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ARCHEOLOGICAL AND GEOARCHEOLOGICAL INVESTIGATIONS ASSOCIATED WITH THE CONSTRUCTION OF THE METROPOLITAN CORRECTIONS CENTER TUNNEL UNDER PEARL STREET, FOLEY SQUARE, NEW YORK

GENERAL SERVICES ADMINISTRATION
REGION 2

Gary McGowan

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

1.0 INTRODUCTION

The following is the second of two reports associated with the construction by the General Services Administration (GSA), Region 2 of a tunnel under Pearl Street that will connect the Metropolitan Corrections Center (MCC) with the new Foley Square Courthouse, and a three-story structure adjacent to the MCC. In accordance with John Milner Associates' (JMA's) proposal, dated March 15, 1994, and an addendum to that document, dated March 29, 1994 (Yamin), the first report, submitted in May 1994, described the methods and results of archeological testing conducted on the parcel adjacent to the MCC between April 14 and May 2, 1994. The present document covers the archeological monitoring of tunnel excavation conducted between July 22 and October 27, 1994. Because this document serves primarily as a management summary, it does not include the results of historical research. Background research was presented in the research design for the MCC/Tunnel project (see John Milner Associates 1994). However, that research did not include in-depth investigations relating to the eighteenth century tanneries along Pearl Street that were briefly described in the Phase IA report for the proposed Foley Square project (Ingle et al. 1990:121-123). Additional research on the local tanning industry will be conducted and presented as part of the final report on the Courthouse Block.

1.1 Purpose and Goals of the Investigation

The purpose of the monitoring was to record information relating to the history of Pearl Street, the eighteenth century tanning industry in this part of lower Manhattan, and geomorphological changes and their relationship to cultural activities through time. As specified in the proposal, this report includes a section co-authored by the project geomorphologist, Dr. Joseph Schuldenrein, who analyzed the sediments underlying Pearl Street in terms of their relationship to the eastern outlet of the Collect Pond and also assisted the archeologists with the identification of deposits relating to the local eighteenth century tanning industry.

The archeological investigations were conducted under the provisions of an original Memorandum of Agreement (MOA) for the Foley Square U.S. Courthouse Project, executed on March 15, 1989, which provided for construction of a subgrade tunnel under Pearl Street. The Advisory Council on Historic

Preservation (Bush 1994) requested that the amended MOA, rather than a new MOA, be followed for this project. Documentary research conducted for this project (John Milner Associates, Inc. 1994) and during preparation of the Final Research Design for Archeological and Historical Investigations of Five Points (Courthouse Block), New York, New York (John Milner Associates, Inc. and Howard University 1993) provided a context within which to evaluate the potential significance of the resources identified. In consultation with the New York City Landmarks Commission, these resources were recorded during the monitoring process and subsequently destroyed by ongoing construction.

The archeological and geoarcheological results are described in a single document. Following a brief description of the project location and personnel, the next two sections of the report (Sections 2.0 and 3.0) present the methods and results of the archeological monitoring of tunnel construction. Section 4.0, authored by the geomorphologists on the project team, describes the geoarcheological procedures and analysis. A final section (Section 5.0) presents conclusions and recommendations based on the results of both the archeological and geoarcheological analyses.

1.2 Project Location

The approximately 50-foot-long tunnel extends from the south facade of the new Federal Courthouse on Pearl Street in lower Manhattan to the north facade of the MCC at the corner of Pearl Street and Cardinal Hayes Place (Figures 1 and 2). The tunnel will enter a three-story elevator-stair tower to be built on the parcel of land immediately adjacent to the northwest corner of the MCC, making it possible to transport prisoners directly from the third floor of the MCC into the courtrooms across the street. The project area abuts the Courthouse Block that was excavated in 1992.

1.3 Project Team

The JMA project team was headed by Dr. Rebecca Yamin, Principal Archeologist/Project Manager. Mr. Tom Johnson, Project Archeologist, assisted by Mr. Jesse Owens, monitored all field activities assisted, on occasion, by Mr. Steve Brighton, Mr. Michael Bonasera, Ms. Claudia Milne, and Mr. Larry Jepson. Mr.

Jesse Owens completed most of the field drawings; finished graphics were done by Ms. Sarah Ruch. Dr. Joseph Schuldenrein, assisted by Ms. Maria Schleidt-Peñalva and Mr. William Monaghan, provided geomorphological expertise in the field. Dr. Schuldenrein and Ms. Schleidt-Peñalva authored Chapter 4.0 of this report. Mr. Daniel G. Roberts provided editorial review of the report, and Ms. Margy Schoettle produced it.

2.0 FIELD METHODS

Tunnel excavation was directed by the General Service Administration's consultant for development and their subcontractor. At the conclusion of the archeological investigation associated with the parcel adjacent to the MCC, the contractor's project manager for the tunnel construction agreed to notify JMA when work associated with the tunnel proper began. JMA received a call from the contractor on May 24 reporting the onset of excavations within Pearl street relating to the relocation of utilities on either side of the tunnel trench.

Since the monitoring of utilities trench excavation was not included in the final scope of work for the project, JMA personnel made only occasional visits to the project area to keep abreast of progress. An archeologist visited the site on May 25 and 27 and on June 1, 6, 16, and 21 when work had ceased. The only find of note during this period was a large granite footing that extended into the tunnel alignment at the corner of Pearl Street and Cardinal Hayes Place. The footing was left in place, to be recorded and removed during the excavation of the tunnel trench proper.

JMA was again notified on July 6 when the contractor began installation of the soldier piles that were to hold the lagging along either side of the tunnel trench. On July 22 a meeting was held at the developer's offices to discuss the first 30-day schedule for tunnel construction. JMA's principal investigator attended the meeting, along with developer and contractor representatives. Because Pearl Street could not be closed during business hours, construction was to take place at night (7 P.M. to 3 A.M.) beginning that night. As is customary on a project of this scale in an urban setting, the schedule was shifted many times at very short notice, sometimes to include only night shifts, at others to include only days, sometimes nights and days, and sometimes one day on the week-end. In order to ensure appropriate archeological activity in all these situations, JMA hired a New York-based technician, who could adapt to any contingency and who worked under the direction of JMA's project archeologist. When necessary during week days, archeological technicians working in the Foley Square lab at the World Trade Center also assisted in the field. The principal investigator spent at least one day a week on the site throughout the project. The project geomorphologist was on call throughout the project and spent approximately one-half day a week on the site during the final two months of field work.

In general, two JMA archeologists monitored all construction activities within the tunnel alignment. All procedures were described in a standard field book and photographs were taken of general field activities as well as of specific archeological features. Short work stoppages were requested when a possible archeological feature was exposed or a profile was ready to be recorded. As had been agreed upon in discussions between JMA, GSA, the developer, and the contractor, double board-width sections (approximately 20 inches) and often larger sections of profile were left unsheathed for periods of time sufficient that recordation (via necessary drawings and photographs) could be completed. The scope of work called for "profiling of the entire eastern side of the trench and those portions of the western side of the trench that significantly vary in strata, features, or anomalies from the eastern side."

JMA archeologists worked closely with the contractor to optimize non-intrusive techniques, effective recordation, and access within appropriate safety parameters, which were ultimately determined by the contractor. The key to accomplishing the required work was constant communication with the contractor's site supervisor and foremen in the field. The foremen came to understand what JMA's archeologists were looking for and anticipated their needs. The foremen were also able to shift workers away from areas the archeologists needed to examine, thus keeping work stoppages to a minimum.

2.1 Decking the Street

On the night of July 22, the contractor, including a caterpillar operator, began removing the pavement and the upper two feet of underlying fill in preparation for decking the street. Fifteen soldier piles were already in place to hold the timber decking (Figure 3). As soon as the pavement had been removed, a web of utilities, including an electrical conduit that had been installed to service the new courthouse, several older electrical conduits, a water main running north-south, and a nineteenth century gas main became visible beneath the street (Plate 1). The complexity of the utilities necessitated that the orange sandy fill surrounding them be removed using manual methods (Plate 2). Utilities were either removed or "hung" (supported by hanging them from the steel beams on which the decking ultimately rested), as appropriate.

A layer of Belgian blocks, apparently a former street surface, was exposed beneath the approximately one foot-thick asphalt paving in one small area at the southwestern corner of the tunnel alignment. The *in situ* blocks originated at the southern curb of Pearl Street and extended out (north) to a little over 3 meters from the curb. Beneath the blocks was an intact profile (Figure 4), indicating that the blocks lay on top of building rubble, and a brick and granite wall that probably represented a facade of a tenement that faced Pearl Street. The wall was the same wall observed during the utilities trench excavations discussed above. The street was apparently widened after the tenement was taken down. Belgian blocks were also present in the fill to the west of the tunnel alignment, but they had been displaced by pipe trenches.

The installation of the decking was completed within a week and the contractor's efforts turned to the underpinning of the MCC (not within the archeological scope of work) and dewatering problems. However, the archeologists remained on the site since, according to the contractor's site supervisor, there was always a chance that some labor would be devoted to the digging of the tunnel. Work on the trench proper began on August 11, at which time the workmen began digging with short-handled shovels at the south end and moved northward under the decked street. In other words, the tunnel was excavated from the side instead of from above (Plates 3 and 4). All dirt was shoveled into a backhoe bucket, the backhoe having been lowered down into the hole next to the MCC with a crane.

2.2 Datum

The steel I-beam at the southern end of the tunnel trench, labeled B-5 on Figure 3, served as a vertical datum for all archeological recording. The soldier-pile that supported the western end of B-5, labeled 10 on Figure 3, served as a horizontal datum. All measurements were taken in meters east of datum and below datum. Measurements along the north-south axis of the tunnel trench were measured north from the southern edge of the datum beam (B-5).

The relationship between vertical datum, B-5, and grade was measured from the top of the decking to the bottom of the supporting beam. The decking was approximately 20 cm. thick, with the beam beneath it being 68 cm. thick. Thus, in order to convert vertical measurements taken from the bottom of B-5 to below grade, it was necessary to add 88 centimeters.

The eastern profile of the tunnel trench extended from Pile 1 on the north to Pile 5 on the south. However, other profiles, as well as several features, were also recorded. Figure 5 is a plan view of the trench showing the location of recorded profiles and features in relation to datum.

2.3 Recording the Profiles

Once the street was decked there was not enough natural light to either see or record changes in the soil profile that was gradually exposed by excavation. While the contractor's portable lights were adequate for monitoring general progress, a higher voltage light was necessary for observing and recording (drawing and photographing) soil distinctions. Accordingly, JMA personnel carried a light weight Foto-light (halogen 1000 watt) at all times, plugging it into the contractor's power supply when necessary.

The profile of the eastern side of the tunnel trench (Figure 6a) was drawn over a two month period, adding sections as the tunnel got deeper. Temporary soil floors are indicated on Figure 6a by dashed horizontal lines. Soil layers were eventually numbered sequentially within segments between steel piles. While some of the upper layers were visibly comparable between piles and could receive the same numbers, the complexity of layers at lower depths required distinct designations in the field. Distinctions were subsequently analyzed using a modified version of the Harris (1979) matrix.

Brief work stoppages were necessary because each section of profile was drawn just before it was lagged. Workmen cleaned the section to be lagged, two JMA archeologists quickly measured and drew the section, took Munsell readings and photographs (Plate 5), and the workmen proceeded with the lagging. The whole process took about five minutes. Additional profiles of exposed surfaces that were not along the edge of the tunnel trench, and were therefore not lagged, were quickly troweled, recorded in the field book, and photographed. The additional profiles contributed to an understanding of the depositional process beneath Pearl Street, including the relationship between various versions of the street and the many intrusive utility trenches that cut into the street, as well as the relationship between the street and a deeply buried organic layer of soil that had also been observed (and characterized as peat) during excavations on the Courthouse Block. The contractor was generally able to shift workmen to other areas while these other profiles were recorded.

2.4 Recording Archeological Features

Major archeological features were encountered at the southern (Structure 1, Feature 1) and northern (Feature 2) extremities of the tunnel trench. Figure 5 shows the architectural features at the southern end of the trench in plan view. Profile drawings were made of the brick section of Structure 1 that appeared to bound the structure on the west along Cardinal Hayes Place (Figure 7) and of the fieldstone section which bound the structure on the north facing Pearl Street (Figure 8). These drawings were done while construction activities continued in other portions of the trench. The recording of Feature 1 (Figure 9), a stepped brick extension off the western portion of Structure 1, required a one hour work stoppage. Feature 1 was left in place until the contractor was ready to remove it. JMA assisted with its removal in order to obtain as much information as possible about the feature's morphological characteristics and date of construction. Some soil was screened through 1/4 inch mesh hardware cloth during this process.

A thick layer of organic material consisting mainly of decaying wood and an associated barrel-shaped feature lined with wooden slats and stones (Feature 2) were recorded at the northern end of the tunnel trench. The contractor moved at a very slow pace in this area, because it was so constricted; this allowed JMA's archeologists to sample the organic layer and record it without requiring any formal work stoppage. A one-by-one meter unit was excavated 1.3 meters from the north wall of the tunnel (Figure 5). The soil removed was screened through 1/4 inch mesh hardware cloth. The portion of Feature 2 within the tunnel trench (representing approximately 1/4 of the total feature) was drawn, photographed, and dismantled. A continuous column sample was taken of the fill within it and later subjected to flotation in the laboratory. Samples were also taken of the wooden lining of the feature and identified under a microscope.

3.0 ARCHEOLOGICAL INVESTIGATIONS

The research design for the archeological monitoring of tunnel excavation (John Milner Associates 1994:14) assumed a relatively rapid construction schedule. Because of expected time constraints and safety issues, the intended focus of JMA's efforts, as stated above, was the execution of a complete profile of the eastern side of the trench.

The pace of construction was considerably slower than expected for a variety of reasons, including the following:

1. traffic congestion on Pearl Street required that all construction take place beneath the decked street, with no interruptions or modifications to traffic flow;
2. a high water table complicated the contractor's dewatering strategy and additional wells had to be installed;
3. the complex of utilities beneath Pearl Street extended to almost 14 feet below grade, necessitating the removal of soil using manual methods to that depth;
4. the presence of possibly contaminated soils at a depth of about 12 feet required hazardous materials testing and a change in disposal procedures.

Although the scope of work required that the archeologists be present on the site only when new excavation was taking place, the contractor's site supervisor could not reliably predict activities for a complete shift. The archeologists were therefore present during most day shifts (and occasionally on week-ends or at night). When not recording the eastern profile of the tunnel trench, they spent their time observing and recording soils and features in other portions of the trench (Plate 6). As workmen hand-shoveled the dirt from between the utilities, for instance, JMA archeologists made detailed drawings of foundation wall segments, took samples of distinctive soils, and drew profiles of soil faces across the trench (from east to west) that were temporarily exposed as excavation moved northward. The monitoring process, therefore, produced more detailed information on the soils beneath Pearl Street than was anticipated. These results, as well as the profile of the eastern side of the trench, are described below.

3.1 The Profile of the Eastern Side of the Tunnel Trench (from South to North)

The upper portion of the profile between piles 5 and 4 was removed during the work associated with underpinning the MCC. It was not drawn. At a depth of 3.5 meters below datum, a layer of sandy fill (labeled 11 on Figure 6a), seen elsewhere within the MCC parcel and probably associated with the building's construction in the 1970s, lay above a dark colored homogeneous clay layer (12) and more fill (23) associated with the MCC. This area appears to have been disturbed down to the uppermost culturally sterile deposits (35), an alluvial facies (bedded sands) that represented pre-contact period drainage regimes and their floodplain.

Between piles 4 and 3 a brick catch basin relating to drainage along the southern edge of Pearl Street cut through layers of sandy fill (1-5), some of which (3-5) may represent bedding for earlier versions of Pearl Street. The cement foundation for the catch basin reached a depth of 3 meters below datum, with sandy fills extending to about 3.5 meters. A distinctly different stratum (14) of iron-stained sand was exposed at 3.5 meters. The iron stained deposits represent the base of a fluctuating water table whose percolation was impeded by the underlying impermeable clays. Immediately beneath the iron stained sand was a thin, but well defined, stratum (15) of waterlogged sand and shreds of wood. This stratum and the two underlying layers of clayey silt and silty clay (16 and 17) were initially identified as a possible peat deposit. However, the presence of cultural material within the matrix and the general disturbance in the area suggests that the waterlogged stratum reflects modification of a streambed and streamside landscapes. The latter relates to reservoirs for soaking and hide preparation associated with eighteenth century tanning activities for which more evidence was found further north in the tunnel trench between piles 2 and 1 (see discussion in Section 3.3 below).

The other side of the catch basin was present between piles 3 and 2. The fill within the basin (6) consisted of coarse sand with pebbles, bricks, and fieldstone fragments, apparently more recent than the fill layers that the catch basin cut through. Later features, such as an electrical conduit trench (C), had disturbed the upper two meters of the area between piles 3 and 2. At a depth of 4.5 meters below grade, however, a profile was observed that appears to represent a high energy stream (see Section 4.0 below and the detailed profile drawing, Figure 6b). The bedded sands (stratum 35) or subsoil were encountered at approximately 5.5 meters beneath the surface and represented the baseline geogenic deposits of the unmodified site landscape. Overlying organic sands with fibrous roots (stratum 34) offset the uppermost alluvium and the surface of the initial habitation.

A variety of utilities and a large diameter sewer pipe had disturbed the soil layers between piles 2 and 1 to a depth of almost 5.5 meters below grade. Below 5.5 meters, the stratigraphy was identical to the stratigraphy between piles 3 and 2 discussed above.

A pronounced wood layer (37), similar to the thin wood lens (15) observed between piles 4 and 3, was present at the northern edge of the section of the trench between piles 2 and 1 and to the north of pile 1. This area was also extensively disturbed and modified. An almost complete dog skeleton (personal communication, Pam Crabtree) was recovered from the top of the wood layer just north of pile 1. Various large chunks of bone and several cattle horn cores were also found more deeply buried in the layer. The wood stratum was underlain by sandy silts, sand, and bedded sands. These deposits, which began at approximately 3.5 meters below grade and extended to the subsoil, had not been disturbed by modern utilities in this location. A wood and stone-lined feature, Feature 2, cut through the intact layers and appeared to be related to them. The soils and feature have been interpreted as associated with an eighteenth century tannery. They are discussed in Section 3.3 below.

3.2 Structure 1 - Feature 1

A brick wall running north-south was exposed by flooding and soil erosion beneath the Pearl Street decking on the west side of the tunnel trench (Figure 7). This wall, and other associated structural components, was designated as Structure 1 (Plate 7). The structure included the brick wall, which turned east and ran for some distance in that direction (Figure 5), but its foundation appeared to be fieldstone (Plate 8). The fieldstone outlined a structure that was 7.8 meters wide. It would have abutted the eastern edge of Cardinal Hayes Place and faced Pearl Street. The dimensions and location correspond to the tenement that is shown on the Perris Atlas maps for 1853 and 1857 and described in the Tax Assessments as a 5-story building measuring 24 by 90 feet on a lot that measured 24 by 95.8 feet (John Milner Associates 1994:7).

The extant portion of the wall was nine courses high (Figure 7) and two courses thick. It rested on a fieldstone footing or pavement. A fieldstone wall running parallel to the east-west portion of the brick wall was exposed about two meters further north in the tunnel trench (Figure 5). The fieldstone wall apparently represents the front wall of the tenement, while the brick wall parallel to it was an internal dividing wall within the tenement's basement. A one-course high brick paved area at the northeast corner of Structure 1 may have been a coal cellar (Figure 5). The fieldstone paving on which both the brick and fieldstone walls rested lay directly on top of several thin layers of sand and a very wet clayey silt with decayed wood (Figure 8). The wet clayey silt and wood layer may be associated with siltation along the margins of the formerly active channel, perhaps as a result of diverted drainage, maintenance of the Collect Pond, and activities associated with the tanning complex discussed below.

Feature 1, located to the west of the western brick wall of Structure 1, probably represents a cellar bulkhead (Figure 5). Although the columns of brick did not appear stair-like when viewed from the south (Figure 9), steps were visible once the soil had been removed from the eastern edge of the feature (Plate 9). The brick stairway rested on a fieldstone footing that was on a horizontal plane with the fieldstone paving underlying the brick and fieldstone walls of Structure 1. A thin layer of highly organic clayey silt containing numerous oyster shells was visible beneath the fieldstone footing for Feature 1 (Plate 10). This layer was not present beneath the other components of Structure 1. Historic period cultural material found within the context of the oyster shells suggests that the layer was intentionally laid down as a construction surface for the stairwell.

3.3 Tanning Remains and Feature 2

The very thin compact layer of waterlogged sand and relatively undecayed wood chips underlain by two clayey layers between piles 4 and 3 resembled features that have been seen elsewhere in association with eighteenth/nineteenth century tanning operations. At the Royer Tannery site in Waynesboro, Pennsylvania, for example, excavated in 1987-1988 by Sheppard (1989), seven tanning vats were identified. All of the vats were rectangular in shape and were cut into a layer of clay fill between 2.5 feet and 2.8 feet in depth (Sheppard 1989:38). According to Sheppard's (1989:38) report, the clay fill lay one foot below the vat bases and was designed to "slow water seepage from the wooden lined tanning vats." The vats themselves measured from 4 to 5 feet in width and 4 to 6 feet in length. Some of them still retained wooden flooring and indications of supports at the corners, but most of the vats investigated at Royer were represented by a "thin lens of decayed wood on which lay a lens of light gray powder, probably lime" (Sheppard 1989:39).

The shape, depth, and wood lining of the vats at the Royer site are consistent with known specifications for eighteenth and nineteenth century tanning vats. Tomlinson (1854:133), for instance, describes tan pits that are "oblong in shape...in forming the tan pit the whole ground is first excavated and covered with clay, the boards which form the lining in each pit are first built up into chests, then adjusted in their places, and filled with earth to weight them down"

The interpretation of the layer of wood between piles 4 and 3 and the underlying clayey layers (nos. 16 and 17 on Figure 6a) as the remains of a tanning vat and its clay matrix is strengthened by the location of the vat next to an old streambed. Fisher's (1986:28) book on tanneries in the Colonial American Craftsman series describes tanners' pits as "huge hogsheads or wooden boxes six feet long and several feet deep sunk into earth near a stream." Fisher's illustration of "a typical small colonial tanyard" (included here as Figure 10) shows the bate vats, liming pits, and tanning pits lined up along the edge of a stream. The availability of water, preferably a rapidly running stream, was essential to the tanning process. Water was used to wash the hides (the first step in the process); to create the lime solutions that made it possible to remove the hair from the skin (the second step in the process); to remove the lime that soaked into the skin, a process called bating that sometimes followed liming and sometimes did not; and finally to make the oozes (mixtures of water and oak bark) that were put in the wood-lined tanning vats. Advertisements for tanning yards for sale always mentioned water: "...the water is conveyed in pipes from a never failing stream" (an 1818 advertisement quoted in Sheppard 1989:21); "comprised of...a large run of water conducted through and into the tan-yard" (an 1819 advertisement quoted in Sheppard 1989:21).

The interpretation of a constructed tannery vat is bolstered by the radiometric data. Of the seven radiometric dates obtained from occupation and geological strata, two of the radiometric determinations came from stratum 16, the organic clays with wood chips. The calibrated dates are within the range of A.D. 1455-1655 (Beta 77028) and A.D. 1415-1675 (Beta 77029), somewhat earlier than the documented period of tannery activities. These older dates are, however, fully consistent with the removal of organically enriched clays from the adjacent, older streamside landscape. The clays were then redeposited as a lining within the excavated eighteenth century trench.

The main water sources that would have served the Pearl Street tanyards were the southernmost impoundment of the Collect Pond and the Eastern Outlet. As discussed in Section 4.0 below, the geoarcheological evidence places the historic location of the MCC tunnel at the eastern margin of the southern sub-basin of the Collect Pond. In the historic past, this setting may have functioned as an overflow channel of the Eastern Outlet. It was logistically suited for hide processing, since it contained a steady supply of water. Flowing water was sustained during periods of high discharge along the Eastern Outlet. During low flow, waters easily could have been diverted to the MCC locality. Over much of the historic period, however, the main channel of the Collect Pond outlet continued in a south-southeasterly direction for several hundred meters.

To the north of the large sewer pipe (see no. 37 on Figure 6a) an approximately one half-meter thick organic stratum composed almost wholly of shreds of bark was uncovered. As mentioned above, the complete skeleton of a dog lay at the top of the bark stratum which also contained numerous cattle horn cores, chunks of bone, and scraps of leather (Plates 11-13). A hand-wrapped, gold-covered straight pin was recovered near the top of the same layer that included the dog, suggesting that the bark and underlying layers dated earlier than 1832 when the technology of pin manufacture changed. Beneath the bark were two layers (nos. 38 and

39) of sandy silt. Layer 39 provided a radiometric date of 180±40 B.P. (A.D. 1655-1890, calibrated; Beta 77032). These dates are consistent with the stratigraphy and the accumulation of various historic features and sediments. The silt layers were also present to the south of pile 1, although the bark stratum appeared to have been truncated by water mains. The absence of soil within the matrix of the bark stratum (it was examined under a microscope) suggests that it represents a portion of a bark trench, not unlike that found at the Royer Tannery in Pennsylvania. Bark trenches were used to store bark from the tanning vats between soakings. Spent bark and fresh bark were used for different purposes, and the oozes were made in different strengths, a procedure that depended on the availability of bark at different stages of depletion.

The Royer bark trench consisted of an approximately two-foot-thick deep depression cut into sandy subsoil. There was evidence of a disintegrated wooden floor at the base of the depression (Sheppard 1989: Feature 9). The trench reached a greater depth than the nearby tanning vats and was in an area that had not been prepared with clay to retard water seepage. Stratum 37 in the tunnel excavation likewise lay on top of sandy silts rather than the clayey soils that underlay the probable tanning vat floor found between piles 4 and 3 discussed above. Both the sandy silts and clayey soils appear to have been laid down beneath distinctive features for particular purposes, the first to encourage percolation and the second to discourage it.

Even further north in the tunnel trench a wooden slat-lined, barrel-shaped feature, Feature 2, was found that may also relate to the tanning process (Plates 16 and 17). The slats were made of eastern white pine (personal communication, Gary McGowan), a low quality soft, readily available wood. The feature cut through the bark trench and underlying sandy strata into the subsoil (no. 40 on Figure 6a) and therefore may post-date the active use of the bark trench. It was approximately eight feet in diameter and had been lined with rocks which were covered with clay, as if to prevent leakage. The wood superstructure lined with rock and clay is reminiscent of the construction of a bark trench described in Diderot's 1771 encyclopedia and discussed in Sheppard (1989). According to Sheppard (1989:44), Diderot depicted two wooden staved trenches with stone lining on either side of the tanyard. However, the size and shape of Feature 2, as well as the fact that it was buried in subsoil, suggests that it was a liming pit.

Liming was an important part of the tanning process. After fresh hides were washed and scraped, they were "placed in pits containing lime water of 3 or 4 degrees of strength...gradually transferred from weaker to stronger solutions until in the course of two or three weeks the lime has dissolved the hair sheath and by combining with the fat, formed an insoluble soap" (Knight 1876:2490). It is also possible that the feature was a bate vat (Figure 10). Bating was a solution into which the hides were put after they were removed from the lime. The bate "removed the lime that had worked into the skin, and made it even softer" (Fisher 1986:26). The feature was apparently filled after the land along Pearl Street was converted for residential use. According to documentary sources, Lots 6-9 were owned by John and George Shaw and then George and Jacob Shaw, who subdivided and sold the parcels for non-tanning use after 1785 (Ingle et al. 1990:121). The artifacts recovered from the brown sandy silt fill (two liter samples from ten centimeter layers down to 170 centimeters were subjected to flotation in order to characterize the fill) corroborate a late eighteenth/early nineteenth century filling date. Several sherds of pearlware (1780-1820) were found near the bottom of the feature. The presence of tiny pieces of coal throughout the fill layers, suggests that filling took place after coal became widely available in New York City in about 1820 (personal communications, Alan Gilbert, March 15, 1995). The size of the coal fragments is consistent with the size used in the manufacture of brick during this period (personal communication, Alan Gilbert, March 15, 1995). Coal inclusions in the brick speeded up the firing process leaving the characteristic pock marks in the finished product. The artifactual content of the fill was relatively low and, with the exception of a few wood fragments and some shells, included virtually no organic material. It appeared to be "clean" fill deposited in one episode.

The proximity of the three tanning-related features--the vat, the bark trench, and the liming pit--suggests that they were associated with a single tanyard. However, the features may have been in use at different times in its history. As previously noted, the fact that the liming pit cut through the bark trench suggests that it is a later feature. Tanning-related remains have also been discovered outside the tunnel alignment (in a dewatering well to the west of the alignment and within Lot 6 on the north side of Pearl Street), and it is possible that they and those within the tunnel trench are related to different tannery operations. The location of the tanning complex along the margins of the southern outlet sill may suggest that buildings and facilities were aligned to make optimal use of both the stagnant waters of the Collect Pond and the stream flow of the active channel. Moreover, the placement of facilities may reflect the changing alignment of the drainage network in the immediate vicinity of the tanyards over the nearly 100 year period during which they were in operation (see discussion in Section 4.0 below).

To the west of the tunnel alignment a large iron hook (Plates 14 and 15) was found in one of the dewatering wells. The hook conforms to an implement described for "handling" the skins during the liming and tanning processes: "in the process of 'handling' the hides are taken out with blunt-pointed, long-handled hooks, placed one over another on a sloping rack over an adjacent pit, and permitted to drain for one or two hours" (Knight 1876:2090). Fisher (1986: Figure 10) also shows such a hook in use.

During the excavation of the Courthouse Block proper a series of strata was found about 50 feet north of Pearl Street within Lot 6 which are very similar to the strata associated with the bark trench within the tunnel alignment. The eastern profile of E.U. 1 on the Courthouse Block (drawn on June 21, 1991) shows a "very dark brown peat with small fragments of leather" about 11 feet below the ground surface. It is underlain by a stratum of sand, and below that is another "peat" layer with "rotting organics including much wood and bark" underlain by another layer of black sandy loam with smaller amounts of leather and bark. The organic layers extended to about 14 feet below ground surface, approximately the same depth as the bark trench layers within the tunnel alignment. The organic layers in E.U. 1 may also relate to a bark trench, although it could not be the same one represented within the tunnel trench. It is therefore likely that several tanyards were present in this part of lower Manhattan or, at the very least, several different time periods are represented.

4.0 GEOARCHEOLOGICAL INVESTIGATIONS

Geoarcheological investigations at the construction site of the MCC tunnel complex (Figure 1) were undertaken between August and October, 1994. The purpose of the work was to record stratigraphic information in conjunction with known historic and potential prehistoric land use in the vicinity of Pearl Street. The historic significance of the area as a center for eighteenth century tanning activities is well documented, and was discussed above. The favored location of colonial tanneries along the margins of streams and major bodies of water suggested that the physical geography of the Pearl Street area differed substantially from that of the present. Further, the presence of the Collect Pond, an extensive pre-nineteenth century impoundment, is widely referenced in historic texts since the early Dutch occupations. Thus, the co-occurrence of the Collect Pond and the tanneries implicated a long-term functional relationship between the landscape and the leather trade. The geoarcheological studies were designed to explore such relationships by examining the composition of the subsurface sediments and tracing their origins. It would then be possible to link sedimentation patterns to present and past drainage features and a landscape history in which both natural and cultural modifications were instrumental. The timing of events was indexed by diagnostic artifact assemblages and by a series of seven (7) radiometric dates from occupation and geological strata. Since excavations were extended to depths beneath the basal cultural fills, it was possible to synthesize sedimentation and site formation processes since the end of the Pleistocene.

Pre-twentieth century deposits were reached at depths in excess of 2 meters and complex hydrological and cultural features were typically reached at 3.5 meters. Here most profiles disclosed vertical and laterally stratified sediment matrices of tanning facilities (i.e. decomposed organics, hides, bark, and wood), and localized drainage fills and "plugs" that entrained eighteenth and nineteenth century artifacts as well as evidence for extensive Industrial Age waste disposal. Deposits between 3 and 5 meters were the focus of detailed radiocarbon sampling and microstratigraphic analysis. Artifact densities dissipated beneath 5 meters. Deep and massively bedded Pleistocene stream sands were uniformly registered at 6 meters. No unequivocal deposits of prehistoric age were identified over the course of the project.

The following account is one of the first attempts to examine historic site formation from the broader perspectives of industrial age landscapes and the effects of human impacts on them. Typically, geoarcheology is a methodology utilized to explore settings of prehistoric sites because of the broad spectrum of earlier Holocene environmental change. This study demonstrates that such approaches are invaluable first, to assess complex, humanly engineered landscapes and second, to synthesize stratigraphic records that span centuries and decades rather than millennia.

This section of the report begins with a summary of field and analytical methods specific to the geoarcheological investigation. It proceeds with an overview of the general geology and geomorphology of lower Manhattan, stressing the Late Quaternary stream and coastal environments that existed in later prehistoric and contact period times. Next, a reconstruction of the early historic geography in the Foley Square vicinity is offered based on assessments of early Dutch, British and colonial maps and surveys. The stratigraphy and sedimentation sequence are then presented based on technical field observations supplemented by the radiocarbon chronology. Observations are finally synthesized into a model of the evolving natural and industrial stream-side environments. An integrative summary concludes the presentation.

4.1 Field and Research Methods

The field work was undertaken in three stages: first, assembly of contemporary and historic maps and subsurface boring records documenting landscape changes since initial historic occupation; second, subsurface investigations describing buried cultural horizons, stratigraphic units and marker beds; third, soil-sediment and radiocarbon sampling to resolve more detailed issues of sedimentation and site formation.

Map research emerged as one of the most instrumental components of the research. The changing street and landscape configurations of Lower Manhattan provided a critical window on patterns of landscape modification through time. By tracing systematic transformations of the street grid and landforms in the Pearl Street and Collect Pond area, it was possible to reconstruct the changing configurations of the tannery complexes as well as their increasing impacts on the natural landscape by the mid-eighteenth century. For example, as discussed below, the changing morphology of the Collect and Eastern Outlet were determined to a large degree by utilization of those features by the tanners and the active regulation of the drainage basin by city agencies after 1733. The changing morphology of the Collect was related therefore to hydrological factors (of both natural and cultural origin), stratigraphic indications of which should be evident in the tannery levels exposed in the MCC profile. The key cartographic sources consulted included the Vingboom (1639) Dutch plan of the city, the Lyne Plan (1728), and the Maerschalk (1754), Ratzer (1767), and Bradford 1789 (in Andrews 1893) maps. The most comprehensive depiction of pre-industrial landscapes plotted on a near contemporary street grid of New York is the Viele (1874) map. The latter served as the baseline for some of the landscape reconstructions offered in this account.

Following inspection of maps and boring logs, a generalized stratigraphy was established. As discussed below, four (4) principal depositional units were differentiated on the basis of either uniform landscape changes, land use patterns, or combinations thereof. Radiocarbon dates indexed the entire span of post-contact occupations in the 7 meter thick section. Sedimentation trended progressively anthropogenic up the sequence. Basal matrices were exclusively geological (i.e. devoid of evidence of human activity) and the uppermost sediments were comprised of recent construction debris and landfill. The central portion of the section featured the key Collect Pond sediments as well as evidence of the tanning process associated with that feature.

Inspection of each of the available exposures was undertaken by the Project Geoarcheologist and an assistant in conjunction with the principal investigator and/or monitor(s) from JMA. The east wall was the primary section selected for description and sampling. Other exposures were examined when they provided diagnostic micro-stratigraphy or unique artifact associations; observations were made at "Structure 1 (SW corner)" and "North Wall". Maximum depth of excavation was 7 meters, well into the late Pleistocene sand-gravel complex. The master profile was constructed by JMA, with input from the geomorphologists, based on archeo-stratigraphic designations following the Harris (1979) matrix system. It is presented as Figure 6a. The detailed geoarcheological profile (Figure 6b) spans the central portion of the profile between depths of 3.2 and 5.5 meters. Significantly, all primary depositional units (I-IV) are preserved within this segment of the profile. The only deposits not described in detail are the uppermost historic fills (twentieth century rubble; Unit I) and the deeper Pleistocene gravels (lower Unit IV); these bracket the major landscape events preserved in the section. As shown in Figure 6a, the detailed profile was synthesized chiefly from observations made between piles 3 and 4, subsuming field strata 10-35.

Stratigraphic nomenclature was standardized following the guidelines of the North American Stratigraphic Code (NASCN 1983). This method was selected because of its versatility in accommodating geological, pedogenic, and cultural stratigraphies. According to broad stratigraphic guidelines, if a sediment body may be characterized by uniform depositional agencies and is bounded by discontinuities, it may be designated a single unit (NASCN 1983: 865). If it is subsequently overridden by a new series of allogenic sediments a new unit may be assigned. The four principal units (I-IV) were segregated on these grounds. In the field, however, more localized facies changes were identified and mapped. In all, nine (9) sub-units were assigned based on discrete textural and structural components within master units.

During field work, several radiocarbon samples were taken from key strata. These included bark or decomposed wood and cribbage from the tanning vats as well as soil humates. At the base of Structure 1 a thin, but continuous lining of oyster shell was sampled for dating purposes. The broad range of organic and carbon enriched matrices at the site afforded a unique opportunity to calibrate ages from different source materials.

Sedimentologic characteristics were recorded on a detailed Soil-Sediment Coding Form. Comprehensive identifications were made of color, structure, texture, ped development, mottling, stoniness, roots, cutans, and pedogenic and sedimentary inclusions (as necessary). Sedimentological criteria were especially critical for this study since it was imperative to distinguish diagenesis and hydromorphic modifications to the parent sediment. For soils (Unit IV only) , identifications of color, composition, and textural and structural features were made in accordance with standard pedomorphic criteria (USDA 1975).

Finally, the most diagnostic geological units were examined micro-stratigraphically. Tanning layers were sampled for trace elements to determine if sediments were enriched with chemical by-products of the hair/fur removal and liming processes associated with hide preparation. These yielded inconclusive results.

In conjunction with the field work, a series of historic maps was consulted to trace landscape modifications that might be reconciled with observed sedimentation patterns. The complexities of stratification coupled with the hydromorphic features in the cultural sediments verified large scale fluctuations in the water table over the past three hundred years. Extensive reduction and oxidation streaks demonstrated further that such oscillations, while initially the product of natural spring charges, were subsequently generated by centuries-old regulation of water sources that emptied into the Collect Pond. Thus, a major component of the study was a systematic investigation of the historic drainage net. The historic maps disclosed periodic re-engineering and draining of the central influents and effluents of the Collect Pond. As discussed, these ultimately accounted for the diachronic patterns of land use over the course of post-aboriginal settlement both locally and regionally in historic lower Manhattan.

4.2 Geology and Historic Geography

4.2.1 *Structural Relations and Late Quaternary Deposits*

The bedrock geology of lower Manhattan has been extensively researched and depths to the basement complex were mapped as early as the mid-nineteenth century (Cozzens 1843). In the vicinity of the project area micaceous schists of the Manhattan Formation are encountered between 25-100 meters below surface (Schuberth 1968; Newman et al 1969), considerably beneath depths of the MCC tunnel excavation.

Early geographers and geologists were similarly aware of the extent and thickness of the overlying, unconsolidated glacial deposits in lower Manhattan (Cozzens 1843; Hobbs 1905). These were mapped variously as "Diluvium" or "Drift" and were not typically differentiated by outwash (stream derived) or till (glacial front) facies. Surface sediments have been formally mapped on a large scale, most recently in a compilation of the Hudson River Quadrangle (4°x6°) (Fullerton 1992). Quaternary deposits in lower Manhattan were classified either as "lake, ice-contact, and outwash sands" or "sand to clay till (ground moraine)", thus establishing the complex glacial landform configuration at the ice front. At the close of the Pleistocene (18,000-12,000 B.P.) glacial lakes Hackensack and Flushing merged near lower Manhattan, leaving distinct varve sequences at lower elevations (Newman et al 1969; Schuberth 1968); local exposures are rarely preserved because of post-glacial erosion, scouring and effects of upwarping. Schuberth (1968: 188) calls attention to surface glacial features, specifically "low and relatively steep-sided hills of sand and gravel called kames" north and west of New York City that are accumulations of rock debris carried in by glacial activity. As discussed below, the kames were the prominent hills that hemmed in the Collect Pond prior to extensive leveling activities in the mid-nineteenth century.

Boring and subsurface exploration in the vicinity of Pearl Street have been undertaken several times over the past 150 years in conjunction with construction programs. Gratacap (1909:36-40) has summarized some of the earliest historic logs, describing two stratigraphic sections that extended up to 30 meters. The first (near Centre Street) consisted of upper levels of "made ground"(land fill) underlain by black muds, blue clays, and gravel and rocks". The second (Broadway and Cedar) featured 2.5 meters of land fill atop fine sands and the "running sands". Gratacap (1909: 40) correctly attributes deposition of the finer materials (sands, muds, clays) to the action of running water, while coarser components--gravelly sands and rock--represent resorted glacial drift. In retrospect, it would appear that the uppermost muds and clays underlying the fills are the products of the terminal phase of Glacial Lake Flushing and the onset of Holocene estuary formation at the mouth of the Hudson. Much of the evidence for near shore sedimentation and stabilization of the Manhattan shoreline (around 5000 B.P.) has been destroyed by twentieth century grading activities. The Gratacap (1909) accounts of upper profiles correspond to intact estuarine sequences assembled for upstream locations (see especially Newman et al 1969; Schuldenrein, in press).

In another phase of work at Foley Square, Geismar (1993: Table 1) presented a series of bore logs from 1914 to 1937, recorded during construction of the County Court House. Over forty (40) borings have been plotted to the west of the MCC Tunnel, attaining depths of 30 meters. While the logs suggest considerable variability in substrate composition, much of this is in the upper 5 meters and represents episodic, highly localized land filling. Geismar's (1993: Figure 9) log location map identifies two borings within 10 m of the tunnel. Here landfill typically extends to in excess of 6 meters. Underlying sediments are dominantly "gravels and sands" and various grades of sorted sands, typically gray to red in color. Significantly, while Geismar (1993) generally identified the location of historic landscape features, including the Collect Pond, stratigraphic evidence is not discernible in the bore sections because of the broad scale of vertical resolution that offsets only the most rudimentary breaks in sediment type; these corings were undertaken for geotechnical and structural purposes only.

An additional series of forty-eight (48) borings was undertaken for the Foley Square Courthouse Annex in 1971 (Gruzen 1971). These spanned the square block bounded by Cardinal Hayes Place, Park Row, Pearl Street and Duane Street. Descriptions for this series are slightly more detailed and include several facies changes between 6-8 meters within the red-brown sediments generally considered to be of alluvial origin in the older logs. Depth of land fill is extremely variable in this area, ranging between <1 to 4 m.

The extensive landscaping across the Foley Square project area has removed most of the Holocene and potential archeological horizons almost everywhere. Moreover, geotechnical boring logs, while abundant, do not isolate finer scale stratigraphic breaks that may preserve sedimentary evidence for land use activities between prehistoric through early Euro-American, agricultural and industrial periods. Prior to the modern age, the impacts of reclamation, engineering, and management activities on the natural landscape were significantly narrower in scope and magnitude. These effects may only be reconstructed by analyses of historic maps and accounts and by detailed microstratigraphic examination in the few remaining intact profiles. The MCC Tunnel is one such example.

4.2.2 *Historic Geography*

The central landscape feature linked to the florescence of the Pearl Street commercial tanneries was the Collect Pond, the main interior impoundment of Lower Manhattan. Historic accounts of its centrality and significance to the economic life of eighteenth century New York have been summarized most recently by Rothschild (1990). Geismar (1993) superimposed the general location of the Collect Pond onto the city grid near Foley Square, based on cartographic information and historic accounts.

While the hydrographic origins of the Collect Pond are difficult to reconstruct, the 1639 Vingboom map, one of the earliest European plots of Manhattan, depicts a wedge-shaped crevasse running transverse to the long axis of the island around Pearl Street. This trough is depicted as a prominent regional landform, apparently the precursor to the historic Collect basin. Whether or not it represents an ancestral glacial outwash valley of the Hudson is unclear. However, the alignment of historically referenced kames and eskers--all elements of glacial valley topography--is suggestive. Alternatively, if the wedge were a localized feature it could have been part of a kame and kettle complex. The position of this elongate basin between the kame outcrops establishes that by Late Holocene times the Collect was the local catchment for runoff when it only intermittently functioned as an outlet to the Hudson estuary and the East River.

The Dutch originally referred to the "Kolck or Kalchhook" on Pearl Street between Park and Elm Streets (Andrews 1893). Local accounts alluded to the Collect as the largest of a series of bog-like ponds, surrounded by hills, that spanned the lower portions of the island (Brown 1913; Cozzens 1843; Gratacap 1909). The approximate perimeter of the Collect Pond was demarcated on the west and east side by today's Elm and the intersection of Baxter and Park Streets and by White and Pearl Streets on its north-south axis (Cozzens 1843). It was approximately 10 acres in extent and waters extended to depths in excess of fifteen meters (fifty feet) (Andrews 1893). The pond was fed by numerous natural springs. Apparently a "tea-water" pump was placed over one of the springs located at the junction of Chatham (Park Row) and Roosevelt Streets in the mid-1700s (Maerschalck Plan 1754). In the early 1700s the pond was heavily stocked with fish and served as a skating pond during the winter (Ingle et al. 1990:39).

Shortly thereafter, the Collect Pond became the central processing station for a burgeoning tanning industry that had continued to migrate progressively northward from the tip of Manhattan. As discussed subsequently, the tanning industry was mobile because it left in its wake contaminated swamps and marshes infilled with by-products, chemicals, and organic discard of animal parts. The Pearl Street tanneries utilized the Collect Pond and its ancillary effluents (i.e. Eastern Outlet) for hide processing, possibly draining the springs and influents that supplied fresh water to the local basin.

Early in the nineteenth century (1801), New Yorkers began to fill in the Collect Pond with earth from the construction of City Hall's foundation (Cozzens 1843). By 1805, the pond was entirely covered over after a debate was raised as to whether a canal should be left running through it. By this time, the pond had become a foul smelling, stagnant pool in which rubbish and especially animal carcasses and hides were discarded. Once filled in, the former pond became the site of the prison referred to as the Tombs.

According to Andrews (1893), the natural outlet for the Collect Pond was a brook named "Old Wreck Brook" which ran through Wolfert's Meadows to the East River. Lispenard's Meadows, the largest of Manhattan's marshes (70 acres), was located on the western margin of the Collect Pond. It too was an extension of the residual glacial valley or the kettle-kame complex. The marsh extended westward from the pond to the Hudson (North) River, and was confined on its southern boundary at Reade Street, crossed Canal Street, and terminated where Spring and Laurens Streets intersect. The marsh was fed by a number of streams, one of which drained westward into the Hudson River (Cozzens 1843). Another stream emanated from the northern end of Lispenard's Meadow whose source was a fresh water spring near Canal Spring and West Broadway.

The Collect Pond experienced numerous hydrographic changes over the course of historic times. Cozzens (1843) hypothesized intrusion of saline waters because of encroachment of the Hudson, thus underscoring the significance of estuarine sedimentation, a sequence that is elegantly recounted by Gratacap (1909). The stagnant waters of Lispenard's Meadows, and by extension the Collect Pond, evidently created a health menace and compelled city agencies to drain the marsh. A drain was carved through the swamp, resulting in the partial depletion of the Collect Pond. Two years later in 1734, farmers and other landowners along the pond filled in 30 feet of the pond's drain in order to prevent further loss of water (Gratacap 1909).

It should be emphasized that no two historic maps place the Collect Pond in the same precise location, nor do they show the same shape and size for the impoundment. While all place the central axis of the pond along Centre, Pearl, and Baxter Streets, a sequential review of historic projections discloses that pond morphology changes as a function of land use. Thus, one of the earliest colonial maps--the Lyne Plan (1728)--illustrates that the Collect initially evolved as two separate sub-basins (upper and lower) within the low-lying terrain of Lispenard's Meadow, when the local landscapes were largely agricultural. The sub-basins were separated by a sill (locally referred to as an island) on which a Powder House was built and which became the natural extension of Pearl Street (Gratacap 1909: 48). In the mid-eighteenth century high run off, perhaps generated by moister climates, established perennial impoundments on both sides of the sill. The Maerschalk map (1754) illustrates the emergence of the Eastern Outlet as a funnel draining the eastern divide of Manhattan Island. Its evolution was apparently linked to the general lowering of the water tables by the drainage of Lispenard's Meadow (1733) and the localized rechanneling of the Eastern Outlet in conjunction with tanning activities (see discussion below). By 1767, the Ratzer map depicts marsh-lands or seasonal impoundments at the locations of the Collect immediately flanking the Powder House; the deepest waters had migrated to the northern extreme of the upper sub-basin. The Taylor-Roberts Plan of 1797 indicates a depleted lower basin, clearly susceptible to annual or seasonal water table fluctuations. Shortly prior to infilling in 1805 the southern sub-basin had receded to a minor pond. Re-engineering and land use planning in the latter nineteenth century precludes accurate reconstructions of the Collect Pond's precise dimensions. It is probable, however, that its shorelines receded and transgressed across tens of meters during its duration. Additionally, cartographic error and inconsistency over 300 years would have resulted in historically variable depictions of the Collect Pond.

Figure 11 is a reconstruction of the local geography in the vicinity of the Collect Pond, based on re-analysis of eighteenth century maps, placements of key landforms and documented land use categories. It assimilates new field observations and reassesses subsurface records. Finally, it draws on spatial relations and landform complexes from the Viele (1874) map.

4.3 Local Landscapes of the Historic Tanneries

The earliest plot of the tanyard complexes in the vicinity of the Collect Pond was the Maerschalk map of 1754 that traces a line of buildings parallel to the north bank of the presumed Eastern Outlet. The earlier Lyne Plan (1728) is devoid of any reference to these structures. Since both maps depict the Powder Magazine along the sill separating the upper and lower sub-basins, it can be inferred that the tanneries were not established in the Pearl Street area until the early eighteenth century. This is consistent with the displacement history of the tanning industry northward up lower Manhattan in search of necessary swamp basins and running water for hide processing. A city ordinance in 1669 mandated that tanning facilities be moved from the then dominant site at Maiden Lane to Beekman Swamp, since the stench of the tanning works had become intolerable to local residents (Lamb and Harrison 1896). The Lyne Plan of 1728 shows that the northern shore of Beekman Swamp is flanked by a cluster of buildings, probably the tanyards, which would be most likely to occupy such a setting. Beekman Swamp was about 1 km southeast of the Collect Pond and was the nearest standing water body. It appears that sometime after 1728, the tanners moved northward again to the Collect Pond and Pearl Street (see also discussion in Ingle et al 1990). The 1767 Ratzer map illustrates that for over at least twenty years the Pearl Street complex was expanding shoreward. After the Revolutionary War the Pearl Street area became increasingly residential. Almost all of the tanyards had disappeared by the end of the first decade of the century when the Collect Pond was filled in.

The logistical advantages afforded by the Pearl Street location are apparent. It featured both the Collect Pond and Eastern Outlet, resources consistent with the traditional prerequisites for tanning infra-structures: proximity to impounded and circulating water sources (Fisher 1986). Competent water flow was required to power the mills that ground bark for tannin, the substance that impeded degradation of the hides. More significantly, the complex cycles of washing, rinsing, desalinization, and deliming of hides necessitated free flow and open drainage. Fisher (1986: 22) details the performance of rinsing and washing tasks by the tanners on stream banks. Finally, springs were favored because of the natural supply of dissolved carbonates, or limes, that softened the waters and enhanced the liming process and removal of stiff hairs from the hides.

The soaking process, the most labor and time intensive steps, could have been largely undertaken in standing water. Typically, 2-3 meter long oblong pits were excavated into substrate, presumably in swampy margins. The pits were lined with clay. Next, the wooden boards that formed the lining of the pits were assembled to form a chest and placed into position. The vats were filled with earth and fitted with pipes used to introduce a processing "ooze" at a later stage. Finally, the exterior of each vat was lined with clay and the excavated area was filled in. Complex liming and curing solutions involving mixtures of lime, shell and tannin required submergence in solution vats for weeks at a time. Since the vats were generally placed along swampy margins, it follows that they would have been abandoned in anaerobic settings, typically in conjunction with peat or marshland fringes. The remnants of decomposing vats would be expected to be moderately well articulated in sediment matrices dominated by clays, peats, decayed wood, and hide debris. Moreover, the careful construction of the vats, in layered fashion, would be preserved in the form of stratified sediments.

Historic accounts of the early days of the tanning industry verify the logistical preference of artisans for tidal margins. These were locales that marked the convergence of a variety of water resources, including springs, salt marshes, streams, and tidal zones, each of which provided advantages for completion of separate stages of the tanning process. Such locales also afforded strong wind currents which would dissipate the foul odors generated from the process (Tomlinson 1854). The geographic preference was transferred to the New World, as the original tanneries were situated at the Hudson estuary at the lower end of Broad Street and subsequently shifted to Maiden Lane, before moving slightly inland to the Collect Pond. When the natural tidal margins fell victim to urbanization or pollution (partially because of over-utilization by the tanners), the industry migrated to locales offering the optimal mix of hydrographic resources formerly available at shoreline margins. These would have constituted, at a minimum, extensive impoundments with muddy margins (atop which tanning structures could be constructed), springs, and a perennial source of competent stream flow. The Collect Pond at Pearl Street and its attendant Eastern Outlet conformed to these standards after the resources afforded by the Beekman Swamp were exhausted.

Figure 12 is a schematic reconstruction of the Collect Pond and the Eastern Outlet in 1750, during the peak operation of the Pearl Street tanneries. The map is superposed on the contemporary street grid. As shown, the MCC Tunnel is immediately to the south of the primary tannery complex. The dimensions of the Collect Pond are taken from primary sources and boring logs. They generally follow the contours of the Viele (1874) map. As shown, the MCC Tunnel is equidistant from the southern margins of the lower sub-basin and the Collect Pond, a linear distance of only 75 meters. Perhaps most significantly, the "Tanning Complex" straddles the sill of the Collect Pond, the high ground separating the sub-basins. The sill would have been the most logical place to dry and process the hides, since it was readily accessible to both sub-basins. The controls afforded by artificial drainage would have enhanced the logistical advantages of this locale. It is assumed that since 1733, when the Collect Pond was originally drained, municipal agencies were sensitive and responsive to the needs of the industrial interests of the city. The benefits of establishing tanning complexes along the southern sill of the Collect Pond was to utilize the intermittent marshes at the margins of the Collect for the construction of the tanning vat networks. As shown, the MCC tunnel is at the distal margin of the tanning complex, whose active center was presumably to the north. It is noted, however, that the shape of the Collect Pond is approximate and would have shifted almost annually in response to runoff and drainage regulatory activities.

As discussed below, field relations and stratigraphy afford a three dimensional perspective on the landscape history. Collectively, the historic map and the subsurface records help to pinpoint the setting and past function of the MCC Tunnel locality within the broader context of the Tannery Complex.

4.4 Stratigraphy and Chronology

The application of the principles of stratigraphic separation to the MCC Tunnel sequence resulted in the establishment of four (4) master Depositional Units (I-IV). Assignment of units was based on structural and textural changes in unit lithology that underscored diverse sedimentary processes and origins. Discrete units were differentiated on the basis of shifts in generic modes of deposition that range from glaciogenic at the base to contemporary filling and grading at the top. While over 20,000 years of sedimentation were represented in a 2.0 meter deep column, the uppermost 1.4 meters (70% by volume) accumulated in less than 400 years. Depositional Unit tops were either unconformities or surfaces at which transitions to different modes of sedimentation were registered. The composite stratigraphy spanning the MCC Tunnel sequence is depicted in Figure 6b. The following Depositional Units were recognized (youngest to oldest):

I. Nineteenth and twentieth century landfill, rubble, and residua of urban habitation (i.e. foundation, utility and construction debris);

II. Eighteenth century mixed organics, peats and muck of Collect Pond marsh; includes decayed debris of tanyards and decomposed vats;

III. Late Holocene stream sediments and fining upward sands, silts, and clays of the pre-eighteenth century drainage complex of the early and antecedent Collect;

IV: Terminal Pleistocene to Early Holocene high discharge sands and gravels of the glacial/early post-glacial Hudson drainageway capped by a Paleosol.

As noted, Depositional Units are typically segregated on the basis of generic modes of sedimentation (i.e. landfill, stream aggradation, etc.). However, within individual Units discrete accumulation facies, episodes, and sedimentation suites were recognized by subordinate strata. Subordinate strata are assigned Arabic numerals from 1 (youngest) to 9 (oldest).

4.4.1 *General Site Stratigraphy*

Figure 6b presents the composite MCC Tunnel stratigraphy keyed to the Unit and sub-unit chronology and depositional environments (right and left sides of figure respectively). The sequence begins at a depth of 3.2 meters below surface, with the basal deposits of the upper land fill (Unit I); the twentieth century land fill stratigraphy is described in Section 3.0 above. Unit chronology is indexed by the two radiocarbon dates obtained from the designated depths in the profiles and by diagnostic artifact assemblages. Depositional environments are reconstructed on the basis of field observations and isolate the history of the locus from terminal Pleistocene alluviation to the onset of historic stream sedimentation, evolution of the marsh margins of the Collect Pond/Eastern Outlet, sedimentation of tannery related refuse, infilling of the impoundment, and the onset of street leveling activities.

Table 1 summarizes the principal sedimentologic properties of the sub-units. Each sub-unit is described with respect to depth; color (Munsell value, chroma, and hue); texture; structure; relative degrees of mottling, stoniness, roots, and oxidation/reduction (Fe/Mn); and distinctness of boundary. A final column details the overall composition of the sediment matrix.

A synoptic classification of the Depositional Units is presented below. Stratification, chronology and sedimentology are indexed to Figure 6b and Table 1.

Unit I

These uppermost sediments consist of two sub-units (1 and 2) that extend to a depth of 0.75 m. Sub-unit 1 also incorporates the uppermost 3.2 m of fill (see Section 3.1). The principal matrix is an admixture of clays, sands and fine pebbles. It is a poorly sorted, brown-gray sandy (glacial) diamict that was transported onto the site from a variety of local sources; it is intergraded with sandy interbeds. Artifact concentrations are dense and include abundant broken construction debris, cinder, refuse and fragmented and rusted iron. The sandy interbeds are slope derived and poorly sorted, though apparently laid down during an episode of erosion, perhaps from a spoil pile flanking the locality. Sub-unit 1 is sharply offset from sub-unit 2 by a 20 cm accumulation of sub-horizontal lenses and cross-beds. These signify a single or closely spaced series of runoff or rivulet discharge events, probably of a highly localized origin. This uppermost fill appears to be associated with building construction activities since the turn of the century, because of abundant concentrations of cinder and brick debris as well as nails and rebar.

Sub-unit 2 documents an earlier period and method of landfilling. Sediments are dominated by a coarser clastic component as well as nineteenth century bottle glass and displaced, cohesive sod mats, and rusted antique machine parts. As in sub-unit 1, matrices are interdigited with thin fluvial sand beds--also laid down by rivulets or even more extensive overflow runnels--that contain extensive oxidation-reduction streaks and stains. The base of sub-unit 2 is a dense, impermeable, and saturated clay that formed a perched water table and may originally have been a "sealer" capping the underlying tannery complex debris at the time that the Collect Pond was buried and abandoned. Sedimentation of this unit post-dates 1800.

Unit II

The uppermost sub-unit (3) is a 0.15 m thick series of laminar structures. They include fine grained organics, degraded bark, wood (with preserved cribbage structures), vegetal remains, peats, clays, and thin, sandy interbeds. These sediments were saturated during site inspection and indicated an active, perched water table.

More detailed microstratigraphic examination disclosed capping, well preserved laminar and fissile beds--apparent silt-clay rhythmites--laid down under standing water conditions. They are gleyed and accumulated over a 10 mm thick clay liner that was subsequently reinforced by flocculation (settling of fines). The clay seals a decomposed cribbage fabric surrounded by vegetation mats as well as thicker clay accumulations (to 5 cm) that are laterally discontinuous. The matrix is mottled and devoid of large (>2mm) clasts. The bottom of the sub-unit is more disaggregated and contains fresh-appearing wood pieces, bark and a continuous peaty, vegetal mat. The peats that underlie the clay liner comprise the parent matrix into which the wood-cribbage structures and liner were set. In places the peats preserve deformed loading structures.

Sub-unit (4) incorporates the disaggregated base of the clay liner-cribbage-peat complex, floored by gravelly sands and clays. The gravels and sands are moderate to well sorted. Gravels are abraded, ovate (10-30 mm along linear axis), and well rounded to tabular. This deposit represents the terminal large-scale fluvial event at the MCC Tunnel and signifies moderately competent channel flow of an active, perennial drainageway. Peaty interbeds suggest spring activity at this location. A date from sub-unit 4 provided a calibrated age range of A.D. 1665-1950 (Beta-77027). Unit II is associated with activities at the Pearl Street Tannery Complex between 1730 and 1800.

Unit III

This is the thickest (>0.5 m) pre-fill sediment accumulation at the MCC Tunnel. It is represented by three sub-units (5-7), the lowermost and uppermost of which (5 and 7) are alluvial sands that bracket a central, generally fining upward sequence of medium to fine sands, silts, and clays (sub-unit 6).

Sub-unit 5 consists of well sorted fine pebbles, sands, silts, and clays. Pebbles are very well rounded, small (5-10 mm on the elongate axis) and entrained in a sandier parent matrix. Uniformity of deposition is characteristic of a single channeling event of limited magnitude and duration. The matrix incorporates locally reworked sands and silts. Moderate to dense oxidation-reduction streaks register the permeability of the sediments, beneath which more anaerobic conditions prevailed. The accumulation, while relatively thick, appears to have been a highly localized event.

Sub-unit 6 preserves 0.3 m of sands, silts, and clays that grade finer up the profile. These may represent either fining upward as well or vertical accretion deposits; exposures were not sufficiently thick or extensive to determine the dominant mode of sedimentation. The matrix preserves decomposed organics and faint krotovinas indicative of a formerly extensive vegetation mat. The uppermost 0.1 m of sediment accumulated either under quiescent flow or near standing water conditions when siltation was the dominant aggradation mechanism. This sedimentation mode is typical of ponding and marsh settings, the conditions that typified a swamp margin environment.

Extending to the base, sub-unit 7 is a rubefied sandy cobble facies with imbricated structures. It is a thin (10 cm), clast supported gravel that entrains organic filaments and root fragments. Stones are well rounded, abraded, and large (20 mm on elongate axis); they accumulated during an abrupt flow event. The red color of the sediment (5YR4/4) and organic inclusions suggests that these are originally Pleistocene sands transported from an older, stabilized surface and redeposited along the channel trough underlying the Collect Pond. It unconformably overlies the Late Holocene paleosol preserved in Unit IV.

Unit IV

Unit IV is the dominant unconsolidated sediment overlying bedrock. It extends to depths of >25 m. At the MCC Tunnel, the diagnostic coarse sands and gravels began at 1.45 m and were exposed for an additional 0.25-1.50 m to the limits of the excavation. Three sub-units (8-10) were isolated that disclosed a moderately developed paleosol ("Ab-E-Bw" sequence). This solum represented the only intact weathered profile. A radiometric determination from sub-unit 9 provided a calibrated age range of A.D. 1405-1495 (Beta-77026) that is consistent with the earliest, stabilized historic surface.

Sub-unit 8 is the buried upper solum ("Ab") and consists of organically enriched medium to coarse sands with a minor gravel (<5%) component. Structure is granular to massive. The sands incorporate significant micaceous inclusions (>10%). Minor accumulations of silt and clay are attributable to pedogenic process. Larger cobbles (30 mm) are concentrated at the base. The "Ab" grades into the leached "Eb" substrate.

Sub-unit 9 is the eluviated horizon ("Eb") and is continuous with sub-unit 8 texturally. Structure is more massive because of limited compaction and lower concentration of fines. Textures are slightly coarser and feature a clast supported fluvial gravel facies at the base. Here imbricated gravels are moderately to steeply bedded. The cobble population is the largest (30-60 mm) and most abraded encountered in the MCC profile.

Sub-unit 10 represents the weathered solum ("Bw horizon"). Because of the dense concentration of sands (with minimal interstitial spaces), soil structures are subdued and bedded, depositional structures are accentuated. These include steeply dipping (20-35°) gravel and sand foreset beds that signify former east-southeast channel flow probably associated with deltaic sedimentation. Diffuse mica-dominant interbeds are indicative of short distance transport and rapid accumulation. Smaller scale cut-and-fill structures near the base indicate scouring and possible interludes of shallow water sedimentation.

The unweathered portion of the profile (below subunit 10) extends 10-20 meters and consists of cyclic, moderate to well stratified beds of gravels and sands. These represent several thousand years of high discharge characteristic of deglaciation and the terminal Pleistocene, early Holocene environments of the ancestral Hudson drainage.

4.4.2 *Radiocarbon Chronology*

The entire succession of events at the MCC Tunnel was indexed by a battery of radiocarbon dates submitted from each of the principal Units. A major emphasis was placed on the Collect Pond and the tannery structures, since both preserved organic materials amenable to dating. Organic sediments from the Collect's margins could date the terminal phases of pond sedimentation, while the decomposed organics from the tannery vats identified in Unit II afforded an independent means for determining synchroneity between tanning activities and pond siltation. Recent refinements in the calibration curves for Late Holocene radiocarbon chronologies offer unparalleled precision in the application of dating techniques to historic sites (Stuiver et al 1993; Vogel et al 1993).

Table 2 summarizes the results of the seven (7) radiocarbon samples submitted. In addition to the East Wall, specimens were obtained from Structure 1, the Center Trench and the Northwest Corner. The master section (Figure 6a) shows the provenience of all dates; in cases where profiles are not presented, proveniences are extrapolated to equivalent strata and/or sedimentary matrices. While determinations were procured from each of the Depositional Units, five (5) were run on specimens from either tannery debris or the associated Collect Pond organics. Materials submitted included bark, wood, organic sediment and shell. Table 2 reports both conventional 14C results (after 13C/12C correction) as well as calibrated results with 2 Σ, 95% probability. The calibrated age is critical for historic determinations because of secular variation and de Vries effects over the past 2500 years (see Taylor 1987).

In general, the absolute chronology was an extremely accurate barometer of the reconstructed depositional sequence. This is illustrated by comparing columns three (Depositional Unit) and six (Conventional 14C Age) in Table 2. Age determinations increase with advancing Unit down the stratigraphic column with the notable exception of the single oyster shell date from Unit II/III. The discrepant and depressed age of this specimen (700±60 B.P.; Beta-77029) may be attributable to its source as a fill laid down for the foundation of Structure 1. It is probable that the clays used for this foundation were older estuarine deposits removed by nineteenth century workers from an intact location flanking the structure. A more consistent result was obtained from wood (320±50 B.P.; Beta-77028) taken from the same provenience.

Four (4) of the remaining specimens were taken from Units II and III at approximate depths of 4.2-4.5 meters in various sections of the MCC Tunnel. In places, the stratigraphic boundaries between these units were gradual and difficult to isolate (Table 1). This is because at the time of operation, the tannery vat and debris were inset into the swamp margins of the Collect Pond. Accordingly, disaggregation of the vats and humification of the swamp were coeval. It is probable that the datable organics from both sources were migrating vertically and laterally. As a result, there is a strong expectation that determinations from the tanning vat wood and bark would be either depressed by introduction of older organics from underlying Collect Pond silts or elevated by assimilation of younger settling deposits. The effect is a radiocarbon determination that provides a "mean residence time" or average age of decomposition of the collective matrix; it may be older or younger than the actual age of the tanning activity (see Sharpenseel 1971; Stein 1992). A second common source of bias in dating is the age of the wood used for *assembling* the vats. The radiocarbon determination measures the age of the tree used for vat manufacture and not the antiquity of the vat itself. This would also have the effect of producing earlier determinations than anticipated (Beta Analytic 1994; Schiffer 1986). It is significant that the range of results reported for the Unit II/III deposits is consistent with both sources of error. The mean uncorrected result of ages for the four determinations is A.D. 1755, corresponding to the peak of tannery activity at Pearl Street.

A final radiocarbon sample was processed for the paleosol of Unit IV at a depth of 5.2 m. The buried "Ab" horizon represents the only intact soil in the substrate. The determination of 470±50 B.P. (Beta-77026) is both consistent with the vertical sequence and offsets the regional, pre-contact surface of the interior of lower Manhattan. As such it is a marker horizon, beneath which soils and sediments are linked to the Holocene and late Pleistocene fluvial history of the pre-Collect Pond landscape.

4.5 Site Formation Processes and the Archeological Record

The MCC Tunnel offers a vertical perspective of landscape changes over the 500 years of historic activity in lower Manhattan. Figure 6b illustrates that four (4) primary modes of sedimentation exemplify shifting land use patterns for this time frame.

The lowermost sediments (Unit IV), at depths in excess of 5.0 meters below street level, were formally dated to the Late Holocene. A 500 year old, moderately developed Cambic paleosol ("Ab-E-Bw" solum) is equivalent to the terminal Late Woodland period in North American prehistory. The sandy texture of the solum as well as its weathering profile suggests that the dominant vegetation at the time was coniferous forest. While Late Woodland artifacts were not recovered, the intact profile and its location within the alluvial belt of an early Holocene channel complex suggests that Native American groups would have favored such a location. The soil formed under moist, generally cooler conditions of the "Little Ice Age". Underlying deposits record complex fluvial cycles of deltaic and lower energy sedimentation during which extensive scouring, cutting and filling and channel migration characterized the ancestral Hudson Valley drainage. These Late Pleistocene deposits are present everywhere across lower Manhattan. Significantly, the finer grained estuarine clays of the stabilized shoreline are not present at Pearl Street and argue that the location was not a near-shore environment during the late Holocene.

Unit III registers the initial sedimentation along the broad valley that extended westward to historic Lispenard's Meadow and eastward through the Collect Pond and Eastern Outlet. Thin, but well bedded channel sands signify a laterally extensive stream belt with point bars accreting along outside bends. While it is not possible to determine the extent of channel activity, nor its precise duration, the thickness of sediment and the age of the underlying soil (500 years) and overlying Collect Pond silts point to the final period of unregulated stream flow prior to the initiation of drainage regulation in the eighteenth century. Accordingly, this stream apparently incised the early Dutch agricultural fields during the 1600's.

Above the channel sands a series of gently upward fining deposits signify a transition to quiescent stream flow and intermittent to seasonal impoundment of waters. These preserve the initial stages of Collect Pond evolution. Both historic accounts and the archeological stratigraphy (Figure 6b) indicate that this development dates to sometime in the middle to latter phases of Dutch occupation, either by design (i.e. drainage modifications) or because of climatic changes. Runoff accumulated in the basin from the surrounding hills (Figure 11). A sill parallel to the drainage axis (northwest to southeast) created two sub-basins which were only breached during periods of high effective moisture; these have been documented for the 1640s and 1670s in New England (Baron 1988). The main source of fresh water was a series of springs that irrigated Lispenard's Meadow and fed the Collect Pond. The accumulation of finely textured sediment (fine sands, silts, and clays) near the top of Unit III is consistent with circulation of spring waters and limited sediment reworking. More prominent are isolated peat beds and humic mats that took root along the margins and floor of the Collect Pond and were nourished under aquatic conditions.

Unit II preserves the most complex stratigraphic contexts. Sediments are only 35 cm thick, but contain intricate laminar structures that isolate both phases of ponding (siltation and rhythmite sedimentation) superposed over a cross-sectioned tanning vat. Micro-stratigraphic observation verified that the vats were submerged along the margins of the Collect Pond, where they soaked over the course of the liming and hair removal process. The exposed vats disclosed discrete layers of clay liner, cribbage, and the underlying silts and overlying clays which entrained the feature. As illustrated in Figure 12, the reconstructed location of the tannery complex places the MCC Tunnel midway between the margins of the Collect and the Eastern Outlet. The micro-stratigraphy is reinforced by the hydrographic properties of the sediment (i.e. reduction stains), linking the vat found in the Tunnel to a swamp facies. At this locus, hide processing involved soaking and/or activities requiring standing water. However, since this location was at the perimeter of the Collect it is not possible to determine the precise margins of the shoreline at the time that the vat was in use. The stratigraphy, and in particular the rhythmites, offer preliminary indications that the shore margins of the Collect varied considerably from year to year.

Stratum I represents the past two hundred years of grading and land filling at the time that Pearl Street was transformed from a tanning center to an urban dwelling area. Two discrete intervals of land filling can be differentiated, largely on the strength of the cultural debris incorporated in the fills. The fabric of the lower fill (sub-unit 2) is indicative of open pasture and perhaps even agricultural land (i.e. sod, humic mats); pockets also contain diamict from the original hills flanking Pearl Street. This conforms to the initial "turnover" of the non-urban landscape. The upper fill (sub-unit 1) is typically a reworked facies of the lower fill reinforced by sands and gravels clearly hauled in from distant locations. By this time the local neighborhoods had been sufficiently ensconced to inhibit unlimited local access to landfill. This marks the beginning of Pearl Street's florescence as an administrative center.

4.6 Synthesis: A Model of Landscape Archeology in Lower Manhattan

While the site formation model presented above applies directly to the archeological record of the MCC Tunnel, its detailed record of landscape change and occupation have more regional ramifications for the dynamic human and physical geography of lower Manhattan. The Collect Pond, for example, was a local feature that was central to landscapes beyond the limits of the tanneries. The pre-contact paleosol was an even more extensive feature, isolating stable surfaces that were probably regional in extent.

The various sources of geologic, cartographic, informant, and historic data abstracted for this study can be merged with field observations to develop a more comprehensive model of landscape archeology for lower Manhattan. A diachronic construct demonstrating the sequential interaction of landscape evolution, land use, occupation, and site preservation is presented in Figures 13a and 13b. The model presents a sequence of cross sections spanning a 10,000 year period based on stratigraphic relations observed at the MCC Tunnel. The sections depicted in Figures 13a and 13b follow a south-southwest to north-northeast transect spanning the reconstructed A.D. 1750 geography of Lower Manhattan (Figure 11). The transect begins at Catimuts Hill, crosses the lower sub-basin of the Collect Pond and the MCC Tunnel, and terminates at the unnamed hill north of the Collect. This is the optimal projection of landscape features and human settlement prior to large scale re-landscaping during the Industrial Age. It is also the most accurate representation of the city setting during the peak period of the Pearl Street tannery complexes.

The reconstruction begins during the Early Holocene (ca. 10,000 B.P.) with the earliest period coeval with human occupation. It then tracks six (6) critical stages in the landscape and human history, each indexed to events registered in the field study and bolstered by regional sequences or documentary records. As shown in Figure 6b, the six stages conform to critical periods in the cultural stratigraphy. These include the Early Holocene (Archaic), Late Holocene (European/contact), A.D. 1650 (Dutch settlement), A.D. 1750 Colonial settlement), A.D. 1850 (Industrial New York City), and the Contemporary twentieth century Pearl Street landscape. The archeological record of the MCC Tunnel is featured in the center of each panel. It forms the baseline for integrating buried archeological manifestations with landforms and/or sediment bodies recorded in the MCC Tunnel stratigraphy. The manifestations include cultural features, occupation surfaces, and activity areas.

Stage I (Early Holocene: 10,000 B.P.) identifies the early post-glacial environment. At this time the ancestral Hudson may have featured a distributary net that migrated southeastward and created the trough that evolved historically into Lispenard's Meadow. The kame features that are noted in nineteenth century geological and geographic accounts of New York City (Cozzens 1843; Gratacap 1909; Hobbs 1905) verify the presence of these steep sided gravel-sand hills until the mid-nineteenth century. The MCC Tunnel preserved deeply stratified and steeply bedded gravels and sands that could only have been derived from extensive meltwater drainage. While Archaic period Native American sites could have been located in the vicinity of Pearl Street, the stratigraphy demonstrates that the local fluvial environments were too dynamic to have preserved archeological remains.

Stage II (Late Holocene: 2000-1000 B.P.) is the earliest period for which geological evidence is recorded, albeit indirectly, in the study area. The Unit IV paleosol probably first stabilized over 1500 years ago and was progressively enriched by soil forming processes. Since the paleosol caps a regionally extensive surface, it would have spanned most of the terrace fronting the channel that bisected the antecedent Lispenard Meadow. The historic breadth of the Meadow and the coarseness of the channel fill indicates that a braided stream would have migrated across the valley. However, the Late Holocene channel would have been considerably narrowed, in response to the 10-15 meter rise in sea level and the stabilization of near shore environments to which the stream drained. The stream was fed by active springs that discharged through the local bedrock aquifer. It is probable that considerable prehistoric Native American activity (Late Archaic-Woodland) would have occurred along the channel banks. Evidence was not encountered at the MCC Tunnel, because of the limited window afforded by the excavations. However, site expectation is high in such a setting.

By stage III times (A.D. 1650-Dutch settlement), historic maps depict extensive agricultural lands. The Lispenard Meadows functioned as farm, pasture and swamp lands depending on the permeability and composition of the soils (see Castello Plan of 1660; Lyne Plan of 1728). At this time the Collect Pond began to develop, perhaps as a result of delicate hydrological balances related to land use (i.e. overgrazing, destructive farming practices, accelerated erosion) and general aggradation of the alluvial surface. Indications are that at least two water bodies emerged at that time, both nourished by springs and run-off from the surrounding kames (Figure 11). By the time of Dutch settlement the southwestern hill had been named Catimuts Hill. The topographic gradients across the transect began to diminish as a result of limited landscaping and the aforementioned sedimentation of floodplain.

In stage IV (A.D. 1750), the Collect Pond became the central fixture of the economic landscape. The entire expanse between Catimuts Hill and northern knoll was part of the tannery infra-structure. As depicted in Figure 13b, both the Eastern Outlet and Collect Pond served distinctive functions in the tanning process. The Collect Pond was a swamp that probably was utilized for long-term hide soaking, while the Eastern Outlet was the source of running water and served to remove chemicals and rinse the hides. Springs feeding both softened the hide fabric. It is probable that vats lined the sill separating the Collect's basins and that sets of vats were emplaced everywhere along the swamp margin of the southern Collect. Extensive debris, animal carcasses and tanyard waste were probably discarded everywhere along the swamp margins. Processing sheds would also have been built along the sill and the higher ground flanking the Collect and Eastern Outlet.

Stage V (A.D. 1850) registers the abandonment of the tanneries and burial of the Collect and the sub-basins associated with the tannery infra-structure. A clay liner at the base of Unit I separates the overlying landfill from tanyard debris. Extensive grading was the dominant regional activity over the course of this period as Pearl Street evolved from being the center of the leather trade to an urban residential center. The kames were leveled and differential grading soon created the even surfaces over which streets and sidewalks were built.

The stratigraphy documents a second major phase of land filling after A.D. 1900 (Stage VI: Contemporary), again attendant to a functional transition in the life of the Pearl Street area. The district evolved to its contemporary role as an administrative and legislative center. The excavated fill records more complex artifact assemblages of the latter twentieth century, including utility debris and large scale construction rubble. The transformation of the prehistoric environment was completed.

5.0 CONCLUDING SUMMARY AND RECOMMENDATIONS

The following conclusions and recommendations reflect the combined archeological and geoarcheological analyses conducted within the MCC tunnel trench. Recommendations pertain to future projects within the environs of the historical Collect Pond.

5.1 Concluding Summary

The archeological monitoring of the excavation of a tunnel under Pearl Street connecting the Metropolitan Corrections Center with the new Foley Square Courthouse was concluded at the end of October 1994. JMA archeologists were on the site from late July through October and the project geomorphologist made weekly visits from late August through October. In spite of the difficulties involved with working in conjunction with ongoing heavy construction activities, it was possible to draw a detailed profile of the eastern wall of the tunnel trench. Several intact archeological features were also recorded, one relating to the nineteenth century tenement that stood on the corner of Pearl Street and Cardinal Hayes Place until its demolition in the mid-1970s and a second relating to an eighteenth century tanyard that was one of many tanyards located in the vicinity of the Collect Pond and its environs. As has been demonstrated by other excavations in lower Manhattan, the presence of buried cultural resources within heavily disturbed areas of the city cannot be discounted. Utility trenches under Pearl Street reached a depth of fourteen feet below grade, but among and between them were remnants of early road surfaces and, most significantly, evidence of eighteenth century tanning operations. Oak bark, artifacts (including leather fragments, a handling hook, cow horn cores, and large chunks of cut bone), and components of vats and pits associated with various stages in the tanning process were recovered, providing rare data on eighteenth century tanning as it was practiced in New York City.

The geoarcheological investigations at the MCC Tunnel produced a wealth of information bearing on the last 20,000 years of human and landscape history of lower Manhattan. Field observations coupled with historic accounts and geological records facilitated a near continuous reconstruction of events since the earliest known occupation of Manhattan Island. The following are the key findings of the geoarcheological study:

1. High energy fluvial deposits minimize the likelihood of recovery of early prehistoric (Native American) sites anywhere in the immediate vicinity of the project area.

2. An extensive 500 year old paleosol offsets the cultural from natural stratigraphy across lower Manhattan. The paleosol is probably regional in extent and may prove to be a diagnostic marker horizon isolating aboriginal from historic surfaces.

3. The Collect Pond emerged as an impoundment in early Dutch times, probably in response to a combination of a changing hydological budget and intensive agricultural land use.

4. During the florescence of the tanneries, the Collect Pond was the central feature of the economic landscape. The tanneries moved to Pearl Street because they had polluted and exhausted analogous settings elsewhere in lower Manhattan.

5. The Collect Pond, the Eastern Outlet, and the springs feeding these resources were pivotal to the tanning infrastructure. Archeological investigations verified that vat facilities were in close proximity (<100 m) to each resource. The Eastern Outlet was used to rinse the hides, while the Collect functioned for longer term soaking. The calcium-charged springs softened the hides and facilitated processing.

6. The margins of the Collect Pond oscillated yearly before and after the tanneries were stationed at Pearl Street. Municipal agencies regulated the drainage of the Collect Pond and would have been responsive to the needs of the tanners in raising and lowering water levels.

7. Radiocarbon dates, when corrected for a variety of sources of error and bias, generally confirm historic records that place the tanneries at Pearl Street between 1700 and 1760.

8. Microstratigraphy was able to register the emplacement of tannery vats in existing marsh margins and peat deposits. It was possible to isolate laminar strata that informed on natural processes of Collect Pond siltation and construction phases of the vats themselves.

9. Collect Pond abandonment after 1800 is registered by the presence of a capping clay liner that sealed the basin and by fills containing artifacts of nineteenth century urban New York.

10. Two phases of urban development are preserved in the MCC Tunnel. Similar sequences should be featured elsewhere in lower Manhattan.

5.2 Recommendations

The presence of intact archeological features beneath Pearl Street associated with the industrial use of the Collect Pond before it was infilled in the early nineteenth century indicates that other areas in the vicinity of the historic Collect may be sensitive for buried archeological resources relating to early industry. Additional information on tanning and/or the other industries (e.g. slaughterhouses, potteries) would contribute significantly to the industrial and commercial history of New York City and, in a more general sense, to the technological history of the various industries as they were conducted in the Colonial and early Federal periods. Accordingly, it is recommended that future projects within the historic drainage of the Collect Pond, with expected impacts of greater than 12 feet below grade, assess the potential for archeological resources relating to New York's eighteenth century industry.

Depositional Unit IV preserved one of the few radiometrically dated soil profiles of Late Holocene age in the New York City area. The date of 700 ±60 B.P. (Beta-77029; see Table 2) conforms to the period of European contact and was taken on the organic fraction of the buried solum. Sediments at or immediately below this level are of potential prehistoric age. However, the coarseness of the sediment and its fluviatile bedding planes implies high energy deposition, great antiquity (i.e. pre-Paleoindian), and marginal preservation potential at this location. The MCC Tunnel would have been part of the channel belt during most of the earlier Holocene. It was not possible to isolate a landform segment that was sufficiently removed from the former channel itself to have permitted preservation of a prehistoric (Native American) site in the immediate vicinity.

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TABLES

Table 1: Sediment characteristics: MCC Tunnel east wall profile (>3.2 m)

Master Unit	*Field Stratum*	*Depth (cm)*	*Color*	*Texture*	*Structure*	*Mottling*	*Stoniness*	*Roots*	*Fe/Mn*	*Boundary*	*Comments*
I	1	0-30	7.5YR4/4	Clays, sands & fine pebbles	Massive with sandy interbeds	M-H	H	L	NA	A,S	Gritty matrix with abundant 20th construction debris, brick fragments, cinder fill and debris; fluviatile (cross beds) extensive lateral and vertical mottling;inclined slopewash interbeds
I	2	30-85	7.5YR5/6	Sands, fine pebbles and debris	Massive with sub-horizontal sandy interbeds	M-H	H	M	H	C,S	Interdigited stream sands & construction debris; laminar sesquioxide beds; reduction stains (field saturated); base demarcated by dense, impermeable reduced clay: sediment trap and perched water table.
II	3	85-113	10YR3/1	Degraded wood-clay and peat matrix	Platey-laminar to angular blocky	H	NA	M	H	A,S	Gleyed clay-liner interdigited with natural peat; layer redeposited for tanning vats; preserved wood casing fragments (80% by volume); extensive reduction stains.
II	4	113-121	7.5YR5/3	Basal peats, gravelly sands and clays	Granular	M-H	H	H	H	A,S	Historic channel lags above which clays (10% by volume) and peats were nourished by active springs; basal deposits of liming pits. 130±50 B.P. (Beta-77027)
III	5	121-130	7.5YR 3/1	Fine gravels, sands, silts, and clays	Laminar to fissile	L-M	M	L	L-M	C,S	Well sorted beds of slow to moderately accreting basin sediment; well rounded, small gravels and cobbles (2-10 mm) signify abrupt, higher discharge event.
III	6	130-168	7.5YR4/2	Medium sands and clays	Laminar to tabular	H	L	L	M	C,S	Upward fining medium to fine sands with variable clay content; thick (>2 mm) laminations suggestive of subdued stream or standing water; decomposed organics and "ghost" structures indicative of vegetation.
III	7	168-182	5YR4/4	Cobbles and coarse sands	Imbricated and massive	NA	H	L	NA	A,S	Episodic and abrupt flow event; matrix entrains organic filaments and root fragments; stratum perhaps associated with migrating channel.
IV	8	182-193	10YR3/1	Gravels and sands	Granular with fissive compound structures	M	M	H	L	G, S	Top of buried solum ("Ab-horizon"); organic sands with mica inclusions (10%) that dissipate with depth; contact period Paleosol (470±50 B.P.; Beta-77026); source sediment is fluvial (post-glacial).
IV	9	193-206	10YR5/2	Gravels and sands	Massive	H	H	L	H	G,S	Leached eluvial ("E") horizon of epi-pedon; dense abraded and pitted sub-rounded gravels signify early Holocene high discharge event associated with ancestral Hudson drainage.
IV	10	>206	7.5YR7/4	Gravelly sands and clays	Massive to subangular blocky; crossbeds to base	M	H	NA	H	NA	Illuvial horizon ("Bw") of epi-pedon; weak, Cambic Paleosol formed in upper portion of discharge sands and gravels.

L=Low M=Medium H=High
G=Gradual A=Abrupt C=Clear
S=Smooth

Table 2. Radiocarbon determinations from MCC excavations

Beta- Sample	Profile	Depositional Unit	Depth (m)	Material	Conventional 14C Age (B.P.)	Calibrated Results* (A.D.)	Master Stratum**	Comments
Beta-77030	Structure 1 North wall	I	2.5	bark	50±50	1685-1740; 1810-1930	4	Late range acceptable; consistent w/ tenement construction and Perris Atlas Maps of 1853 & 1857
Beta-77027	East Wall	II	4.3	wood	130±50	1665-1950	16	Acceptable date; incorporation of wood into older Collect Pond organic
Beta-77031	NW Corner	II/III	4.5	wood	150±40	1665-1950	16/17	Acceptable date; incorporation of wood into older Collect Pond organics
Beta-77032	Center Trench	II	4.4	wood	180±40	1655-1890; 1905-1950	16	Late range acceptable; incorporation of wood into older Collect Pond organics
Beta-77028	Structure1	II/III	4.2	wood	320±50	1455-1665	16/17	Acceptable date; footing of structure excavated into swamp margin organics & tannery fills
Beta-77026	East Wall	IV	5.2	organic sediment	470±50	1405-1495	31	Acceptable date; consistent w/ stablization of youngest (Euro-American) pristine surface
Beta-77029	Structure 1	II/III	4.3	shell	700±60	1415-1675	16/17	Date rejected; shell matrix depresses age range

* 2 sigma, 95% probablity
** Refer to Figure 6a for provenience

FIGURES

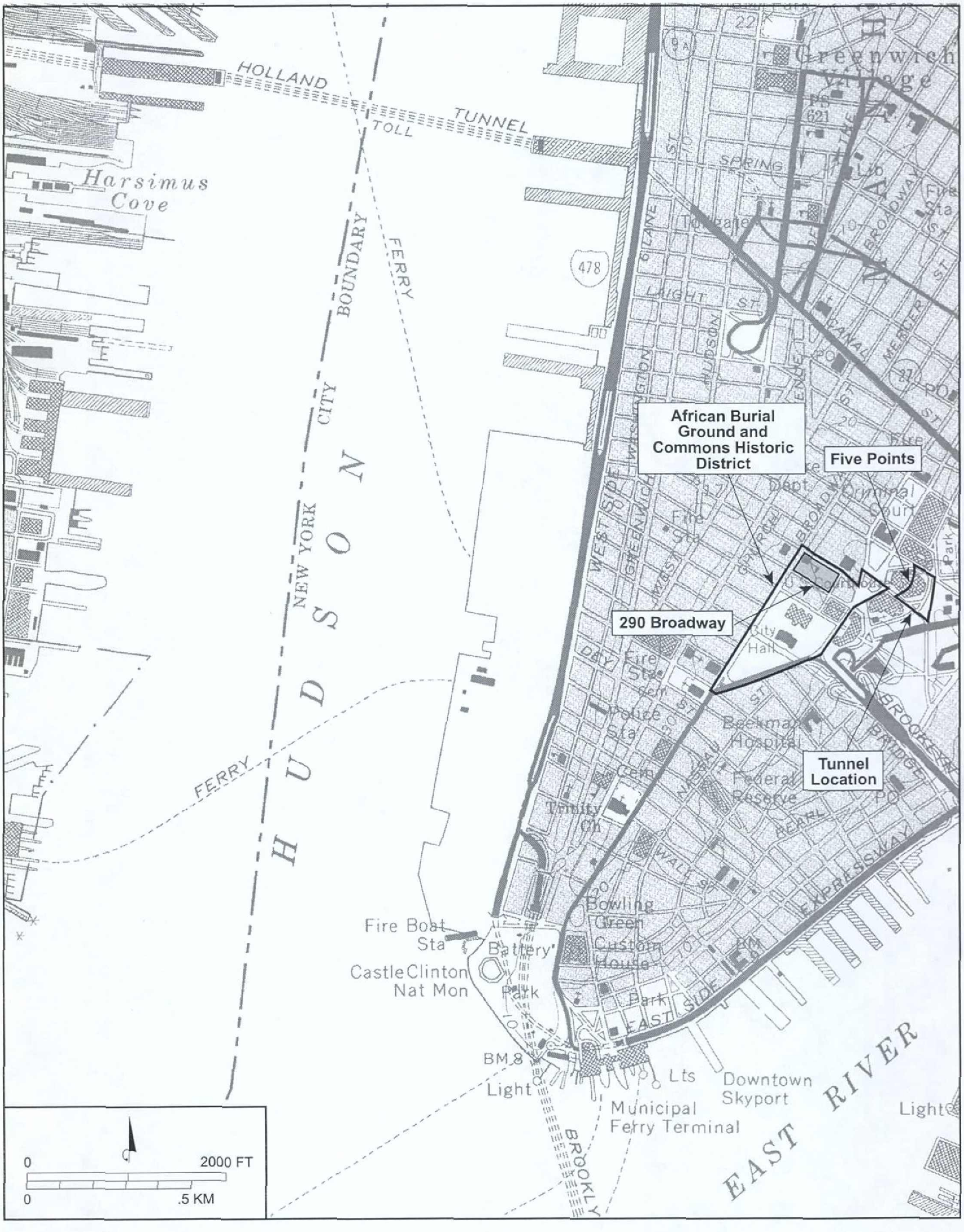


Figure 1. Project area location (detail of *Jersey City, N.J.-N.Y. 7.5 Minute Quadrangle*; USGS 1967, photorevised 1981)

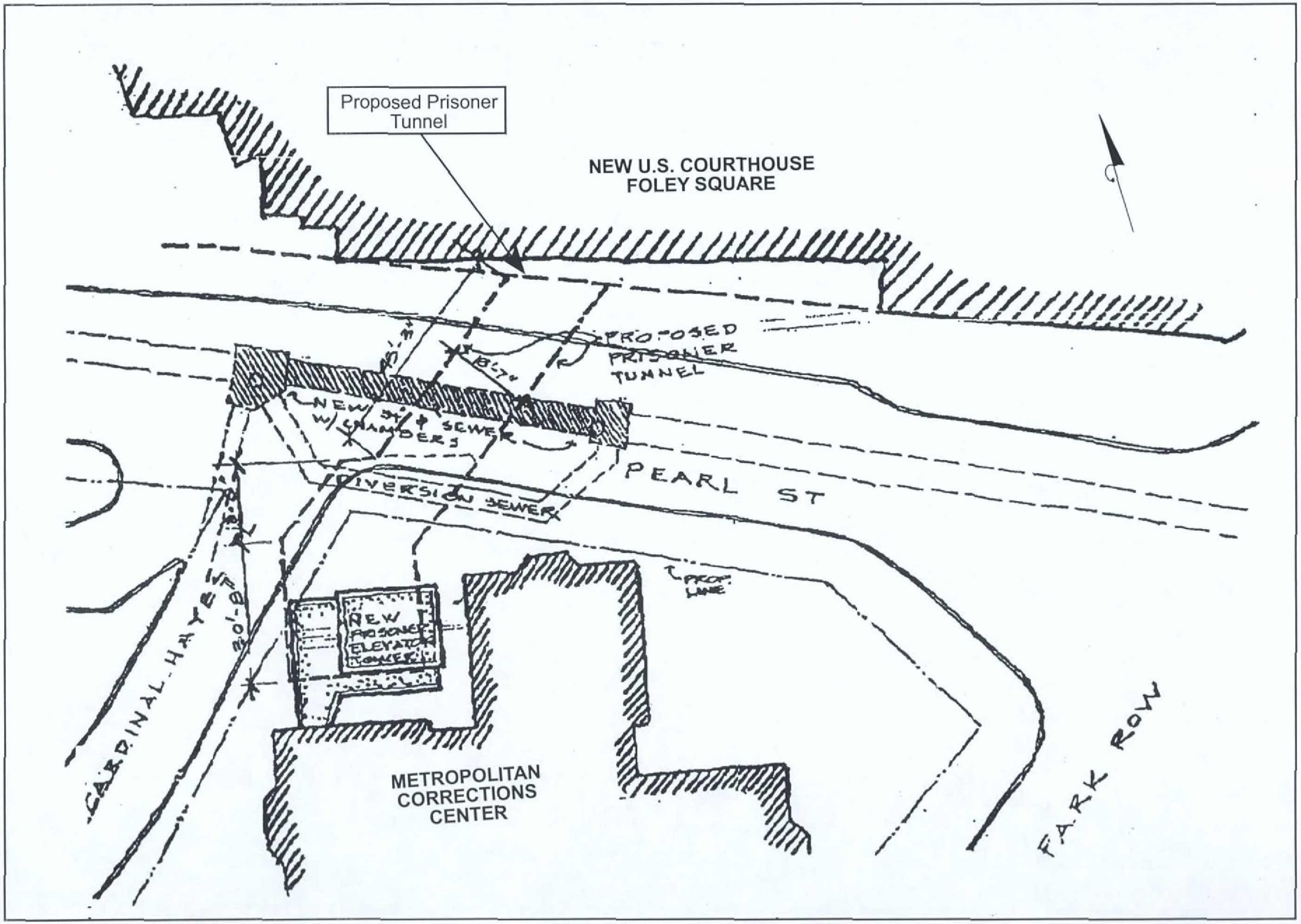


Figure 2. Schematic showing proposed prisoner tunnel between the Metropolitan Corrections Center and the new U.S. Courthouse. Site plan provided by the General Services Administration.

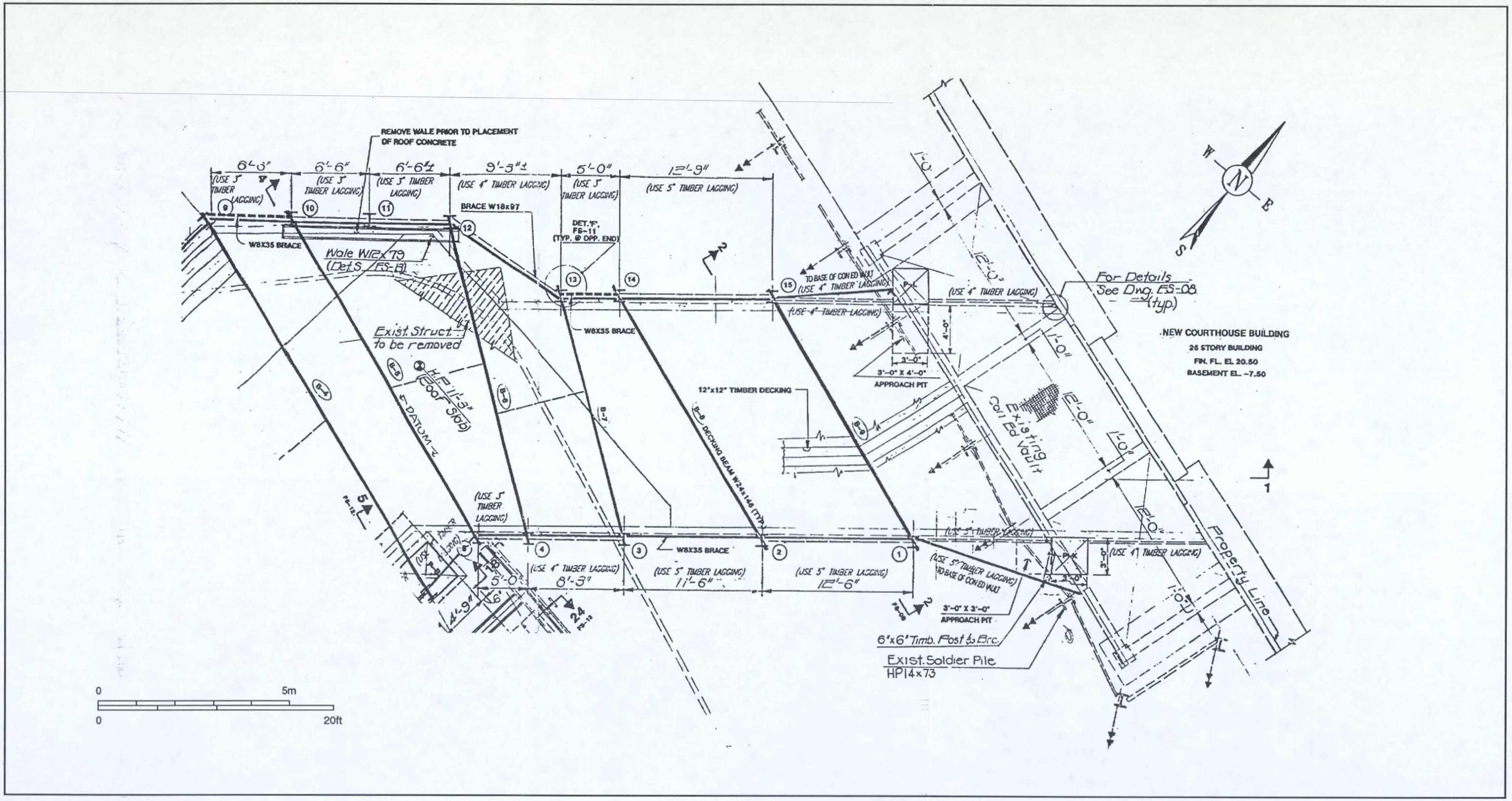
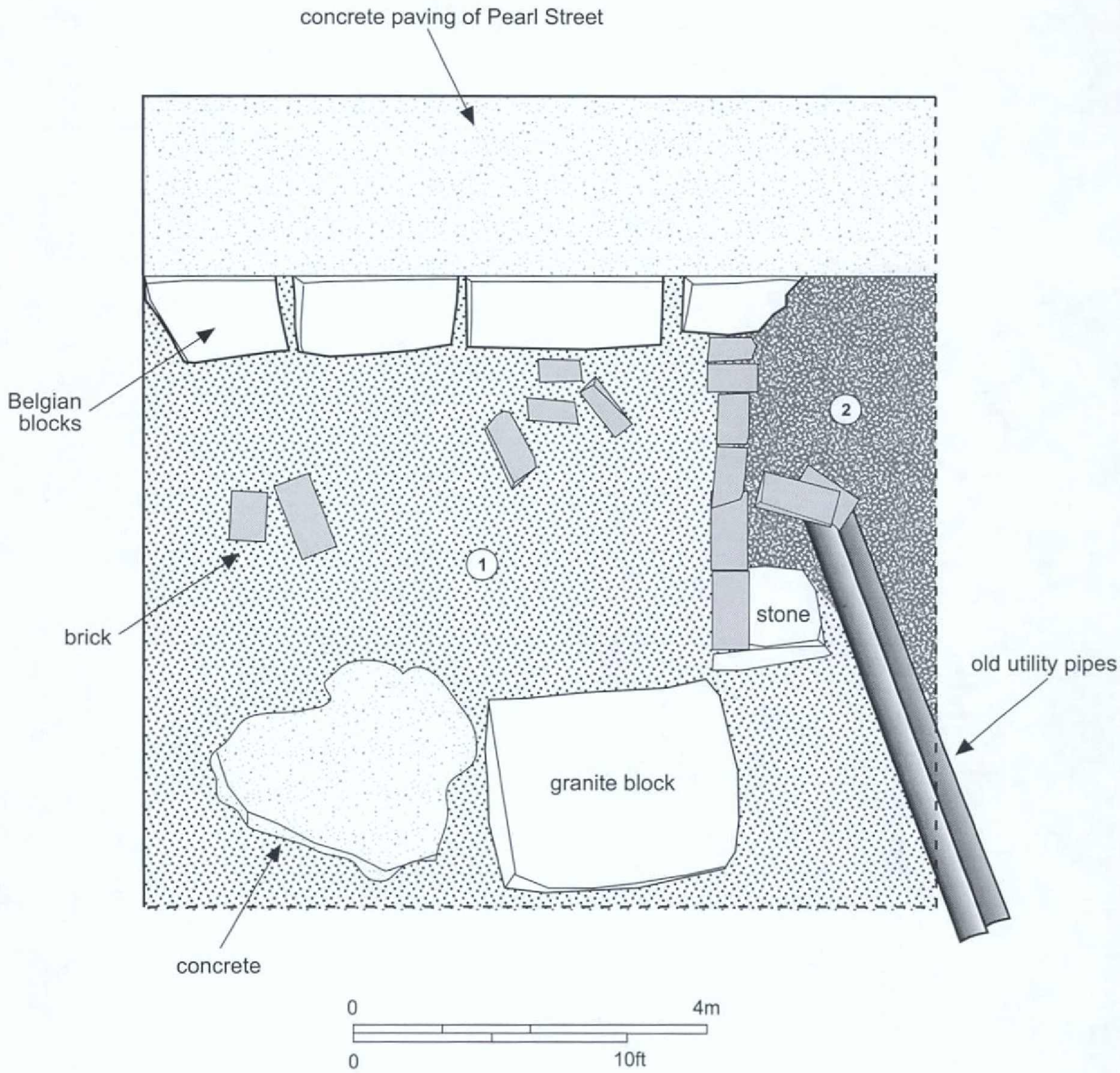


Figure 3. Detailed plan of tunnel showing piles 1-5 (east side) and 9-15 (west side), for decking. After Slattery Associates Inc. FS-06, Excavation Support System Decking Plan - Stage 2.



1 10YR4/3 brown coarse sand with small pebbles and brick

2 asphalt with gravel; fill

Figure 4. West profile extending north from Pearl Street curb showing buried Belgian block street surface and tenement wall below.

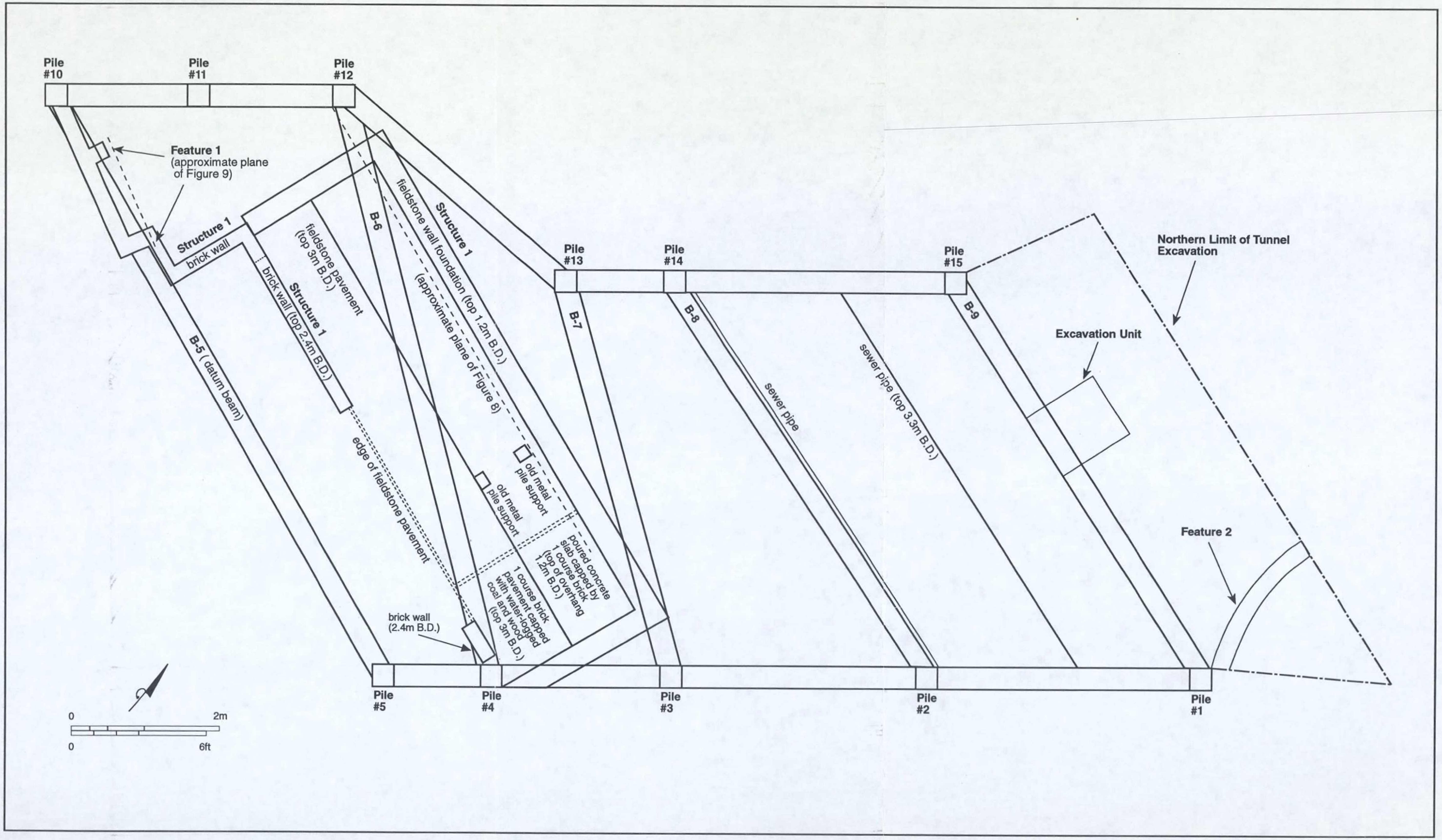


Figure 5. Plan view showing major structures and features within the tunnel trench.

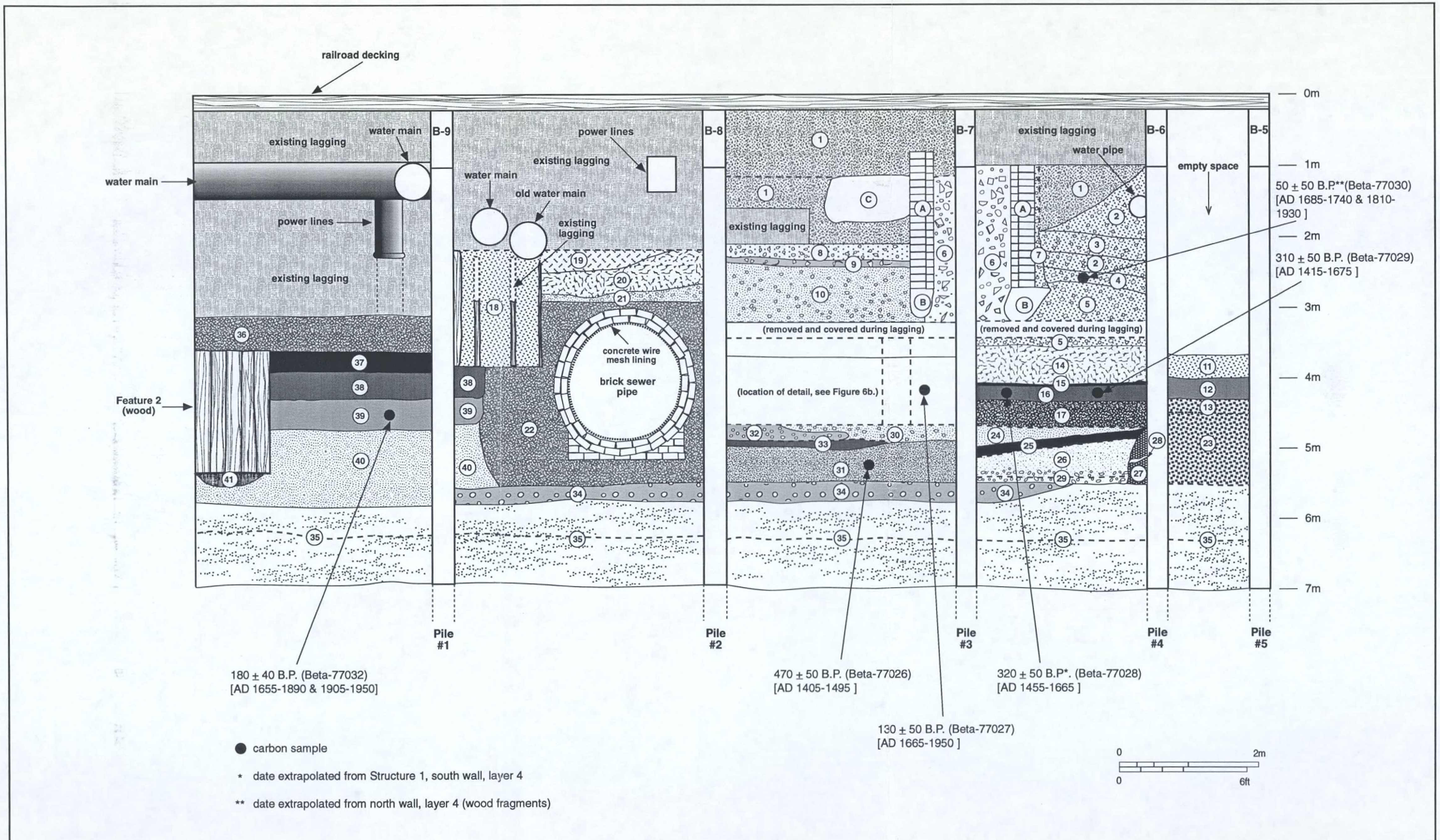


Figure 6a. Profile of eastern wall of tunnel trench.

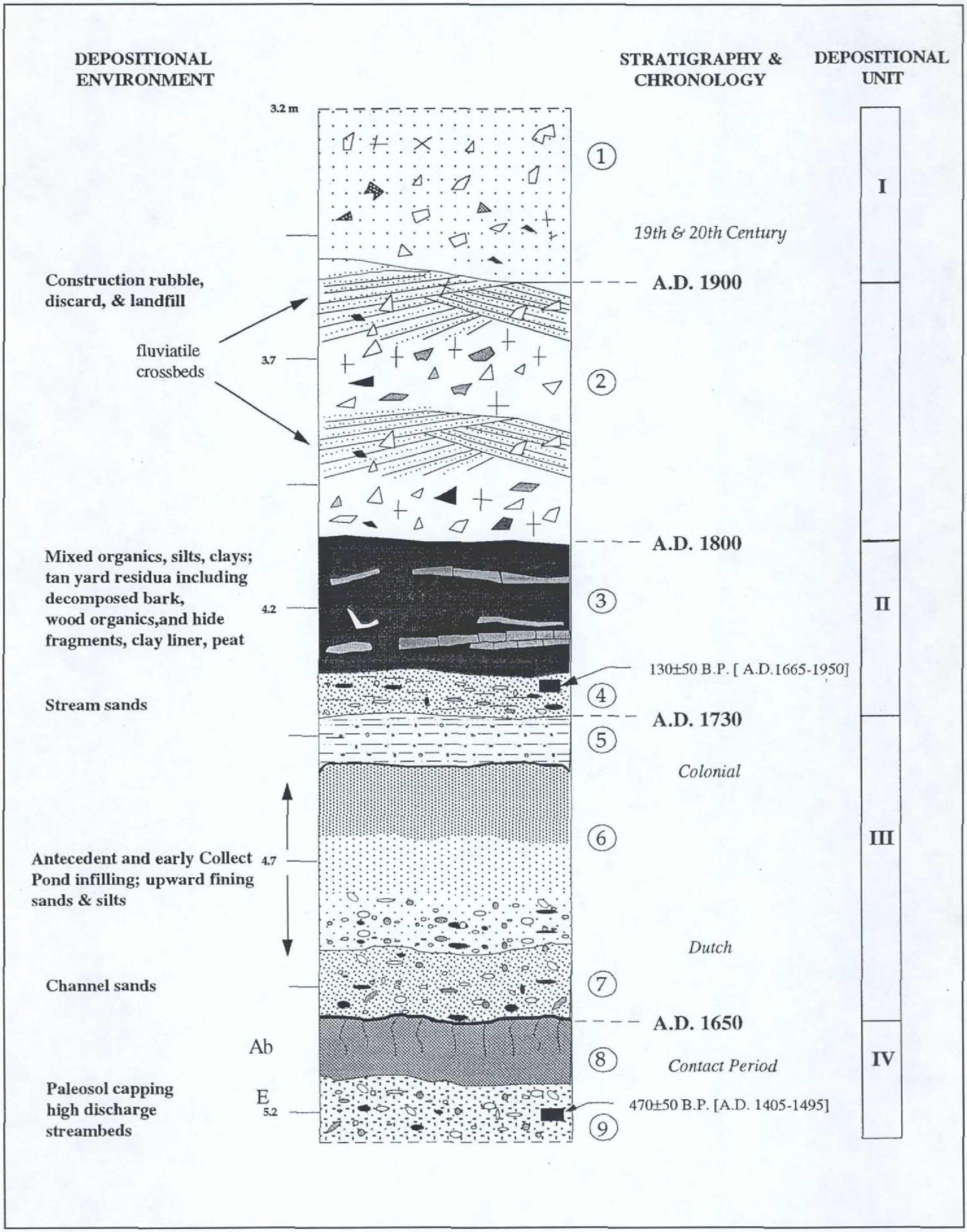
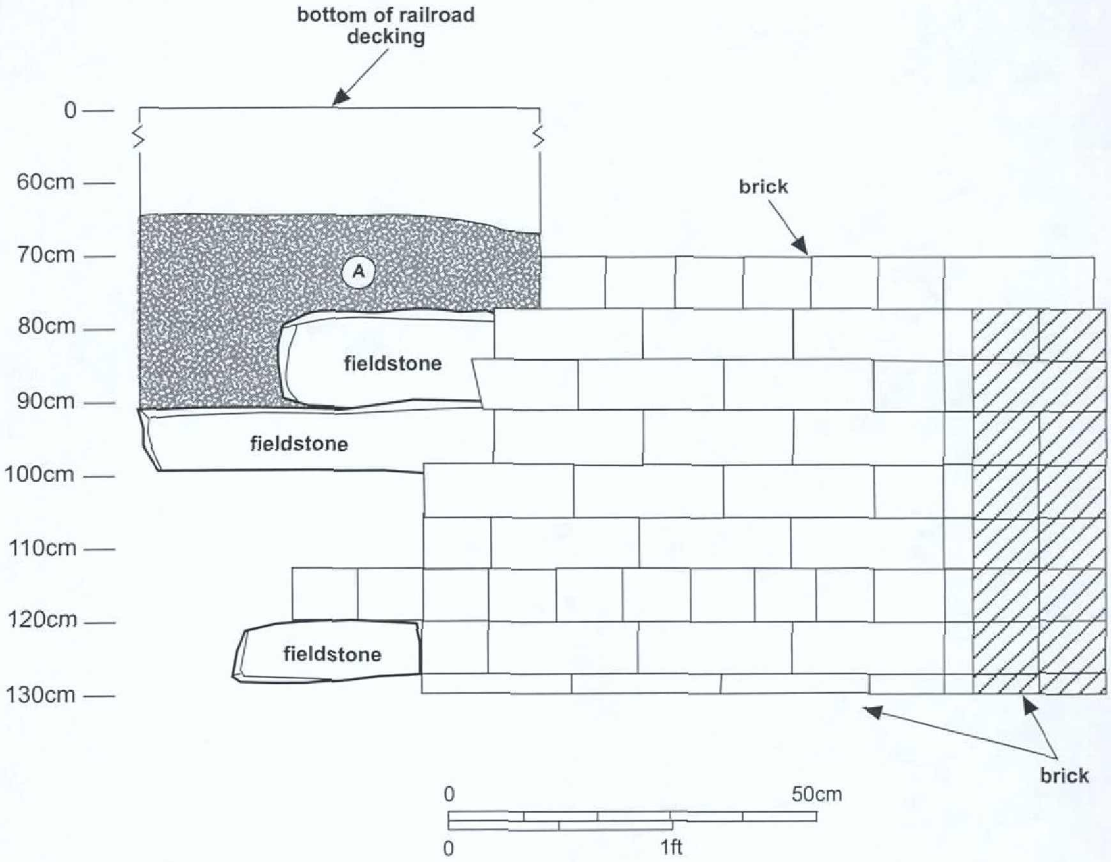


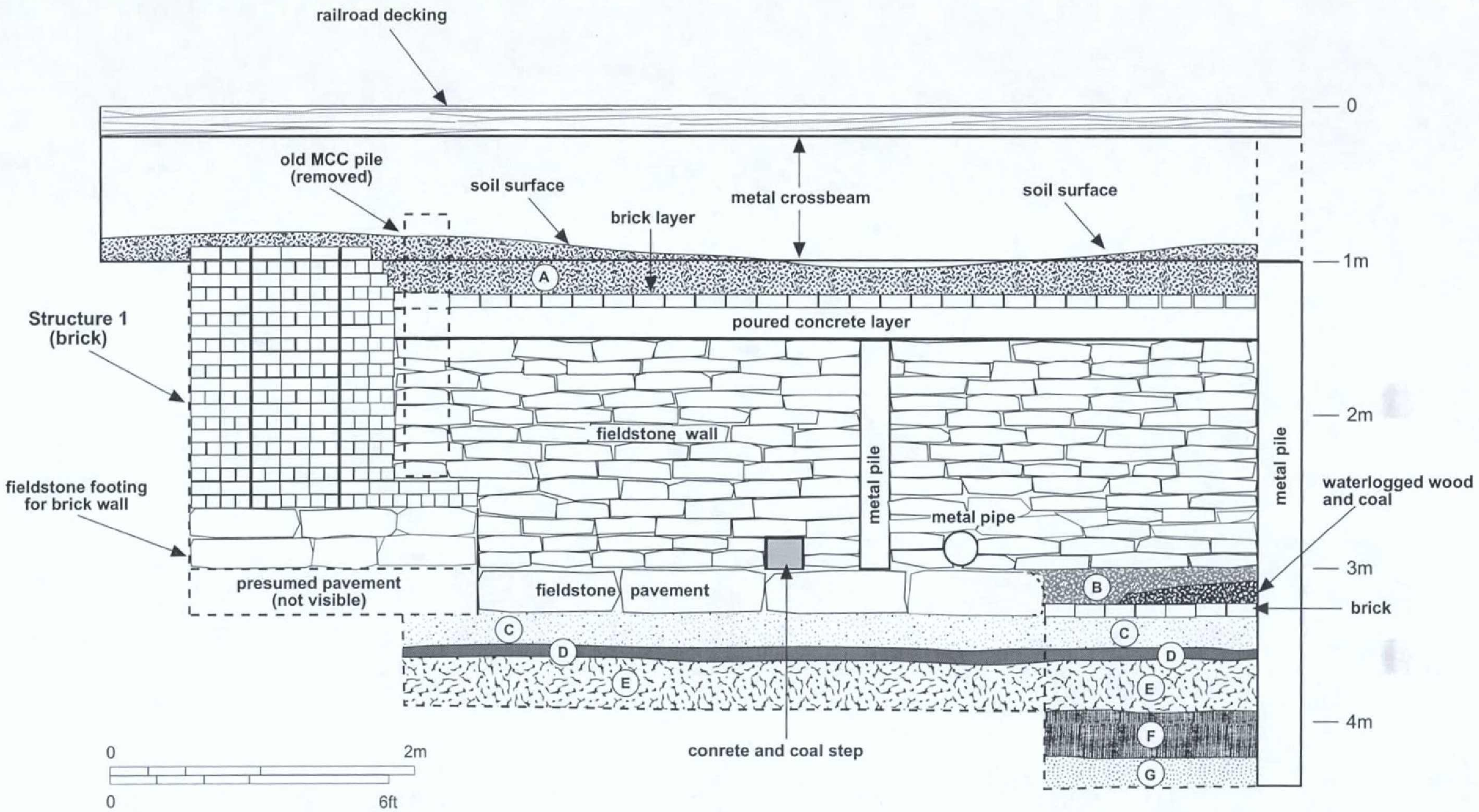
Figure 6b. Historic stratigraphy, MCC Tunnel.



A *7.5YR5/4 brown sand with cobbles and construction debris*

bricks forming eastern extension of wall

Figure 7. Profile of western wall of Structure 1.



A 7.5YR5/4 brown sand with cobbles and construction debris

B 10YR5/2 grayish brown silty sand and 7.5YR5/4 brown sand; contains cinder, mortar, cobbles, and construction debris

C 10YR4/4 dark yellowish brown fine silty sand with small pebbles

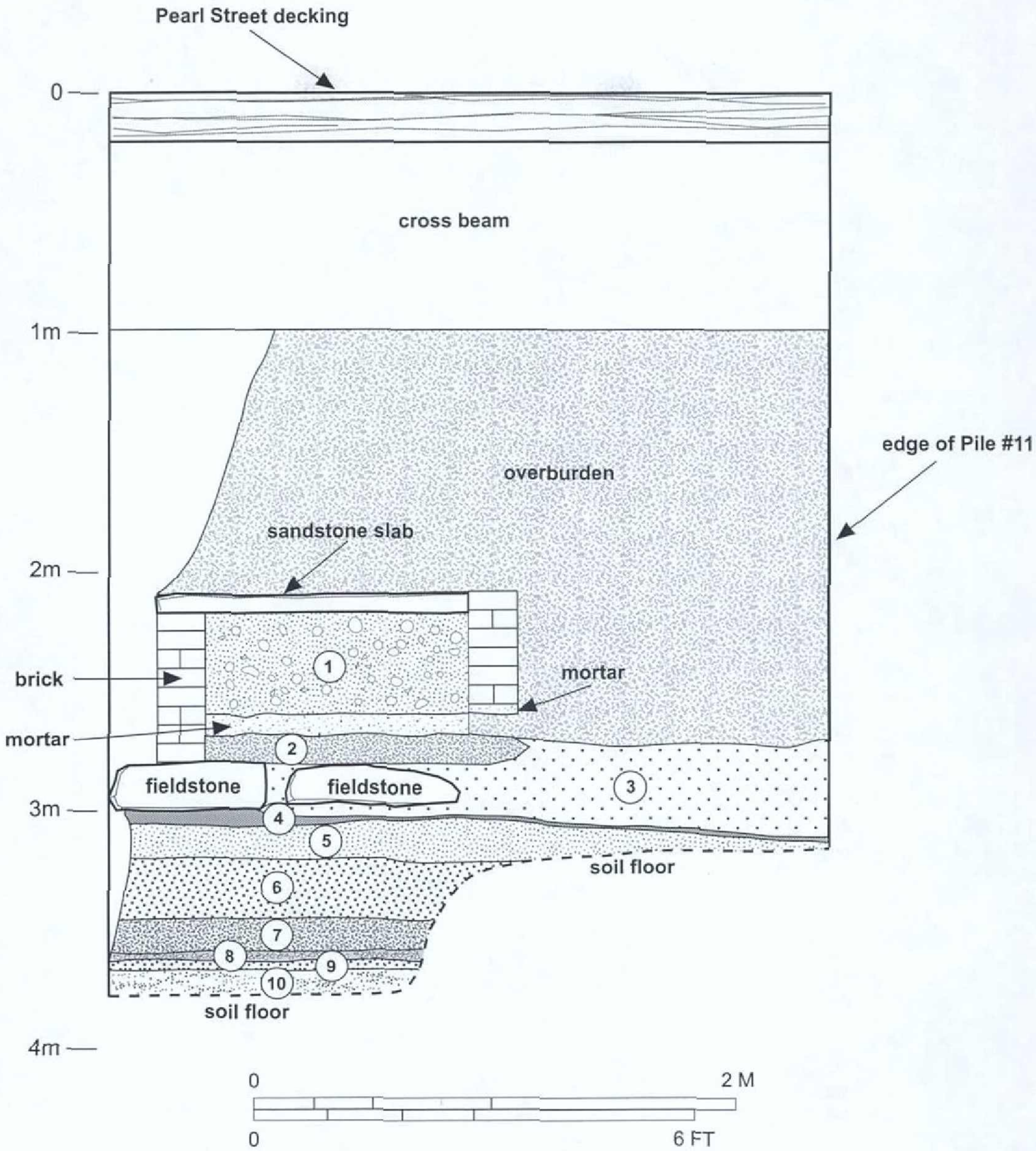
D 10YR3/1 very dark gray silty sand

E 7.5YR4/3 brown and 7.5YR4/4 dark yellowish brown lenses of silty sand (iron staining)

F 10YR3/2 very dark grayish brown very wet clayey silt with decayed wood

G sand; weather eroded subsoil

Figure 8. Profile of northern foundation wall of Structure 1.



1 7.5YR/44 brown medium sand mottled with 2.5YR6/8 light red medium sand with building debris, oyster shell, bone, and small to medium cobbles

2 7.5YR4/4 brown medium sand with building debris, oyster shell, mica and charcoal

3 7.5YR6/3 light brown slightly sandy silt with mica flecks and small amounts of building debris

4 7.5YR5/1 gray highly organic clayey silt

5 5YR3/3 dark brown medium sand

6 7.5YR5/6 strong brown medium sand

7 *7.5YR4/6 strong brown silty sand*

8 7.5YR6/2 pinkish gray lens of micaceous schist

9 5YR4/3 reddish brown fine sand with small amounts of gravel

10 10YR5/2 grayish brown matrix of medium to coarse sands

Figure 9. Feature 1 brick staircase at southwest corner of Structure 1.

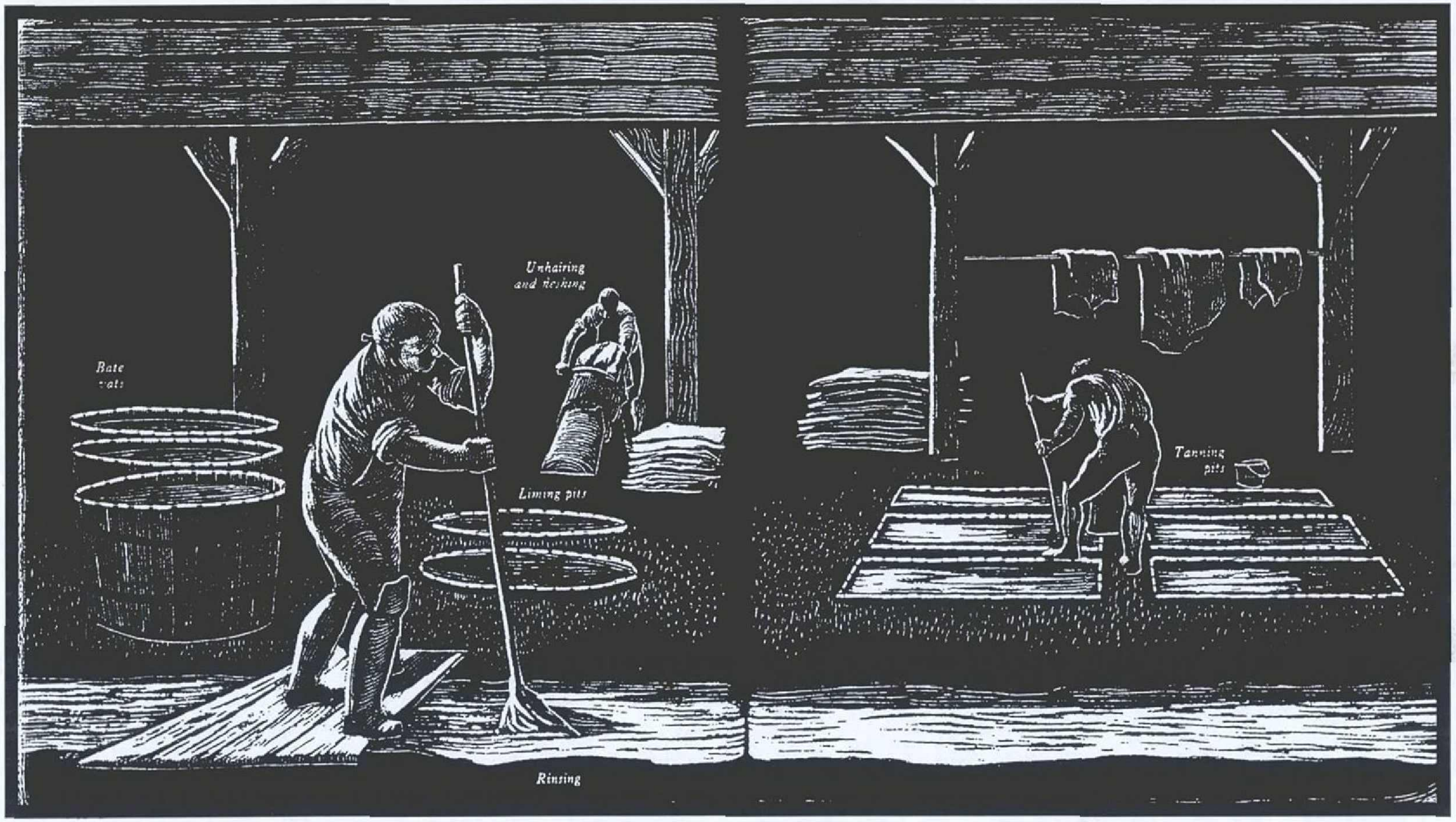


Figure 10. Layout of a typical small colonial tanyard. From *The Tanners* by Leonard Everett Fisher.

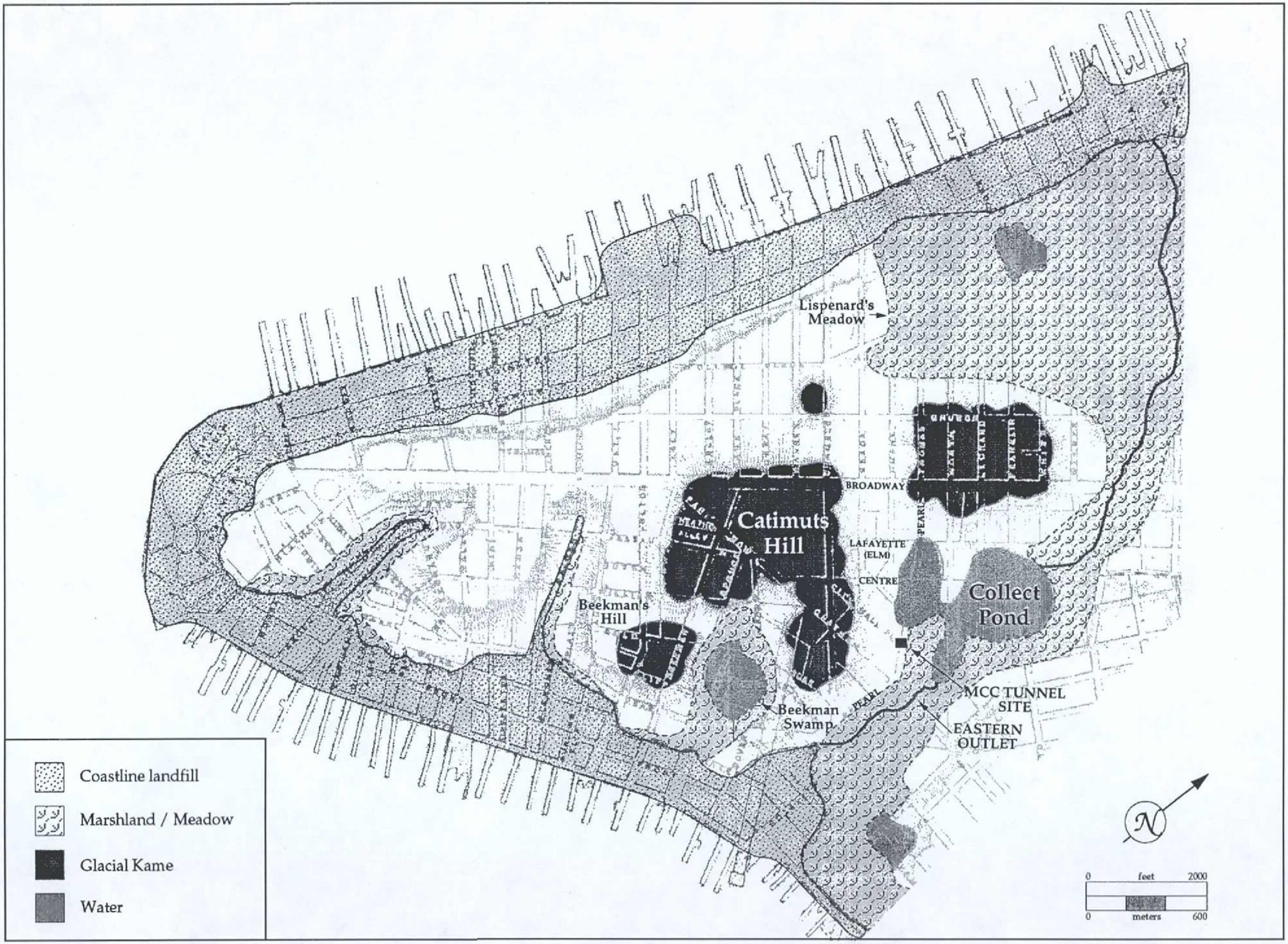


Figure 11. Eighteenth century landscapes, Lower Manhattan.

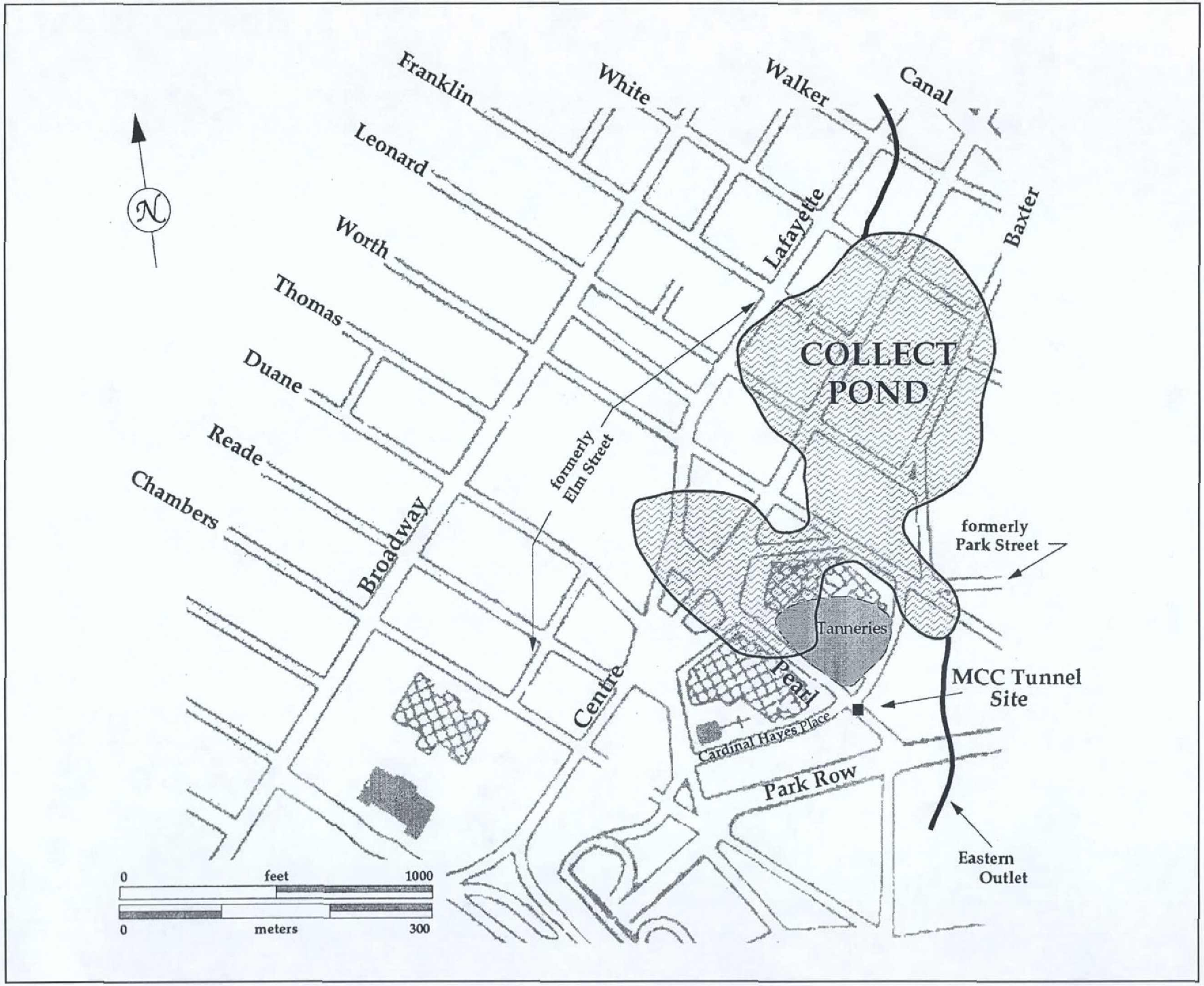


Figure 12. Historic setting of the MCC Tunnel and tannery complexes.

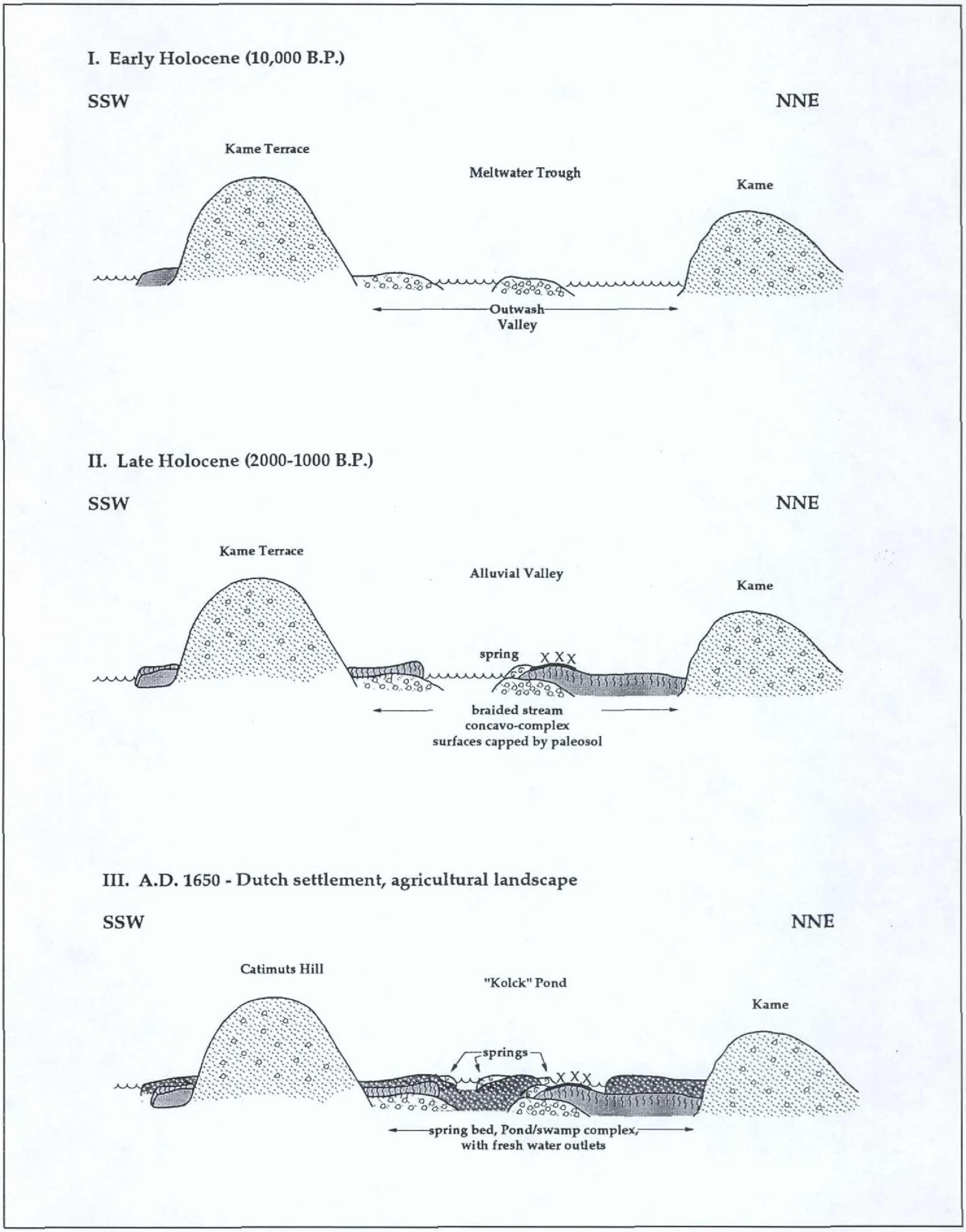


Figure 13a. Diachronic model of land use and occupation, Five Points area
(10,000 B.P. - A.D. 1650)

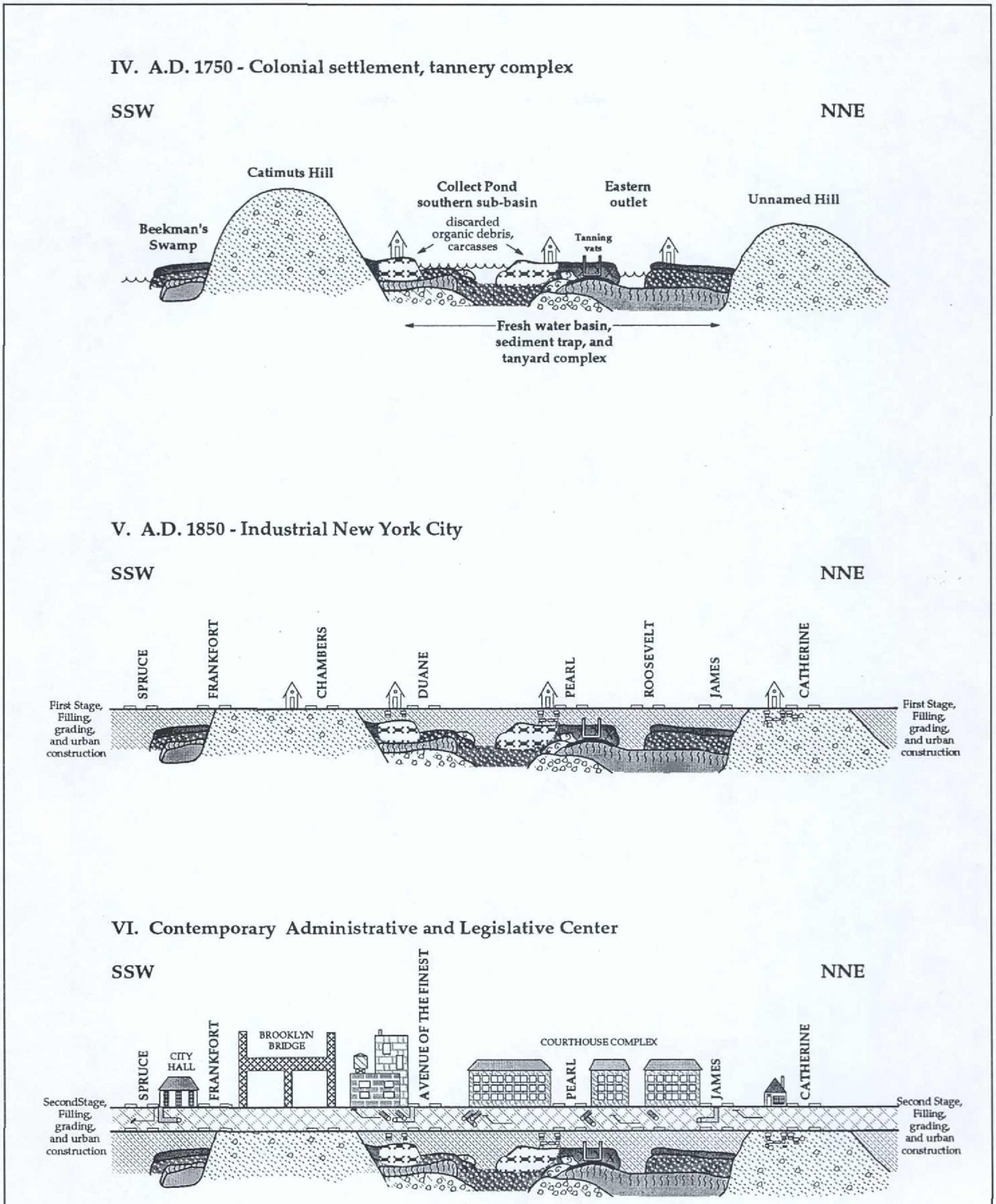


Figure 13b. Diachronic model of land use and occupation, Five Points area
(A.D. 1750 - present).)

PLATES

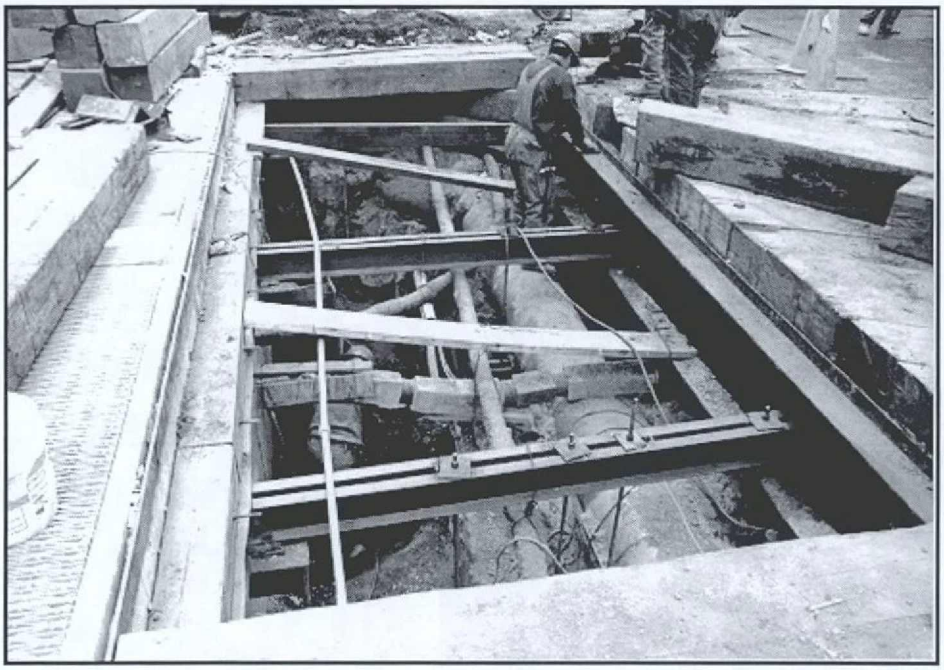


Plate 1. Complex of utilities beneath the Pearl Street pavement. Looking east.

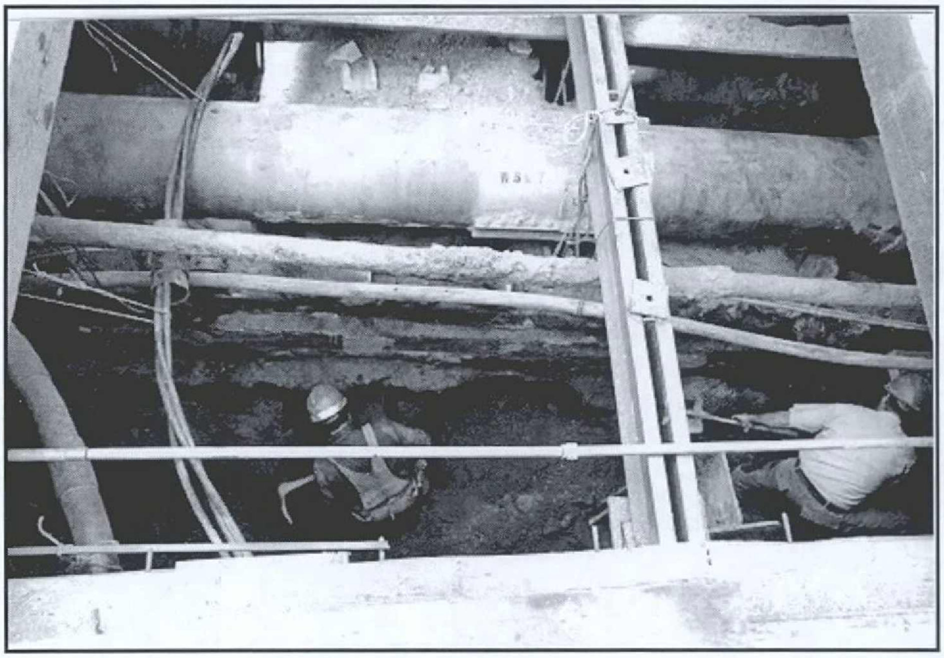


Plate 2. Workmen using manual excavation methods. Looking south.

Plate 3. Entrance to the tunnel excavation under Pearl Street early in the project. Looking north.

Plate 4. Entrance to the excavation showing Pearl Street above the tunnel. Looking northeast.

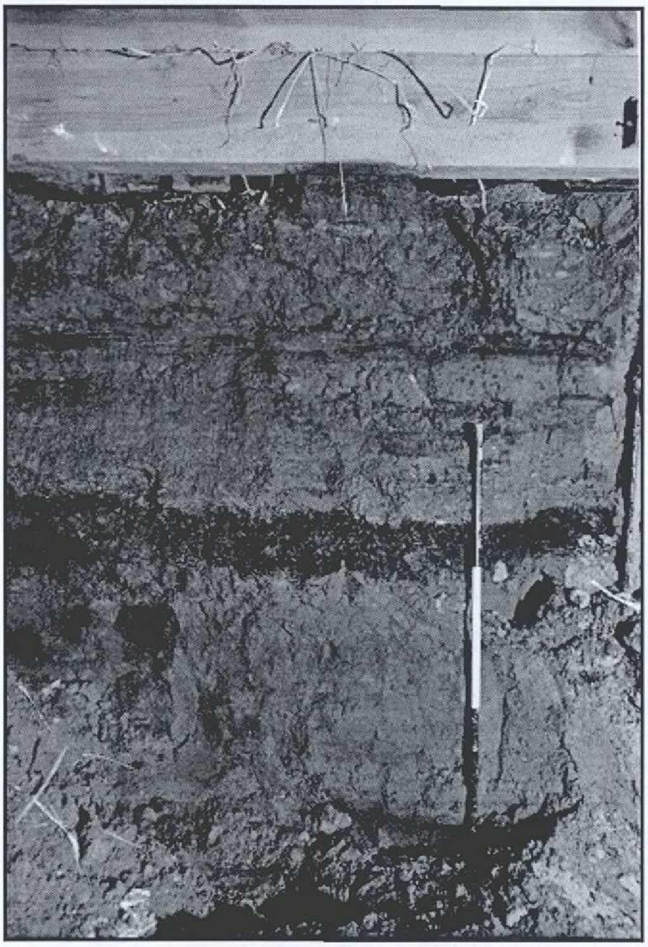


Plate 5. Sample profile section (between Piles 2 and 3) ready to be drawn. Looking east.

Plate 6. Archeological monitor and machine operator. Looking northwest.

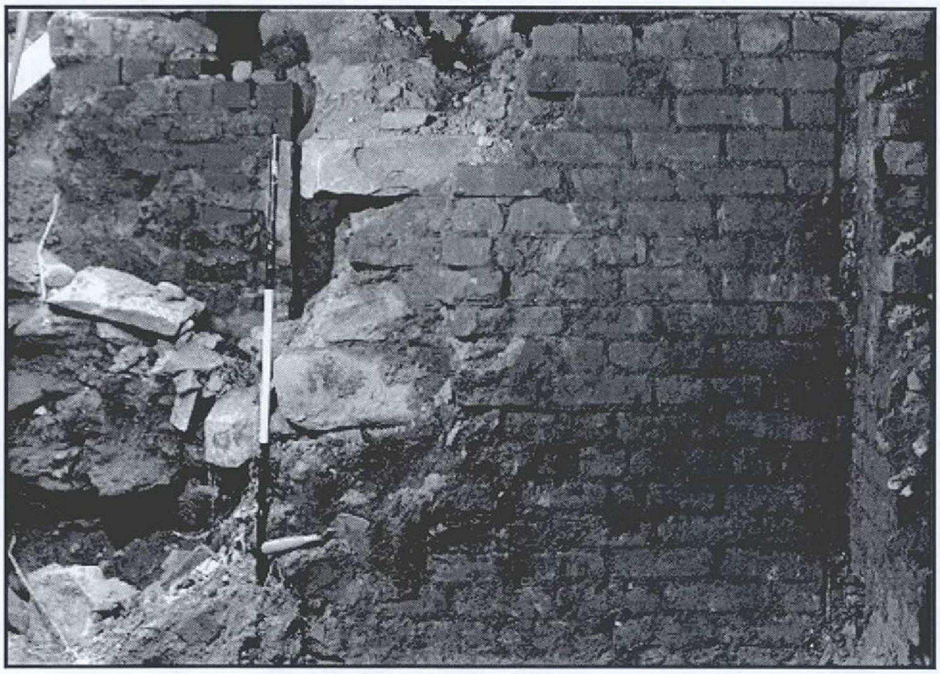


Plate 7. Structure 1, north-south portion of the brick wall at the intersection with the east-west portion of the wall. Looking west.

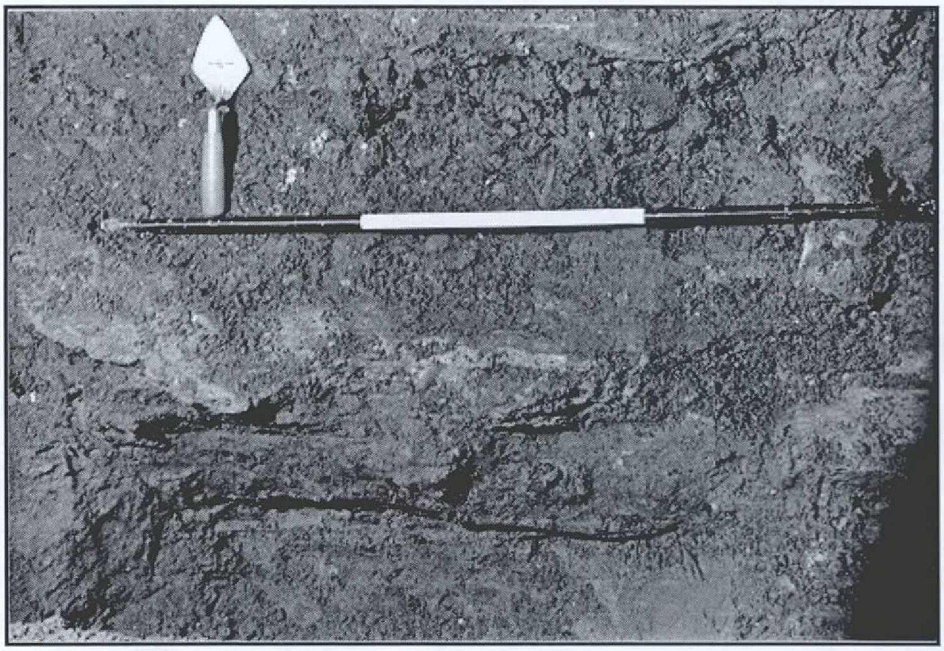


Plate 8. Detail showing the fieldstone footing of Structure 1. Looking north.

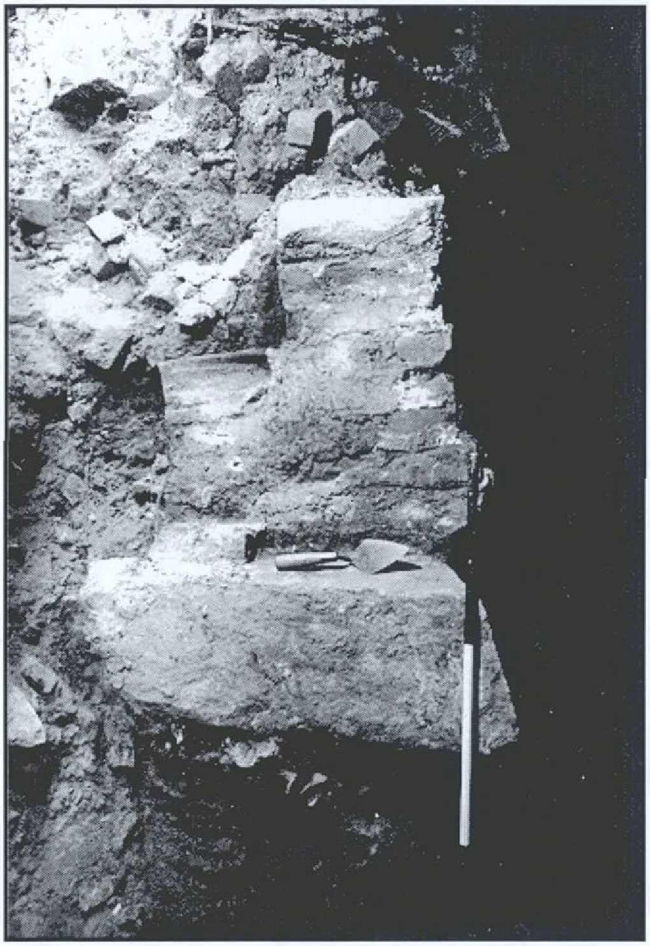


Plate 9. Feature 1, a probable cellar bulkhead stairway.
Looking west.

Plate 10. Detail showing silt with oyster shell beneath Feature 1. Looking west.

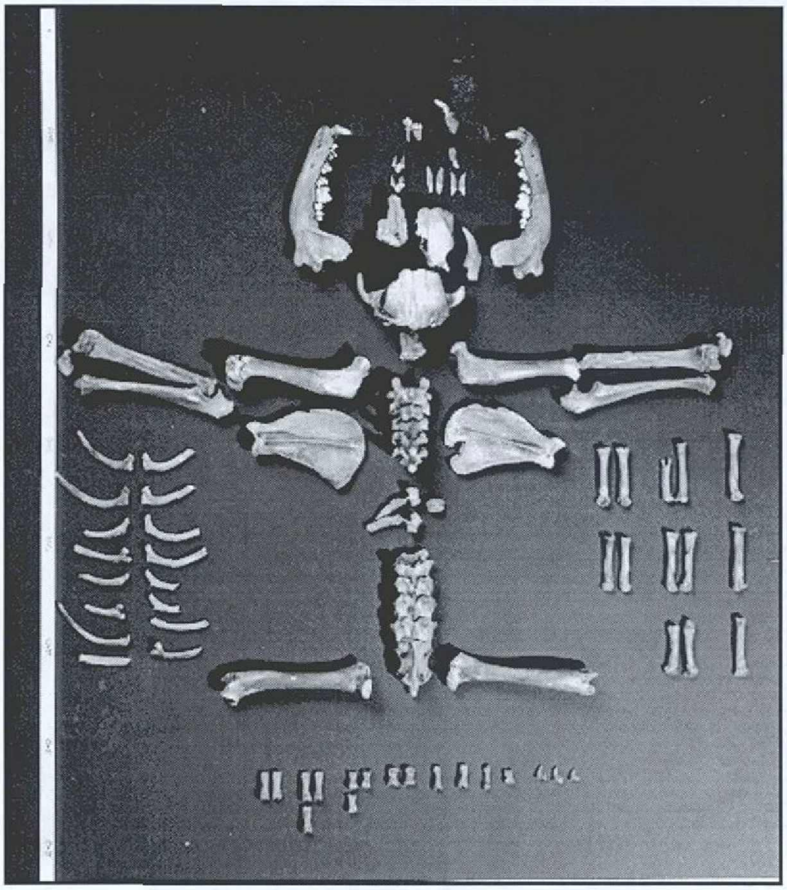


Plate 11. The dog skeleton found at the top of a stratum composed of shredded oak bark.

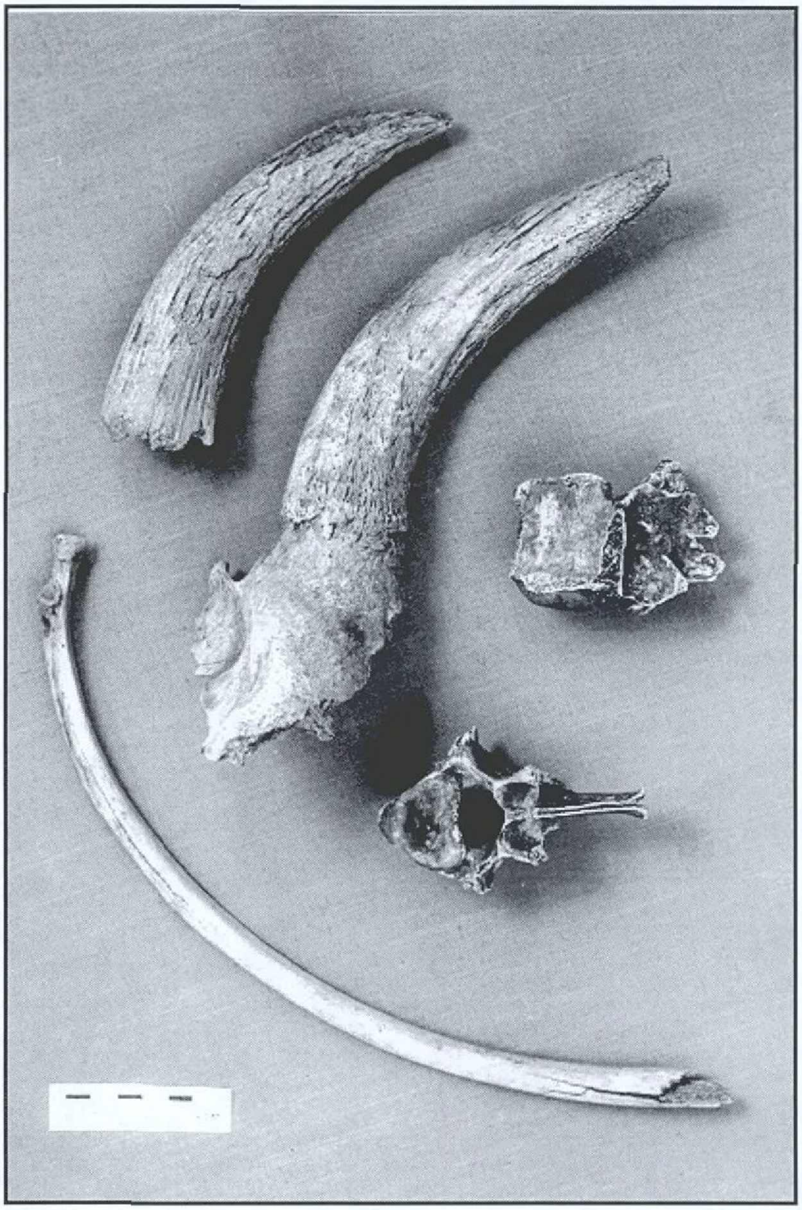


Plate 12. Cattle horn cores and miscellaneous bone found buried in the stratum composed of shredded oak bark.

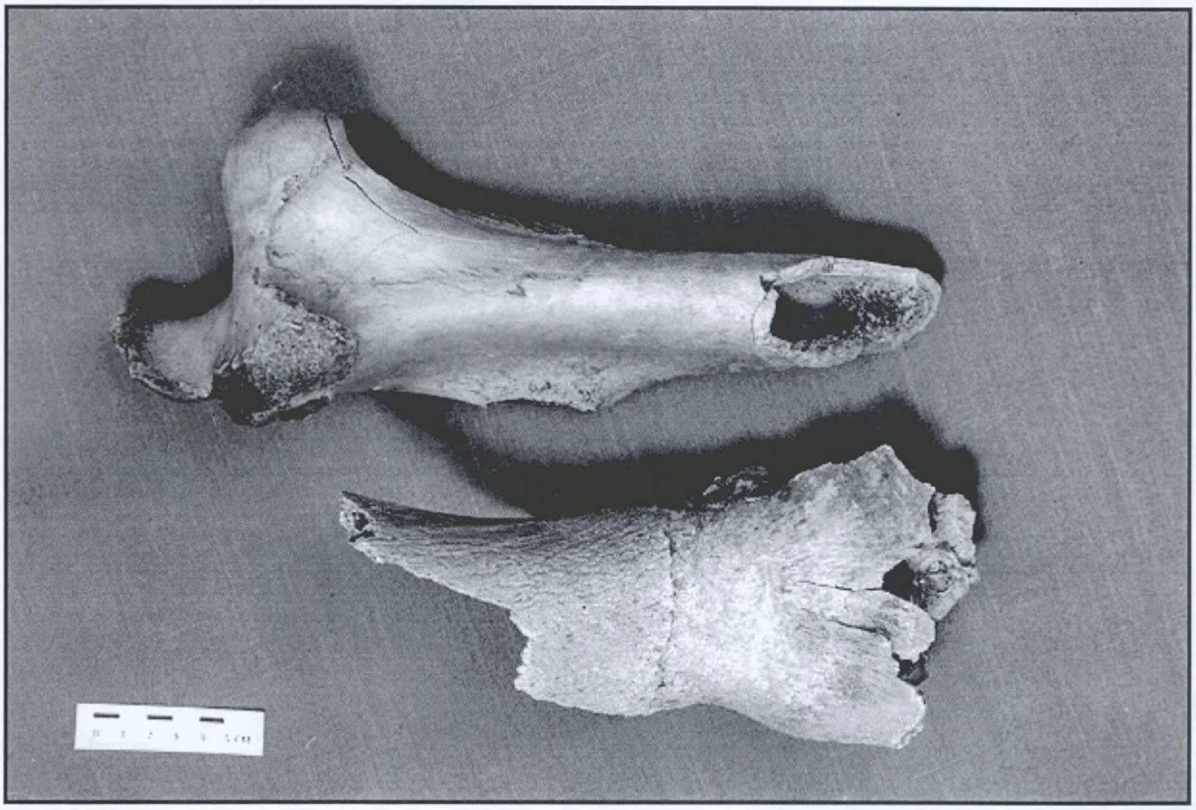


Plate 13. Horse femur (above) and cow bone found buried in the stratum composed of shredded oak bark.

Plate14. Iron hook used in "handling", an activity associated with tanning.

Plate 15. Detail of impressed mark on iron hook used in "handling".

Plate16. Feature 2, wood-slat lined pit. Looking northeast.

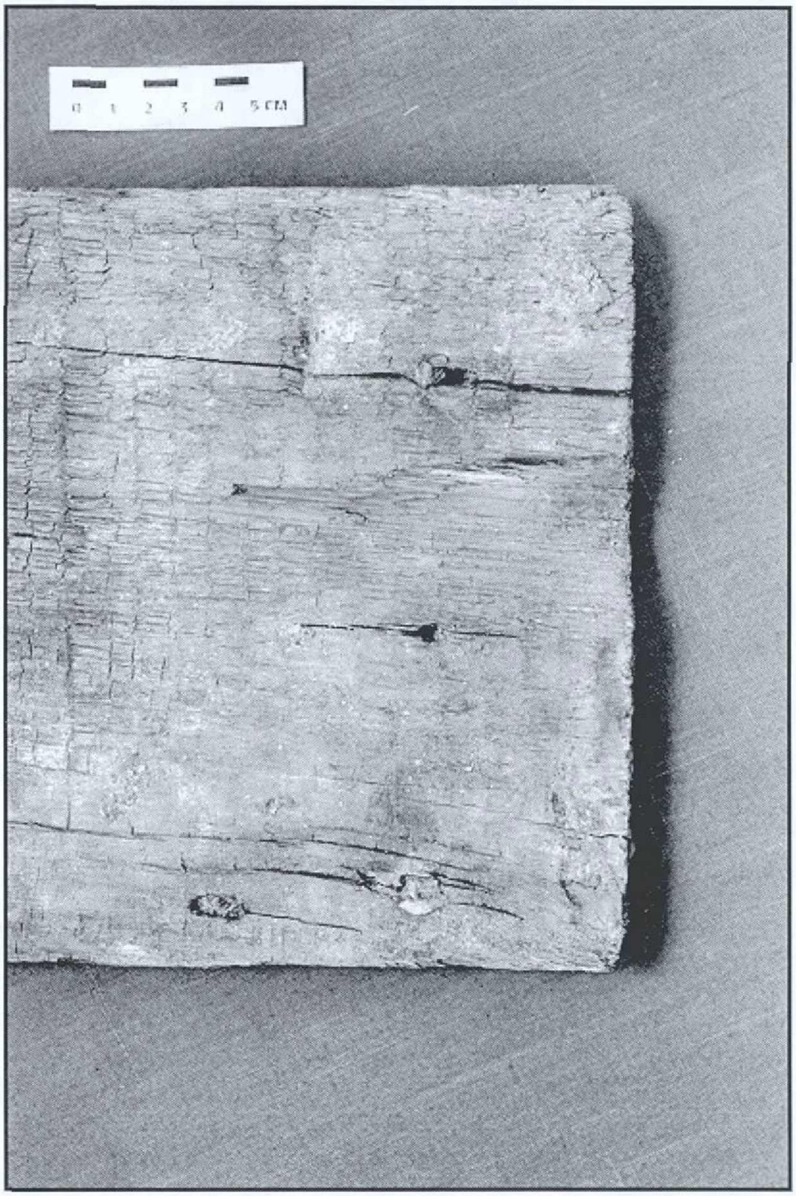


Plate17. Detail of one of the wooden slats from Feature 2. The slats were made of eastern white pine.

APPENDIX A:

INVENTORY OF ARTIFACTS RECOVERED FROM THE MCC PARCEL, THE TUNNEL ALIGNMENT, AND TANNING-RELATED DEPOSITS WITHIN LOT 6 ON THE COURTHOUSE BLOCK

Provenience - MCC Parcel	Group	Class	No.	Description
Contractor Unit #1 from Boring in Original Soil	A	Mortar	6	Mortar Fragments
Contractor Unit # 1	A	Ceramic	1	Hexagonal bathroom tile in mortar matrix
	A	Metal	1	Pipe fastening
	K	Glass	42	Colored glass, unidentified vessel body fragment
	K	Ceramic	2	Porcelain plate fragments
	K	Ceramic	1	Brown plate edge, unidentified decoration
	K	Ceramic	1	Yellowware, marble design body
	K	Ceramic	2	Whiteware plate body fragments
	K	Ceramic	1	Whiteware, green featheredge plate rim and body
	K	Ceramic	1	Redware, unglazed
	K	Ceramic	1	Stoneware, Rockingham
	A	Ceramic	1	Tile, white
	A	Metal	1	Unidentified metal object
	Faunal	Shell	1	Oyster shell
	Faunal	Bone	1	Unidentified bone, cut
	K	Ceramic	1	Burned stoneware, unidentified vessel
	K	Ceramic	1	Gray stoneware, unidentified vessel, body
	K	Ceramic	1	Whiteware, exterior glaze, body
	K	Ceramic	1	Porcelain, unidentified vessel
	K	Glass	1	Clear glass, lip and neck screw top
	K	Glass	4	Unidentified, glass fragments
	K	Ceramic	1	Whiteware, unidentified vessel with "Trenton, NJ" embossment
Contractor Unit #2	K	Ceramic	1	Whiteware, unidentified vessel
	K	Glass	1	Green glass, unidentified vessel, leaf pattern
Infill 14' -19' Below Datum	A	Stone	1	Mortar
	K	Glass	1	Green bottle glass, unidentified vessel
	K	Ceramic	1	Whiteware, unidentified vessel body sherd
Contractor Unit #3	K	Ceramic	1	Redware, unidentified vessel, body fragment
	K	Ceramic	1	Porcelain, unidentified vessel, body fragment
Contractor Unit #4 at Approximately 30"	K	Ceramic	1	Pearlware bowl or cup form with hand painted design
	K	Ceramic	1	Creamware plate or cup shoulder fragment
	K	Ceramic	6	Creamware body fragments
	K	Ceramic	6	Body fragments unidentified vessel
	K	Ceramic	1	Creamware plate rim
	K	Ceramic	1	Stoneware bottle, oval shape
	K	Ceramic	5	Stoneware unidentified vessel body fragments, cobalt blue decoration and pink interior
	K	Ceramic	2	Stoneware body fragments

Provenience - MCC Parcel, continued	Group	Class	No.	Description
	K	Ceramic	3	Interior glaze
	K	Ceramic	1	Stoneware, squat oval form
	K	Ceramic	1	Stoneware lip green-gray interior glaze
	K	Ceramic	1	Stoneware body fragment, tan exterior glaze
	K	Ceramic	1	Pearlware, plate rim, feather edge
	K	Ceramic	1	Porcelain fragment, unmarked body
	K	Ceramic	1	Porcelain, unidentified vessel, red and green floral pattern
	K	Ceramic	1	Whiteware, sprig decoration 1820's - 1890's
	K	Ceramic	1	Redware, slip trailed, unidentified vessel
	K	Ceramic	1	Redware, brown exterior
	K	Ceramic	1	Whiteware, finial or door pull
	A	Ceramic	1	Bathroom tile 19th - 20th c.
	A	Metal	1	Copper wire
	A	Metal	3	Wire
	A	Metal	1	Lead, possible window lead
	Faunal	Shell	14	Oyster shells, whole
	Faunal	Shell	1	Clam shell, whole
	Faunal	Bone	1	Unidentified long bone cut and sawn
	Faunal	Bone	3	Unidentified long bone fragment
	Faunal	Bone	1	Distal end large mammal bone
	A	Stone	1	Mortar
	A	Glass	1	Window glass
	T	Ceramic	2	Kaolin pipe fragment
13.4' Below Standpipe	I	Rubber	1	Rubber rim possibly gasket
10' x 10' Unit Fill	K	Ceramic	1	Stoneware, body fragment
Shovel Test Pit 17' below Standpipe	Faunal	Bone	1	Unidentified faunal item
	K	Ceramic	1	Whiteware, bowl or plate fragment
	K	Ceramic	1	Whiteware, body fragment
	K	Ceramic	3	Redware, brown interior glaze
	K	Ceramic	1	Porcelain, plain body fragment
SE Corner Lens 18.3'-18.45' Below Standpipe Datum	Faunal	Bone	4	Unidentified long bone fragments
	A	Glass	1	Window glass
	A	Metal	1	Wire
	K	Glass	1	Embossed glass jar rim
	K	Ceramic	1	Whiteware body fragment
2' or Less Above Water Table	A	Glass	1	Glass tile
	K	Ceramic	2	Whiteware, body fragments

Provenience - MCC Parcel, continued	Group	Class	No.	Description
	K	Ceramic	1	Whiteware, rim, possibly bowl
	K	Ceramic	1	Whiteware, body sherd pressed design and green interior mid 19th c.
	K	Ceramic	1	Stoneware, art deco, body sherd
	K	Glass	1	Machine molded bottle, neck and lip
	K	Glass	1	Bottle glass
Lagging Beam	A	Metal	1	Cut nail
14.9' Below Standpipe	A	Stone	1	White bathroom tile
10' x 10 Unit at 15' Below Datum	A	Glass	1	Glass tile
	A	Metal	1	Wire nail
	K	Glass	1	Clear, unidentified vessel base
	K	Ceramic	2	Porcelain, plate base fragment late 19th c.
	K	Ceramic	1	Porcelain, unidentified vessel body sherd
	K	Ceramic	2	Whiteware, plate rim sherds
	K	Ceramic	1	Whiteware, black transfer print flower pattern 1820-1840's
	K	Ceramic	1	Redware, unidentified vessel rim
Red Sand above Concrete Floor at SE Corner of Excavation	K	Ceramic	1	Redware fragment slip decorated 18th c.
	K	Ceramic	1	Creamware plate basal fragment 18th-19th c.
	K	Ceramic	1	Unidentified salt glazed stoneware, gray exterior body fragment
	K	Ceramic	1	Shell-edged pearlware bowl fragment 18th-19th c.
	K	Ceramic	1	Unidentified sort paste porcelain fragment with willow pattern
	K	Ceramic	1	Unidentified whiteware rim fragment
	K	Ceramic	1	Unidentified soft paste porcelain body fragment possibly willow pattern
	K	Ceramic	1	Unidentified pocellaneous basal bowl fragment
	K	Ceramic	1	Burnt' body fragment
	Faunal	Shell	1	Oyster shell fragment
	Faunal	Faunal	1	Long bone, large mammal exhibits cut marks
	T	Ceramic	1	Kaolin pipe stem
	A	Stone	1	Brick with "Hendricks" embossed on it
	A	Ceramic	1	Tan building tile, possibly terra cotta
	A	Ceramic	3	Sewer pipe fragments
		Kiln furniture	2	Spacers
	K	Glass	1	Wine bottle fragment, basal
	K	Glass	1	Clear unidentified vessel rim fragment
	K	Glass	1	Green wine bottle body fragment
	K	Glass	3	Possible soda bottle, base and neck with crown top

Provenience - Tunnel Trench	Group	Class	No.	Description
Fill between Foundation and Brick Wall Structure	Faunal	Faunal	1	Unidentified small mammal long bone fragment
	Faunal	Faunal	1	Unidentified small mammal, rib with marks near proximal end
	K	Ceramic	1	Whiteware butter jar "Greenwood" c. 1870
	K	Ceramic	1	Whiteware platter Greenwood c. 1870
	K	Ceramic	1	Whiteware
	K	Ceramic	1	Unidentified stoneware fragment
	K	Ceramic	1	Unidentified stoneware fragment gray exterior
	K	Glass	1	Bottle fragment with molding
	A	Glass	1	Purple glass fragment
	K	Ceramic	1	Ironstone base with "Ford" on side
Feature 1, Overburden	Z	Glass	1	Glass marble
	T	Ceramic	1	Kaolin pipe stem
	Faunal	Faunal	1	Unidentified long bone distal end epiphyses not formed
	K	Ceramic	1	Sugar bowl lid with facial design on lid
	Faunal	Faunal	2	Oyster shells
	Faunal	Faunal	4	Clam shells
	Floral	Wood	6	Pieces
	K	Ceramic	1	Salt glaze stoneware Rhenish
	K	Ceramic	1	Salt glazed stoneware, unidentified body glaze
	T	Ceramic	1	Kaolin Pipe stem
	Faunal	Faunal	1	Almost complete dog skeleton
Fill NW Portion in Front of South Flagstone Walls	K	Glass	1	Machine molded bottle, crown top
	K	Glass	1	Small medicine bottle "Moores Indian Root Pills"
	K	Glass	1	Large base wine bottle
	K	Ceramic	1	Pitcher lip, rim, ironstone late 19th-early 20th c.
Fill NW Portion in Front of South Flagstone Wall and East Wall	K	Ceramic	1	Ironstone body fragment
	K	Ceramic	1	Whiteware lip and rim fragment mid 19th c.
	K	Ceramic	1	Slip trailed redware plate rim
	K	Ceramic	1	Black exterior glazed redware fragment
	K	Ceramic	1	Creamware plate rim fragment
	K	Ceramic	1	Creamware bowl rim fragment
	K	Ceramic	1	Porcelaneous base, possible bowl or vase
	K	Ceramic	1	Gray exterior and brown interior lip and rim possible squat form
	K	Ceramic	1	Tan exterior glazed, unglazed interior possibly tall oval shape pre-1850's
	A	Ceramic	1	Possible bathroom fixture
	Faunal	Faunal	1	Large mammal long bone
	Faunal	Faunal	1	Medium mammal rib

Provenience - Tunnel Trench, continued	Group	Class	No.	Description
	Faunal	Faunal	1	Large mammal proximal cut and sawn
	Faunal	Faunal	1	Medium mammal proximal end longbone, cut
	Faunal	Faunal	1	Medium mammal longbone, cut
	Faunal	Faunal	4	Oyster shells whole large
Fill NW Portion in Front (South) of Flagstone Wall	Faunal	Shell	3	Oyster shells
Structure 1, Layer 1	Faunal	Bone	2	Cut long bone fragments
	Faunal	Bone	1	Long bone fragment
	A	Metal	3	Possible nail fragments
	K	Ceramic	1	Pearlware bowl base
Fill overlying Feature 1 and below Feature 1	K	Ceramic	1	Pearlware bowl fragment
	K	Ceramic	2	Creamware bowl fragments
	K	Ceramic	2	Salt glazed stoneware with blue decoration
	K	Ceramic	1	Shoulder American salt glazed stoneware
	K	Ceramic	1	Base, possible waster American stoneware
	K	Ceramic	1	Whiteware body fragment with transfer print
	K	Ceramic	1	Porcelain possible small tea cup
	K	Ceramic	1	Whiteware cup rim with red stripe design on interior edge
	K	Ceramic	1	Whiteware bowl rim fragment
	A	Glass	3	Window glass
	Faunal	Bone	1	Small mammal, long bone
	Faunal	Bone	1	Bird bone
	K	Glass	1	Medicine bottle "Omega oil"
	K	Glass	1	Wine bottle base
	K	Glass	1	Green beer bottle glass body
	K	Glass	1	Molded crown top type bottle
	K	Glass	1	Brown machine molded crown top bottle
	A	Metal	1	Cut nail
	Z	Ceramic	1	Porcelain, possible nail part
Between Foundation and Brick Wall Structure	K	Glass	1	Clear flask type bottle marked "wine" 20th c.
	K	Glass	1	Soda bottle "Party King Sparkling Beverages" Brooklyn, NY
	K	Glass	1	Possible whiskey bottle screw top marker 1 pt. past 1932
	K	Glass	1	Unidentified bottle 20th c.
	K	Glass	1	Machine molded bottle, unidentified type
	K	Glass	2	Green beer bottle, modern, pre-1932
	K	Glass	2	Brown beer bottle 1903-1932
	K	Glass	2	Soda bottles/ NY Bottles, Inc. 20th c.
	K	Glass	1	Soda bottle "Purritas Mineral Water Co." 20th c.

Provenience - Tunnel Trench, continued	Group	Class	No.	Description
	K	Glass	1	Unidentified brown glass base
	K	Glass	1	Unidentified modern bottle
	K	Glass	1	Unidentified modern bottle
	Z	Clothing	Biological	Four hole button, bone
	A	Stone	1	Marble building fragment
South of Fieldstone Wall	A	Ceramic	1	Sewer pipe fragment
	K	Ceramic	1	Redware unglazed rim and body possible storage pot
	K	Ceramic	1	Stoneware base
	K	Glass	1	Wine bottle base
	Faunal	Bone	1	Medium mammal long bone
	Faunal	Bone	1	Unidentified long bone
	Faunal	Bone	1	Medium mammal rib
West Wall MCC	K	Ceramic	2	Porcelain plate rim, body fragment Newcastle china, Newcastle, PA late 19th c.
	K	Ceramic	1	Stoneware crock or lug Albany interior slip
Fill Surrounding Piles 11/12 West Wall	Industrial	Ceramic	1	Kiln furniture
	Faunal	Shell	1	Oyster shell
	K	Ceramic	1	Stoneware bottle
	K	Ceramic	1	Rim gray stoneware plate 18th c.
	K	Ceramic	1	Redware, slip trailed design
	K	Ceramic	1	Gray stoneware handle with cobalt decoration, mid 18th c.
	K	Ceramic	1	Creamware lid mid 19th c.
	K	Ceramic	1	Yelloware body fragment
	K	Ceramic	1	Stoneware crock
	Z	Ceramic	1	Porcelain lid to child's toy set
Structure 1, Feature 1, Layer 1	A	Stone	3	Brick fragments
	A	Stone	1	Partial brick with mortar
	A	Glass	3	Window glass
	K	Ceramic	2	Creamware, plate body fragments
	K	Ceramic	1	Salt glazed stoneware, basket pattern
	K	Ceramic	2	Burnt whiteware
	K	Ceramic	2	Porcelain 20th c. red overglaze wreath design
	K	Ceramic	1	Whiteware, possibly chamber pot rim
	K	Glass	1	Unidentified vessel base
	K	Glass	1	Unidentified bottle fragment
	Faunal	Shell	16	Oyster shells
	Faunal	Shell	4	Clam shells
	Faunal	Bone	3	Medium mammal vertebrae fragments

Provenience - Tunnel Trench, continued	Group	Class	No.	Description
	Faunal	Bone	1	Unidentified long bone
Fill Surrounding Piles 11/12	I	C	2	Kaolin pipe fragments
	K	Glass	2	Soda bottle "Wm. Davis"
Structure 1, Layer 1	K	Glass	1	Soda bottle "Fris Co." possibly 20th c.
	Faunal	Shell	2	Oyster shells
	K	Ceramic	1	Gray stoneware basal sherd, squat ovoid shape
	K	Ceramic	1	Gray stoneware unidentified vessel body sherd
	K	Ceramic	1	Porcelain unidentified vessel body fragment
Layer 3	Faunal	Bone	1	Unidentified bone fragment
	C	Biological	1	Unidentified leather tool
From Fill Surrounding Western Most Projection of Brick Wall	Faunal	Shell	1	Oyster
Structure 1, Layer 10	A	Ceramic	1	Porcelain electric insulator
Structure 1,Layer 5	K	Glass	1	Green, unidentified vessel body sherd
Fill just North of Structure 1 Fieldstone Wall	A	Stone	1	Brick fragment
Reddish Brown Sand under Oyster Bed under Feature 1,	K	Ceramic	1	Rockingham glaze, neck and rim canning jar
Structure 1	Faunal	Bone	1	Unidentified large mammal, cut
	K	Ceramic	1	Salt glazed stoneware, bowl form rim
	Z	Glass	1	Coal
Back Fill from between Brick and Fieldstone Walls	K	Glass	1	Bottle base
Fill with Structure 1 East End b/w Brick and Fieldstone Walls	A	Ceramic	2	Toilet bowl fragments
Structure 1 Feature 1 Layer A	A	Stone	3	Mortar with plaster on interior
	A	Glass	2	Window glass
	A	Glass	1	Tile
	Faunal	Shell	1	Mussel
	K	Ceramic	1	Ironstone rim fragment unidentified vessel
	K	Ceramic	1	Whiteware body fragment
Fill just North of Structure 1, Fieldstone	C	Glass	1	Cobalt blue glass button two holes
	K	Glass	1	Wine bottle neck with string lip
	K	Glass	10	Machine molded bottle "Wm. Davis 729 Greenwich St. New York"
				Registered this bottle not to be sold
	K	Glass	1	Bottle, machine molded body machine applied to lip
	K	Glass	1	Neck lip and shoulder long stemmed bottle, blown neck and lip
Unprovenienced from North of Sewer Pipe	K	Ceramic	1	Whiteware, unidentified vessel body
	Z	Metal	1	Twisted wire
Fill Surrounding Piles 1 + 2 West Wall	Faunal	Bone	1	Large mammal bone butchered
	Faunal	Bone	1	Large mammal, head of femur
	Faunal	Bone	1	Large mammal, long bone

Provenience - Tunnel Trench, continued	Group	Class	No.	Description
	Faunal	Bone	1	Large mammal, long bone
	Faunal	Bone	1	Large mammal rib fragment, cut at distal end
Feature 2	A	Stone	2	Brick fragments
	Faunal	Bone	1	Unidentified faunal item
	K	Ceramic	1	Whiteware, bowl or plate fragment
Northwest Corner Test Pit	K	Ceramic	1	Whiteware, body fragment
	A	Metal	2	Corroded nails
	A	Metal	3	Medication objects
	K	Glass	1	*Clear* circular molded pattern
	K	Glass	5	Unidentified, clear body fragments
	K	Glass	1	Unidentified clear basal fragment
	K	Glass	2	Unidentified clear bottle fragments, ribbed decoration body and base
	K	Glass	1	Clear glass, rim fragment diamond design
	K	Glass	1	Green beer bottle body fragment
	K	Glass	1	Brown beer bottle body fragment
	K	Glass	1	Opaque white glass fragment
	K	Glass	1	Unidentified bottle base
	K	Glass	2	Whiteware rim and body fragments with possible handle
	K	Ceramic	4	Whiteware body fragments unidentified vessel
	K	Ceramic	1	Ironstone basal fragment
	K	Ceramic	1	Chinese export porcelain body fragment
	K	Ceramic	1	Whiteware body fragment design on exterior and interior
	K	Ceramic	1	Whiteware
	K	Ceramic	1	Brown exterior glaze, gray interior glaze stoneware body fragment
	A	Stone	1	Yellow and brown tile modern
	Clothing	Glass	1	Orange and white button two holes 20th c.
	P	Glass	1	Possible mirror fragment
	M	Linoleum	1	Linoleum tile green
	M	Linoleum	2	Linoleum tile, multi-colored
Excavation Unit #1 Layer 4	Clothing	Biological	1	Leather scrap
North End of Tunnel, Layer 6	Faunal	Faunal	1	Large, mammal long bone, cut marks
West Wall between Piles 11 and 12, Layer 6	A	Metal	2	Cut nail spikes
MCC Tunnel	Faunal	Bone	4	Horn cores, with portion of skull
	Faunal	Shell	8	Oyster shells whole
	Faunal	Bone	1	Cow horn core with skull attached
	Faunal	Bone	2	Large mammal (cow ?) vertebrae
	Faunal	Bone	1	Medium mammal rib

Provenience - Tunnel Trench, continued	Group	Class	No.	Description
	Faunal	Bone	8	Miscellaneous bone fragments
	Faunal	Bone	1	Possible scapula, large mammal
	A	Stone	1	Brick fragment
	Floral	Wood	1	Wood fragment
	K	Glass	1	Green bottle glass fragment
	K	Ceramic	1	Gray stoneware handle, possibly 18th c.
	I	Ceramic	1	Kaolin pipe stem
North End of Trench, Layer 6	Faunal	Bone	1	Large *mammal* unidentified long bone, distal end exhibits shatter
140 cms from the Top of Feature 2	Faunal	Bone	1	Oyster shell
	Faunal	Bone	1	Large mammal, unidentified long bone cut
	Faunal	Bone	1	Mammal, unidentified long bone epiphyses fused
	K	Ceramic	3	Gray stoneware possible jug, base, body, neck, and lip
	K	Ceramic	2	Stoneware bottle neck and body
	K	Ceramic	1	Whiteware plate rim late 19th c.
	K	Ceramic	1	Redware unidentified vessel body sherd
	C	Leather	1	Leather shoe heel
	K	Ceramic	1	Red stoneware teapot lid
	K	Ceramic	1	Redware slip trailed fragment
Excavation Unit 1, Layer 3			1	Leather scrap
Layer 6			1	Leather scrap
Fill in Vicinity North of Lower Pipe	Faunal	Bone	1	Unidentified medium mammal long bone
Feature 2	A	Stone	3	Brick fragments
	K	Glass	1	Brown bottle base
	K	Glass	1	Clear bottle glass body fragments
	K	Ceramic	1	Whiteware basal fragment
	K	Ceramic	1	Unidentified unglazed ceramic fragment
North End Tunnel Layer 4 Interface with Layer 5	Floral	Wood	2	Wood fragments
	K	Ceramic	1	Gray stoneware, unidentified vessel body fragment
	Faunal	Shell	2	Oyster shells
	Z	Metal	1	Straight pin, hand wrapped, gold covered pre-1832
	Faunal	Bone	1	Horn core
Dewatering Well #5 (Pit #1)	K	Glass	1	Blue glass vase, Carter's stamped into bottom
	?	?	1	Modified lithic, possibly bifacially retouched
	K	Glass	1	Wine glass, basal fragment
	K	Glass	1	Milk bottle neck tip 20th c. cow decoration
	K	Glass	1	Clear glass basal fragment, possibly milk bottle
	K	Glass	1	Clear glass, pressed glass

Provenience - Tunnel Trench, continued	Group	Class	No.	Description
	K	Glass	1	Clear glass, basal fragment
	K	Ceramic	1	Salt-glazed stoneware, exterior glaze, light brown interior glaze
	K	Ceramic	1	Stoneware body fragment, possibly bottle
	K	Ceramic	1	Porcelain cup handle, blue transfer print on handle
	I	Ceramic	1	Kiln furniture
	A	Stone	1	Brick
	A	Ceramic	1	Insulator, electrical
	A	Glass	14	Window glass
Unprovenienced Fill	K	Glass	1	20th c. Coke bottle
	Faunal	Bone	1	Unidentified bird bone
	K	Glass	1	Small medicine bottle
Courthouse Lot 6 Excavation Unit 2	Faunal	Bone	16	Horn cores with skull attachment
Back Fill	K	G	1	Whiskey bottle, whole 1902-1932
	K	G	1	Bitters bottle, 1860-1883
	A	Biological	3	Modern workers chalk
	Faunal	Bone	1	Small mammal rib
KEY: A Architecture				
K Kitchen				
T Tobacco				
Z Activities				
P Personal				
I Industrial				
M Manufactured				