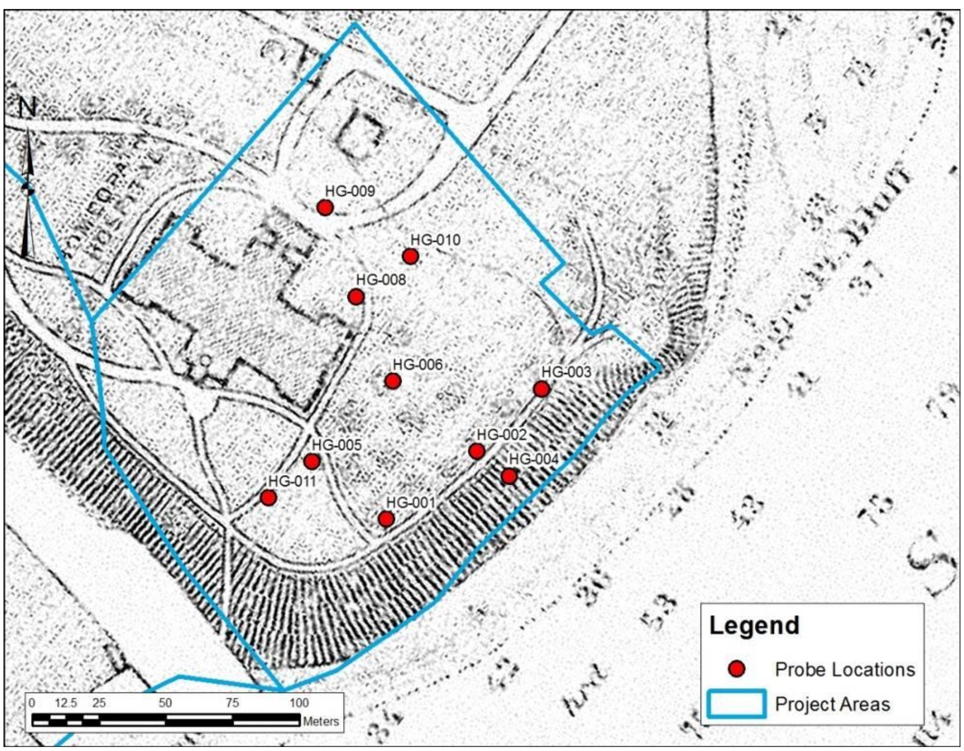


Figure 21. Hell's Gate Probe locations superimposed on 1887 map (Coast and Geodetic Survey, 1887).

4.2.1.1 Field Work

A total of ten (10) geoprobe cores were excavated from the Hell's Gate Fields parcel (Figure 22). Eleven (11) localities were tested; however one testing locality was not sampled (HG-7) due to an impenetrable ground cover of rubble and construction debris. Locations were designed to provide systematic coverage across the entire project area. The only area excluded was the footprint of the now demolished homeopathic hospital in order to avoid its basement and footing fill. In the field, other location adjustments were made to accommodate probe refusals, construction debris, and the heavily disturbed surface associated with tower footings of the Hell Gate Bridge.

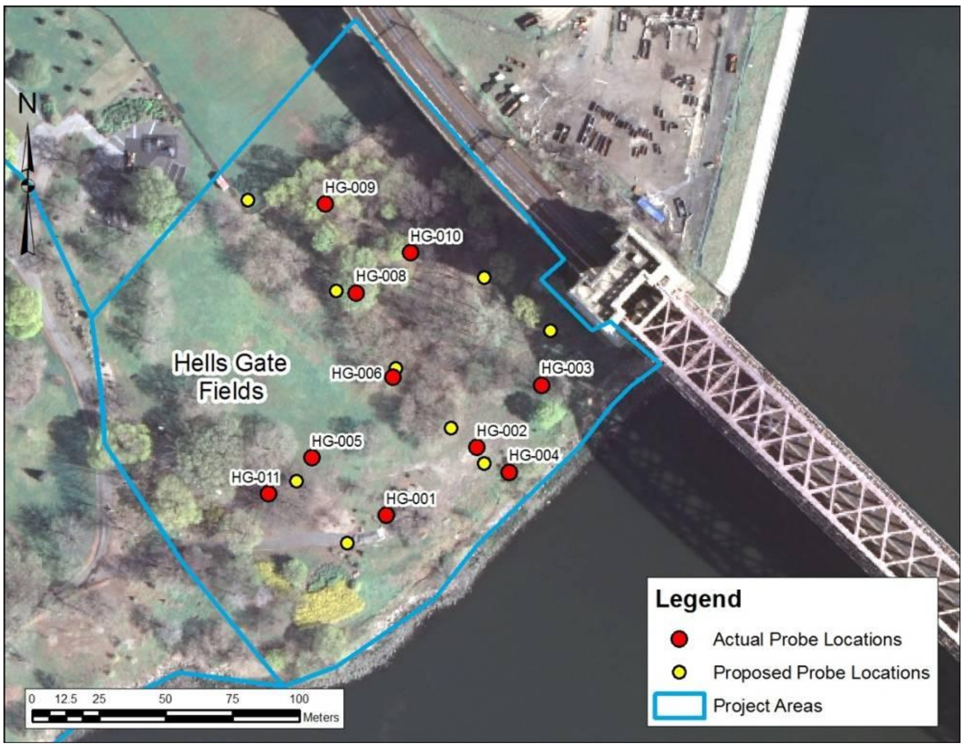


Figure 22. Aerial image of Hell's Gate Fields with proposed and actual Geoprobe locations (base: 2006 USGS orthoimage).

In addition to the cores, an exposure created by road construction along the southern edge of the proposed construction area (Figure 23) provided limited 2-3 ft deep exposures, which aided in the interpretation of core stratigraphy (e.g., Figure 24). The aim of the investigations was to develop a stratigraphic sequence for the fields to determine the potential for buried prehistoric or historic cultural resources which could be impacted by future construction.

Figure 23. Road cut profile locations on 2006 aerial image.


Figure 24. Representative road cut profile (38 ft).

4.2.1.1 Surface Features

For logistical and descriptive purposes, it was convenient to subdivide the field tracts into zones. The central zone (primarily the location of the former hospital building) was free of vegetation and stripped of topsoil. Wall remnants from the former hospital building were clearly visible in areas, some of which consisted of stone blocks while others consisted of brick (Figures 25, 26). When superimposed on the 1887 map, the walls are offset to the southwest by about eight meters (Figure 27). This displacement may reflect the limitations of the surveyor's GPS measurements, the accuracy of the original map, the georeferencing of that map, or a combination thereof.

Figure 25. Stone wall remnant (view to west).

Figure 26. Brick wall remnant (view to north).

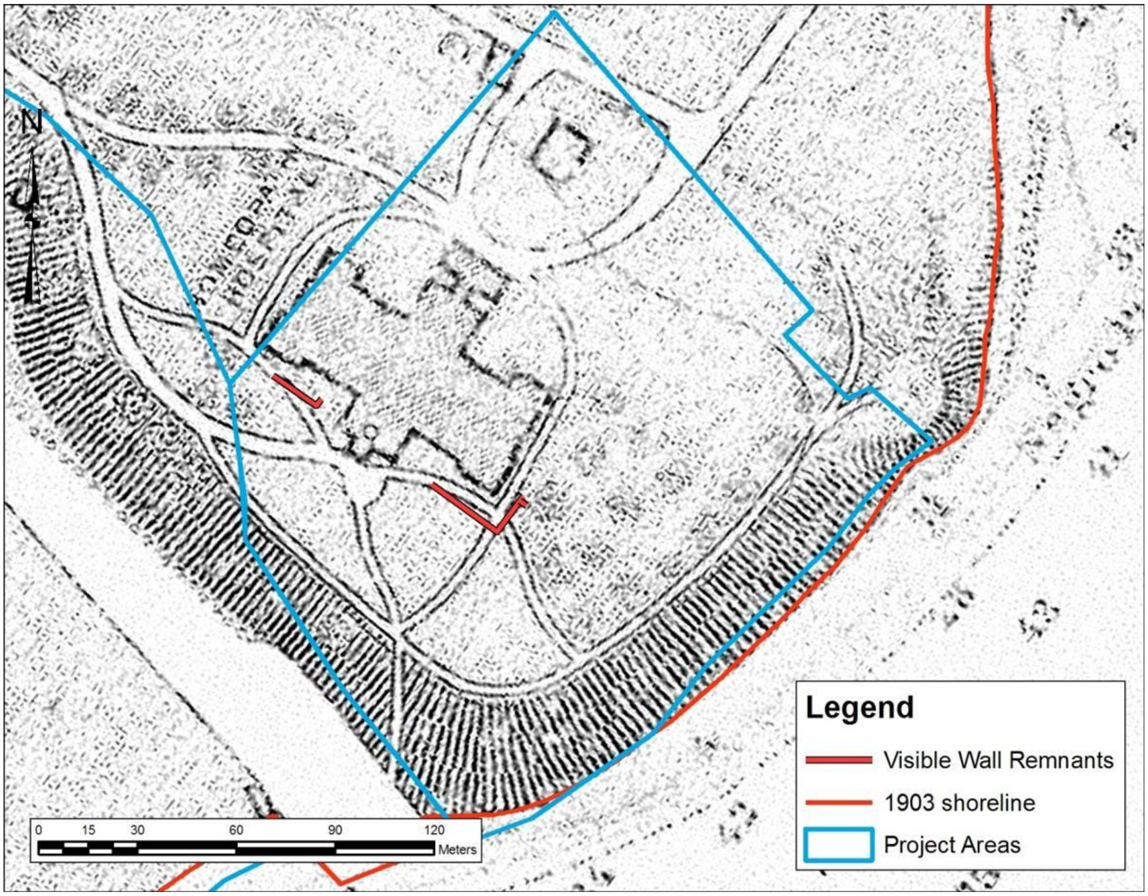


Figure 27. 1887 map of Hell's Gate Fields location with modern visible wall elements overlaid (Coast and Geodetic Survey, 1887).

The zone adjacent to the Hell Gate Bridge was covered by extensive scrub interspersed with trees. Surface gradients were uneven and the ground was littered with extensive construction debris. Surface features included segments of street curb and an *in situ* fire hydrant (Figure 28). The southwest and southeast portions of the property were relatively free of scrub and lightly wooded. An asphalt pathway ran along the southern and eastern edge of the bluff. A forerunner to this pathway is visible in the 1887 map at approximately the same location (see Figure 27).

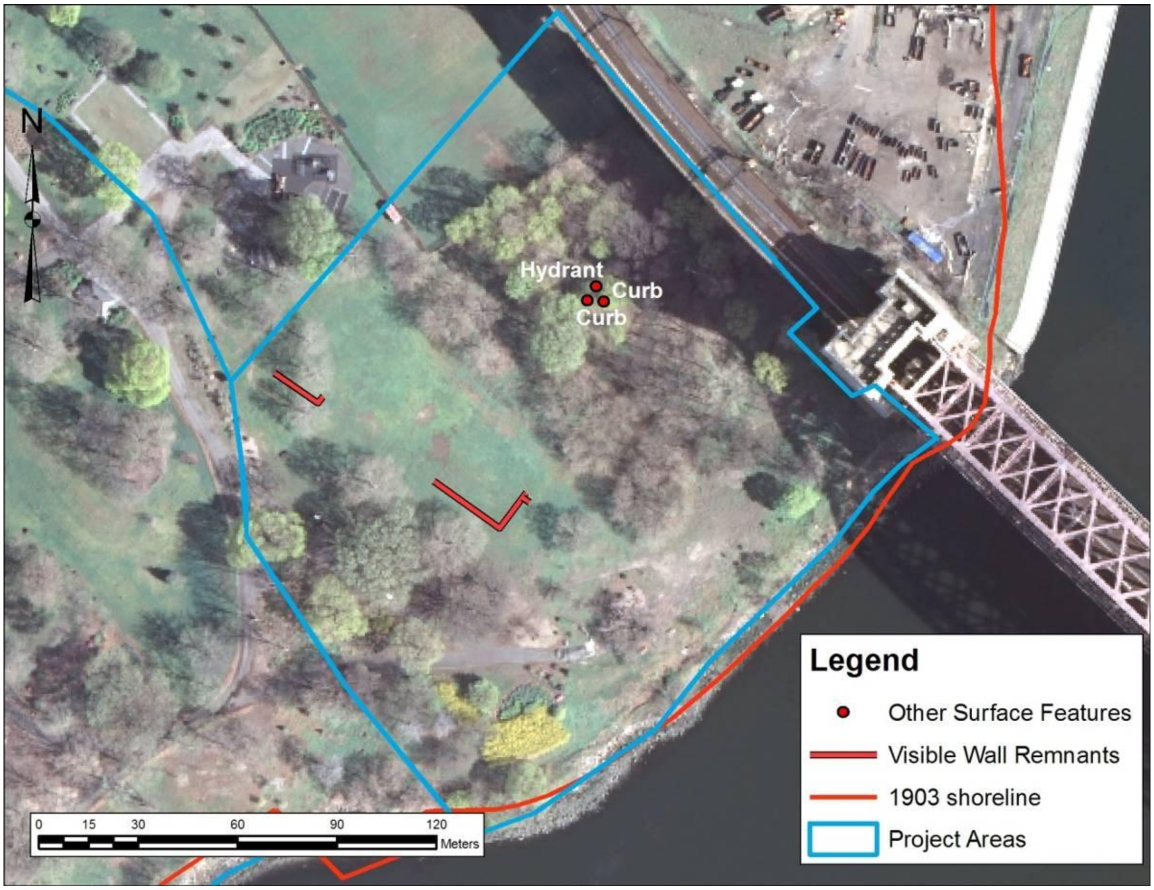


Figure 28. Aerial image of Hell's Gate Fields with surface feature locations (base: 2006 USGS Orthoimagery).

4.2.2 Hell's Gate Fields Stratigraphic Observations

The cores preserved evidence for three discrete stratigraphic complexes across the area of the proposed Hell's Gate Fields (see Figure 29):

1) ***Shallow fill capping disturbed subsoil formed in glacial till*** was observed in the southeastern portion of the project area in cores HG-1, HG-5, and HG-11. Here fill and disturbed soils extend to a maximum depth of approximately 1 m (~3.3 ft). Relatively intact subsoil formed in glacial till was observed in these cores, which suggests that the Pleistocene (and therefore pre-cultural) glacial till below the disturbances are intact. Gravel or gneiss bedrock at the base of these cores was encountered at a range of 260-435 cm (8.5-14.3 ft).

2) ***Multiple historic fill sequences above glacial till*** were observed in two cores along the eastern edge of the project area overlooking the East River (HG-3 and HG-4) and one near the center of the project area (HG-10). In these cores the fill succession is deeper with depths exceeding 2 meters (6.6 ft). The fill is composed of cinders, brick fragments, and some modern plastic debris. Concrete was observed in HG-3 and HG-4 and separates the upper fill of cinders, brick and construction materials and a deeper historic disturbance matrix that is incorporated into an underlying soil formed in glacial till. This concrete is probably derived from the pathway visible on the 1887 map or a later pavement (see Figure 8). Bedrock gneiss or impenetrable gravels were encountered between 460-575 cm (15.1-18.9 ft).

3) ***Deep historic fill unconformably overlying truncated glacial till*** was identified in cores HG-2, HG-6, HG-8, and HG-9. These cores are distributed across the project area, with three cores located on the edges of the historic U-shaped ridge (HG-2, HG-8, HG-9) and one in the basin of the small swale (HG-6) depicted in the 1851 map. The fills in these contexts is generally deeper than the other settings, with depths extending to 3.0 m in HG-6 and 4.0 m in HG-8. These deep fill sequences are devoid of cultural artifacts or trash and contain heterogeneous gravels and sands with occasional root fragments. The greater depths of fill may be due to the infilling of the depression with sands and gravels in advance of the hospital construction starting in 1866. The underlying bedrock or impenetrable gravels ranged in depth from 4.6-5.4 m (15.1-17.7 ft).

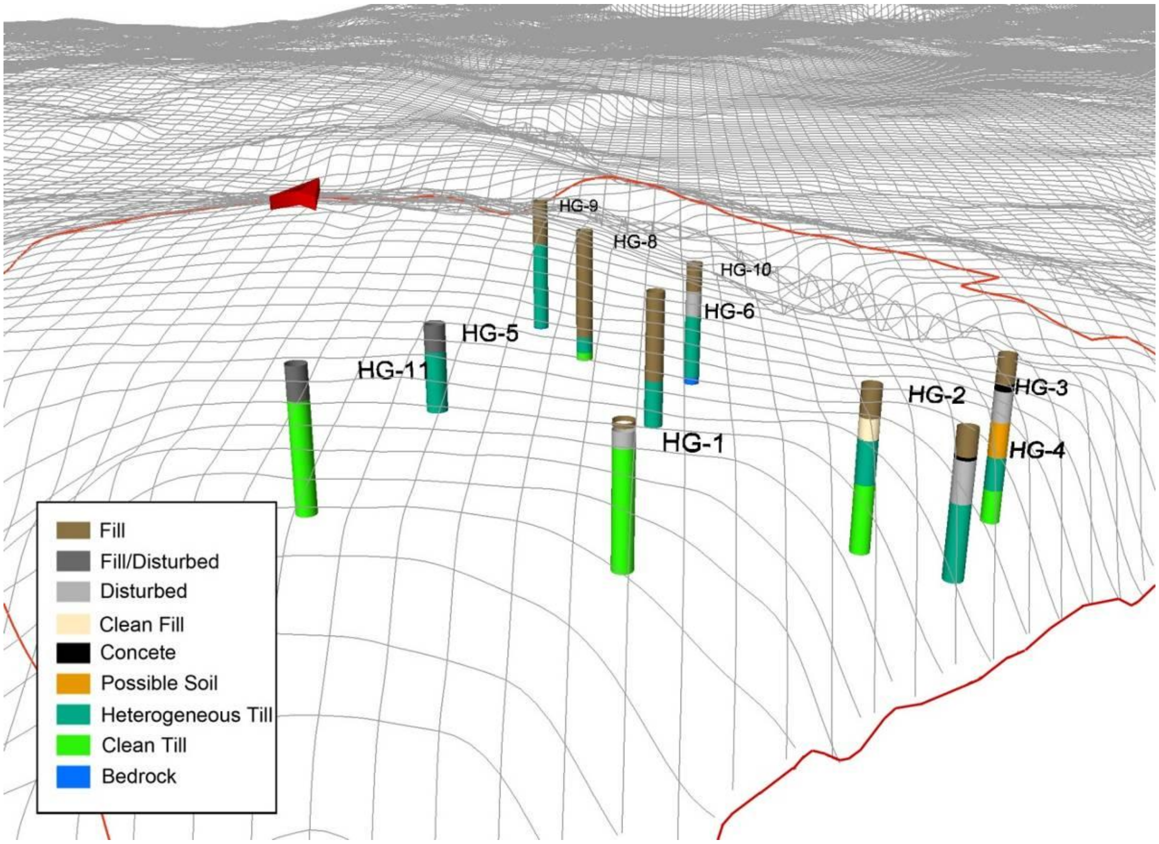


Figure 29. 3-D model of probes and surface of Hell's Gate Fields (view to north, 20 foot grid overlay and x5 vertical exaggeration).

Cultural artifacts were limited to historical items preserved in fill. The only discernible pattern in their distribution is that the majority of artifacts were found in cores with multiple fill sequences (HG-3, HG-4). In these cores flat clear glass (3/16 inch thick), a plastic bottle rim, and small plastic bag fragments were identified in deep fill below concrete. One clear glass fragment was identified within fill in HG-8 near the surface. The recovery of plastic in the deeper fill sequence suggests that the cinder-rich upper fill deposits are relatively recent (<50 years). The lack of artifacts in what is likely 1860s fill of the original topographic depression suggests clean fill gravels were used to level the surface. Taken together, the lack of historic artifacts and the absence of evidence for an intact surface argues for a low probability for deeply buried cultural contexts—both historic and prehistoric.

The Phase IA report indicated a high potential archaeological sensitivity for the Hell's Gate Fields property based upon the presence of the homeopathic hospital, a higher elevation, and similarity to a historic description of the Wards Island potter's field. Geoprobe testing, however, reveals that the entire area has undergone numerous episodes of fill deposition signifying extensive and multiple episodes of reworking of the landscape. The shallowest depth of this fill and/or disturbance is located in the southeastern section of the property where it ranges from 0.7 to 1.0 m (see Figure 30). While there is a possibility for perseveration of post-landscaping (circa 1860) features *within* the reworked fill, it is unlikely that any significant features pre-dating that period have survived intact. Post-1860 features encountered during the course of fieldwork included remnants of the homeopathic hospital and 20th century street utilities. The testing provided no evidence that any portion of the Wards Island potter's field was located on the Hell's Gate Fields property.

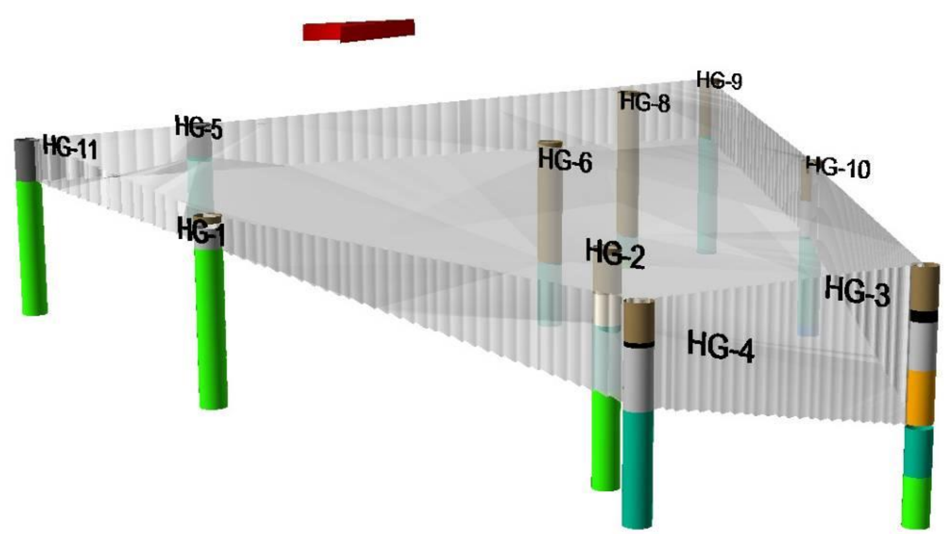


Figure 30. 3-D view of probes showing the stratigraphic layers above till in grey (view to northwest). Note the relative thinness of these layers in the cores comprising stratigraphic complex 1 (SE portion of study area).

4.2.3 Central Fields Observations

The Central Fields are located it what once was the uplands of Wards Island. The 1851 coast survey map of the project area depicts the Central Fields area as higher terrain with distinctive small hills towards its southern half (Figure 31). These discrete small hills are potentially landscape features created by glacial action, commonly known as kames. Kames are knob-like mounds or ridges of stratified sands and gravels deposited by a glacier (Martini, et al. 2001). There are a number of ways these landscape features form: they can be deposited by a subglacial streams, within depressions along supraglacial streams, or along the margins of a retreating glacier. These features are common in glaciated terrain; however, like many natural landscape features in the New York City area these features have been systematically leveled across the landscape in the interests of historic agriculture and building construction. The project area is now level terrain with no surface expression of these glacial features; however, some evidence of these features was identified in core stratigraphy. The 1887 coast survey map has no indication of the kames, therefore they must have been leveled between 1851 and 1887 (Figure 32).

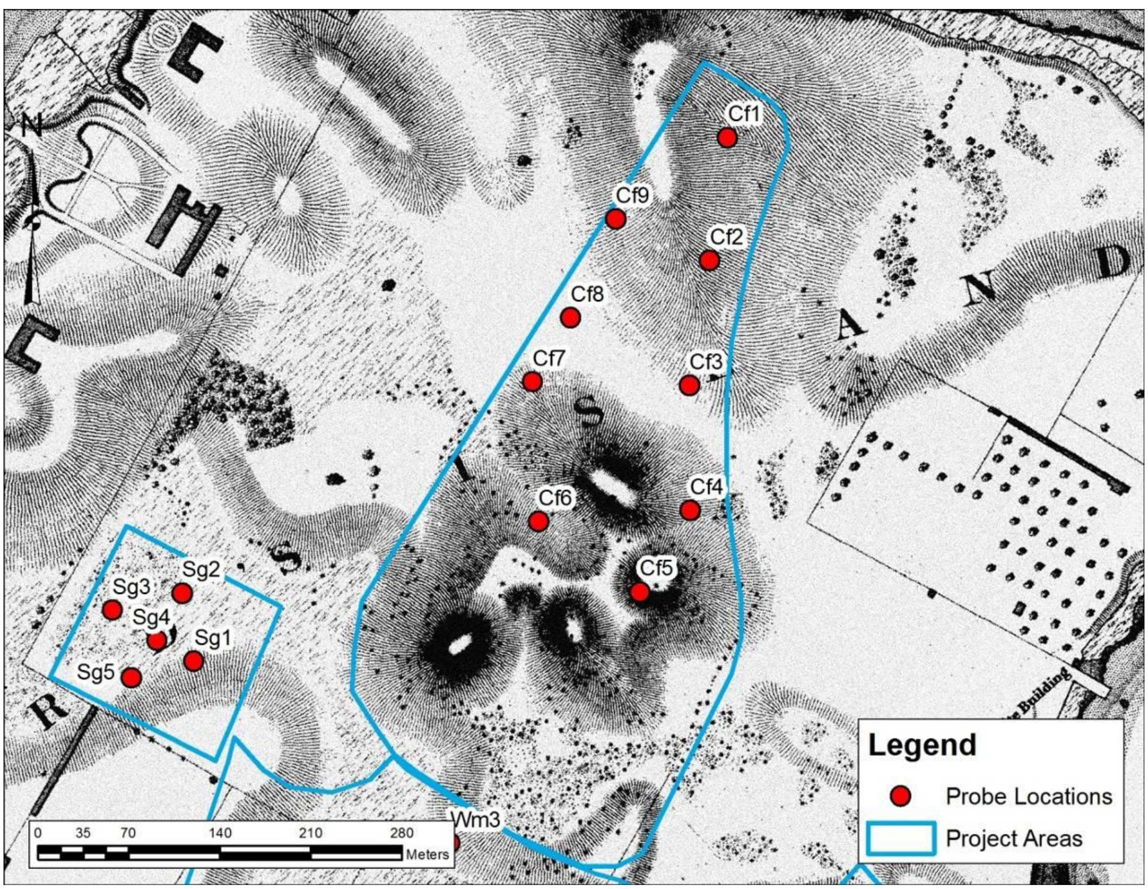


Figure 31. Central Fields probe locations superimposed on 1851 map (Survey of the Coast of the United States, 1851).

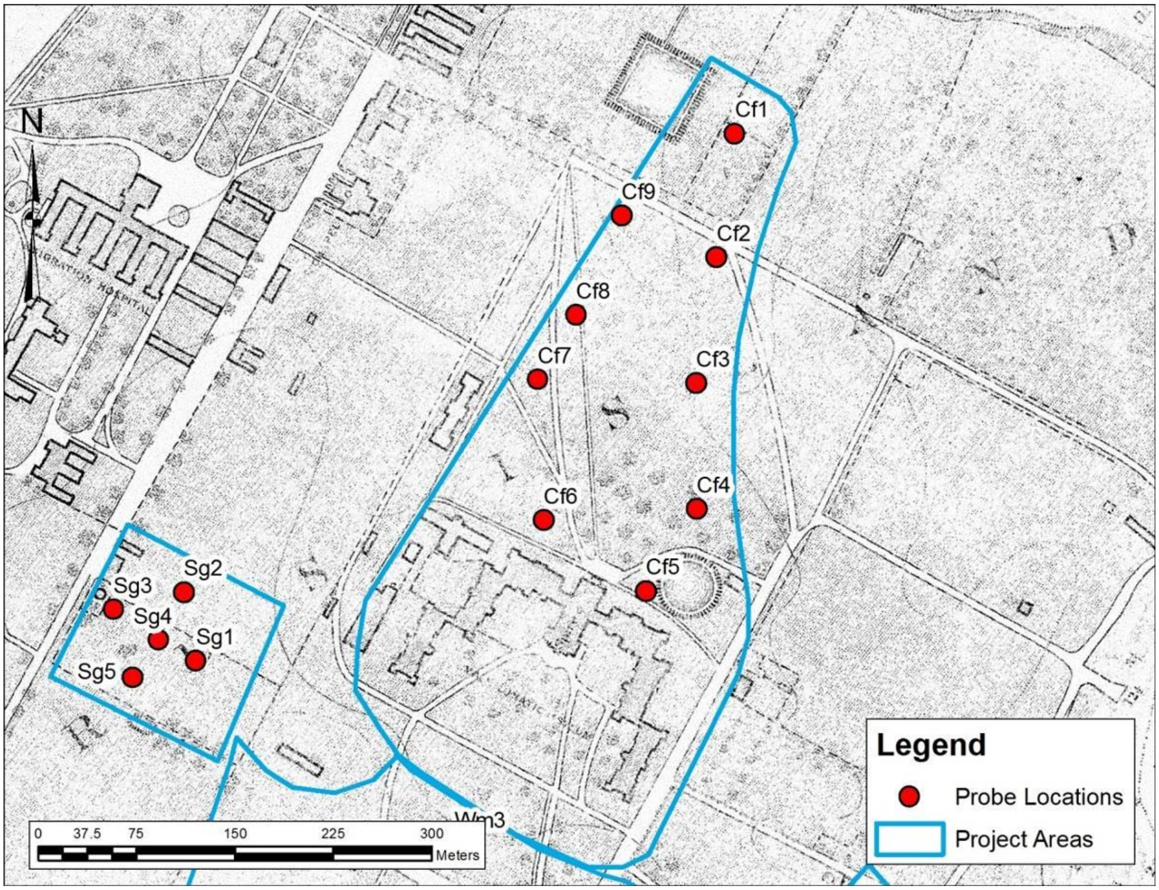


Figure 32. Central Fields probe locations superimposed on 1887 map (Coast and Geodetic Survey, 1887).

4.2.3.1 Fieldwork

A total of nine (9) geoprobes were extracted across the Central Field Project Area. Cores were located flanking the edges of the soccer fields. The original plan was to cross the center of the area with a transect of cores (see Schuldenrein et al. 2008). At the request of the client, however, and after consultation with LPC, the central cores were relocated to the perimeter of the area. The southern third of the demarked project area was inaccessible due to extant buildings and parking lots.

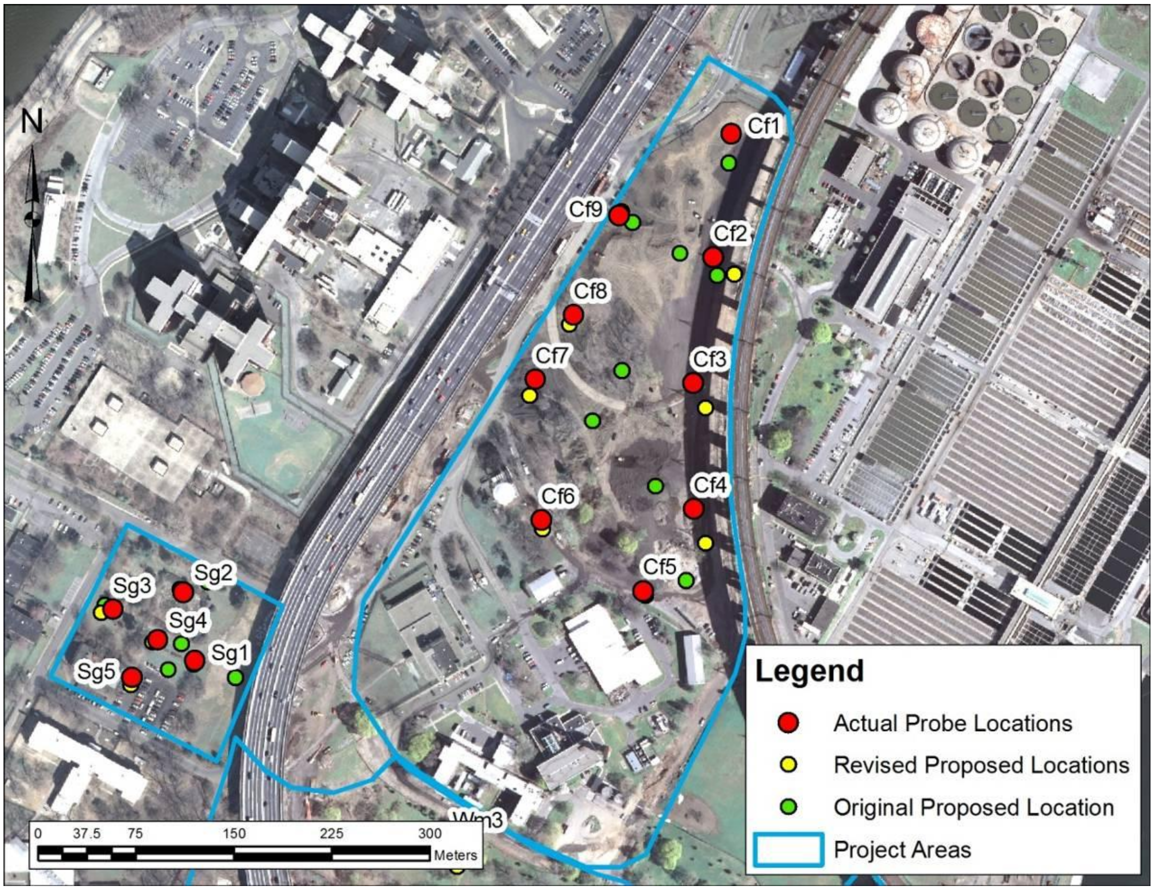


Figure 33. Aerial image of Central Fields with proposed and actual Geoprobe locations (base: 2006 USGS Orthoimagery).

4.2.4 Central Fields Stratigraphic Observations

The subsurface stratigraphy was generally uniform across the project area. The depth of historic fill and disturbances ranged from 40 cm to 355 cm with the average depth of fill extending to 171 cm below ground surface. The fill commonly consisted of disturbed black loam topsoil with occasional brick, gravel, and cinder fragments interbedded with clean fill soils gravel and sand. Only two geoprobes (CF-6 and CF-7) contained distinctive cinder fill horizons.

Below fill consisted of one of three sequences:

1. **Fill above truncated sands and gravels of glacial till (CF-3, -4, -5, -6, -7, and -9);**
2. **Fill above a truncated weathered soil horizon (Bw) formed in glacial till (CF-2 and CF-8); and**
3. **Fill above a disturbed historic surface (CF-1).**

Fill above truncated glacial till (1) was by far the most common subsurface sequence. At Central Fields six (6) geoprobes (CF-3, -4, -5, -6, -7, and -9) encountered this stratigraphic sequence. These cores typically had the deepest fill, including the cinder fill, top soil fill, and clean soil fill. The great depths of fill typically preclude the ability to interpret what the landscape of the Central Fields area was like before widespread historical reconfiguration. In these cores, any potential for intact archaeological surfaces has been negated by the complete removal and or disturbance of historic or prehistoric contexts to leave only glacial till (pre-cultural) deposits intact.

The three (3) remaining cores encountered disturbed topsoil or subsoil immediately below historic fill. Geoprobe CF-1 was the only core that encountered an intact, albeit disturbed soil sequence below 110 cm of fill. In this case, a disturbed buried surface horizon (2Ap) of dark brown (7.5YR3/3) loam was identified below fill from 110-120 cm below ground surface. Below the surface horizon is a transitional zone with intrusive gravels (2ABp) underlain by a weakly developed subsoil (Bw) of dark yellowish brown (10YR4/6) loam to a depth of 200 cm, which is formed above unweathered glacial till (2C). The buried surface of CF-1 would have potential for archeological or historical deposits, save for the disturbances of intrusive fill and mixing with subsoil which likely have compromised the integrity of archaeological deposits.

The remaining two cores (CF-2 and CF-8) lack the buried A horizon as seen in CF-1 and instead historic fill has truncated the former surface and lies unconformably above weathered subsoils. The intact subsoil of CF-2 is relatively well intact and thick (120-210 cm), with well developed redoximorphic pedogenic features (2Bg horizon) which implies natural wet/dry cycles of soil moisture. The presence of these soil features also implies that these are intact deposits, as these soil features generally take millennia to form. The intact subsoil of CF-8 was relatively thin (240-275 cm) and was a strong brown (7.5YR5/6) loam with weak to moderate soil structure. Neither of these two cores has the potential for archaeological resources because these weathered soils are formed in glacial sediments, which are older than prehistoric cultural occupation of the region.

Unlike the other project areas, bedrock was not reached in any of the samples from Central Fields. All cores terminated in sand and gravel deposits of glacial till (pre-cultural), thereby allowing a full assessment of the potential for archaeological deposits. These results underscore the prominence of surficial glacial deposits across the island terrain. Though Wards Island is bedrock-controlled, the review of historical maps and the thickness of the glacial deposits, as exposed, in these cores indicate that the topography of the natural surface Wards Island is largely a product of glacial processes.

With a lone exception, the depth of fill here precludes an accurate landscape reconstruction of the Central Fields terrain prior to widespread historical recontouring. Geoprobe CF-5 was positioned atop a knoll, a probable glacial kame. The subsurface sequence registered in this core was a shallow mixed fill and soil topsoil only 40 cm thick above a truncated glacial till sequence. The shallow fill above deposits which typically form the parent material of kame features suggests that this former knoll was only minimally impacted, and what was once one of the higher elevations within the project area and across Wards Island is now level with the rest of the Central Fields area. It follows that the rest of the project area was infilled to extend the grade with the truncated kame features. The deep fill sequences confirm this assumption, as the emplacement of artificial fill would have been necessary to raise surfaces and extend near-level contours across the uplands of Central Fields.

4.2.4 Sunken Garden Observations

The 1851 coastal survey map depicts the northwestern two-thirds of the project area to be lowland while the southeastern third is upland (Figure 34). Relative to these historical landforms all five cores were located in the lowlands, with SG-1 and SG-5 along the edge with the upland. By 1887, the project area seems to have been leveled and smaller buildings associated with the Immigration Hospital had been built along its western edge (Figure 35). In recent times, the area was covered with a garden, a parking lot and a small structure (Figure 36).

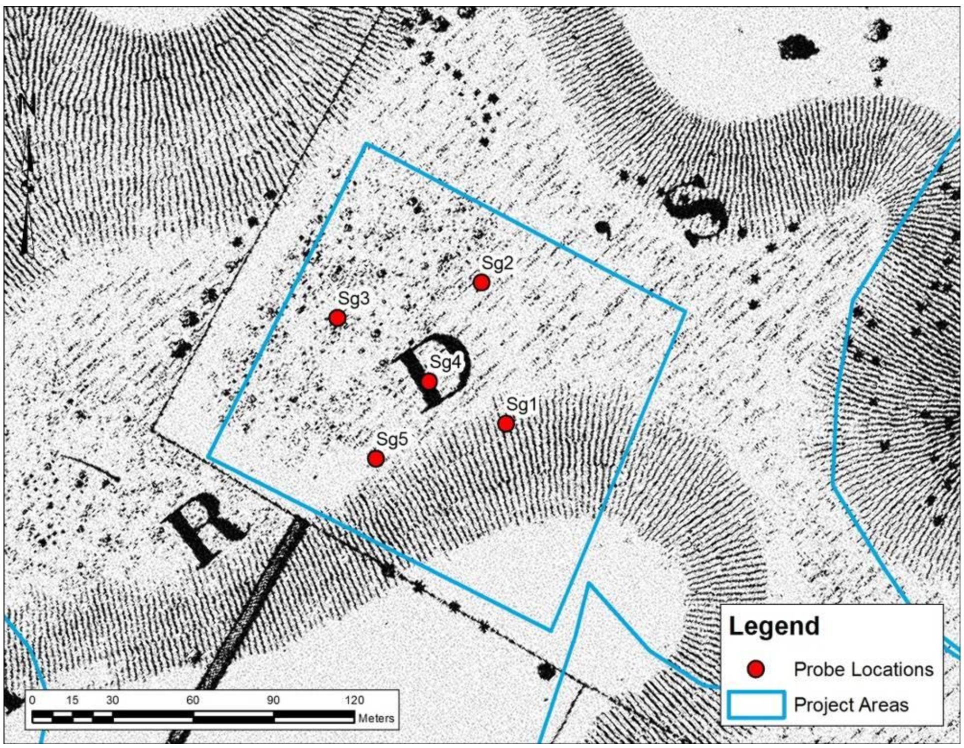


Figure 34. Sunken Garden probe locations superimposed on 1851 map (Survey of the Coast of the United States, 1851).

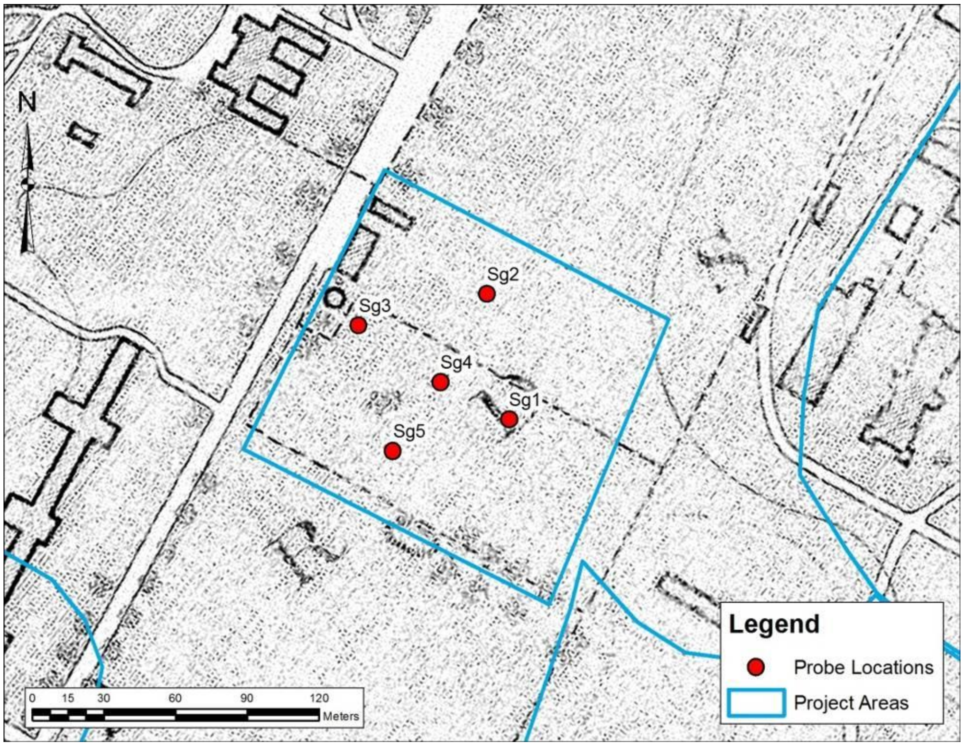


Figure 35. Sunken Garden probe locations superimposed on 1887 map (Coast and Geodetic Survey, 1887).

Figure 36. Sunken Garden probe locations superimposed on orthoimage dating to late 1990s.

4.2.4.1 Fieldwork

A total of five (5) geoprobes (SG-1 to SG-5) were excavated in the Sunken Gardens Fields. Unlike the other areas under investigation, this project area had few limitations as to where geoprobes could be emplaced. The most significant modification was a westward shift of transects due to active construction of a large wall adjacent to the RFK (Triborough) Bridge (Figure 37). Fieldwork ran concurrent with construction, with the probes excavated after surfaces were cleared and graded with gravels but before actual placement of artificial turf. On average the cores attained a depth of 460 cm (15 ft).

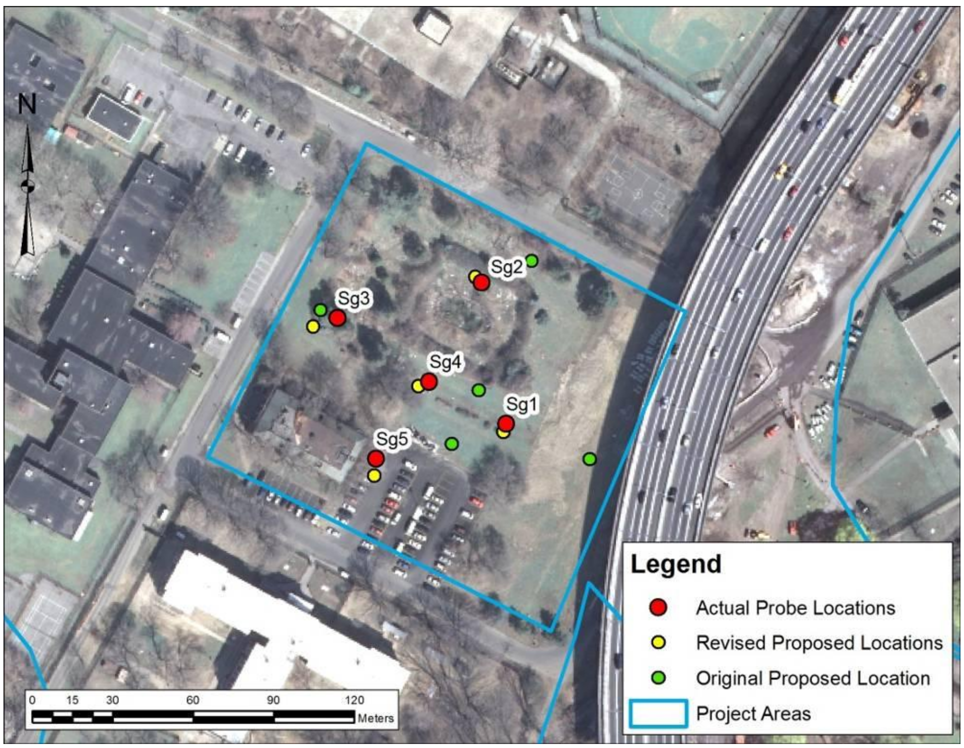


Figure 37. Aerial image of Sunken Gardens with proposed and actual Geoprobe locations (base: 2006 USGS ortho-image).

4.2.5 Sunken Gardens Stratigraphic Observations

All but one of the geoprobes encountered intact sequences below historic fill. SG-3 consisted entirely of fill to its terminal depth of 430 cm, which included the recovery of oily, saturated vegetal material at its base. The remainder of the cores shared a similar sequence. Fill is deep in all of the cores, ranging from 160 to 225 cm thick, with an average thickness of 183 cm. The fill sequence is variable, which likely reflects the repeated historical use of this area. As mentioned previously, the graded surface was covered with a gravel bed, which was reflected in the upper 10-20 cm of cores SG-1, -2, and -3. Sub-fill sequences varied: cores SG-2 and SG-3 had concrete immediately below the gravel bed, suggestive of former roads, structures, or constructed surfaces; SG-2 and SG-5 had thick beds of cinder fill while the remainder had mixed fill sequences of clean soil fill and/or mixed fill with soil and debris (gravels, brick, cinders). Plastics (a drinking straw and a wrapper) were recovered in cores SG-2 and SG-4 within both cinder fill (SG-2) and in mixed fill sequences (SG-4). The recovery of plastics strongly indicates that these fill sequences are largely mid- to late-20th century.

Below the fill sequences were intact sequences of natural deposits, with the exception of aforementioned SG-3. In all instances an intact but disturbed former surface was buried by capping fill to depths ranging from 160 to 225 cm bgs. These disturbed buried surface horizons (2Abp) averaged 14 cm thick and consisted of 7.5YR3/2 (dark brown) mottled loam with examples of intrusive fill, historic disturbances, and mixing with lower horizons. The historical disturbances in the form of asphalt (SG-1) and brick (SG-2) indicate that this was once a historic surface. Below the historic surface horizon is a weathering sequence (2E-2Bg) indicative of stable subsoils impacted by water table fluctuations. The soils consist of gleyed loamy fine sands with common 2.5Y6/3 (light yellowish brown) reductions and 7.5YR4/6 (strong brown) oxidations, which increase in prominence with depth. These soil features are characteristic of repeated wetting and drying over millennia, due to the area's lower elevation. These soils are likely formed in sandy glacial till sequences like the other upland settings (Hell's Gate and Central Fields). However because Sunken Gardens is lower in elevation than the other upland project areas, fluctuating water tables, likely associated with sea level rise, has led to more pronounced soil formation. A bulk sediment sample from unweathered very dark gray (2.5Y3/1) loamy sand 325-345 cm below ground surface in SG-5 was dated by AMS to Cal. B.P. 18,790-18,520 (15,240 $\pm$ 70 14C yrs BP) (Beta-25607), which indicates a glacial origin of these deposits (see Appendix G: Radiocarbon Reports).

Unweathered glacial till is found beneath the gleyed horizons. The glacial till is gravelly sand with colors ranging from reddish (2.5YR4/2 (weak red) and 7.5YR4/6 (strong brown)) to yellowish (10YR5/4 (yellowish brown)). The till sequences in Sunken Gardens are more heterogeneous than in other areas tested in Wards Island, with both stratified sandy horizons (as seen in SG-4 and SG-5) as well as poorly sorted heterolithic gravelly matrices (as seen in SG-1, and the base of SG-4 and SG-5). Glacial till sequences extend to the limit of the probes in cores SG-3 and SG-5. Schist bedrock and saprolite (weathering bedrock) was attained in cores SG-1 and SG-4.

The results of investigations at Sunken Gardens show that this project area has an intact historical surface that has been completely capped by historical fill. The fill is heterogeneous and recent (<50 yrs), based on plastic debris found within. Below is an intact, albeit disturbed, historical soil. The soil has been variously truncated by subsequent fill sequences (SG-2), had intrusive elements from the overlying fill disturb its surface (SG-5), and experienced historical modifications (SG-1 and SG-4). This surface was formed in sandy glacial till, and therefore the entire prehistoric and historic record would be compressed within this surface horizon (2Abp). There is little potential for intact archaeological deposits from this horizon due to its relatively limited thickness (~14 cm) and the wide range of disturbances this buried surface has been subjected to. Below the buried surface are weathered sub-soils formed in glacial till. These subsoils experienced wetting and drying cycles likely associated with Holocene water table fluctuations, which in turn are underlain by unweathered glacial till and or schist bedrock. These deeper subsoils and unweathered horizons have no potential for archaeological deposits because they were deposited by glaciers before human occupation of the region.

4.2.6 Wards Meadow Observations

Wards Meadow Fields consists of 37 acres in the southeast corner between the RFK (Triborough) Bridge and the Hell Gate Bridge which were cleared by razing ten two-story buildings, erected in 1917 as a military base hospital (New York City Guide 1939:425). Historic maps depict the project area as being low-lying estuarine and near-shore environments with extensive made-land along the margins of the island. Historically the landform had a deltaic shape with a small tidal estuary along the western third of the landform and the remaining two-thirds depicted as vegetated meadows. Extrusive bedrock is depicted along the southeastern corner of the project area, which was known historically as "Negro Point".

4.2.6.1 Fieldwork

Cores were excavated across the project area with some constraints. The athletic fields had already been constructed, such that the coring effort was focused on the periphery of the fields. This left the central portion of the project area untested. A large spoil pile in the northeast corner of the project area also limited the areal extent of the investigations. The surface elevations are highest along the northern third of the project area (~15 ft asl) with a gentle slope down to approximately 10 ft asl along the leveled southern two thirds of the project area where the athletic fields are located.

The cores registered a complex stratigraphy across the project area with deep fill sequences along the distal portions of the project area (which include the athletic fields) and intact deeply-buried glacial and estuary sequences along the proximal upland portions immediately north and northwest of the athletic fields.

4.2.7 Wards Meadow Stratigraphic Observations

Three generalized subsurface sequences were identified:

1) Deep fill sequences along the distal (shoreline) portion of the landform in the area depicted as meadows (-6, -7, -8 and possibly -5). All of the cores identified fill sequences to depth greater than 2 meters, with an average depth of fill at approximately 2.23 m. The fill is stratified with three components: a topsoil that incorporates fill materials, clean heterogeneous soil, and black cindery fill with common pebbles, cinders and brick and trash fragments. The cindery fill is typically the thickest component of the fill. The fill overlies either schist bedrock (-6, -7); complex fluvio-till sands (-5) or an underlying intact stratum that was never attained (-8).

2) Intact estuary sequence below historic fill (-2) was identified in the only core located entirely within the historical estuary on the western portion of the project area. Fill extends to a depth of 2.10 m, and consists of a sequence of topsoil, soil fill, and cindery fill. Below the fill are intact estuary sediments. These sediments consist of reduced silts, gray (5Y5/1) to brown (7.5YR5/3), coarsening upward to loamy silt from 2.10 to 2.50 m. The coarsening sequence, which oxidizes up-profile, suggests a depositional environment that transitions from a subaqueous mudflat or tidal zone to a shoreline setting. Below is a thin (2.50-2.85 m) very dark gray (7.5YR3/1) silt, which appears organically enriched and is likely a buried intact surface of an estuarine marsh. Bulk matrix from the horizon was collected for radiometric dating, and recovered a date of 13,930 $\pm$ 70 14C yr B.P. (Beta-256405). Below is a sequence of loamy sands, with a complex depositional origin to a depth of 4.40 m. The sands have attributes of complex post-glacial high-energy nearshore environments – possibly a delta formed along the margins on the uplands forming Wards Island or localized redeposited till. The upper component is a gray (7.5YR5/1) loamy sand with few medium gravels while the lower component is a yellowish brown (10YR5/4) loamy sand with an increase in rounded pebble gravels. Interpreting the depositional origin of this unit is complicated because this landform is situated at the edge of an upland mantled by till, and surfaces that would be subject to shoreline transgression during the Holocene. Below these sands are compacted silts with a tracing of fine horizontal bedding typical of rhythmites or 'varves', which are indicative of cyclical deposition along the bottom of lakes. Deposits similar to these were identified in an unrelated project in similar deep stratigraphies across from Randall's Island, along the former shorelines of Manhattan along Second Avenue (Schuldenrein et al. 2008). A bulk soil sample was collected from this horizon, which dated to 20,470 $\pm$ 100 14C yr B.P. (Beta-256406). This date correlates to age determinations for the Second Avenue investigations and confirms that these are glacial lake deposits from the Pleistocene Epoch.

3) **Truncated estuary and near-shore sediments capped by historic fill (-1, -3, -4)** are generally found along the proximal edge of the landform at the contact between upland landforms and the meadow contexts. The fill sequence in these cores is far shallower than other contexts, averaging only 0.78 cm deep in comparison to +2.0 m depths in the other contexts. Below the fill is a complex of sand and silt loam that towards its base has

pedogenic evidence of wet-dry cycles in the form of redoximorphic features. These features consist of reduction (gleying) along the exterior (faces) of peds and accumulations (oxidization) within the interior (core) of the peds. In this nearshore context, these features suggest that these buried surfaces represent settings adjacent to estuarine environments. This assessment is reflected in the locations of Cores -1, and -3 on historic depictions, as they are located in upland settings immediately adjacent to the estuary on the west end of the project area.

4.2.8 East River Field Observations

No subsurface investigations were conducted at the East River Fields. Construction of the fields was completed by the time this study was initiated. While spoil piles were accessible (as reported in an earlier section of this report) developing a strategy for thorough subsurface investigations proved to be too formidable of a task, as subsurface testing would damage the artificial turf fields. Negotiations between the Parks Department and Landmarks culminated in a plan to hold off on subsurface investigations until future renovations or maintenance of the fields affords the opportunity to obtain samples below field levels without damaging artificial turf surfaces.

5. Synthesis

A systematic program of minimally invasive geoarchaeological probing facilitated the reconstruction of natural and anthropogenic landscape change at Wards Island, New York. That reconstruction was structured on the basis of chrono-stratigraphic relationships coupled with intensive archival research and contextual assessment of the local archaeological record. Taken together, this program enabled an informed assessment of potential for buried cultural resources.

Many, but not all, of the landforms within the historic boundaries of what was once Wards Island were tested during our investigations. Because deep historic fill now caps the southern third of Randall's Island, as well as localized land segments to the north, the Geoprobe-based testing strategy emerges as one of the most viable approaches for comprehensive archaeological exploration for the Phase 1B level of investigation.

In this section we demonstrate that the differentiation of sediment types, or *facies*, by age is a most efficient approach for assessing subsurface archaeological probability. For example, if a facies is of Pleistocene age, archaeological potential is confined only to the near-surface or upper portion of the facies because its deeper contexts pre-date human arrivals to North America. By the same token, a fill facies, commonly deep and mantling much of the island, precludes the preservation of contextually significant archaeological materials in most cases. An exception is a situation in which the fill itself is critical for inferring land use or an activity function.

A second strategy for evaluating archaeological probability is spatially-based and considers the developmental history of the island as landscape, through time. Because the island emerged as a habitable but dynamic setting over the past 15,000 years, the modeling of landscape history would show which parts of the island were habitable over discrete Holocene intervals. Towards that end it is possible to structure a GIS based model of island evolution and transformation through time.

The balance of this presentation details the stratigraphic and spatial basis for projecting archaeological preservation along the various segments of the project footprint.

5.1 Stratigraphic Basis for Archaeological Preservation

Figure 38 is a matrix that orders the various sediment facies for the project area by age. The individual facies are ordered from bottom to the top (oldest to youngest). As shown, the most varied and deepest facies is the *Historic Fill* which contains eight (8) sub-facies ranging from clastic components (i.e., concrete, gravels) to softer matrices (clean fill and disturbed sub-soil). *Holocene* deposits are relatively diffuse, discontinuous, and poorly represented. Only two (2) sub-facies are represented and these are typically in near-shore settings. The sparse distribution of Holocene deposits accounts for the relatively low preservation potential for prehistoric sites across the landscape. The *Terminal Pleistocene* is represented by (5) sub-facies and several (various tills, in particular) are widely distributed across the landscape.

Table 2 details the facies distributions across the overall project area by tract and age. More detailed discussion follows together with illustrations of the various facies as recognized in the cores. Both on technical and taxonomic grounds, bedrock is not considered a facies, although it is a key component in the assessment of sub-surface relations and paleo-topography.

Finally, we propose that the facies model represents a utilitarian baseline for indexing future explorations of sub-surface stratigraphy and archaeological preservation across Randall's Island.

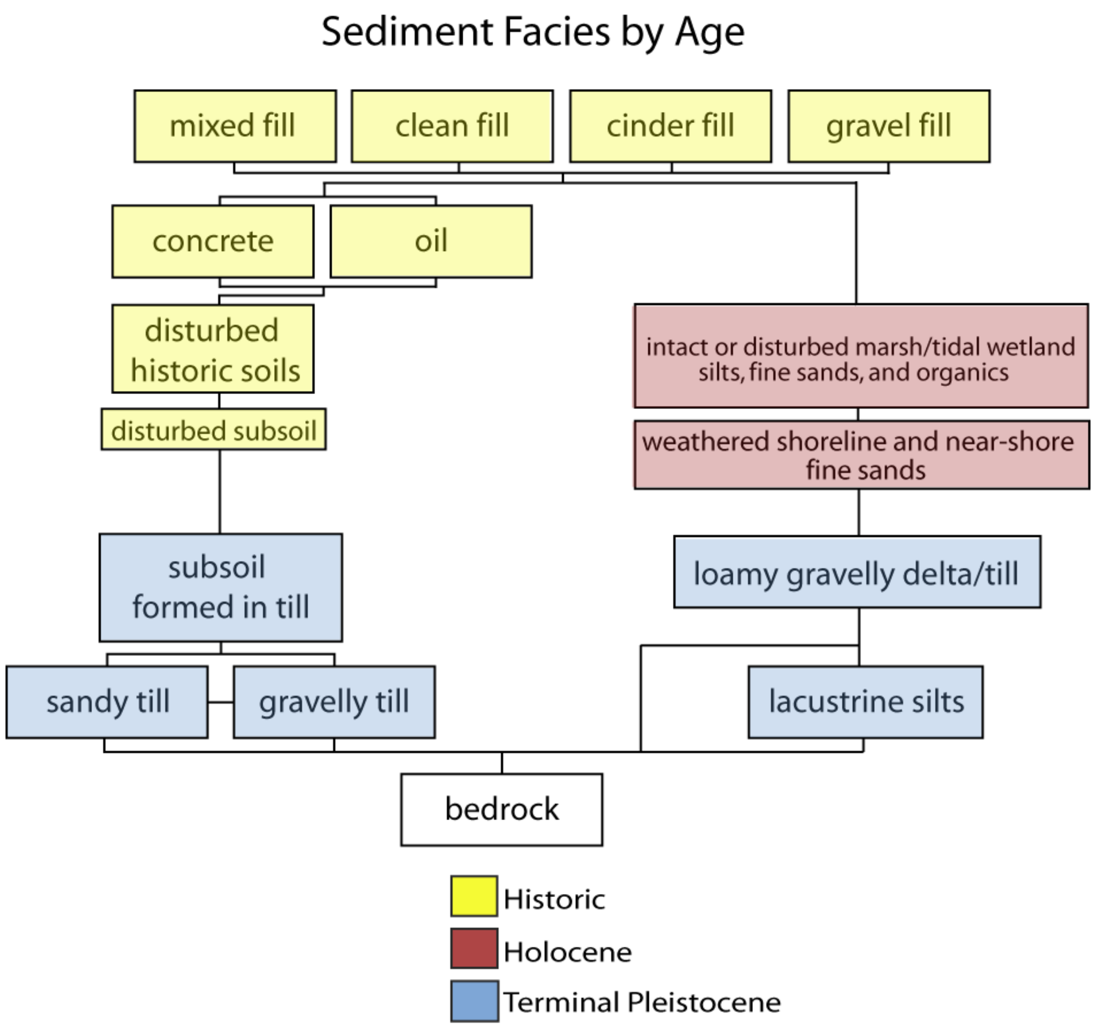


Figure 38. Sediment facies by age.

Facies	Chronology	Composition	General characteristics	Tract
Fill	19th century CE – Present	Reworked glacial deposits, topsoil, disturbed wetland sediments	Brick fragments, concrete, modern plastic debris, marsh peats	HG-1 through HG-11; CF-1 through CF-9; SG-1 through -8; WM-6, -7, -8 and possibly -5
Shore margins	Holocene (10 kya – 19th century CE)	Marsh peats, shoreline deposits, subsoils formed in till	Estuarine/marsh deposition, near-shore sands	CF-1, -2 and -8; SG-1, -2, -4, and -5; WM-1 through -4
Till	Late to Terminal Pleistocene (~18-10 kya)	Reddish sand and gravel	Heterogeneous, poorly sorted, no inclusions. Deposits vary with depth (thickest at high elevations, thinnest near sea level)	HG-1 through HG-11; CF-2 through -9; SG-1, -3,-4, -5
Lacustrine	Late to Terminal Pleistocene (~18-10 kya)	Varved silts	Present in only one core (4.5 m bgs)	WM-2; SG-1, -3, -4
Bedrock	~380 Ma	Schist/gneiss	No bedrock recovered from high-elevation cores; saprolite common at contact with overlying sediments	WM-6 and -7; SG-1 and SG-4

Table 2. Facies distributions of subsurface deposits by age and tract

Bedrock

Bedrock across the project area is largely black schist and gneiss. Typically weathered unconsolidated bedrock, or *saprolite,* is encountered. Bedrock was not encountered in the higher elevations of the island tested in Central Fields, but where it was encountered in lower lying areas along the margin of the island, consisting of gravelly micaceous reddish brown to black weathered bedrock (see Figure 39).

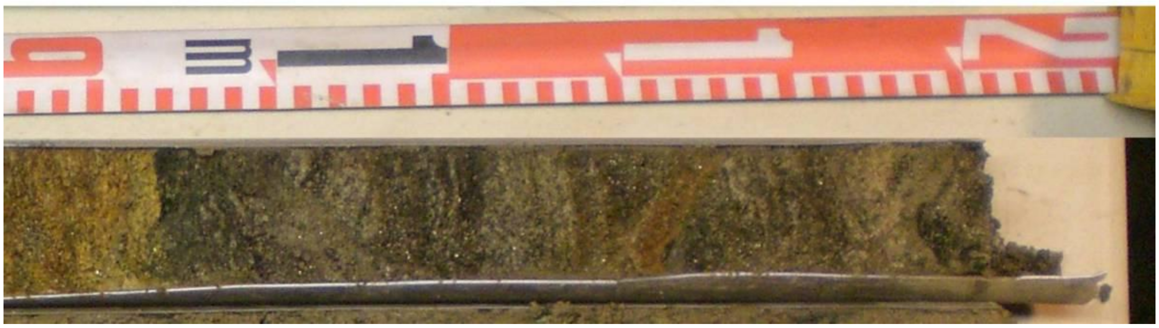


Figure 39. Closeup of weathered bedrock at base of core WM-4.

Terminal Pleistocene: Lacustrine silt subfacies

Paleo-lake deposits were only found at the base of one core (WM-2), deeply buried in Wards Meadow at approximately 4.5 meters below ground surface (see Figure 40). These distinctive sediments are finely bedded (varved) silts deposited at the bottom of the glacial lakes which formed in the basins of the ancestral Hudson and East Rivers after glaciers retreated but before glacial meltwater had an outlet to the sea via either the Narrows or through Long Island Sound. Radiocarbon dating of bulk sediment confirmed the antiquity of these deposits, which precede human occupation in the region, and correlate to other dated lacustrine deposits identified along the shoreline of Manhattan (Schuldenrein et al. 2008).

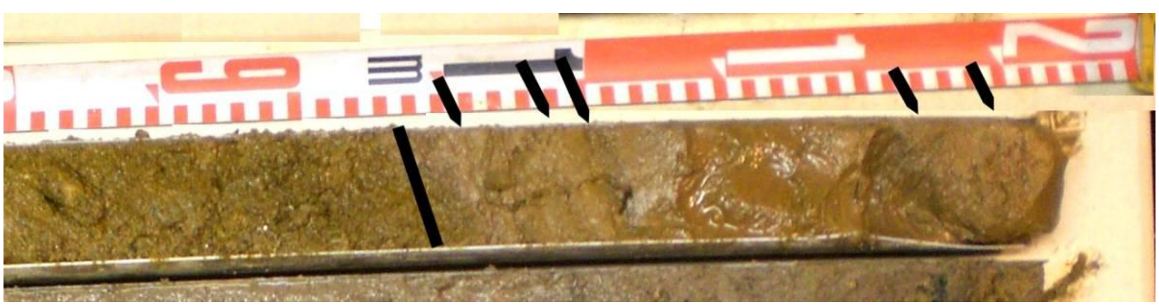


Figure 40. Closeup of lacustrine silt sub-facies (Late Pleistocene) at base of WM-2. Black bar demarcates till (above, to the left) and lacustrine silts (below, to the right). Arrows point to faint, finely laminated varves.

Terminal Pleistocene: Sandy and gravelly till subfacies

Till sequences (unsorted sediments deposited by glacial action) were identified across almost the entirety of the Wards Island. Their extensive distributions underscore the pervasive impacts of glaciation across the region. Tills are deepest towards the higher elevations of the island, as registered in Central Fields. These sequences correlate to glacial features identified on early topographic maps, which correspond to kames; these are knob-like hills of glacial till left by receding glaciers. Till is often difficult to differentiate from sandy or gravelly fill because it can share some of the same features as the latter. It is typically poorly-sorted, has irregular bedding structures, and its lithology can be heterogeneous (i.e. rock of non-local origin transported by glacial action) (see Figure 41). In this study we were careful to only identify till when there was a complete lack of intrusive materials and debris (which is typical of fill) and when bedding structures signified a natural deposit. While both sandy and gravelly sequences were identified, there was no pattern to their distribution. The tills had no potential for archaeological preservation.

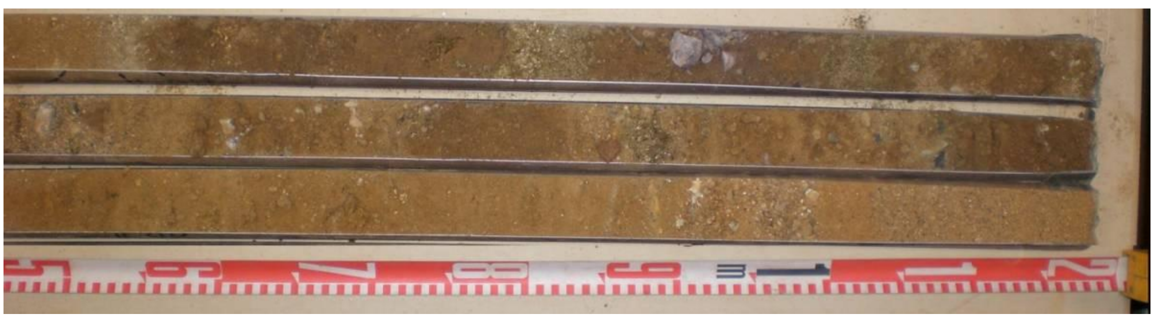


Figure 41. Till sequence at base of HG-11. Bottom core is sandy till while the upper two cores are gravelly till.

Terminal Pleistocene: Subsoil in till subfacies

In limited instances across the upland settings of the project areas an intact soil formed in till was encountered. In all instances there was no evidence of an intact topsoil, instead only the weathered subsoil horizons were intact. These subsoils, *or endopedons,* are truncated remnants of stable landforms which have undergone weathering since glaciation. Soil development trends from weakly expressed (*cambic* or *Bw horizon*) structural development to well developed reduction and oxidation features (*Bg horizon*) These weathering sequences typically have a mixture of colors with yellowish brown to brown oxidized matrix and reduced matrix trending towards gray colors.

Terminal Pleistocene: Loamy gravelly delta/till subfacies

This sequence was identified only along the southeastern margins of Wards Island within the Wards Meadow project area. This unit is a complex mix of sediments with some pedogenic alteration associated with saturated conditions. This unit overlies both bedrock and lacustrine deposits. Its position relative to the island suggests it is a wedge of till or secondarily deposited sediments that formed a delta along the margin of the Wards Island after glaciation. These deposits were subsequently saturated by water tables – likely associated with rising sea levels – which left diagnostic redoximorphic mottles in the soil profile (see Figure 42).

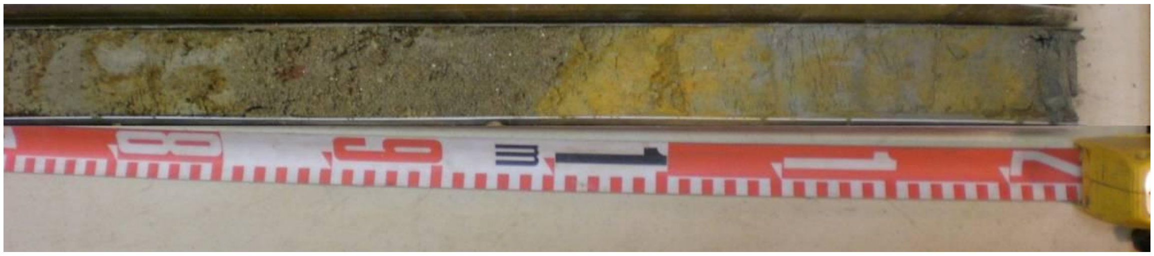


Figure 42. Saturated and redoximorphic Pleistocene clays in deltaic context.

Late Holocene: Disturbed marsh/tidal wetland silts, sands, and organics subfacies

Estuarine sands and silts were generally more mixed than would be expected in a distal margin of the shoreline. These sediment complexes are typically formed in concave depressions along the margins of the tidal zone. Here mildly organic silts accreted in a basin setting and near-shore sands were swept in during tidal conditions (Figure 43).

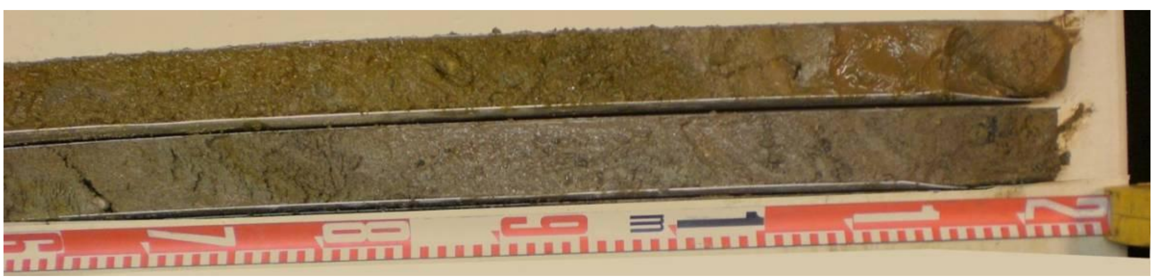


Figure 43. Disturbed marsh-estuarine wetlands that were saturated during retrieval of core.

Late Holocene: Weathered shoreline and nearshore fine sand subfacies

Weathered soils formed in distal segments of the nearshore environment. These are typically Bw soils that can be considered Cambic, as they are rubefied and have minimal illuvial clays within the B-horizon. Their presence signifies limited weathering at distal locations, away form the zone of inundation (see Figure 44).


Figure 44. Weathered soil clearly offset from the depositional matrices and its fine texture is, to some degree, a product of illuviation.

5.2 Three Dimensional Arc GIS Model

5.2.1 Background and Precedent

GRA and others have previously documented a general transgressive sequence for the New York-New Jersey harbor from the Pleistocene Last Glacial Maximum (LGM) through the Holocene (Schuldenrein et al., 2007; Schuldenrein & Aiuvalasit, 2011). This is corroborated by other studies documenting sea level rise on the Eastern Seaboard of North America (Fleming et al., 1999); Kenan, 1999). One objective of this project is to use this research in conjunction with field stratigraphic data and the upgraded sea level curve (Schuldenrein et al., 2007) to develop a geographic information systems (GIS) – based, three-dimensional temporally successive landscape model of Randall's and Wards Islands. GRA investigations of the New York/New Jersey harbor (Schuldenrein et al. 2007) and the 2nd Avenue subway line in Manhattan (Schuldenrein & Aiuvalasit, 2011) provide the precedent for this GIS-based graphic representation of sea level rise and landscape evolution.

5.2.2 Data Sources and Model Setup

This study presents temporal snapshots of Randall's Island and the East River from the Pleistocene (20,000 years B.P.) to the Holocene, using digital elevation models (DEMs) derived from modern elevation data, historical estuarine bathymetry data and historical maps. These DEMs are used together with projected sea levels and stratigraphic and subsurface data collected over the course of the project to develop a sequential series visualizing the landscape evolution of Randall's Island. The temporal resolution of the model "snapshots" is designed to highlight significant geological moments with respect to glacial history, sea level rise and human impact.

The USGS Central Park Quadrangle (7.5 min series topographic map) DEM serves as the baseline dataset. This DEM was modified within ArcGIS to approximate the pre-settlement topography of the islands. Littoral marsh and low elevation wetlands are delineated based on a digitized and georeferenced image of Viele's "Sanitary and Topographical Map of the city and Island of New York" (1874). The shoreline position and marsh elevation for each time period is adjusted based on subsurface data and the sea level curve of Schuldenrein et al. (2007). Bathymetry data is derived from a digitized and georeferenced image of the "Navigation Chart of Hell Gate and its Approaches" (1875), a navigational hazard map from the Historical Map and Chart Collection, Office of Coast Survey/National Ocean Service/National Oceanic and Atmospheric Administration (NOAA) archives.

Modern and historic topographic maps, archeological investigations and geological and geophysical investigations provide the baseline data for reconstructing regional topography. Generalized land surface maps date to the early colonial era and provide useful documentation for examining modern changes to the region, but topographic data for Randall's Island and its vicinity is significantly easier to access and use than bathymetric data. Local bathymetric data is restricted to navigable waters, restricted by the natural rapids at Hell Gate.

These natural bedrock features acted as controls on estuarine bathymetry until 1851, when the U.S. Army Corps of Engineers began removing channel obstructions to enable easier navigation in the East River. Continuing modification to the channel has significantly altered the bathymetry of the East River around Randall's Island, and dredging of the East River, Harlem River and Long Island Sound obscures accurate reconstruction of the bathymetry. Extensive and detailed historic mapping of the Hell Gate navigational hazards exists for the lower East River south of Wards Island (Viele, 1874) prior to the removal of the rapids, but no historic maps with this level of detail cover the northern part of the channel. As a result, the GIS model for the northern vicinity of Randall's Island involves a greater deal of bathymetric approximation and is less likely to reflect the actual paleo-bathymetry.

5.2.3 Model Results

20,000 years B.P.: Stratigraphic evidence from Randall's and Wards Islands (notably the deep till deposits from the Central Fields region of Randall's Island) indicates that the bedrock knobs that eventually developed into Randall's and Wards Islands were covered with a mantle of glacial sands and gravels during the Wisconsinan glaciation. The entire New York City archipelago was inundated to a depth of 9 meters above modern sea level during the Pleistocene Last Glacial Maximum, and these topographic high points were almost completely submerged under the Lake Hudson/Lake Bayonne complex (Figure 45A). Intact sediments from this period are not culturally significant.

13,000 years B.P.: The proglacial lakes covering Randall's and Wards Islands drained as climate warmed and the glacial front retreated to the north (Figure 45B). Glaciofluvial melt incised the former lake bed, removing most evidence of lacustrine deposition. Water levels fell to -22 m below modern sea level, and much of the former lakebed was exposed as a series of steep-sided terraces above the new floodplain. Most erosive activity was likely focused in the troughs of this channelized system, leaving the higher elevation Randall's and Wards Islands blanketed by glacial/glaciolacustrine deposits.

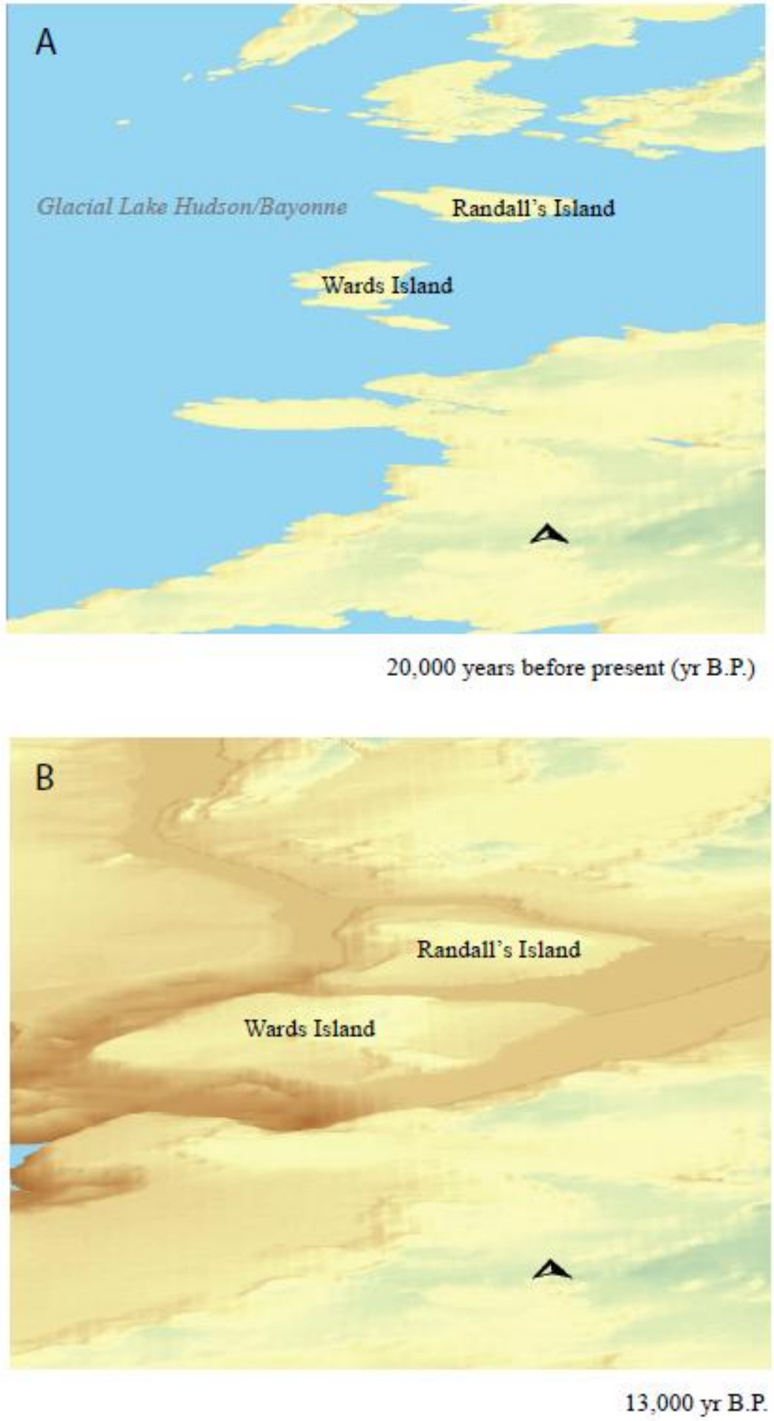
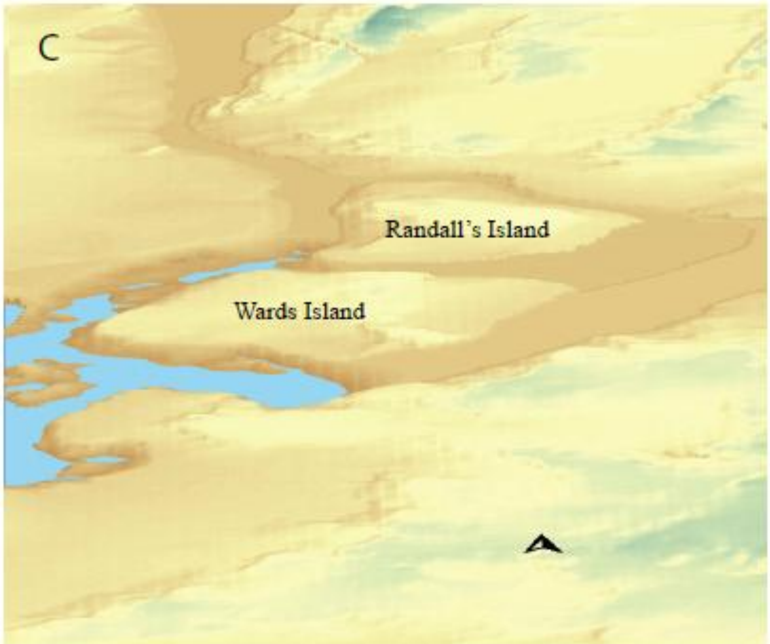


Figure 45. (A-B). 3-D topographic models of Randall's Island and its vicinity showing the landforms and relative sea level at 20,000 years B.P. (A) and 13,000 years B.P. (B).

6,000 years B.P.: Marine transgression driven by warming climate and glacial retreat brought sea levels to -11 m below modern sea level (Figure 46C), and the paleo-East River estuary became a transitional marine-fluvial depositional environment. Fluvial sands transported from the terraces and shallow marine deposits were deposited on top of the former glaciolacustrine sediments. Shoreline-fringing salt marsh development begins as estuarine environment becomes dominant. Core stratigraphic data from Wards Meadow provides evidence for a shallow, low-energy estuarine mudflat environment transitioning to a higher-energy sandy shoreline environment to accommodate rising sea levels. Core data from the Waterfront Pathway area also reveals potentially reworked shoreline deposits.

1,000 years B.P.: Sea level rise decelerates after ~3000 years B.P., and the tide-dominated estuarine environment reaches homeostasis. Estuarine and marsh sedimentation remain the primary depositional regimes, with glacial sediments still present on the higher island elevations. Continued sea level rise drives the landward expansion of marshes with variable salinity. *Spartina alterniflora* dominates the low marsh environment, and sediment trapping forms tidal mud flats and meadowlands (Figure 46D).



6,000 yr B.P.

1,000 yr B.P.

Figure 46. (C-D). 3-D topographic models of Randall's Island and its vicinity showing the landforms and relative sea level at 6,000 years B.P. (C) and 1,000 years B.P. (D).

Historic: A tide-dominated estuarine system existed prior to the alteration of Hell Gate and large-scale infilling of marsh and wetland environments (Figure 47E). Truncated glacial deposits and artificial fill material (brick, gravel) across all of the study areas provide evidence for disturbance of the pre-historic glacial topography of the islands. Archeological evidence of permanent institutional structures (notably the foundations of the homeopathic hospital on Wards Island) illustrates the Industrial Age expansion of development on Randall's and Wards Islands.

Modern: The modern land surface of Randall's Island reveals an elevated post-fill topography (Figure 47F). The East and Harlem River channels are deepened by continuing dredging, and the estuarine bathymetry is altered by the removal of the Hell Gate reef to the south of the former Wards Island. Estuarine circulation remains tide-dominated, with increased interchange with the Hudson River due to Harlem River dredging. Former marshland is infilled to expand the land surface area, and invasive marsh vegetation becomes prevalent. The subaerial footprint of the islands is increased through mid-20th century infilling of the Sunken Meadows marshland and the Little Hell Gate strait separating Randall's and Wards Islands. The surficial geology of Randall's/Wards Islands is mapped entirely as fill (Cadwell 1991), and the modern stratigraphy of Randall's Island consists of varying depths of artificial fill (typically 1-2 m) overlying naturally deposited strata. These natural strata fall into three general categories: buried or disturbed shoreline/marsh soils; till and glaciolacustrine deposits; and bedrock (primarily Manhattan schist). The 20th century saw a dramatic expansion of development on Randall's Island, including the construction of the RFK (Triborough) Bridge, Icahn Stadium and an extensive network of sports and recreation fields and facilities (Figure 47).

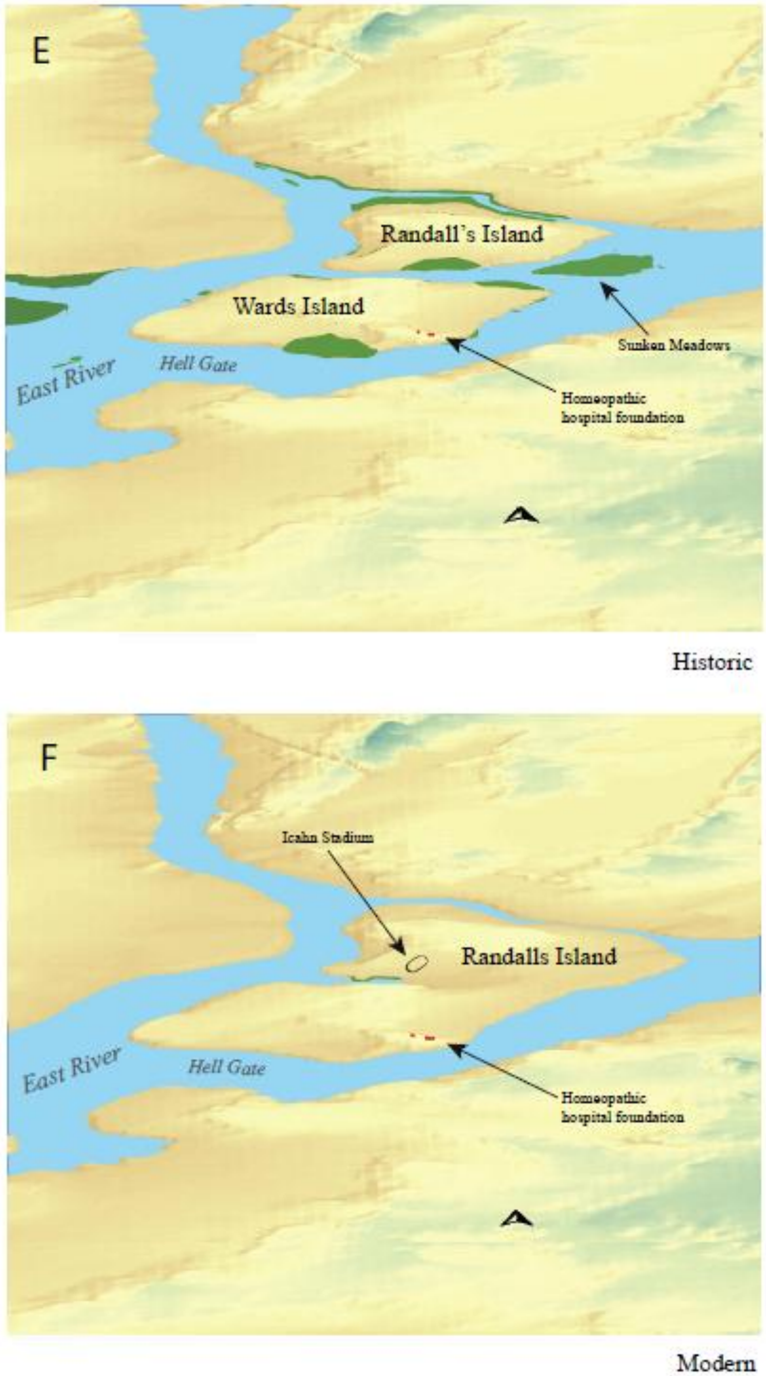


Figure 47. (E-F). 3-D topographic models of Randall's Island and its vicinity showing historic (E) and modern (F) landforms and relative sea level.

5.3 Archaeological Sensitivity Map

The collective product of historic research, systematic stratigraphic investigations, 3-D topographic imagery, and integrative GIS modeling is depicted in a comprehensive Archaeological Sensitivity map (Figure 48). Because of significant disruptions to the substrate, as demonstrated during field testing, the potential for encountering key archaeological deposits with integrity is minimal for the four (4) properties under investigation.

Two caveats to this assessment should be noted. First, for the Central Fields property, there is limited potential for historic deposition since the imprint for the 19th century Male Lunatic Asylum could not be tested in comprehensive fashion. Because of the size, complexity, and extent of this edifice, historic features and assemblage distributions can assume a variety of forms, not all of which could be tested by the protocols that were utilized in this study. For this reason, we assess a Medium to Low sensitivity ranking to the Central Fields property.

Next, the integrity of the East River Fields could not be tested at all. As noted earlier, a program for such testing may be implemented in the future, in accordance with the maintenance and upkeep schedules that are agreed upon by RISF and regulatory agencies. A preliminary assessment of the East River Fields is that there may be potential for identifying buried shoreline elements on the southwest corner of the island such that an overarching testing strategy for the East River Fields, should be implemented per the protocols that were instituted for the four properties tested and assessed in the present study.

Figure 48. Archaeological Sensitivity Map

6. Conclusions and Recommendations

This geoarchaeological study at Randall's Island was undertaken in conjunction with plans for improving and developing sports facilities on the southern portion of Wards Island. Five tracts were investigated and included: Hell's Gate, Central Fields, Sunken Garden, Wards Meadow, and East River. Phased cultural resource investigations for this project were undertaken concurrent with construction of the sports fields.

Field relations coupled with examinations of historic fills and natural sediments led to a systematic program design for geoprobe-based subsurface testing. Test transects were positioned along alignments traversing the fields scheduled for impact. Three (3) radiocarbon samples were collected to date key buried landform components. The dates confirmed the Late Pleistocene age of much of the substrate underlying the impact areas. All of the areas, with the exception of the East River Fields and a portion of Wards Meadow, were subject to subsurface testing. These latter areas could not be tested since artificial turf fields had already been constructed.

The geoarchaeological model for cultural resource sensitivity followed a two-stage strategy. First, the various soils and sediments in the substrate were differentiated and grouped by age and depositional origins. The differentiation of these sediment types, or *facies,* by age is a most efficient approach for assessing subsurface archaeological probability. Five (5) facies types, with several sub-facies, were recognized and spanned ages from the Terminal Pleistocene (tills and lake sediments) to recent and sub-recent fills. The archaeological potential of each sediment complex for archaeological preservation was assessed.

A second strategy for evaluating archaeological probability was spatially-based and considered the developmental history of the island as landscape, through time. Because the island emerged as a habitable but dynamic setting over the past 15,000 years, the modeling of landscape history would show which parts of the island were habitable over discrete Holocene intervals. Towards that end it was possible to structure a GIS-based model of island evolution and transformation through time. This approach established cultural sensitivity on spatial grounds.

The field work and emergent geoarchaeological model verified that no surfaces of apparent prehistoric age were present, even though evidence of Late Holocene estuarine marshes were recognized. It was concluded that the broad and deep extent of recent and historic disturbance and the thin and diffuse strata of Holocene age precluded the presence of substantial archaeological resources. The approach implemented here should serve as a heuristic tool for future cultural resource investigations in Randall's Island. No further field-work is warranted, except for potential subsurface testing of the East River fields and southwestern Wards Meadow, per agreements coincident with future maintenance scheduling.

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Appendix A: 1855 (Aug. 21) New York Times Article on Wards Island Potter's Field

NEW-YORK CITY. RAMBLING ABOUT WARDS ISLAND.
A Visit to Potter's Field.

Lately we sketched the appearance of Trinity Church and where many of “the great, the tall, the reverend lie”--powdered already to the “brown, infragrant powder,” to which Rev. SIDNEY SMITH saw himself hurrying. It was but natural to wish next to see how " the cheaper classes" are entombed- to note whether their monuments are so soon moss-covered, if the trees over their unaching heads are as rich in worms, and if dust so buries up all the shrubbery that should make their resting places inviting to passers by.

So we took a Second avenue car, paid twice a half dime and were set dawn at "the Red House" in Harlem, crossed the Race Course, held up at the Ferry. foot of One Hundred and Sixth-street, didn't break a leg on that rascally old wharf, was rowed across in an open boat, whereof the rowers do not row “for a consideration;" was set down at the Wards Island Hospital wharf, and was told to turn to the South, and push on to the end of the Island if we wished to visit the POTTER’S FIELD.

POTTER’S FIELD was our destination, so we followed directions, till at the door of a snug wooden house that looks out on Hell Gate, and New- York in the distance, we found the jolly guardian of the FIELD- Mr. WEBB.

“What can I do for you, gentlemen?" asked, be, blandly.

“Show us how you bury the poor and the friendless, - let us see these brave lodgings for one to which not even Poverty, nor Famine, nor Murder can deprive any citizen of his ‘title clear.’”

So Mr. WEBB, buckling his suspenders a little tauter, addressed himself to the task.

First, he would have us take an observation of the glorious scenery on which the house looks out. The green turf slopes gently down to the water, which is but a few rods off, flanked on one side by an orchard, whose fruit would sorely tempt a Young American of the strictest integrity and on the other by a wooded pasture-ground. It is a little cove that puts in here. The Hog's Back is in front, a little to the left. The “Hen and Chickens” and “Flood Rock” are directly in front - Mill Rock is to the right.

The southern part of the island separates Harlem River, a clear, still, deep stream, from Hell Gate, through which the waters roar, and break, and tumble, as if veritably they were at the mouth of a bottomless pit; for none must think because subterranean and sub-aqueous engineers have blown up some of the more threatening rocks, that this is a smooth strait, or a gently-rippling river, which is called Hell Gate because our fathers thought it terrible. While we stand talking, we hear a skipper shouting from a schooner's deck – “Hard up, hard up your helm!” But the shout comes a moment too late. His craft's bows have struck an eddy, and now, swiftly, as if twisted by a giant hand, she spins 'round without reference to the gentle breeze that did fill her sails, and the tide is working her in- she must anchor and wait till both wind and tide favor, or she will go bumping on the rocks. It is a most glorious landscape - for we suppose where the sea most prevails there especially is a landscape - that lies before us. Far away is the city, its spires easily descried, but the centre obscured by Blackwell's Island, On the right is JOHN JACOB ASTOR’S old place - Mr., BRISTED’S now we believe - the house mostly hidden by fine old trees that look like so many hale and hearty chronicles of the olden time in a green old age. In the background, on the left, lies Astoria, always a beautiful suburb whether seen as with a bird's eye far away, or traversed throughout its villa-bordered streets, Nearer, on the left, is Hallett's Cove, One point that bounds it is still surmounted with the ruins of an old fortress. The line of mounds is turf-covered now and green - to the east of this; but another point gave us a better look at it.

"Ready, gentlemen?" said Mr. WEBB, at last"

"Quite." And we started. We fallowed a cowpath from the point up to the field - a crooked, right-angled path that made it a quarter of a mile away. But there was an evil odor, the fragrance of humanity in its dissolution, that took the shortcut across the brush, and the swamp and the wood - and reached us so soon that we thought we were close by the dreaded enclosure. We halted a moment on the site of the old house, which years and years ago the Long Island Sound cruisers remembered "the old house on 'Great Barn Island,'" for it is a modern trick calling this "Wards Island." There was an old man living a year or so back, in the Eleventh Ward, who was born on this spot 87 years ago. For years he has come over here on his birthday and reviewed the landmarks. But this year he failed - indeed he may have passed away like the old house and the "old barn" itself, but we have not noticed it in the papers.

Climbing a slight hill and entering a gate we are within the POTTER'S FIELD. Our route to reach it has been a pleasant one. Now, let us stop to tell the route by which the poor stranger reaches it after his spirit that is immortal has been expired.

A large wagon daily conveys the dead that are to be buried at the City's expense to the river-side somewhere near Bellevue Hospital. Its contents, in plain substantial coffins, are transferred to a row-boat and so borne to the landing-house, which stands by the head of a small wharf on the shore of the cove spoken of as hollowing the south end of Wards Island, thence by an easy sweep the road leads to a large receiving vault at the western hill end of the cemetery. This vault is an admirably constructed tomb, which has not get been put to use, being scarcely now completed. In it are airtight separate chambers, where the bodies of those that have died suddenly are retained a few days after death, to facilitate recognition by friends. A forcing-pump connecting with a well at some distance, and with drains and sewers, enables all necessary cleanliness to be enforced. With a supply of ice there will be no difficulty in preserving unmarred the features of the unrecognized dead for just so long a time as may be deemed desirable. But those who have died uncared for by any but strangers, or by those whom the City's blessed, charity has made friends, are not stopped here. They are carried directly into the cemetery. And what fashion of place is that?

POTTER'S FIELD.

Some two acres are enclosed within a tight board fence. One corner of the enclosure you will notice is graded some four feet higher than the rest. Under this are three trenches filled, and in them there lie the remains of 16,000 people. The fourth trench has been open only a few weeks. Already it has over 600 buried in it. This trench is dug 15 feet deep, 300 feet long and 18 feet wide. They begin to bury at one end of it. The trench is wide enough to admit three coffins lying end to end, and they are piled up till the uppermost is within two feet of the surface. The average of doily burials here at present is eighteen, or 125 a week. During hot weather the corpses arrive in the early morning and after nightfall. When the new arrivals are announced at the trench, the diggers throw aside the little dirt that covers the last lot, deposit the new ones and cover them. When the whole trench is filled, the earth of a new trench is thrown upon the late one, and it is graded off like the mound before spoken of, some four feet above the former surface. This is done, because when the coffins decay the earth sinks. The mound is to be turfed so soon as it has settled, and cedars, willows, and other appropriate trees planted.

We spoke of an offensive odor that met us far away from the spot. But standing by the side of the open trench it was intolerable. With the wind west, we are told that it is wafted - a horrible stench - to the sick in the hospitals on the other end of the Island; and, if we were told that it sometimes is borne across the East River to the delightful residences of the grandees on that shore, we should think it no marvel. But we do wonder that the Governors of the Almshouse are so choice of the Wards Island soil. They have an abundance of it - if it is not all as compactly placed as they might desire - to afford enough to each new cargo of the dead to prevent their being an offence to the living, a terrible fright to the sick, and an unseasonable memorial of the corruption that awaits us to the quiet dwellers in sea-side mansions. The poorest man has a right to earth enough to be buried in. Gentlemen Governors, be good enough to order that none be cheated out of their proper share.

Of those buried here the Commissioners generally send up one-third, though at seasons the emigrant proportion is larger. Nor let any suppose that all are thus buried indistinguishably in the ditch. If any one has a friend who will request it, his body is given a separate grave. If one at the Almshouse dies, his old mate's wish is heeded to place him in another part of the yard, and a headstone, if any care to erect it, or a hard with the name and age painted on it, if that alone can be afforded, will mark the spot. Many such single graves there are already. The Governors are now cutting off by a fence an acre on West End, wherein each Randall's Island boy that falls in his unequal race will be laid to deep, and for each such one a stone of memorial is to be planted The Commissioners of Emigration have several times undertaken lo lay out a cemetery of their own, but for various reasons the project has never been carried into effect. By an arrangement lately entered into, all their dead are buried by the Governors, a fee of fifty cents being paid for each one buried.

Ah! reader, it is good that it is only in imagination you are visiting Potter's Field. Inimitably beautiful as the scenery is from the hill, you would not have lingered long enough to have seen half we have written of. We will not dwell upon *the* reasons, however. It is no wonder that the sailors look up with a shudder at tile spot when they pass through Hell Gate at midnight. If the spirits of the dead hover over their mortal resting plate, where the moon looks down on them, what a congregation must crown that hill. Sixteen thousand ghosts of newly buried men, women, and children, gibbering in the night wind, or mutely gliding and noiselessly jostling each other - too thick to sit and weep over their unhonored sepulture! Cold chills creep through the mariner's veins at the thought, and the hair of his flesh rises up.

Let as leave the place. Striking south and eastward, it is but a few rods to the shore, which here is an abrubt wood-crowned bank. The great steamers are just passing from the city, and the wind serving with the tide, a fleet of sail vessels are crowding in from the Sound. It is a scene of unequaled beauty. The land opposite, on Long Island, is laid out in noble homesteads. The houses are capacious and tasteful, the grass is well- trimmed, and into the road that winds along the shore, defended by a stout seawall, open at pretty regular intervals, the gates that admit to the yards of each proprietor. They say that if a man goes there to buy a lot, he has to give references as if he were an Irish girl seeking service. They want not the cash merely, but the “position,” specially. They are the men that buy none but “Little Neck Clams, fresh"- from Catharine Market, when the market-man thinks he is going to be stuck with a stale lot. These are they who delight to buy weak fish - from the jolly fisherman who swaggers and swears as he carries one only on his finger, that he caught it trolling in South Bay, and wants a smashing price for it ;- but the jolly fisherman chinks the silver in his pocket as he goes back to his boat, whose lie scores of other weak fish with pale gills, all which he bought exceedingly cheap of a smack-man down by Catherine Market But we must hold up here ; our jocular keeper of the " field " suggests that it is time to lunch, and the printers say it is time to go to press. So putting a pin in where we left, we will hold up. We have a good deal of walking, some rowing, and more talking to do before we are done with Wards Island.

Appendix B: Road Cut Profile Descriptions

Randall's Island
Hell's Gate/Wards Meadow - North Face Road Cut Sections

Seven small subsurface profiles exposed along a road cut near the Hell's Gate spoil piles on Randall's Island were cleaned, examined, and recorded. These profiles were investigated in order to determine the potential for intact buried surface horizons within the project area. Although no time-diagnostic artifact materials were located during observation on November 13, 2008, seven small sections (identified here by their location along a 100-foot tape, running east to west) did provide indication of infilling, road-building, and possible re-contouring of the Hell's Gate Fields prior to current landscape modification work. At least three episodes of fill appear to cap two horizons with soil-like characteristics, as described below.

At 0 feet:

Fill 1 (0-4 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (4-10 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Smooth, abrupt lower boundary with Fill 3.

Fill 3 (10-21 inches below surface): 10YR 4/4 mixed with 10YR 6/6 fine to medium sandy silt fill with frequent small gravels, historic or modern ceramic fragments (white wares) and brick bats & brick bits. Very compacted and heavily mixed with no natural soil structures. Non-plastic, non-sticky. Wavy, clear lower boundary with soil-like Horizon A.

Horizon A (21-24 inches below surface): 10YR 5/3 and 4/3 soil-like fine sandy loam to silt loam with occasional small gravels, brick bits, historic/modern ceramics (white wares). Very weak subrounded blocky to nearly massive structure. Darkened, organic hue to horizon, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Lower boundary not observed. Potentially another fill layer with enriched organic component.

At 12 ft:

Fill 1 (0-6 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (6-16 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Over-thickened in this profile as compared to others observed to east and west. Smooth, abrupt lower boundary with Fill 3.

Fill 3 (16-21 inches below surface): 10YR 4/4 mixed with 10YR 6/6 fine to medium sandy silt fill with frequent small gravels, historic or modern ceramic fragments (white wares) and brick bats & brick bits. Very compacted and heavily mixed with no natural soil structures, although very slightly platy structure observed infrequently. Deep (3-5 inch long), dark (10YR 3/2) intrusions into Fill 3 zone (possible post-depositional bioturbation or seep from overlying asphalt?). Non-plastic, non-sticky. Smooth, abrupt to slightly wavy, clear lower boundary with soil-like Horizon A.

Horizon A (21-26 inches below surface): 10YR 5/3 and 4/3 soil-like fine sandy loam to silt loam with occasional small gravels, brick bits, historic/modern ceramics (white wares). Very weak subrounded blocky to nearly massive structure. Darkened, organic hue to horizon, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Lower boundary not observed. Potentially another fill layer with enriched organic component.

At 25 ft:

Fill 1 (0-8 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (8-18 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Over-thickened in this profile as compared to others observed to east. Smooth, abrupt lower boundary with Horizon A.

Horizon A (18-23 inches below surface): 10YR 5/3 and 4/3 soil-like fine sandy loam to silt loam with occasional small gravels, brick bits, historic/modern ceramics (white wares). Very weak subrounded blocky to nearly massive structure. Darkened, organic hue to horizon, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Abrupt, smooth lower boundary with soil-like Horizon B. Absence of Fill 3 in this section may reflect local microtopography of the Hell's Gate landform or possible re-contouring associated with the construction of the asphalt road. Potentially another fill layer with enriched organic component.

Horizon B (23-31 inches below surface): 10YR 5/6 and 10YR 4/6 soil-like fine to medium sandy silt to fine sandy loam with very infrequent small gravels. Very weak subrounded blocky to nearly massive structure. No visible organics. Frequent oxidation mottles up to 5mm diameter. Non-plastic, non-sticky. Lower boundary not observed. Potentially another fill layer.

At 38 ft:

Fill 1 (0-6 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (6-13 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Over-thickened in this profile as compared to others observed to east. Smooth, abrupt lower boundary with Fill 3.

Fill 3 (13-18 inches below surface): 10YR 4/4 mixed with 10YR 6/6 fine to medium sandy silt fill with frequent small gravels, historic or modern ceramic fragments (white wares) and brick bats & brick bits. Very compacted and heavily mixed with no natural soil structures, although very slightly platy structure observed infrequently. Deep (3-5 inch long), dark (10YR 3/2) intrusions into Fill 3 zone (possible post-depositional bioturbation or seep from overlying asphalt?). Non-plastic, non-sticky. Not observed in section at 25 ft mark. Smooth, abrupt to slightly wavy, clear lower boundary with soil-like Horizon A.

Horizon A (18-23 inches below surface): 10YR 5/3 and 4/3 soil-like fine sandy loam to silt loam with occasional small gravels, brick bits, historic/modern ceramics (white wares). Very weak subrounded blocky to nearly massive structure. Darkened, organic hue to horizon, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Abrupt, smooth lower boundary with soil-like Horizon B. Potentially another fill layer with enriched organic component.

Horizon B (23-31 inches below surface): 10YR 5/6 and 10YR 4/6 soil-like fine to medium sandy silt to fine sandy loam with very infrequent small gravels. Very weak subrounded blocky to nearly massive structure. No visible organics. Frequent oxidation mottles up to 5mm diameter. Non-plastic, non-sticky. Lower boundary not observed. Potentially another fill layer.

At 60 ft:

Fill 1 (0-17 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Over-thickened in this location. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (17-22 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Over-thickened in this profile as compared to others observed to east. Smooth, abrupt lower boundary with Fill 3.

Fill 3 (22-25 inches below surface): 10YR 4/4 mixed with 10YR 6/6 fine to medium sandy silt fill with frequent small gravels, historic or modern ceramic fragments (white wares) and brick bats & brick bits. Very compacted and heavily mixed with no natural soil structures, although very slightly platy structure observed infrequently. Deep (3-5 inch long), dark (10YR 3/2) intrusions into Fill 3 zone (possible post-depositional bioturbation or seep from overlying asphalt?). Non-plastic, non-sticky. Not observed in section at 25 ft mark. Smooth, abrupt to slightly wavy, clear lower boundary with soil-like Horizon A.

Horizon A (25-29 inches below surface): 10YR 5/3 and 4/3 soil-like fine sandy loam to silt loam with occasional small gravels, brick bits, historic/modern ceramics (white wares). Very weak, very fine subrounded blocky to nearly massive structure. Darkened, organic hue to horizon, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Abrupt, smooth lower boundary with soil-like Horizon B. Potentially another fill layer with enriched organic component.

Horizon B (29-32 inches below surface): 10YR 5/6 and 10YR 4/6 soil-like fine to medium sandy silt to fine sandy loam with very infrequent small gravels. Very weak, very fine subrounded blocky to nearly massive structure. No visible organics. Frequent oxidation mottles up to 5mm diameter. Non-plastic, non-sticky. Lower boundary not observed. Potentially another fill layer.

At 75ft:

Fill 1 (0-17 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Over-thickened in this location. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (17-23 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Over-thickened in this profile as compared to others observed to east. Smooth, abrupt lower boundary with Fill 3/Horizon A.

Fill 3/Horizon A (23-27 inches below surface): 10YR 5/6 soil-like fine to medium sandy silt to fine sandy loam with very infrequent small gravels. Very weak, very fine subrounded blocky to nearly massive structure. Slight darkened organic-rich appearance, although no significant root development noted in section or hand samples. Very occasional oxidation mottles up to 5mm diameter. Very slightly plastic, very slightly sticky. Abrupt, smooth to clear, wavy lower boundary with soil-like Horizon A/B. Potentially another fill layer with enriched organic component.

Horizon A/B (27-37 inches below surface): 10YR 4/3 soil-like fine sandy loam to silt loam with occasional small gravels. Slight darkened organic-rich appearance, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Lower boundary not observed. Potentially another fill layer.

At 100 ft:

Fill 1 (0-8 inches below surface): 10YR 4/2 modern surface sandy silt to sandy loam fills with very frequent small to large gravels (infrequent boulders), historic and modern artifacts (ceramics, metal can tabs, iron nails), and small to medium gravels. Heavily compacted in places across section, elsewhere loose and eroded. Over-thickened in this location. Non-plastic, non-sticky. Smooth, abrupt lower boundary with Fill 2.

Fill 2 (8-15 inches below surface): 10YR 3/2 degraded road asphalt with very infrequent inclusions of small gravel or brick bits. Over-thickened in this profile as compared to other sections observed to east. Smooth, abrupt lower boundary with Horizon B/A.

Fill 3 (15-22 inches below surface): 10YR 5/6 soil-like fine to medium sandy silt to fine sandy loam with very infrequent small gravels. Very weak subrounded blocky to nearly massive structure. Slight darkened organic-rich appearance, although no significant root development noted in section or hand samples. Very occasional oxidation mottles up to 5mm diameter. Abrupt, smooth to clear, wavy lower boundary with Fill 4/Horizon B?. Potentially another fill layer with enriched organic component.

Fill 4 or Horizon B? (22-30 inches below surface): 10YR 4/6 compacted but soil-like fine to medium sandy silt to fine sandy loam with very infrequent small gravels. Very weak subrounded blocky to nearly massive structure. Very occasional oxidation mottles up to 5mm diameter. Non-sticky, non-plastic. Abrupt, smooth lower boundary with soil-like Horizon A?. Potentially another fill layer.

Horizon 2A? (30-36 inches below surface): 10YR 5/3 soil-like fine sandy loam to silt loam. Very weak subrounded blocky to nearly massive structure. Slight darkened organic-rich appearance, although no significant root development noted in section or hand samples. Very slightly plastic, very slightly sticky. Lower boundary not observed. Potentially another fill layer.

Appendix C: Geoprobe Core Logs – Hell's Gate Fields

HG-1

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-25	Ap	10YR3/1 (very dark gray) organic silty loam, common fine to medium roots, common partially decayed organics, few coarse sand grains and fine pebbles, clear lower boundary.
Buried disturbed historic soil	25-35	Abp	10YR3/1 (very dark gray) loam mottled with 10YR4/3 (brown) subsoil that increases in prominence and percent of matrix with depth, few fine red brick fragments, clear lower boundary.
Buried disturbed subsoil	35-50	Bp1	7.5YR5/4 (brown) clay loam with common indistinct 10YR3/1 (very dark gray) intrusions from overlying horizon, few fine pebbles, abrupt lower boundary.
	50-70	Bp2	10YR5/8 (yellowish brown) clay loam with common fine to medium distinct 10YR3/1 intrusions from overlying horizons, few fine pebbles, abrupt lower boundary.
Heterogeneous gravelly till	70-195	C1	7.5YR4/6 (strong brown) loam, 5% fine to medium heterolithic pebbles, abrupt lower boundary.
Sandy till	195-300	C2	10YR6/6 (brownish yellow), silt loam to sandy loam, strongly micaceous matrix, few fine heterolithic pebbles, clear lower boundary
Heterogeneous gravelly till	300-420	C3	10YR5/4 (yellowish brown) gravelly sandy loam to loam, heterolithic gneiss prbblrd fragments and black micaceous schist fragments, few red sandstone pebbles, gneiss bedrock obstruction at base.
bedrock	420-422+	R	Gneiss bedrock

HG-2

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-5	Oep	10YR2/2 (very dark brown) organic loam, abrupt lower boundary.
	5-55	Ap1	10YR3/2 (very dark grayish brown) gravelly loam, common black cinders and few fine pebbles throughout, ground concrete, abrupt lower boundary.
	55-82	Ap2	10YR2/1 (black) loam, with few cinder fragments and common fine pebbles, abrupt lower boundary.
	82-98	Ap/Cp	Mixed horizon of 10YR5/4 (yellowish brown) loam and 10YR2/1 (black) mottles and intrusions from overlying horizon.
Clean soil fill	98-165	Cp	Clean fill (possibly) of 10YR5/4 (yellowish brown) to 7.5YR5/6 (strong brown) loam to sandy clay loam with occasional 10YR2/1 (black) mottles, abrupt lower boundary.
Heterogeneous gravelly till	165-305	2C1	10YR4/4, 5/4 (yellowish brown) gravelly micaceous sand, with gneiss, schist, marble rock fragments and small pebbles, possibly stratified, undetermined lower boundary.
	305-525	2C2	7.5YR5/3 (brown) gravelly fine sand, heterolithic common (5-10%) well rounded gneiss pebbles and black schist fragments, gneiss bedrock obstruction at base.
bedrock	525-527	R	Gneiss bedrock

HG-3

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-15	Oap	10YR2/2 (very dark brown) organic loam, abrupt lower boundary.
	15-95	Ap	2.5Y3/1 (very dark gray) gravelly sandy loam, small fragments of cinders, tar, asphalt, pebbles, and fine brick fragments, with 10YR5/6 (yellowish brown) mottles, abrupt lower boundary.
Concrete	95-120	Concrete	Upper 10 cm (95-105 cm) large 10YR7/3 (very pale brown) concrete fragments, pulverized concrete below with brown plastic screwtop bottle rim fragment, clear plate glass, abrupt lower boundary.
Buried historic fill and topsoil	120-140	2Ap	10YR3/2 (very dark grayish brown loam with wood fragments, clear bottle glass, and plate glass (3/16 inch thick) fragment, abrupt lower boundary.
Buried disturbed subsoil	140-225	2Bp	10YR5/6 (yellowish brown) gravelly loam with occasional 10YR3/3 (dark brown) soft masses (fill?) heterolithic gravels with micaceous schist and gneiss rock fragments and pebbles.
Subsoil formed in till	225-290	2B1	10YR5/6 (yellowish brown) clay loam, clear lower boundary.
	290-345	2B2	7.5YR4/4 (brown) sandy clay loam with few heterolithic schist fragments and gneiss pebbles, undetermined lower boundary.
Heterogeneous gravelly till	345-460	2C1	10YR4/4, 5/4 (yellowish brown) gravelly micaceous sand, with gneiss, schist, dolomitic marble rock fragments and small pebbles, possibly stratified, undetermined lower boundary.
	460-575	2C2	5YR5/3 (brown) gravelly fine sand, heterolithic common (5-10%) well rounded gneiss pebbles and black schist fragments.

HG-4

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-10	Oa	10YR2/2 (very dark brown) partially decayed organic mat, abrupt lower boundary
	10-80	Ap	2.5Y3/1 (very dark gray) gravelly sandy loam, small fragments of cinders, tar, asphalt, pebbles, and fine brick fragments, with 10YR5/6 (yellowish brown) mottles, abrupt lower boundary
Concrete	80-90	Concrete	10YR7/3 (very pale brown) concrete, broken and weathered at base, abrupt lower boundary
Buried historic fill and topsoil	90-105	2Abp1	10YR2/2 (very dark brown) gravelly loam with common fine to medium cinders and asphalt with fine plastic fragments of Wise potato chip bag at base, clear lower boundary
	105-170	2Abp2	10YR2/1 (black) loam with an increase with depth in 10YR5/4 (yellowish brown) from mottles to the dominant matrix color at base of horizon, few fine roots, clear lower boundary.
Buried disturbed subsoil	170-220	2BCp	10YR5/4 (yellowish brown) gravelly sandy loam with few fine plastic fragments, common fine pebbles, intrusive 10YR2/1 (black) mottles (worm casts, mechanical intrusions?), abrupt lower boundary.
Heterogeneous gravelly till	220-460	2C	10YR6/4 (light yellowish brown) gravelly sandy loam with 10% heterolithic fine to medium pebbles of quartzite, marble, and micaceous schist

HG-5

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-40	Ap	10YR2/2 (very dark brown) gravelly sandy loam, common fine sand, few cinders, wood and root fragments, abrupt lower boundary.
Disturbed subsoil	40-80	Bp	7.5YR5/6 (strong brown) sandy loam, few fine pebbles and mottles of 10YR2/2 intrusive sandy loam, clear lower boundary.
Heterogeneous gravelly till	80-260	2C	10YR5/4 (yellowish brown) loamy fine sand, micaceous matrix with occasional heterolithic pebbles and rotting schist, gravel obstruction at base.

HG-6

Unit	Depth (cm)	Soil Horizon	Description
Clean soil fill	0-30	Ap1	10YR3/2 (very dark grayish brown) loam with root and stem fragments, clear lower boundary.
	30-300	Ap2	10YR5/6 clay loam with occasional roots and heterolithic gravels of gneiss, schist, red sandstone, fine root throughout, undetermined lower boundary.
Heterogeneous gravelly till	300-460	2C	10YR4/4, 5/4 (yellowish brown) gravelly micaceous sand, with gneiss, schist, dolomitic marble rock fragments and small pebbles, possibly stratified, undetermined lower boundary.

HG-8

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-75	Ap	10YR2/2 (very dark grayish brown) sandy loam to loam, occasional fine pebbles, few fine roots, few fine brick fragments, 1 clear bottle glass fragment, clear lower boundary.
Clean soil fill	75-135	Cp1	Heterogeneous fill of 7.5YR4/3 (brown) and 7.5YR5/6 (strong brown) gravelly sand to loam, few fine roots, small gravels throughout, uncertain lower boundary due to slump and poor recovery.
	135-265	Cp2	7.5YR4/6 (strong brown) gravelly loamy sand, 7% poorly sorted fine pebbles with occasional medium pebbles, loose, undetermined lower boundary due to slump and poor recovery.
	265-400	Cp3	7.5YR5/4 (brown) gravelly sand, 15% medium to fine heterolithic pebbles, fine roots throughout, loose, undetermined lower boundary due to slump and poor recovery.
Sandy till	400-460	2C1	7.5YR6/4 (light brown) fine sand, clean, micaceous, abrupt lower boundary.
	460-490	2C2	7.5YR4/4 (brown) sandy loam few rounded small to medium pebbles.

HG-9

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-125	Ap	10YR3/2 (very dark grayish brown) gravelly loamy sand, few fine to medium pebbles, very few fine brick fragments, few fine roots, undetermined lower boundary.
Clean soil fill	125-175	Cp	10YR5/6 (yellowish brown) loam, very few fine pebbles, faint fine dendritic mottles, few fine roots, abrupt lower boundary.
Heterogeneous gravelly till	175-225	2C1	7.5YR4/6 (strong brown) gravelly medium to coarse sand, 15% fine heterolithic pebbles, micaceous matrix, abrupt lower boundary
	225-350	2C2	7.5YR6/3 (light brown) gravelly sand, 10% heterolithic fine to medium pebbles of schist, gneiss, marble, abrupt lower boundary.
	350-535	2C3	7.5YR4/3 (brown) gravelly loamy sand, 5% heterolithic pebbles, less micaceous, abrupt lower boundary.
Bedrock	535-540	3CR	5YR4/4 (reddish brown) gravelly sand, possibly weathered bedrock/saprolite.

HG-10

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-35	Ap	10YR2/2 (very dark brown) loam, large brick fragment, abrupt lower boundary.
	35-110	Cp	7.5YR4/4 (brown) gravelly sand, medium to fine heterolithic gravels of gneiss, schist, and marble in loose fill, abrupt lower boundary.
Buried disturbed historic soil	110-130	Apb	7.5YR3/2 (loam) few fine roots, diffuse lower boundary.
	130-210	BCp	10YR4/6 (dark yellowish brown) loam, 7.5YR3/2 (dark brown) mottles decreasing in frequency with depth, few fine pebbles, slight firm, abrupt lower boundary.
Heterogeneous gravelly till	210-360	2C1	7.5YR4/6 (strong brown) gravelly sand, slightly micaceous matrix, fine to medium pebbles of heterolithic marble and gneiss, undetermined lower boundary.
	360-460	2C2	7.5YR4/3 (brown) loamy sand, micaceous matrix, few fine gravels and schist rock fragments, abrupt lower boundary.
Bedrock	460-490	3CR	7.5YR5/8 (strong brown) sand, weathered/saprolite gneiss bedrock.

HG-11

Unit	Depth (cm)	Soil Horizon	Description
Clean fill	0-25	Ap	10YR3/2 (very dark grayish brown) sandy loam, few fine roots, few fine pebbles, clear lower boundary.
Disturbed subsoil	25-100	Bp	7.5YR4/6 (strong brown) sandy clay loam, few fine roots, common root casts and distinct mottles of 10YR3/2 matrix intrusive into horizon, abrupt lower boundary.
Sandy Till	100-120	C1	7.5YR5/6 (strong brown) sandy loam with occasional gravels, undetermined lower boundary.
	120-210	C2	7.5YR5/6 (strong brown) sand, occasional fine gneiss pebbles and schist fragments, few fine roots, abrupt lower boundary.
Heterogeneous gravelly till	210-435	C3	7.5YR6/6 (reddish yellow) gravelly fine sand, 5-10% fine heterolithic gravels of schist, marble, gneiss.

Appendix D: Geoprobe Core Logs – Central Fields

CF-1

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-110	Ap	7.5YR2.5/1 (black) loam with few brick and cinders, few fine roots, abrupt lower boundary.
Buried disturbed historic soil	110-120	2Ap	7.5YR5/3 (brown) loam with faint fine mottles of underlying horizon, undertermined lower boundary due to slump and empty top of 2nd sample core.
	120-165	2ABp	10YR5/4 (yellowish brown) loam, very few gravels and intrusive root stains, clear lower boundary.
Subsoil formed in till	165-200	2Bw	10YR4/6 (dark yellowish brown) loam, very fine prismatic structure, abrupt lower boundary
Sandy till	200-460	2C	7.5YR3/4 (dark brown) gravelly loamy sand, heterolithic rounded quartz, gneiss, red sandstone.

CF-2

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-120	Ap	7.5YR2.5/1 (black) loam with an increase in sands with depth, few brick and cinders, few fine roots, abrupt lower boundary.
Buried disturbed subsoil	120-135	2Bp	10YR5/4 (yellowish brown) loam, very few gravels and intrusive root stains, clear lower boundary.
Subsoil formed in till	135-210	2Bg	10YR4/6 (dark yellowish brown) loam, very fine prismatic structure, increase in distinct prominent 7.5YR4/6 (strong brown) redox concentrations with depth, abrupt lower boundary.
Sandy till	210-225	2C	10YR3/6 (dark yellowish brown) fine sand, abrupt lower boundary.
Heterogeneous gravelly till	225-460	3C	7.5YR3/4 (dark brown) gravelly loamy sand, heterolithic rounded quartz, gneiss.

CF-3

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-20	Ap1	7.5YR2.5/1 (black) loam with few brick and cinders, few fine roots, abrupt lower boundary.
	20-100	Ap2	7.5YR2.5/1 (black) loam with an increase in sands with depth, few brick and cinders, few fine roots, abrupt lower boundary.
	100-155	Ap3	7.5YR3/4 (dark brown) loamy sand mottled with 10YR3/2 (very dark grayish brown), few cinders, few brick fragments, abrupt lower boundary.
Sandy till	155-320	2C	10YR3/6 (dark yellowish brown) fine sand, abrupt lower boundary.
	320-345	3C	7.5YR5/8 (strong brown) sand, faint fine (lamina) bedding, abrupt lower boundary.
	345-440	4C1	10YR6/3 (pale brown) fining upward from coarse to medium loose sand, heterolithic quartz, micaceous, abrupt lower boundary.
	440-460	4C2	10YR6/3 (pale brown) fining upward medium sand with 7.5YR5/4 (brown) silt cap.

CF-4

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-75	Ap1	7.5YR2.5/1 (black) loam with an increase in sands with depth, few brick and cinders, few fine roots, abrupt lower boundary.
	75-192	Ap2	7.5YR3/4 (dark brown) loamy sand mottled with 10YR3/2 (very dark grayish brown), few cinders, few brick fragments, abrupt lower boundary.
Sandy till	192-207	2C	7.5YR5/6 (strong brown) fine sand, abrupt lower boundary.
Heterogeneous gravelly till	207-460	3C	7.5YR3/4 (dark brown) gravelly loamy sand, heterolithic rounded quartz, gneiss.

CF-5

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-40	Ap	10YR3/2 (very dark grayish brown) sandy loam, few fine gravels and 10YR2/1 (black) mottles at base, abrupt lower boundary.
Heterogeneous gravelly till	40-345	2C	7.5YR3/4 (dark brown) gravelly loamy sand, heterolithic rounded quartz, gneiss.

CF-6

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-40	Ap1	10YR2/2 (very dark brown) loam with few cinders, abrupt lower boundary.
Concrete	40-45	Ap2	Broken concrete fragments, abrupt lower boundary.
Cinder fill	45-310	Ap3	10YR2/1 (black) gritty loam cinder fill, undetermined lower boundary due to wash and no recovery at to top 3rd sample core.
Clean fill	310-355	Ap4(?)	10YR4/4 (dark yellowish brown) silt loam with 10YR4/2 indistinct medium mottles, fine sand, micaceous
Heterolithic gravelly till	355-460	2C	10YR4/4 (dark yellowish brown) gravelly loamy sand with common well rounded heterolithic pebbles.

CF-7

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-28	Ap1	10YR3/1 (very dark gray) organic silty loam, common fine to medium roots, common partially decayed organics, few coarse sand grains and fine pebbles, clear lower boundary.
	28-150	Ap2	10YR2/2 (very dark brown) loam with few cinders, abrupt lower boundary.
Cinder fill	150-170	Ap3	7.5YR3/1 (very dark gray) gravelly loam, common black cinders, tar, abrupt lower boundary.
Clean soil fill	170-240	Ap4	7.5YR4/4 (brown) gravelly sandy loam, mottled with darker 7.5YR4/2 indistinct medium mottles, broken gray siltstone gravels, abrupt lower boundary.
Sandy till	240-345	2C1	7.5YR4/6 (strong brown) gravelly sand, few rounded heterolithic gravels, undetermined lower boundary due to slump and no recovery at top of 4th sample core.
Heterogeneous gravelly till	345-460	2C2	7.5YR5/4 (brown) gravelly loamy sand, few to many heterolithic gravels.

CF-8

Unit	Depth (cm)	Soil Horizon	Description
Clean fill	0-5	Ap1	10YR3/1 (very dark gray) organic silty loam, common fine to medium roots, common partially decayed organics, few coarse sand grains and fine pebbles, clear lower boundary.
	5-75	Ap2	7.5YR3/4 (dark brown) loamy sand, clean, abrupt lower boundary.
Mixed fill	75-105	Ap3	10YR2/2 (very dark brown) loam with few cinders, few large brick fragments, abrupt lower boundary.
	105-240	Ap4	10YR3/6 (dark yellowish brown) gravelly sandy loam with few pebbles and woody stem fragments, undetermined lower boundary due to slump and poor recovery at top of 3rd sample core.
Subsoil formed in till	240-275	2Bw	7.5YR5/6 (strong brown) loam, slightly firm, few fine pebbles, clear lower boundary.
Sandy till	275-345	2C1	7.5YR4/6 (strong brown) gravelly sand, few rounded heterolithic gravels, clear lower boundary.
Heterogeneous gravelly till	345-425	2C2	7.5YR5/4 (brown) gravelly loamy coarse sand, abrupt lower boundary.
	425-460	2C3	2.5YR4/4 (reddish brown) gravelly loamy sand, heterolithic with pink gneiss, rotting schists, red sandstone gravels

CF-9

Unit	Depth (cm)	Soil Horizon	Description
Clean fill	0-35	Ap1	10YR3/1 (very dark gray) organic silty loam, common fine to medium roots, common partially decayed organics, few coarse sand grains and fine pebbles, abrupt lower boundary.
	35-70	Ap2	7.5YR3/4 (dark brown) loamy sand, clean, abrupt lower boundary.
Gravel fill	70-85	Ap3	10YR3/2 (very dark grayish brown) rock gravel, similar to rock mat top-bedding observed at Sunken Gardens.
Heterogeneous gravelly till	85-345	2C	7.5YR4/6 (strong brown) gravelly sand, common rounded heterolithic gravels of rotten black schist, quartzite, gray gneiss.

Appendix E: Geoprobe Core Logs – Sunken Garden Fields

SG-1

Unit	Depth (cm)	Soil Horizon	Description
Gravel fill	0-10	Ap1	10YR3/2 (very dark grayish brown) rock gravel bed with black plastic matting at base.
Mixed fill	10-160	Ap2	2.5Y4/2 (dark grayish brown) gritty loamy sand mottled with 10YR3/2 (very dark grayish brown), common cindery grit, few brick fragments, foil-paper wrapper at 105 cm, clear lower boundary.
Buried disturbed historic soil	160-170	2Abp	2.5Y4/2 (dark grayish brown) loam, few sand fragments, asphalt fragments towards top, few vertical root stains extending towards base, clear lower boundary.
Subsoil formed in till	170-290	2Bg	Loamy fine sand with common 2.5Y6/3 (light yellowish brown) reductions and 7.5YR4/6 (strong brown) distinct fine oxidations which increase in prominence with depth, abrupt lower boundary.
	290-315	2Cg	7.5YR4/6 (strong brown) loamy sand to sandy clay loam, abrupt lower boundary.
Heterogeneous gravelly till	315-345	3C	7.5YR4/6 (strong brown) gravelly sandy clay loam, medium to large pebbles, undetermined lower boundary due to slump/no recovery at top of 4th tube.
bedrock	345-460	4CR	Weathering schist bedrock.

SG-2

Unit	Depth (cm)	Soil Horizon	Description
Gravel fill	0-16	Ap1	10YR3/2 (very dark grayish brown) rock gravel bed with black plastic matting at base.
Concrete	16-32	Ap2	Broken concrete fragments, abrupt lower boundary.
Mixed Fill	32-120	Ap3	2.5Y4/2 (dark grayish brown) loam, few sand fragments, plastic drinking straw at ~90 cm, asphalt fragments towards top, few vertical root stains extending towards base, clear lower boundary.
	120-200	Ap4	10YR3/2 (very dark grayish brown) loamy sand, few frit fragments, and mottles, abrupt lower boundary.
Concrete	200-225	Ap5	Broken concrete fragments and gravels, abrupt lower boundary.
Buried disturbed historic soil	225-230	2Abp	7.5YR3/1 (very dark gray) loam, few fine roots, very few fine brick fragments, weakly mottled, clear lower boundary.
Subsoil formed in till	230-315	2Bg	Common 2.5Y5/2 (grayish brown) reduced and 7.5YR4/6 (strong brown) oxidized mottles in loamy fine sand, clear lower boundary.
	315-335	2C	10YR5/3 (brown) sand, abrupt lower boundary.
	335-365	2Bg	Common 2.5Y5/2 (grayish brown) prominent, distinct reductions and weak 7.5YR4/6 (strong brown) oxidized mottles in loamy fine sand Undetermined lower boundary due to slump/no recovery top of 4th tube.
Sandy till	365-375	3C	2.5YR4/2 (weak red) fine sand, few fine gravels, abrupt lower boundary.
	375-430	4C	2.5Y5/4 (light olive brown) becomes more oxidized with depth to 10YR5/6 (yellowish brown) coarse sand, common micaceous grains.

SG-3

Unit	Depth (cm)	Soil Horizon	Description
Gravel fill	0-15	Ap1	10YR3/2 (very dark grayish brown) rock gravel bed with black plastic matting at base.
Concrete	15-20	Ap2	Broken concrete fragments, abrupt lower boundary.
Cinder fill	20-230	Ap3	2.5Y4/2 (dark grayish brown) loam, few sand fragments, asphalt fragments towards top, few vertical root stains extending towards base, few cinders which increase in abundance towards the base, clear lower boundary.
Clean fill	230-345	Ap4	Common 2.5Y5/2 (grayish brown) reduced and 7.5YR4/6 (strong brown) oxidized mottles in loamy fine sand, clear lower boundary.
oil	345-430	Ap5	Black oily vegetable mat, saturated with hydrocarbons.

SG-4

Unit	Depth (cm)	Soil Horizon	Description
Cinder fill	0-175	Ap1	2.5Y4/2 (dark grayish brown) loam, few sand fragments, plastic wrapper at ~60 cm, few-common large brick fragments towards top, few vertical root stains extending towards base, common black cinders, abrupt lower boundary.
Buried disturbed historic soil	175-195	2Abp	7.5YR3/2 (dark brown) mottled loam, few fine roots, clear lower boundary.
Subsoil formed in till	195-320	2Bg	Common 2.5Y6/3 (light yellowish brown) reductions and 7.5YR4/6 (strong brown) distinct fine oxidations which increase in prominence with depth, abrupt lower boundary.
Sandy till	320-345	3C	10YR6/2 (light yellowish brown) loamy sand, few fine bedded lamina, undetermined lower boundary due to wash/empty top of 4th sample tube.
	345-430	4C	10YR5/4 (yellowish brown) coarse sand, micaceous, few fine-medium pebbles, abrupt lower boundary.
bedrock	430-460	5CR	Unconsolidated bedded micaceous sands, becomes firmer towards base.

SG-5

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-90	Ap1	2.5Y4/2 (dark grayish brown) loam, few sand fragments, few-common large brick fragments towards top, few vertical root stains extending towards base, common black cinders, abrupt lower boundary.
Cinder fill	90-170	Ap2	7.5YR3/1 (very dark gray) gravelly loam, common black cinders, tar, abrupt lower boundary.
Buried disturbed historic soil	170-190	2Abp	10YR4/2 (dark grayish brown) loam, intrusive pebbles and gravels, abrupt lower boundary.
Subsoil formed in till	190-210	2E	10YR6/3 (pale brown) loam, intrusive organic films from above, clear lower boundary.
	210-305	2Bg	Common 2.5Y6/3 (light yellowish brown) reductions and 7.5YR4/6 (strong brown) distinct fine oxidations which increase in prominence with depth, abrupt lower boundary.
	305-325	2C	2.5Y5/1 (gray) medium sand, few fine lamina, slightly micaceous, abrupt lower boundary.
Sandy till	325-345	3C	2.5Y3/1 (very dark gray) loamy sand, few fine lamina, moist, slightly organic, undetermined lower boundary because 4th sample core has wash and empty at top.
	345-415	4C	7.5YR4/6 (strong brown) gravelly sand, abrupt lower boundary.
	415-460	5C	2.5Y4/2 (dark grayish brown) coarse sand, heterolithic with 3-4 cm thick lamina of loamy fine sand at top and near bottom of exposure.

Appendix F: Geoprobe Core Logs – Wards Meadow Fields

WM-1

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-92	Ap	Mottled 7.5YR2.5/1 (black) and 7.5YR4/3 (brown) gravelly loam, few medium sized pebbles and rock fragments, very few cinders, abrupt lower boundary.
Truncated shoreline/nearshore/beach?	92-107	2AB	10YR4/4 (dark yellowish brown) silt loam, very few fine charcoal, abrupt lower boundary, truncated nearshore-shoreline?
Slightly oxidized subsoil shore/beach?	107-170	2Bw	7.5YR5/6 (strong brown) sandy loam, very weakly oxidized, well sorted, abrupt lower boundary
Reduced/oxidized, fines upward	170-187	2Bg1	Silt with 5Y6/2 (light olive gray) distinct reduced ped faces with faint oxidized 7.5YR6/8 reddish yellow ped cores, clear lower boundary.
	187-215	2Bg2	Sandy clay loam with 5Y6/1 (gray) faint distinct reduced ped faces with faint oxidized 7.5YR5/4 (brown) ped cores, sands are medium to coarse, clear lower boundary.
Clean sands (high energy shoreline?)	215-340	2C1	7.5YR4/3 (brown) loamy sand with few rotten schist fragments, abrupt lower boundary.
	340-460	2C2	10YR4/3 (brown) loamy sand with few small rounded pebbles, moderately micaceous

WM-2

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-40	Ap1	10YR4/2 (dark grayish brown) loam, few medium roots, few pebbles, cinders, and small shell fragments, abrupt lower boundary.
Clean fill	40-70	Ap2	10YR3/1 (very dark gray) loamy fine sand, few fine roots, abrupt lower boundary.
	70-160	Ap3	10YR4/4 (dark grayish brown) sandy silt loam, mottled with occasional gritty cinders and fine pebbles.
Cindery fill	160-210	Ap4	10YR2/1 (black) gravelly cindery fill, common cinders, 1 large brick fragment, common medium angular pebbles, abrupt lower boundary.
Mudflat-marsh	210-250	2Bg	5Y5/1 (gray) silt, coarsens upward to a loamy silt, becomes more oxidized to a 7.5YR5/3 (brown) at top, micaceous, abrupt lower boundary
Marsh surface/near-surface	250-275	2Ab	7.5YR3/1 (very dark gray) silt, completely decayed organics, abrupt lower boundary, matrix collected for bulk dating of soil organics.
Reduced top of underlying sands (hetero fluvial-till?)	275-285	2ABb	GLEY 6/1 5GY (greenish gray) loamy sand, reduced matrix formed at top of underlying sands, clear lower boundary.
Upper hetero fluvio-till?	285-345	3BC	7.5YR5/1 (gray) loamy sand, medium to coarse sands, slightly micaceous, few medium gravels, moist, gradual lower boundary.
Lower hetero fluvio-till?	345-440	3CB	10YR5/4 (yellowish brown) loamy sand, 5% gravels, rounded pebbles, saturated, abrupt lower boundary.
Top glacial lake deposits	440-460	4C	7.5YR5/4 (brown) silt, very firm, saturated very faint to indistinct fine rhythmites (varves?) collected for possible 14C dating of bulk sediment.

WM-3

Unit	Depth (cm)	Soil Horizon	Description
Clean fill	0-78	Ap	10YR5/6 (yellowish brown) loam to sandy loam fill, abrupt lower boundary.
Truncated marsh/shoreline	78-85	2ACb	10YR5/3 (brown) silt loam, very few fine organics, very weakly micaceous, clear lower boundary.
Shoreline	85-200	2BCg	Silt loam with 7.5YR5/6 (strong brown) oxidized ped cores with reduced indistinct 2.5YR5/1 (gray) ped faces, weak fine prismatic structure, prominence of redox features reduced up horizon to a weakly oxidized 7.5YR5/4 (brown) matrix at top, very few fine charcoal and shell fragments at top, weak micaceous throughout, clear lower boundary.
Transition shoreline/ fluvio-till	200-225	2Cg	7.5YR5/4 (brown) loamy sand to fine sand, 5% fine pebbles, weakly oxidized, abrupt lower boundary.
hetero fluvio-till	225-400	3C	10YR4/3 brown gravelly loamy sand, fines upward from fine to medium sand with few fine gravels to loamy sand with common coarse gravels.
bedrock	400-430	4CR	7.5YR2.5/1 (black) rotten soft micaceous schist/gneiss with few milky and brown colored quartz

WM-4

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-40	Ap1	7.5YR2.5/1 (black) loam, with 0-5% gravels and occasional cinders, mottled with 7.5YR4/2 (brown) towards the base, abrupt lower boundary.
Clean fill	40-65	Ap2	10YR5/4 (yellowish brown) loam, mottled with 7.5YR4/2 (brown) and very fine gravels, abrupt lower boundary.
Shoreline-Marsh (poss. Historic)	65-110	2ACp	2.5Y4/2 (dark grayish brown) loamy silt, firm, weak fine prismatic structure with 2.5Y5/4 (light olive brown) vertical cylindrical reduction features roughly along ped faces, clear lower boundary.
Transition shoreline/ fluvio-till?	110-200	3C1	10YR4/3 (brown) loamy sand, sands fine upward, moist, moderately micaceous, few rotten black schist fragments, clear lower boundary.
hetero fluvio-till?	200-260	3C2	10YR4/3 (brown) gravelly loamy sand, fine to medium pebbles, increasingly micaceous with depth, undetermined lower boundary due to slumping in cores.
bedrock	260-345	4CR	Unconsolidated bedrock of 5YR5/4 (reddish brown) to 7.5YR2.5/1 (black) schist/gneiss.

WM-5

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-30	Ap1	7.5YR2.5/1 (black) loam, with 0-5% gravels and occasional cinders, mottled with 7.5YR4/2 (brown) towards the base, abrupt lower boundary.
	30-230	Ap2	10YR4/4 (dark yellowish brown) gravelly loam, common fill gravels, few brick fragments, occasional roots, undetermined lower boundary because of slump.
Transition shoreline/ fluvio-till?	230-345	2Cg	10YR4/3 (brown) loamy sand, sands fine upward, 2% gravels, moist, moderately micaceous, few rotten black schist fragments, clear lower boundary.

WM-6

Unit	Depth (cm)	Soil Horizon	Description
Mixed fill	0-30	Ap1	7.5YR2.5/1 (black) loam with few brick and cinders, few fine roots, abrupt lower boundary.
	30-75	Ap2	7.5YR4/3 (brown) gravelly loam with few cinders, 5% pebbles and mottles, abrupt lower boundary
Cinder fill	75-218	Ap3	7.5YR3/1 (very dark gray) gravelly loam, common black cinders, tar, cloth fragments, abrupt lower boundary.
Bedrock	218-315	2C	GLEY 1 4/1 10Y (dark greenish gray) loamy sand, highly micaceous, few fine to coarse rock fragments, unconsolidated bedrock, abrupt lower boundary.
	315-345	2CR	GLEY 1 4/110Y-3/N (dark greenish gray to very dark gray) firm rotten schist.

WM-7

Unit	Depth (cm)	Soil Horizon	Description
Cinder fill	0-212	Ap	7.5YR3/2 (dark brown) loam, common gritty cinders, asphalt and gravels.
Bedrock	212-230	Cp/CR	7.5YR5/4 (brown) loamy sand, few rounded pebbles and rotten black schist rock fragments.

WM-8

Unit	Depth (cm)	Soil Horizon	Description
Clean fill	0-15	Ap1	7.5YR3/1 (very dark gray) loam, few pebbles, abrupt lower boundary.
concrete	15-20	Ap2	Concrete, shattered, abrupt lower boundary.
Cinder fill	20-95	Ap3	7.5YR3/2 (dark brown) loam, few cinders, brick fragments, roots, very few gravels, abrupt lower boundary.
Clean fill	95-110	Ap4	2.5Y4/3 (olive brown) very fine sandy loam, few black fill mottles, abrupt lower boundary.
Cinder fill	110-230	Ap5	10YR3/2 (very dark grayish brown) loam, common fine gravels, concrete fragments, brick fragments, asphalt

Appendix G: Radiocarbon Reports

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Joseph Schuldenrein — Report Date: 3/17/2009

Geoarcheology Research Associates — Material Received: 2/25/2009

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 256405	13960 +/- 70 BP	-26.9 o/oo	13930 +/- 70 BP
Beta - 256406	20390 +/- 100 BP	-20.4 o/oo	20470 +/- 100 BP
Beta - 256407	15270 +/- 70 BP	-26.7 o/oo	15240 +/- 70 BP

Beta - 256405
SAMPLE : WM-2-250-275cm
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 15010 to 14280 (Cal BP 16960 to 16230)

Beta - 256406
SAMPLE : WM-2-450-460cm
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes

Beta - 256407
SAMPLE : SG-5-325-345cm
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (peat): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 16840 to 16580 (Cal BP 18790 to 18520)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.9:lab. mult=1)

Laboratory number: **Beta-256405**

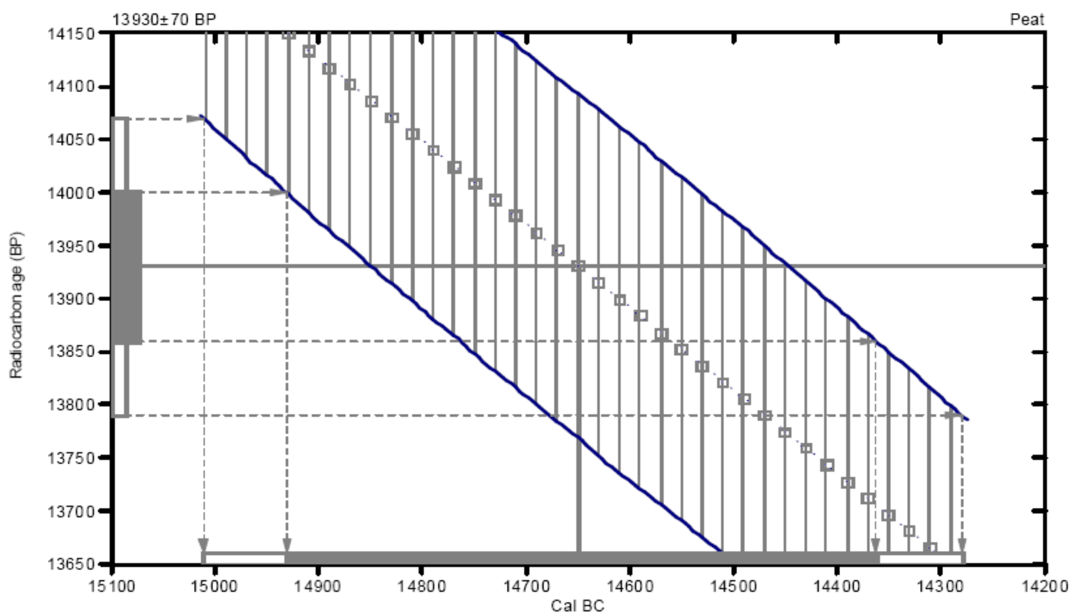
Conventional radiocarbon age: **13930±70 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 15010 to 14280 (Cal BP 16960 to 16230)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 14650 (Cal BP 16600)

1 Sigma calibrated result: (68% probability) Cal BC 14930 to 14360 (Cal BP 16880 to 16310)



References:
Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory
4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.7:lab. mult=1)

Laboratory number: **Beta-256407**

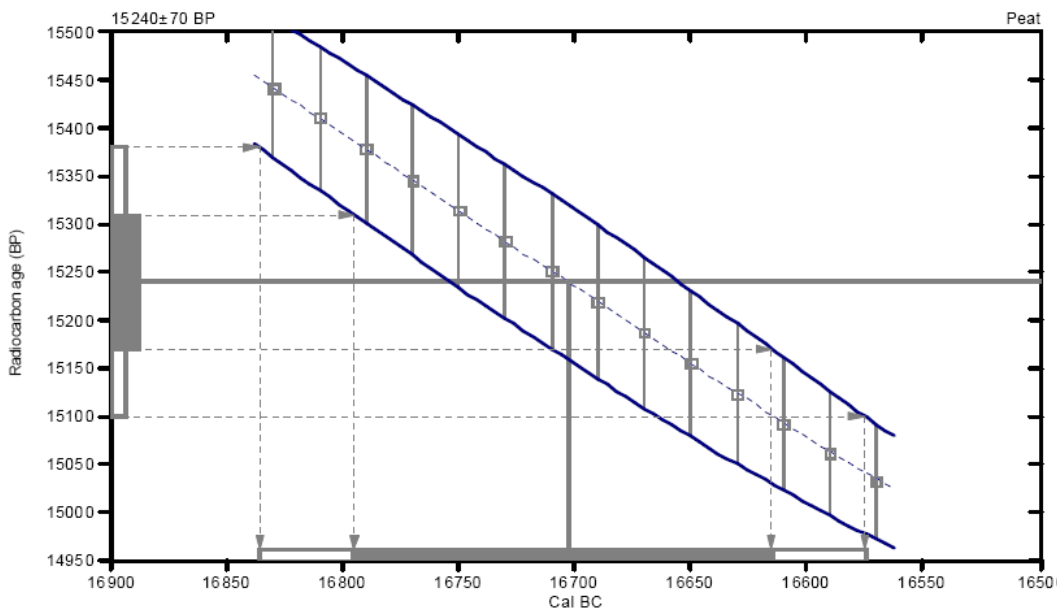
Conventional radiocarbon age: **15240±70 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 16840 to 16580 (Cal BP 18790 to 18520)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 16700 (Cal BP 18650)

1 Sigma calibrated result: (68% probability) Cal BC 16800 to 16620 (Cal BP 18740 to 18560)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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