"The Starting Point in the History of New Castle":

Geophysics and Exploratory Archeology at the Site of Fort Casimir, City of New Castle, Delaware

Prepared for

Delaware Division of Historical and Cultural Affairs
Dover, Delaware

Prepared by

John Milner Associates, Inc.
West Chester, Pennsylvania

Final
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GEOPHYSICS AND EXPLORATORY ARCHEOLOGY AT THE SITE OF FORT CASIMIR (7NC-E-105E), CITY OF NEW CASTLE, DELAWARE

Prepared for

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April 2014

FINAL

ABSTRACT

In June 2012 a limited amount of archeological and geophysical field investigations were undertaken at the purported site of Fort Casimir (7NC-E-105E). The field work was intended to follow on the earlier investigations conducted in 1986 by Edward "Ned" Heite and Louise Heite. Building on and augmenting the earlier work through the application of geophysical survey and GIS mapping, the 2012 investigations included a ground-penetrating radar survey (GPR), the excavation of a former test unit (ER6), excavation of two mechanical trenching (East Trench and West Trench), and limited excavations (ER20 and several features) to further investigate the deposits first discovered and reported by the Heites. Through the use of GPR, ER6 was relocated along with the locations of several other units excavated by the Heites. The field investigations verified the presence of seventeenth-century deposits in the earlier test unit (ER6) as well as in the East and West Trenches and in ER20. The results of the 2012 investigations confirm the Heite's findings, but also show that their excavations only literally scratched the surface of an infilled trench or ditch likely associated with the former forts Casimir, Trinity, and/or Amstel. In addition to the infilled ditch two other features were discovered only a few inches below the ground surface that may represent the remnants of palisade lines. Whether these features are associated with the forts remains to be determined. Future investigations at the site could be planned to further examine these various features.

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1.0 INTRODUCTION

1.1 PURPOSE AND GOALS OF THE PROJECT

In the summer of 2012 (29 May through 16 June), a team of professional archeologists and volunteers, under the supervision of Craig Lukezic of the Delaware Division of Historical and Cultural Affairs (DHCA) and Wade Catts of John Milner Associates, Inc. (JMA), undertook a limited geophysical and archeological survey of the purported site of the seventeenth-century Fort Casimir (7NC-E-105E)(also known for a short time as Fort Trefaldighet or Trinity) in the City of New Castle, New Castle County, Delaware (Figure 1). The project was funded by the Delaware Department of State and supported by the Trustees of New Castle Commons.

The purpose of these investigations was fourfold: 1) conduct ground-penetrating radar survey to evaluate the presence or absence of subsurface remains of Fort Casimir; 2) re-locate Heite's archeological excavation units from 1986 (Heite 1989); 3) re-excavate the re-located ER6 excavation unit and evaluate the stratigraphy; and 4) monitor and record the stratigraphy of a mechanically-excavated trench extending off the unit. These tasks were designed as a minimally-invasive method for investigating stratigraphy interpreted by Heite as consistent with the remains of Fort Casimir. The GPR survey was carried out 29 May, 2012. Following data analysis, including GPR processing and GIS overlay of maps of Heite's excavation units, Heite's excavation unit (labeled ER6) was relocated and reexcavated, and a backhoe trench was excavated and recorded. The following report provides a brief historical context for the project area, presents the methods and results of the survey, and offers conclusions and recommendations based on collected geophysical and archeological evidence.

1.2 WHY ARCHEOLOGY OF FORT CASIMIR?

Fort Casimir is an icon of Delaware History. For more than three centuries, the myth and memory of the fort has survived in the minds of the citizens of the state and of the City of New Castle. The fort site and the early life of the community associated with it are steeped in history, but that history has comparatively little physical evidence to mark its passing. In 1905, local historian Alexander Cooper gave a public lecture and declared Fort Casimir to be "the starting point in the history of New Castle" (Cooper 1905).

There are several compelling reasons to look for the archeological remains of Fort Casimir. This small portion of the City of New Castle may be the only area remaining in the state of Delaware where intact remains of the Dutch colony can be found. When the National Park Service came to Delaware to look for a new park, they wanted to find a place that represented the unique contributions the state has made to the nation. They decided to focus on the early Dutch, Swedish, and English settlement. Yet, there is little above or below ground for a visitor to experience. Finding and revealing the remains of Dutch New Amstel could contribute to new ways of interpreting this early heritage.

In comparison to the colony on the Delaware (or South) River, the history and archeology of the Dutch Colony of New Netherland on the North River (Hudson River) is well-known. As a result of the excellent scholarship in New York State, we know intriguing details about the lives of people at Beverwyck (Albany) and New Amsterdam (New York City). The historical research is dynamic and on-going as demonstrated by the New Netherland project, http://www.nnp.org/ that features the continuing translation of Dutch colonial documents. Beginning in the 1970's with the excavations of Fort Orange, New York archeologists have developed a respectable corpus of data that documents the life ways of the colonial Dutch (cf. Blackburn and Kelly 1987; Huey 2005).

Figure 1. Approximate Project Area location shown on the 1993 7.5-minute USGS *Wilmington South, Delaware* quadrangle.

While the documentary record indicates the Dutch settled in Delaware, we have little archeological or material culture information about them. Comparatively few archeological sites have been identified or archeologically investigated in the region that provide any meaningful data regarding the material remains of the Dutch venture. There are even less tangible remains of the colony. In New Castle, the "Dutch House" may have been built by a inhabitant of Dutch descent, but recent scholarship suggests construction occurred after 1700, perhaps two generations after the Dutch Colony of New Amstel, and archeological investigations in the rear yard did not encounter any seventeenth-century artifacts or features (Klee 2003; Mancl 2011). Nearby at the Read House on the Strand, an archeological assemblage attributed to Isaac Tayne, a French-born Dutch settler who acquired land at New Amstel in the 1660s has been recovered and analyzed (De Cunzo 2013:202-204).

As with other archeological projects, we built on the research of past scholars and researchers, most especially the work of the late Edward "Ned" Heite. In 1986, Ned and Louise Heite reported on the history of Fort Casimir, its site on Bull Hill, and excavated several test units in an effort to provide archeological evidence for the fort's location. Their research on the land use of Bull Hill and the soils of the testing indicate extensive ground disturbance during the last quarter of the nineteenth into the mid-twentieth century. Despite the earlier work by the Heites and the tentative results of their work, it is conceivable that most of the remains of the fort no longer survive. If this is the case, the best we could anticipate discovering are the surviving fragments and sections somehow undamaged during several centuries of construction activities at this location, particularly construction and landscape modification associated with the development and operation of the New Castle Ferry terminal.

1.3 PROJECT AREA AND ENVIRONMENTAL SETTING

The Fort Casimir project area is situated along the Delaware River shoreline, at the foot of Chestnut Street. At the time of JMA's fieldwork the project area was a mowed field with low topographic variability, limited surface evidence of archeological components other than remnants of the late historical ferry terminal, and few major obstructions to fieldwork (Figure 2; Plates 1 and 2). The project area is situated east of the Market Street and Chestnut Street intersection. Numerous houses with fenced lots are present along Market Street, and a parking lot southwest of these houses provides access for public use of the property. An alley along the back fences of the house lots is presumably a town-owned right of way, likely for utilities.

The geology of the project area is a complex palimpsest of Holocene stratigraphy, with strong influence from the Delaware River, unconformably formed above variably preserved and overlapping Pleistocene stratigraphic units (Ramsey 1998; 2005). Along the western side of the city of New Castle is found the Columbia Formation (Qcl), a middle Pleistocene glacial outwash draped on the eroded surface of the Miocene-aged Calvert Formation (Tc). The Columbia Formation comprises yellowish to reddish brown sand of varying composition and grain size, with discontinuous beds of tan to reddish gray clayey silts, grayish to reddish brown clayey silts, and variably-thick gravel beds with cobbles and boulders. Eroded and transported materials from the Valley and Ridge Province are common, along with pegmatites and micaceous schists. Near the center of the city and toward the modern coastline is the upper Pleistocene-aged Lynch Heights Formation (Qlh), which overlies the Columbia Formation. This is a relatively thin unit (roughly 20 feet) comprising transgressive marine deposits (tidal flats and channels, beach and bay deposits) and fluvial sediments. The stratigraphy generally includes an upper stratum of fine, well-sorted and occasionally cross-bedded sand, with inclusions of variably thick, discontinuous beds ranging in size from gravel to clayey silts. The upper sand strata, where finer-grained, are usually micaceous. The colors of the Lynch Heights Formation are variable, ranging from light gray to brown to light yellowish brown.

Figure 2. GPR survey area boundaries overlaid on modern aerial photograph.

Plate 1. View of the project area, looking north. In this image the GPR survey is underway.

Plate 2. View of the GPR survey in the project area, looking northeast, upriver towards the Delaware Memorial Bridge.

Farther to the east and running parallel to the modern Delaware River is the Upper Pleistocene-aged Scotts Corners Formation (Qsc), a transgressive sequence of swamps and marshes, as well as estuarine, beach, and bay deposits. This unit has variable texture ranging from coarse to fine sand, gravelly sand, and pebble gravel with occasional clayey silt beds. The colors range from light gray to brown to light-yellowish brown, and unit thickness is on the order of 15 feet. The current project area is entirely within this unit, as mapped. Overlying the Scotts Corners Formation are areas of Holocene marsh deposits (Qm) ranging from one to 40 feet thick. These deposits comprise black to dark gray, silty clays to clayey silts with high organic contents, peat beds, and occasional shells, and some of the clayey silts are from estuarine channels.

Soils within the project vicinity are mapped as the Hambrook-Urban land complex (NRCS 2013). These upland soils are characterized by well-drained sandy loam found on shallow slopes (0 to 5 percent) along flats, fluviomarine terraces, knolls, and depressions. Found on rises and rarely flooded, these soils have relatively deep water tables (40 to 72 inches). A typical soil profile is as follows: 0 to 10 inches, sandy loam; 10 to 14 inches, loam; 14 to 28 inches, sandy clay loam; 28 to 65 inches, loamy sand; 65 to 80 inches, silt loam. Other soil units in the vicinity include Udorthents, wet substratum soils found in upland and lowland settings with 0 to 2 percent slopes. These soils are weathered into fluviomarine deposits and are composed of loam and sandy loam.

1.4 PREVIOUS ARCHEOLOGICAL INVESTIGATIONS

Twenty-one previous archeological studies have been completed in the vicinity of the project area that may have a bearing on the potential features and artifacts that could be found at the purported site of Fort Casimir (Table 1).

Table 1: Previous archeological investigations within the boundary of the New Castle Historic District

Location	Archeological Site No.
New Castle Courthouse	7NC-E-105A
Immanuel Church	7NC-E-105B
George Read House and Gardens	7NC-E-105C
The Arsenal	7NC-E-105D
Fort Casimir	7NC-E-105E
Garden of the Dutch House	7NC-E-105F
Amstel House Garden	7NC-E-105G
Gunning Bedford House Garden	7NC-E-105H
Tile House Site	7NC-E-105J
S. Guthrie House (30 The Strand)	7NC-E-105K
1 The Strand	7NC-E-105L
28 The Strand	7NC-E-105M
58 The Strand	7NC-E-105N
128 East Second Street	7NC-E-105P
8 East Third Street	7NC-E-105Q
26 East Fourth Street	7NC-E-105R
54 East Fourth Street	7NC-E-105S
19 West Fourth Street	7NC-E-105T
Marble Hall	7NC-E-105U

Location	Archeological Site No.
312 Delaware Street	7NC-E-105V
8 The Strand	7NC-E-105W

1.5 FORT CASIMIR INVESTIGATIONS

In 1986, Ned Heite and Louise B. Heite completed a reconnaissance-level archeological survey searching for the remains of Fort Casimir (Heite and Heite 1989). The project was funded by the landowner, the Trustees of New Castle Commons. Aside from extensive historical research, the Heites excavated two excavation units, eight post holes, and one backhoe trench to investigate the 'Fort Lot'. A map of the unit locations was created by the archeologists, though there were no absolute tie points to the modern setting which resulted in some discrepancies and difficulty pinpointing the unit locations. This was one of the main reasons for JMA's GPR survey.

The Heites surveyed a ten-foot grid across the project area running parallel to an alley and the back yard of existing house lots. Incremental numbers denoted North-South grid direction, while letters indicated East-West grid direction. The Heites excavated post holes, sometimes after the top foot of sediment was removed with shovel and pick, to initially prospect for intact stratigraphy below widespread fill units (Figure 3). Post hole excavations were numbered sequentially and given the prefix ER (Excavation Record). A total of eight post holes were excavated to varying depths, with one opened as larger excavation unit based on promising stratigraphy (ER6). Heite also excavated a small test unit (ER7) and a backhoe trench in the southern portion of the project area.

Excavation ER1 (Figure 3) revealed one foot of modern fill units over apparently natural soils composed of clay, sand, and gravel strata. ER2 through ER5 exhibited coal ash and clinker layers, with natural soils (a "...smooth brown sand that appeared to be natural" (Heite and Heite 1989:29) encountered only at the base of ER3. The depth of excavation for ER2 was 40 inches, ER3 extended to 42 inches, ER4 was 35 inches deep, and ER5 was terminated at 27 inches below surface. Post hole ER6 revealed six inches of topsoil over smooth clay, containing a fragment of yellow brick, to a depth of 21 inches. The post hole was excavated to a depth of 27 inches where tin-enameled earthenware was encountered. Heite ceased excavation of the post hole, and opened a 5ft by 5ft excavation unit. The northwest 5ft by 5ft quadrant was excavated first. This unit revealed a thin layer of fill capping three strata: ER6A, ER6B, and ER6D. ER6A was a "loam with clods of yellow clay" (Heite and Heite 1989:32). ER6B was a "light brown clay soil" exhibiting three postmolds. ER6B contained cobbles and yellow bricks that were found at the contact with the lower stratum (ER6D), as well as other historical artifacts including pipe stems and majolica that were interpreted as originating from elsewhere. The Heites observed that ER6B was apparently a fill unit within a ditch or depression. Below was ER6D, a "mottled gray and yellow soil" (Heite and Heite 1989:32).

To further investigate the ditch/depression, the Heites began excavation on the southwestern quadrant of ER6 which was a 5ft by 5ft unit separated from the northwestern quadrant by a balk. They observed yellow subsoil in the southwestern corner of the unit, which had been cut at a steep angle by the ditch observed in the northwestern quadrant. Stratum ER6C, a "mottled grey and yellow soil" (Heite and Heite 1989:33), appeared to be resting on the sloping subsoil. This ditch apparently had been cut through the subsoil and ER6B (the stratum below ER6C). A stratigraphic break exhibiting artifacts was observed in stratum ER6B. The Heites called the newly uncovered stratum ER6E and interpreted the artifacts as coming from the top of this layer. A stratum of ""gray and yellow soil with much wood ash" (Heite and Heite 1989:33), labeled ER6F and interpreted as identical to stratum ER6D from the Northwestern Quadrant of ER6, was minimally excavated because Heite felt it was a sealed seventeenth-century archeological deposit.

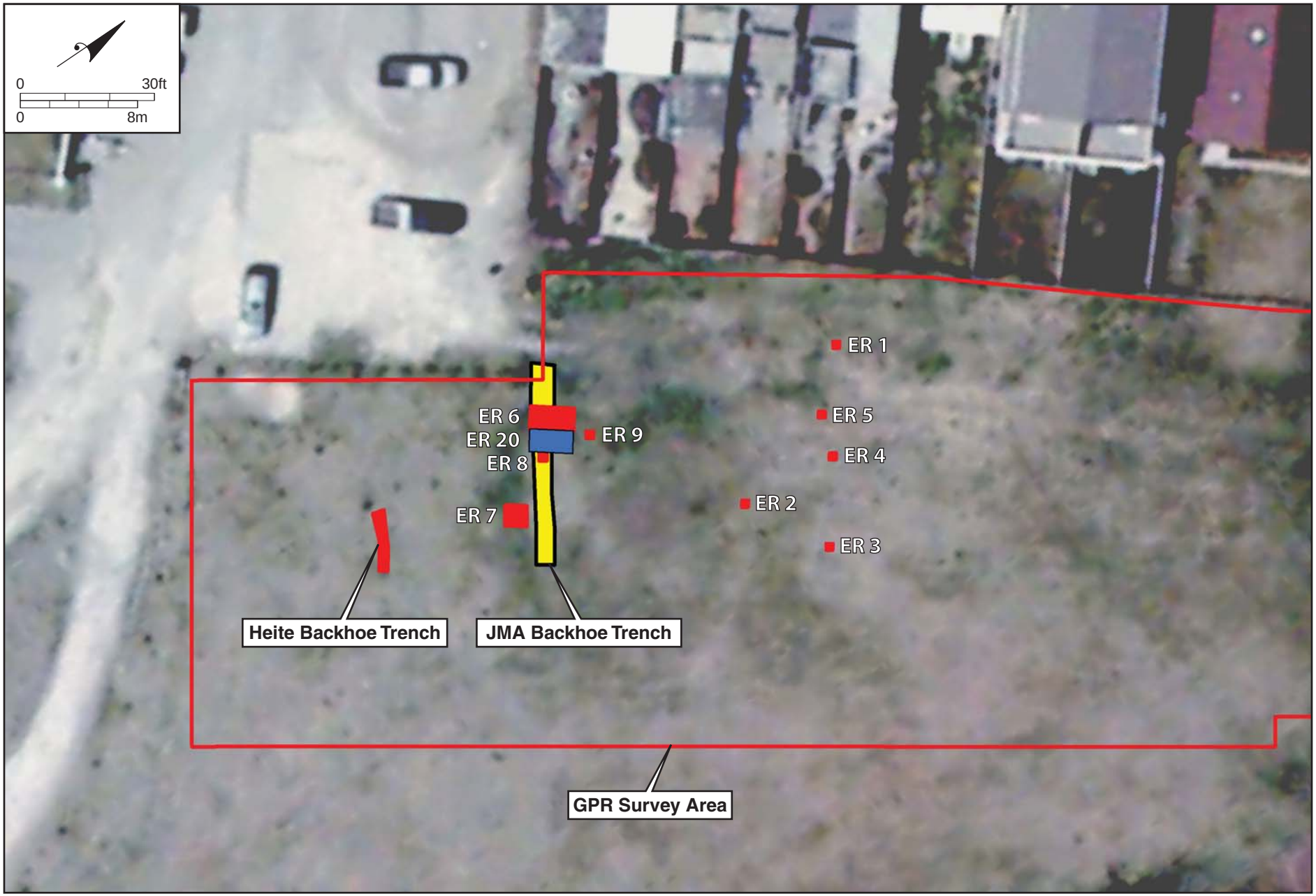


Figure 3. Locations of the Heites excavation units and JMA backhoe trench in relation to GPR grids, houses and fences, and other nearby features.

A 5ft by 5ft excavation unit, ER7, was opened twenty feet to the east of ER6 to evaluate the lateral extent of ashy fill. ER7 contained fill units, including crushed rock and an ashy fill layer that extended to 36 inches below surface and capped an apparently natural sand stratum. Post hole ER8 was excavated between ER6 and ER7 to further test the limits of the steeply cut subsoil. The stratigraphy was nearly identical to that of ER7, and revealed 36 inches of fill over natural sands tested to 42 inches below surface. The last post hole, ER9, was excavated to the north of ER6. The excavation revealed modern trash at the surface that capped a "smooth brown clay loam" to a depth of 15 inches below surface. A "smooth orange sandy clay" (Heite 1989:32) was recovered from 15 to 42 inches below surface, which overlaid pebbly sand (Heite and Heite 1989:32). The final excavation was a 13ft backhoe trench, located roughly 25ft south of ER7, excavated to a depth of five feet below surface. The trench revealed nearly five feet of later historical fill layers capping loose gray sand overlying cobbly gray sand.

The Heites concluded through analysis of stratigraphy and cultural materials that a sealed seventeenth-century archeological deposit was present in the project area. Artifacts recovered from his excavations included Dutch Majolica, grey Rhenish salt-glaze stoneware, red earthenware, yellow bricks and a few tiles. Other finds included pipe stems, glass, and iron artifacts. In concert, the Heite's datasets lead them to conclude that "Fort Casimir [had] been found" (Heite and Heite 1989:45). While he could not determine which part of the fort had been uncovered, Heite speculated that other archeological remains of the fort likely existed under the adjacent parking lot. Heite finalized his excavation and subsequent report with the hope that future archeological fieldwork would shed more light on the extent and state of preservation of this historically significant site.

The Heites' work summarized the historical information available at the time of the survey, and explored the hypotheses that the fort had been washed away by the Delaware River or that later construction had destroyed its remains. The report noted that both hypotheses were partly correct. The present geophysical survey and archeological testing are intended to follow up on Heite's earlier work, and to apply new techniques unavailable in the mid-1980s to the study of the site.

2.0 HISTORICAL BACKGROUND

In their report of the archeological investigations at Fort Casimir (7NC-E-105E), the Heites (1989:12-25), building on the earlier historical studies of such scholars as Alexander Cooper (1905:5-38), Amandus Johnson (1927), and C.A. Weslager (1961), summarized the principal historical information regarding Fort Casimir/Trinity. More recently Len Tantillo, aided by Dr. Charles T. Gehring and Peter A. Douglas, has published a volume on the history, construction, and possible location of the fort (Tantillo 2011). For the purposes of this technical report, those historical summaries will serve as this background for the project, and this report should be read in conjunction with those detailed historical studies. Other historical studies published since the 1986 field investigations include the translation and transcription of Governor Johan Risingh's Journal (Dahlgren and Norman 1988), publication of the proceedings of a conference held to commemorate the 350th anniversary of the founding of New Sweden (Hoffecker et al. 1995), most recently a edited volume examining the role of Scandinavian colonialism in Europe and North America (Naum and Nordin 2013).

Table 2. Chronology of Fort Casimir/Trinity/New Amstel, 1651-1679

1651	Fort Casimir established by Peter Stuyvesant [Dutch]. Cooper suggests that the fort was built in early summer, perhaps June (Cooper 1905:10).
1654	20 May (Trinity Sunday) Fort Casimir surrenders to Swedish force under command of Governor Johan Risingh [Swedish]. The Fort is renamed Fort Trinity (Trefaldighet). According to Per Lindeström, Swedish engineer, Fort Trinity consisted of four bastions.
1654	During the summer of 1654 (beginning 27 June), Fort Trinity was substantially rebuilt from its foundations. A water battery was also constructed during this period. The fort was damaged 22 October 1654 by a nor'easter storm. According to Governor Risigh "the entire embankment beneath the bulwark (which had taken…the whole summer to build) was washed away(Dahlgren and Norman 1988:217).
1655	10 September, Peter Stuyvesant returns to the Delaware [South] River and captures Fort Trinity, reverting ownership to the Dutch. Fort Christiana surrenders soon after.
1655	Stuyvesant appoints Jean Paul Jacquet to be the administrator (vice director) of Fort Casimir and the settlement associated with the fort. Jacquet reports on Christmas day that the fort is "completely decayed in its walls and batteries" and recommends that its walls should be rebuilt from the ground up since the outerwork had mostly collapsed and the remainder was badly compromised (Heite and Heite 1989:17).
1656	19 December, owernship of Fort Casimir is transferred from the Dutch West India Company to the Burgomasters of the City of Amsterdam, and the name of the settlement is changed to New Amstel, and the fort is called Fort Amstel (or New Amstel).
1657	The new commander at the fort, Jacob Alrichs, reports that he is in need of oxen and horses to haul timber to repair the fort "which is much decayed on the shore side" and other parts require a great deal of timber (Heite and Heite 1989:18).
1658	October, Alrichs reports that a bakery (30x20 feet), lower story 9 feet and second story 6 ½ feet was constructed with a tile roof, as had been a residence of (50x20 feet) and a new guard house (16x20 feet), and repair of a portion of the house he resided in. The soldiers' barracks needed to be torn down, and the entire for rebuilt, since a considerable part of the fort was 'washed away outside on the river" (NYCD 2:50).

1659	August. Alrichs, in reporting his progress over the previous three years to the Burgomasters, noted that he had constructed at the fort a new barracks "right under the fort" (190x17feet), with eleven compartments and covered with reeds, in addition to a large store and a commissary (NYCD 2:69). Jacob Alrichs dies this year and Lieutenant Alexander d'Hinojossa is appointed to command at Fort New Amstel.
1664	30 September, An English expedition, commanded by Sir Robert Carr, attacks and captures the Dutch fort and garrison at Fort New Amstel. The action is short, but results in nearly one-third of the Dutch garrison as casualties. The attacking force consisted of the Guinea (variously reported as 36 or 40 guns) and the William and Nicholas (10 guns), and approximately 130 soldiers (Tantillo 2011:76; Weslager and Hart1982:92). The Dutch colony of New Amstel passes ownership to the English.
1671	Captain John Carr proposes that since the houses in the fort are "greatly decay'd" and cannot stand long, "their tiles, brick, iron, and other materials may be taken down" and retained for building new structures, if needed (Heite and Heite 1989:20). The defensive works protecting New Castle are built in other locations in the town, and the former site of the fort at the Sand Hook is superfluous.
1677	November. Engelbert Lott petitions the court to give him the lot of ground at the east end of town "where the old forte formerly stoode…" (Heite and Heite 1989:21).
1678	January. Court granted the fort lot to Engelbert Lott, with the condition that he level the former fortification and leave a space for a street.
1679	The property is formally surveyed to Lott on May 24, 1679.

JMA georectified selected historical maps and aerial photographs which reveal much about the past conditions within the project area. The 1804/5 Latrobe survey (Latrobe 1804/5) suggests that the project area was undeveloped and the Delaware River shoreline was approximately 65 to 105 feet to the east of the GPR survey grids and, as expected, in a much different configuration that at present (Figure 4). By 1868 (Beers 1868) three buildings attributed to E. Jefferson were present along market street and east of Chestnut Street, while two additional buildings, also E. Jefferson, are depicted to the southeast along what must have been a hypothetical extension of Front Street (Figure 5). The 1868 shoreline is likely a stylized representation, but nonetheless it is drawn further to the east than that of the Latrobe survey and the location of the modern shoreline.

Considerable erosion and storm damage was reported by residents of New Castle during the last quarter of the nineteenth century. Storm damage was particularly bad in 1878 and again circa 1880. Alexander Copper, in his study of the site of Fort Casimir, reported in 1905 that much of the "high, fast land" known as the Sand Hook or Bull Hill where the fort may have stood "has been washed away by the river" (Cooper 1905:16). He further commented that in the previous forty years (approximately since 1865):

> Front or Water Street, which ran in front of the fort in a southerly direction, is (at that point) now entirely obliterated. To the personal knowledge of this writer [Cooper] some 30 or 40 feet of the fast land, and perhaps more, has been swept away by the erosion of the tides….(Cooper 1905:16).

By 1932 (USDA 1932) the project area had seen major development with the installation of a ferry terminal (Figure 6). An access road, potential parking area, and ferry landing area clearly visible, as is a small building within the GPR survey area. The shoreline appears to have been heavily cut back to the west, and at least one large building is present immediately to the west of the GPR survey area (in the vicinity of the modern houses).

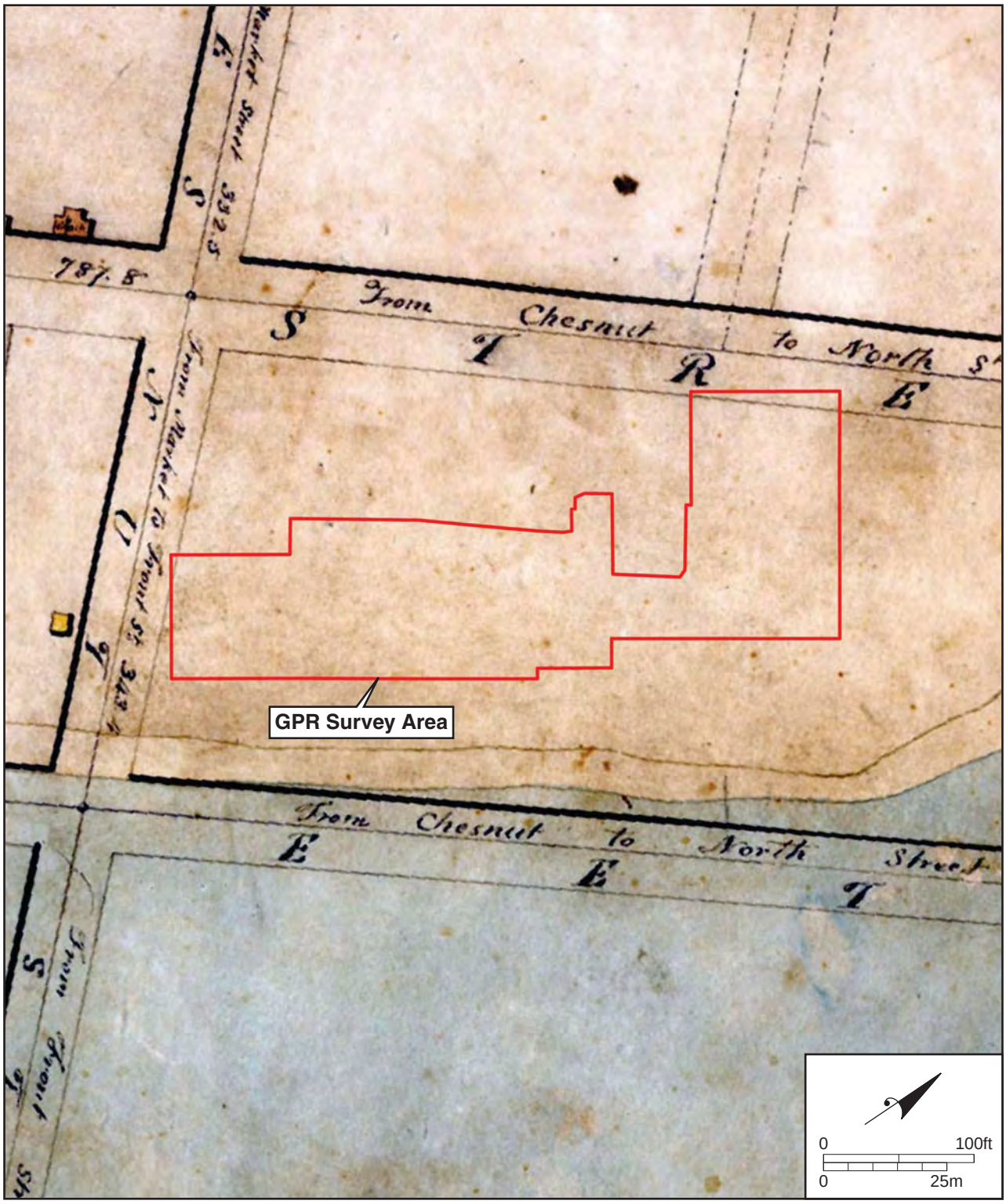


Figure 4. GPR survey area boundaries overlaid on Latrobe Survey (Latrobe 1804).

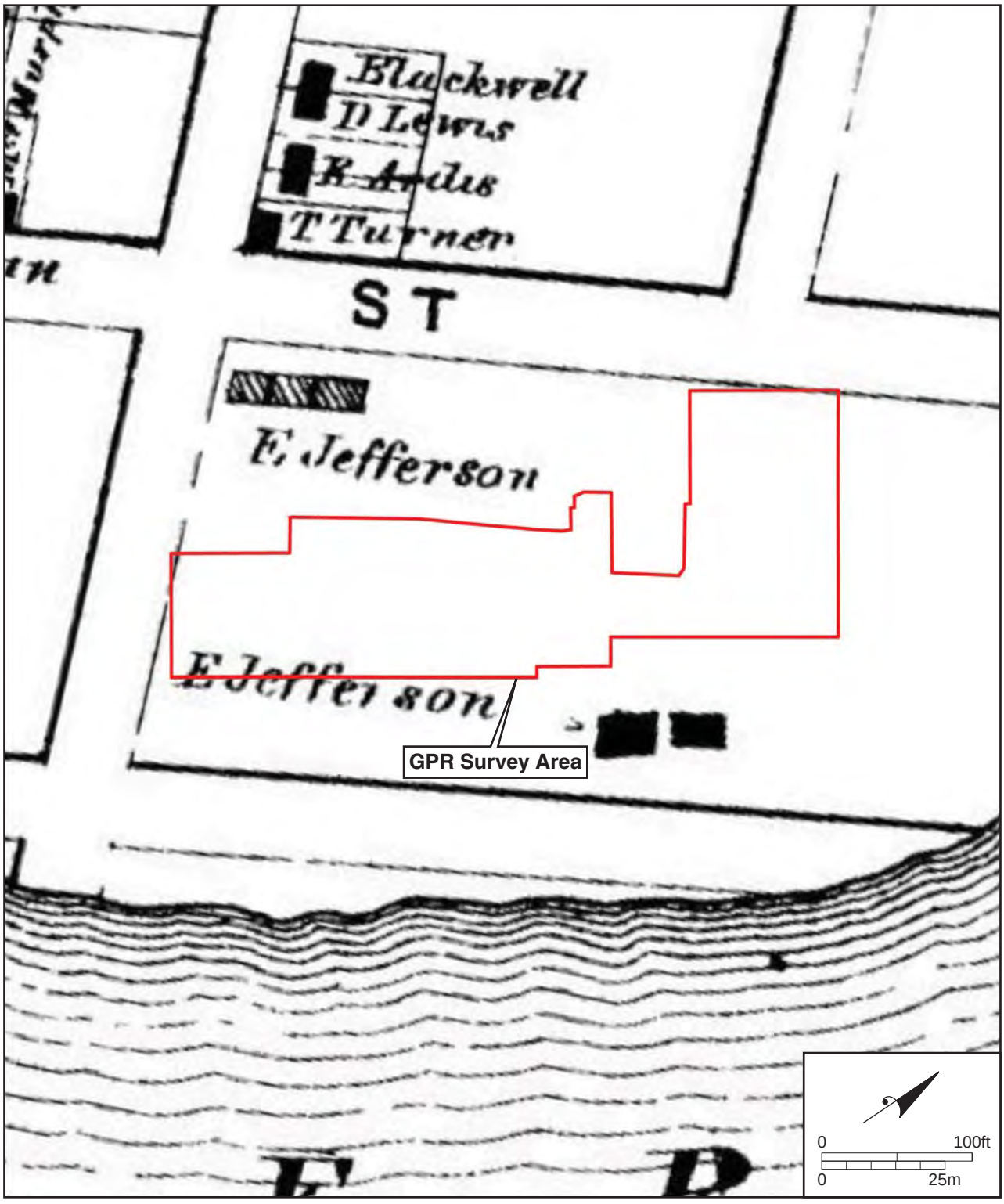


Figure 5. GPR survey area boundaries overlaid on 1868 Beers Atlas (Beers 1868).

Figure 6. GPR survey area boundaries overlaid on 1932 aerial photograph (USDA 1932).

The ferry terminal was abandoned in 1951 once the Delaware Memorial Bridge opened. Between 1932 and 1952 the ferry terminal had expanded considerably, larger parking lots had been added to the north and south of the access road, and the shoreline had been modified and extended slightly to the east. The State of Delaware purchased the ferry company tract in 1952. These improvements are visible on the 1961 aerial photograph which shows the abandoned terminal, and what appears to be a wooded area in the location of the modern day houses (Figure 7). In 1966 the Trustees of New Castle Commons acquired the remnants of the former fort tract from the State of Delaware (Heite and Heite 1989:24-25).

By 1973 little had changed in the shoreline except for erosion of coastal features and variations in intertidal vegetation communities (Figure 8). To the northeast of the project area a considerable amount of fill material had been deposited, while to the northwest/west houses had been constructed, and a building of unknown origin was present along the waterfront just north of the ferry terminal. Modern aerials show that additional houses were constructed after 1973 and that filling has occurred to the south of the ferry terminal and in the northern portions of the project area (Figure 2). A playground and a basketball court have also been installed in the northern project area.

Figure 7. GPR survey area boundaries overlaid on 1961 aerial photograph.

Figure 8. GPR survey area boundaries overlaid on 1973 aerial photograph (USGS 1973).

3.0 METHODS

Field methods applied for the study at the site of Fort Casimir (7NC-E-105E) included geophysics – a ground-penetrating radar survey (GPR) – mechanical trenching, and hand excavations. Geophysics is a non-invasive method that does not provide conclusive evidence that the anomalies identified during the survey are related to human activity. Therefore, "ground-truthing" of some of the identified anomalies followed the GPR survey. A single, mechanically excavated trench was placed to confirm the relocation of EU 6, centered on the rediscovered unit EU6 and extending towards the Delaware River. JMA personnel monitored the excavation of the trench, and following completion of the excavation of the trench, recorded relevant information regarding the stratigraphy and features exposed within the trench. A sampling of artifacts was recovered from the trench walls providing additional knowledge to the understanding of any features encountered. In addition to the mechanically-excavated trench, hand-excavations within the trench and sampling of features were completed by the project team. The particulars of each field method are described below.

3.1 GROUND-PENETRATING RADAR (GPR)

3.1.1 GPR Background

Ground-penetrating radar (GPR) is an active, non-invasive geophysical method that records contrasts in the dielectric properties of subsurface materials (Clark 1990; Conyers 2004; Conyers 2006; Daniels 2004; Bristow and Jol (eds) 2003; Heimmer and De Vore 1995). The term dielectric refers to the response of a given material to the transmission of electromagnetic energy (Conyers 2004). Materials are considered dielectric when electromagnetic energy can travel through them without being dissipated, such as an electrically resistive material. Highly conductive materials, such as metal, mineralogical clays, or materials with high salt content are not dielectric. A pulse of transmitted electromagnetic energy emitted from the GPR antenna is reflected or absorbed by dielectric contrasts and the resulting reflections are recorded to produce a vertical profile. The majority of reflections are generated at interfaces between materials of differing relative dielectric permittivity, i.e. at the boundary between different stratigraphic layers, where changes in velocity, or the speed of the energy as it travels through subsurface materials, occur. Stronger returns (for both negative and positive amplitudes) are generated at major dielectric contrasts and indicate a significant change in subsurface materials.

The GPR dataset comprises two-dimensional profiles collected along tightly gridded lines. As the GPR system is moved along survey lines the calibrated odometer wheel triggers pulses of energy, or traces, that are stitched together to produce an image of dielectric contrasts that represent vertical and horizontal stratigraphy. In this sense GPR is not providing a true stratigraphic profile, rather it is generating a representation of local, vertical and horizontal dielectric contrasts which provides a proxy for subsurface stratigraphic changes.

The depth of penetration for GPR depends on numerous factors, including but not limited to the antenna frequency, sediment type, moisture content, compaction, and salt content. Higher frequency antennas are capable of resolving smaller targets and interfaces, though depth penetration is sacrificed. Moisture content increases sediment density through filling of interstitial pore spaces, while compaction causes a similar effect through compressing spaces between particles. The presence of water, salts, and clay particles results in an increase in conductivity and thus a reduction in the quality of GPR data (Conyers 2006:145). Clays, shale, and other high conductivity materials may attenuate or absorb GPR signals (Conyers 2004; Conyers 2006).

GPR is an established method of non-invasive prospection for historic archeological features, including wells, privies, and other shaft features, as well as buried building foundations, trenches, and stratigraphic features. GPR is capable of identifying these features due to the dielectric contrasts that often exist between feature fill and surrounding sediment, visible truncation of internal stratigraphic layers, or high reflection amplitude from intense signal reflection from bricks or stones. Additionally, utility lines, buried walls, and other large subsurface objects provide an ideal point-source to generate a characteristic hyperbolic reflector. These hyperbolic reflections (observed in GPR data as upside-down U-shaped anomalies) are "artifacts of the data" in that the "tails" on the hyperbolic reflectors are not true representations of subsurface objects. These "tails" appear because the GPR antenna transmits a cone of energy into the ground, rather than a thin beam of energy directly below the antenna. Hyperbolic reflections can be used to depth-correct the GPR data using advanced software-based migration techniques, and in the process the "tails" on the hyperbolic reflectors are removed.

Post-processing routines for the GPR data were conducted in GSSI's RADAN software and generally included position correction (time zero), background removal (for removal of banding related to digital noise), migration (for depth calibration), and high and low pass filtering (for suppression of unwanted data noise). Depth correction for GPR data was calculated by RADAN using software migration based on hyperbolic reflectors. Due to the variable nature of surface and subsurface materials in project areas, and resulting vertical changes in the velocity of radar energy propagation, the depth correction is a general correction that is not as accurate as it would be in areas of relatively uniform stratigraphy. For all spatially coincident survey data, profile lines were combined into one file using the Super3D function of RADAN and processed simultaneously. The data were interpreted in cross-section view (2D) as well as in 3D mode.

Modern GPR data benefit from advances in computing power, both for in-field data collection and computer post-processing. One of the main advantages of utilizing these modern systems is the ability to combine individual two-dimensional GPR data into three-dimensional datasets. This process, conducted within GSSI's RADAN software, combines individual cross-section profiles, with areas between lines interpolated, using grid coordinates to produce a three-dimensional cube of the entire dataset. The cube can be sliced through at different depth intervals to reveal horizontal patterning between subsurface anomalies that may otherwise be missed though analysis solely of cross-section profiles. The resulting "time slices", or plan view maps at user-defined depths, are exported from the program as images. Another aspect of the time slice software is the ability to define a "depth window", or an averaging of data at specific intervals above and below the depth of interest. This method often provides greater interpretability to GPR time slices by showing more of a given depth range at once, thus "fleshing out" anomalies that extend across a wide depth range. For example, a time slice may be viewed at 60 centimeters below ground surface, with a depth window of 60 centimeters. In this case, the time slice would be centered at 60 centimeters below ground surface, but the data shown would be an average of all data between 30 cm and 90 cm deep, or 30 cm above and below the depth of interest.

Time slices at many different depth intervals were exported from RADAN for georectification and subsequent overlay with other field data and maps. These time slices were imported to ArcGIS, georectified to the GPS data, and then clipped to remove no-data areas.

3.1.2 GPR Field Methods

JMA used a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 GPR system with a 400 MHz central-frequency antenna (Plate 3). This GPR system is registered with the FCC under CFR 47, Part 15. The antenna and datacollector were mounted on a Utility Cart and utilized odometer-triggered collection of

Plate 3. GSSI Ground-penetrating radar system.

Plate 4. Mechanical trench excavation, view to the south. Reopened EU 6 is to the northwest (foreground) of the trench.

one reading every 2cm (0.8 inches). The 400 MHz antenna is the standard GSSI antenna used for archeology, can be easily mounted on a Utility Cart, and offers an ideal compromise between penetration and resolution. GPR antennae of higher frequency than the 400 MHz provide higher resolution, but depth penetration for these antennae is quite limited. Conversely, lower frequency antennae provide greater depth penetration while overall resolution is decreased.

Geophysical grids were laid out with surveyor's tape measures along an arbitrary "grid North" oriented perpendicular to the alley and house lots. This grid orientation was chosen to maximize survey coverage, to align as close as possible with Heite's original grid layout, and to provide stratigraphic profiles perpendicular to the Delaware River (essential due to the complex nature of natural and fill stratigraphy). JMA laid out six geophysical grids and collected GPR profiles spaced at 50cm apart along the Y axis of each grid (grid North; 55.25 degrees west of true North). JMA collected all GPR profiles in a unidirectional pattern. Unidirectional lines, running grid south to north (southeast to northwest), allowed data to be collected outside of grids while maintaining the ability to incorporate these data into three-dimensional time slices and increased the survey's coverage area.

3.2 ARCHEOLOGICAL EXCAVATIONS

JMA used a combination of methods to re-locate Heite's unit ER6. Among the techniques were GPR analysis, GIS mapping including georectification of Heite's excavation map, plotting of Heite's description of unit locations, and field observations. Once re-discovered, ER6 was used as the focal point for additional hand excavation and mechanical excavation of trenches.

The stratigraphy of the trench and ER20 was complex and required much effort to sort out in the field. Arbitrary stratigraphic designations were entered in the field to sort out various layers and allow unique identifiers to be established. During data and artifact analysis following the fieldwork, JMA established sequential stratigraphic designations using Roman numerals that began with "I" and ended at "XXIX", with "I" denoting the oldest stratum and "XXIX" representing the youngest (modern) stratum. The provenience of artifacts collected from trench and ER20 strata were updated to reflect the change in stratigraphic designation, and a concordance of these field and analysis designations was created (Table 3).

The project team monitored the excavation of two trenches and ER20 adjacent to Heite's ER6. These trenches were the most efficient means of investigating the extent of potential seventeenth century strata originally uncovered by Heite. Excavations began after Heite's ER6 had been relocated by hand excavation. The trench began two feet to the southeast of the ER6 east wall in an attempt to preserve intact stratigraphic units for hand excavation. The trench was excavated with a flat-bladed bucket by an experienced operator, and sediments were removed in relatively thin layers to ensure that no important archeological deposits were unnecessarily disturbed (Plate 4). The excavation was frequently halted by to investigate potentially interesting discoveries.

The revealed stratigraphy was recorded by JMA geoarcheologists with careful attention to detail. Munsell colors, sediment texture, and stratigraphic layers were recorded on graph paper in 10-foot trench segments with line levels used for each section. The sections were later stitched together to form a complete profile of the entire trench. JMA paid close attention to artifact contexts of trench strata, and made a concerted effort to sample sediments and cultural materials from all strata (where possible). Extensive photo-documentation (with a 10 megapixel color digital camera) of the trench resulted in a high-quality visual record. JMA collected many overlapping photographs of trench walls for generation of a merged panorama of the north and south trench walls.

Table 3. Trench stratigraphy summary and concordance

Stratum	*Stratum Number -- Field*	Munsell Color	Texture and Description	General Description	Additional Comments	*Cultural Materials*	*Time Period*	*Correlation with Heite Stratigraphy*	*2012 ER6 and ER20 Stratigraphic Designations (Labeled in Field)*
I	Not Directly Sampled	Unknown	Unexcavated stratum below Stratum I -- likely Pleistocene deposits	----------	----------	None Observed or Recovered	Pleistocene	***Heite's "Natural Yellow Clay Subsoil"***	Not Sampled During ER6 and ER20 Excavations
II	Subsoil	10YR 5/6	Silt	B horizon of subsoil weathered into likely Pleistocene sediments. This stratum is extremely compact, and has had it's upper soil horizons stripped away. Exhibits numerous dark, linear features, one is a later historical sewer trench (with terra cotta pipe) and others may exhibit post molds but did not contain datable cultural materials.	Stratum is steeply cut by a possible trench or ditch, dips steeply to the east/southeast in ER6. Fairly flat-lying to the west of ER6. Not observed anywhere else in the trenches and excavations, suggesting that the sand units encountered in the bottom of the backhoe trench represent ancient coastal onlap facies.	None Observed or Recovered	Pleistocene	Not Sampled by Heite	***Subsoil***
III	Coarse Lag Deposit	2.5Y 4/3	Gravelly Coarse Sand	----------	Likely Upper Pleistocene Scotts Corner or Lynch Heights Formations	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
IV	Sand Stratum	2.5Y 5/3	Med to Coarse Sand	Less mica than units above, coarse sand and gravel at base	Likely Upper Pleistocene Scotts Corner or Lynch Heights Formations	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
V	Stratum 9	10YR 4/3	Micaceous Fine to Med Sand	Brown, micaceous, water saturated. This stratum represents organnic-rich layers that are likely Pleistocene tidal flats.	Likely Upper Pleistocene Scotts Corner or Lynch Heights Formations	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
VI	Stratum 10A	5Y 7/4	Micaceous Silty Sand	Saturated, loose, high mica content	Likely Upper Pleistocene Scotts Corner or Lynch Heights Formations	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
VII	Stratum 10B	5Y 7/4	Vf Sandy Silt	Stiff, light tan-colored, clay inclusions	Likely Upper Pleistocene Scotts Corner or Lynch Heights Formations	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
VIII	Stratum 10	2.5Y 5/3	Micaceous Silty Fine Sand	Apparently massive sand unit with occasional pebbles. Sand is quite loose and easy to dig	Just above water table, upper portions exhibit slight iron mottling. Rests below strat IX	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
IX	Stratum 11	10YR 4/6 to 5Y 7/4	VF to Fine Sandy Silt	Appears to be a relatively old, weathered surface. On NW side of trench the unit contains pebbles and small cobbles. Top of layer concreted, iron stained and mottled with areas of black reduced (?) iron	Upper boundary difficult to trowel through. Layer is up to 6 inches thick in places, rests above strat VIII.	None Observed or Recovered	Pleistocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
X	Stratum 12	2.5Y 4/4	Slightly Silty Fine Sand	Appears to be a massive sand unit overlying the weatherd upper boundary of stratum IX, but does not seem to be related to it. Most likely a beach or dune deposit. Contains few scattered pebbles	This stratum appears to contain no artifacts, and in NW side of trnech seems to interfinger/ transition into artifact-bearing strata from Heite's ER6	None Observed or Recovered	Late Pleistocene/ Holocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations
XI	Stratum 12A	10YR 4/6	Slightly Silty Fine to Med. Sand w/ Pea Gravel	Sand and pea gravel layer overlying stratum X and underlying stratum XII. Layer exhibits an apparent fining-upward sequence from very coarse to coarse sand at the interface with stratum X, grading into fine to medium sand at top of layer and contact with stratum XII.	----------	None Observed or Recovered	Holocene	Not Sampled by Heite	Not Sampled During ER6 and ER20 Excavations

Table 3. Trench stratigraphy summary and concordance

Stratum	*Stratum Number -- Field*	Munsell Color	Texture and Description	General Description	Additional Comments	*Cultural Materials*	*Time Period*	*Correlation with Heite Stratigraphy*	*2012 ER6 and ER20 Stratigraphic Designations (Labeled in Field)*
XII	Stratum 13B	10YR 5/6 with Dark Mottling	Sily Fine Sand	Stratum is slightly compact, seemingly weathered, ehibiting olive/tan mottling and dark brown root casts/root stains. Layer extends below Heite's ER6 and appears to underlie all archaeological layers. In ER20, artifacts appeared to be pressed into this layer from above stratum XIII. In the vicinity of ER20 and ER6 this layer seems to be the upper stratum of either a dune or beach ridge, or possibly the top of a trench cut into Pleistocene sediments.	De Cunzo excavation terminated at this layer, after recovering a clay pipe bowl (17th century form) from interface with overlying stratum XIII. This layer does not appear to contain cultural materials	None Observed or Recovered	Late Holocene/ Early Historic Period	Not Sampled by Heite	***Unnamed Stratum***
XIII	Stratum 12B	2.5Y 5/4	Silt with Traces of VF Sand	Seemingly massive, silty (very smooth) stratum overlying stratum XII and underlying stratum XIV. Stratum appears to drape over the NW-dipping surface of stratum XII.	This layer prduced a large piece of a redware plate, from either the base of stratum XIV or within the interface between stratum XIV and this layer. Stratum also produced a clay pipe bowl (17th century form). This layer represents the oldest archaeological deposits observed in the trench and excavations. The surface of stratum XII dips to the NW and may be a trench or ancient dune/beach ridge, on which this stratum is resting. To the northwest (the western half of ER6) a steeply cut, yellow-brown subsoil is present. De Cunzo's excavation of ER20 uncovered a small area of this stratum. Stratigraphic profiling revealed that Heite's ER6 did not reach this layer	Clay pipe bowl (mid to late 17th century form), metal object (xray suggests grenade)	Mid to Late Seventeeth Century	Not Sampled by Heite	***Stratum G***
XIV	Stratum 13	2.5Y 3/2	Silty Fine Sand	In East Trench, stratum is a thin brown layer above stratum X. In ER20, rests abouve XII and XIII. Likely early historical fill layer. Contains approx. 10% coarse clasts, pea gravel and smaller. Unit thickens to the northwest, apears to have been truncated to southeast	Contains shell fragments, decayed shells, brick, and slag at upper boundary in trench, none in ER20. Stratum may not have been distinguishable from XV during excavation. Was visible in profile after excavation.	Westerwald stamped blue sherd (1675-1775), pipe stems (one 1650-1680, one 1680-1710), glazed earthenware (Dutch Borden/Schotel; 17th Century), free-blown bottle fragments, green flat glass (38 pieces), brick fragments (12), unidentified nail, cermamic tile, glazed and unglazed redware	Late Seventeenth to Early Eighteenth Century	***Heite Stratum 6F/D***	***Stratum E/F***

Table 3. Trench stratigraphy summary and concordance

Stratum	*Stratum Number -- Field*	Munsell Color	Texture and Description	General Description	Additional Comments	*Cultural Materials*	*Time Period*	*Correlation with Heite Stratigraphy*	*2012 ER6 and ER20 Stratigraphic Designations (Labeled in Field)*
XV	Stratum 13D	2.5Y 5/4	VF Sandy Silt	Stratum is a thin (4 inches on average)layer above stratum XIV and beneath stratum XVI. Layer is lighter in color than bounding strata.	This is most likely the layer that Heite interpreted as a sealed 17th century stratum (ER6F/D). Heite excavated only to the top of this stratum and then ceased excavation. The profile of ER6 after re-excavation revealed that this stratum may have continued for a few inches below bottom of original ER6 and then transitions into stratum XIV. The bottom of Heite's ER6 was rather difficult to discern.	Westerwald stamped blue sherd (1675-1775), pipe stems (one 1650-1680, one 1680-1710), glazed earthenware (Dutch Borden/Schotel; 17th Century), free-blown bottle fragments, green flat glass (38 pieces), brick fragments (12), unidentified nail, cermamic tile, glazed and unglazed redware	Late Seventeenth to Early Eighteenth Century	***Heite Stratum 6F/D***	***Stratum E/F***
XVI	Stratum 13A	10YR 5/4	VF Sandy Silt	Apparently massive, thick silty layer that contained abundant artifacts in ER20, and at least 4 partial to nearly complete yellow bricks, a few cobbles, and red brick fragments. Stratum overlies stratum XV, and underlies stratum XVII.	Likely the same layer as Heite's stratum ER6E.	Tin glazed earthenware (1640 - 1800), 2 pipe stems (approx. 1680 - 1710), window glass, free blown bottle fragment, cut or wrought nail, redware, coal, 154 brick fragments, possible artillery round (identified through xray as possible cannon ball)	Late Seventeenth to Early Eighteenth Century	***Heite Strata 6B and6E***	***Straum E1/E2***
XVII	Stratum 13C	Mixed	Silty Fine Sand to Fine Sandy Silt	Fill unit of massive, stiff silt that in all likelihood is related to strata XXIII and XXIV	Unit cross-cut by post hole excavation (unknown if Heite-related or not).	None Observed or Recovered	Nineteenth to Twentieth Century	Heite Stratum 6A	***Stratum A***
XVIII	Stratum 14A	2.5Y 4/2	Gravelly Medium to Coarse Sand	This stratum is a coarse lag overlying stratum XIV and underlying stratum XIX. Contains abundant gravel and small peblbes mostly angular clasts. Also contains small shell fragments.	This layer is likely an intertidal deposit, found within the central 20 feet of the west trench, that apparently cut into stratum XIV	None Observed or Recovered	Later Historic Period	----------	----------
XIX	Stratum 14	2.5Y 7/3	Fine Sand	Loose sand unit above XVIII and below XX. Appears to be well sorted beach sand. SE side of layer contained large quantity of later historical ceramics. Occasional small shell fragments and few pebbles.	Layer exhibits thin, discontinous, apparently organic-rich laminae that dip toward the Delaware River. In a different context it might be interpreted as a historical midden.	White grantite ware (1842-1930), domestic gray stoneware (Albany slip exterior and interior (1805-1940), window glass, brick fragments, nails, domestic gray salt glazed stoneware, 20th century refined earthenware, milk glass, machine made bottle, bottle fragments, slag	Nineteenth to Twentieth Century	----------	----------

Table 3. Trench stratigraphy summary and concordance

Stratum	*Stratum Number -- Field*	Munsell Color	Texture and Description	General Description	Additional Comments	*Cultural Materials*	*Time Period*	*Correlation with Heite Stratigraphy*	*2012 ER6 and ER20 Stratigraphic Designations (Labeled in Field)*
XX	Stratum 15	2.5Y 3/1	Silty Fine Sand to Fine Sandy Silt	Brown, artifact-bearing stratum above stratum XIX. Could be the upper horizonz (O/A) of a soil profile weathered into XIX. Layer is quite thin and underlies a thick, concreted stratum of coal and coal ash.	Sediment has a reddish tint and very coarse sand scattered throughout. Could be a fill layer or a truncated remnant of a formerly thicker unit.	Wire, misc. stoneware, refined earthenware, yellowware, machine-made bottle fragments, milk glass, unid. Metal, slag, eyeglass lens	Mid to Late Nineteenth and Twentieth Century	----------	----------
XXI	Stratum 16	Variable	Fining-upward sequence from gravel-sized materials at base to coarse/very coarse sand-sized materials at top	This is a SE-thickening layer, resting above stratum XX and XXII, that appears to be a coarse clast and shell hash deposit. Likely an intertidal deposit made up of reworked shells and industrial shoreline mateirals (coal, slag, etc.)	Stratum may predate ferry terminal, but is likely contemporary. Few artifacts other than a large section of a stoneware pot recovered from base of this unit in north wall of east trench. Stratum starts at 30 feet into the trnech, and thickens toward Delaware River	Gilded whiteware, coal, slag	Late Nineteenth, Twentieth Century	----------	----------
XXII	Stratum 17	2.5Y 2.5Y/1	Coarse, gravel-sized slag and coal	This layer is an industrial fill layer, of variable thickness, composed of concreted coal, coal ash, and other industrial materials. This unit leses out around 15 feet from the NW end of east trench.	Unit is flat-lying in SE wall of trench, at around 20 ft into trench begins to rise steeply toward the NW end of trench, like it was deposited on a slope or in a trench or pit.	Milk glass jar fragment, coal, slag	Twentieth Century	----------	----------
XXIII	Stratum 18	10YR 4/3	VF Sandy Silt	Thick, apparently massive sandy silt layer, very compact, that overlies stratum XXII. Likely a late historical fill unit	Layer contains few artifacts. Appears from 10 to 35 feet into trench.	Window glass, hard paste porcelain, bottle fragments, coal, slag, wire nail, brick fragment,	Twentieth Century	----------	----------
XXIV	Stratum 19	2.5Y 6/4	Silt	Fill unit resting above straum XXIII. Fine sediment flakes apart as it dries out.	----------	Brick Fragment, Slag	Twentieth Century	----------	----------
XXV	Stratum 20	2.5Y 2.5Y/1	Gravelly coarse to VC sand	Thin layer of coal, slag, industrial materials resting above XXIV and below XXVII	Layer is thin, continuous, and slightly undulating on contact with stratum XXIV. It looks like stratum XXVII was pressed into it.	None Observed or Recovered	Later Historic Period	----------	----------
XXVI	Mixed Fill Units	Mixed	Instrusive pit or ditch with mixed fill	Cuts through many strata and is likely a very young disturbance	----------	None Observed or Recovered	Modern	----------	----------
XXVII	Stratum 21	2.5Y 5/1	Cobbly, Silt and Coarse Sand	Very cobbly (angular to subangular) coarse sand and sily layer resting above, and apaprently pressed into, stratum XXV.	This layer is the same as the coarse grey sand and VC sand/small gravels that Heite's ER6 cut through (that helped to find the unit). Layer is very cobbly toward Delaware River. From 20 to 35 feet in trench cobbles are approx. 1 to 5 inches; from 20 to 15 feet very few cobbles and layer comprises grey silty coarse and and small gravels.	None Observed or Recovered	Mid to Late Twentieth Centruy	----------	----------
XXVIII	Stratum 22	2.5Y 3/2	Silty Fine Sand	This stratum is the lower horizon of the modern Root mat	Layer contains few, if any, artifacts.	Wire nail, brick fragment, bottle fragment, glazed earthenware marble	Late Nineteenth to Twentieth Century	***Heite's "Ash-Filled Topsoil"***	***Modern***
XXIX	Stratum 23	2.5Y 3/1	Silty Fine Sand	Modern root mat/ ground surface	----------	None Observed or Recovered	Modern	***Heite's "Ash-Filled Topsoil"***	***Modern***

Upon completion of fieldwork JMA placed a grey plastic tarpaulin over the central and western sections of the trench, while plastic bottles and other materials were deposited in the eastern (and deepest) sections of the trench. These materials, in conjunction with GIS data, should facilitate the relocation of JMA's trench by future investigators.

3.3 TOTAL STATION SURVEY

JMA used a Topcon GTS-239W total station for all phases of the investigation (Plate 5). Geophysical grid nodes and topography were surveyed, as well as surface features (such as: concrete and metal from the former ferry terminal, playground and basketball court boundaries, fences, and fence posts). Excavation-related features were mapped, including two nails from Heite's ER6, archeological features uncovered during trenching and excavation, and the outline of the mechanically-excavated trench. The local coordinate system was tied into the GPR grid coordinates. Appendix I provides local coordinates, as well as northings and eastings (UTM), for significant mapped data points which should facilitate future high-resolution re-location of relevant features. Total station data points were processed and imported to ArcGIS, where they were georectified to modern high-resolution aerial photographs and elevations corrected through extraction of elevations from LiDAR data. A topographic surface was created in ArcGIS from these points (Figure 9).

3.4 GIS MAPPING

Unlike the earlier survey of the Casimir site by Heite and Heite (1986), the Fort Casimir GPR study incorporated the technology of ESRI's Geographic Information System (GIS), a powerful tool unavailable to the former researchers. A GIS is the intersection of computer mapping software, database capabilities, qualitative and quantitative analysis, and expert user input. For this project, a GIS used various geographical datasets to aid in the interpretation of the historic landscape, and create renderings of the projects findings.

The GIS component consisted of two main components: 1) digitizing and or georeferencing historic information and natural landforms into the GIS; and 2) create maps of pertinent themes. The segmentation of tasks in this way was beneficial in that each task built off the information produced by the previous task.

Part one of the GIS task included georeferencing historical documentation gathered by the team and previous researchers, and physical features of the landscape obtained using a Global Positioning System (GPS). Historical information with a spatial component included city maps, land plats, shore line maps, land-cover features, aerial images, and roads, much of which has been digitized by James Meek. Inexact historically referenced locations were mapped using historic maps and modern aerial photographs. The result of this georeferencing was the synthesis of available spatial and historical information into a single location. Once in the GIS, the layers of historic and natural locations can be overlain and interpreted within any number of contexts.

The final part of the GIS task included a synthesis of the findings of the historic research and GPR study placed onto maps. The information stored and created through the GIS provides the basis for these maps. Further, the geospatial data created in the GIS and pertinent to the project is provided as a deliverable (see attached disk). The project-specific data is in the form of ESRI shapefiles. Metadata for each GIS file is provided in the Federal Geographic Data Committee (FGDC) standard format.

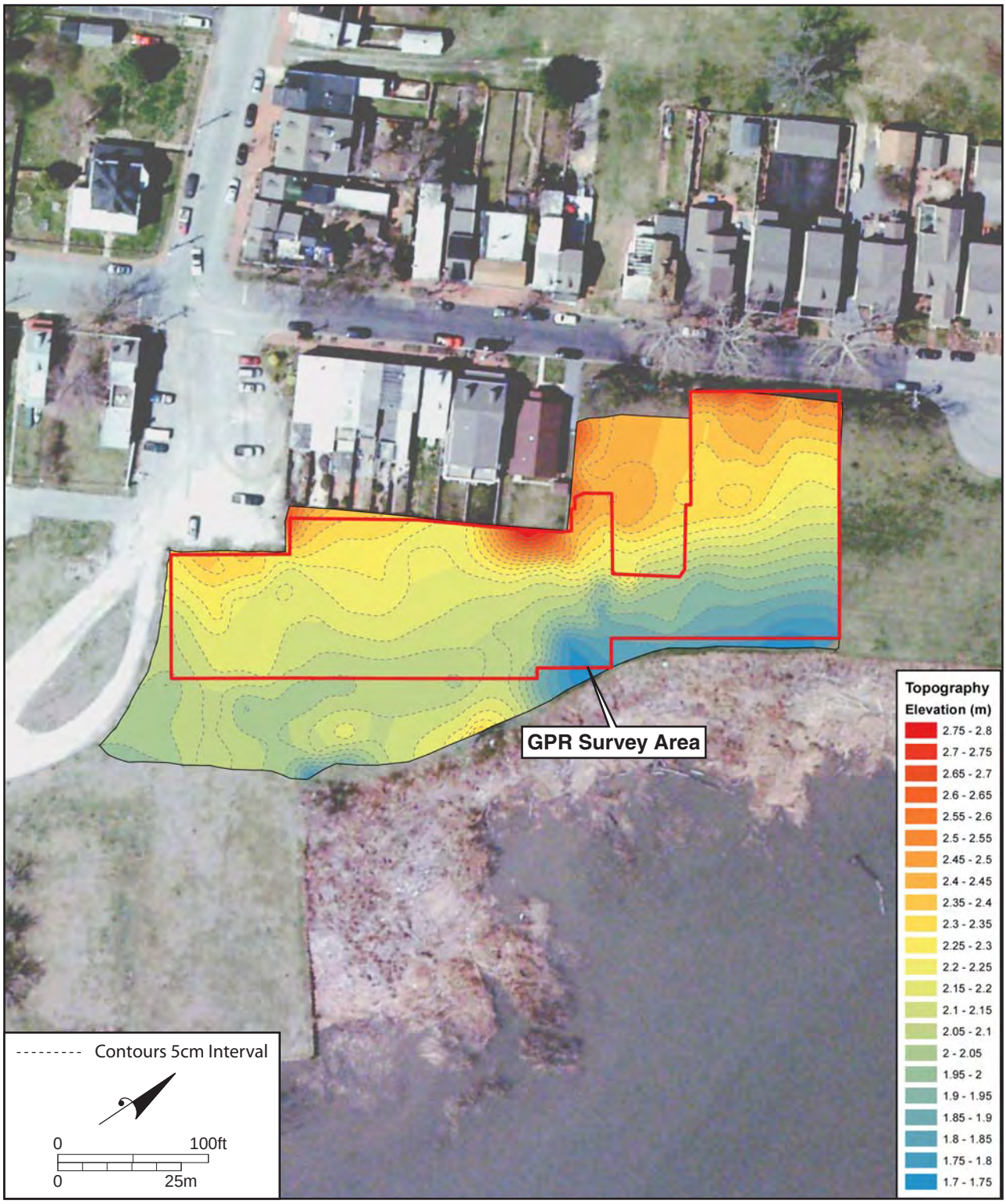


Figure 9. Results of JMA's topographic survey.

Plate 5. Peter Leach with JMA's Topcon GTS-239W total station. Photograph taken during earlier survey of the New Castle Green.

3.5 ARTIFACT ANALYSIS

Artifacts recovered in the course of the field investigations were cleaned and inventoried following *Curatorial Guidelines and Standards* (1997) established by the DHCA (Appendix II). At the direction of the DHCA, only artifacts diagnostic to the seventeenth and/or eighteenth century were analyzed at this time. Temporally significant artifacts from the mechanical trenches were cleaned and inventoried, as were temporally significant artifacts from ER20. While additional artifacts were retained, these artifacts have are not further discussed in this report, and await future analyses. Overall, 387 artifacts were cataloged during this study (Table 4).

To the extent possible, the recovered artifacts were identified as to material, temporal or cultural/chronological association, style, and function. All artifacts and related documents (field records, photographs, artifact inventories, etc.) will be delivered to the Delaware State Museums repository for curation.

4.0 RESULTS

4.1 GEOPHYSICAL RESULTS

JMA collected a total of 337 individual GPR profiles, in six coterminous geophysical grids, across 1.08 acres (4380m^2; 47148.5ft^2). These data were collected in areas adjacent to the public parking lot along Chestnut Street, southeast of a row of houses and an alley, around a small playground, and along a portion of 2nd Street (Figure 2). The GPR data extended beyond grid boundaries in some areas. JMA's GPR survey produced high-resolution data that facilitated comprehensive mapping of subsurface features, and thus creation of a detailed plan of action, prior to archeological fieldwork. Appendix III contains a series of GPR time slices at 0.50ft intervals for the reader's reference.

JMA's main task was to use the GPR data to re-locate Heite's ER6 excavation unit. Georectification of Heite's excavation plan maps was an adequate starting point for this effort, and this GIS analysis provided a general area for potential excavation locations. As Heite's excavation plan was tied to features that may or may not have been consistent with those observed today (certain posts, fencelines, etc.), GIS analysis could only be used as a guide. The GPR time slice data revealed a high-amplitude feature in the mapped vicinity of ER6 that was consistent in size with its rectangular (5x10ft) dimensions. This anomaly was most apparent on the time slices from the ground surface to roughly 0.50ft below surface (Appendix III). Two-dimensional time slices in this area revealed a sloping reflector consistent with the subsoil observed by Heite. Immediately to the south, the profiles showed apparently stratified deposits within a ditch-like feature. Further to the south the profiles showed apparent fill layers extending toward the Delaware River. The GPR time slices and profiles were consistent with the location and stratigraphy described by Heite, and this was considered a high potential location for ER6. Heite's excavation plan was transformed in GIS to match this anomaly, and the anomaly's location was uploaded to a sub-meter GPS unit for placement of excavations during fieldwork. A subsidiary goal was to evaluate the GPR data for evidence of anomalies related to archeological features, landscape elements, and other potentially significant subsurface anomalies. As the main goal was to relocate Heite's ER6, the majority of the GPR dataset was left untested and awaits future archeological ground-truthing.

A noted by Heite, and observed during JMA's excavation of the West Trench, the subsoil adjacent to the house lots and alley is quite shallow. Though there were features present, the subsoil is potentially too shallowly buried to produce resolvable GPR data, and the features probably exhibit low dielectric contrast with the surrounding subsoil which would prove difficult to image with GPR. Indeed, few obvious anomalies appear on the time slices in these areas (Appendix III) which supports this interpretation. Magnetometry, mechanical stripping, or hand excavation are suggested for these areas of shallowly buried subsoil. Along the southern edge of the shallow subsoil, and parallel to the modern fenceline, two long, linear anomalies of mid-amplitudes were observed in the GPR time slices. These anomalies (Linear Anomaly 1 and Linear Anomaly 2, Figure 10) ran along most of the project area and interfaced with the high amplitudes of the possible Bull Hill remnants near the playground (Appendix III). Area Anomaly 3 may also be related (Figure 10). This anomaly is consistent with the location of the eighteenth and seventeenth century strata identified in Heite's and JMA's excavations in ER6 and ER20 (see below). The two-dimensional GPR profiles show stratified deposits associated with this anomaly that are consistent in location and depth with the stratified historical layers. This anomaly may represent the historical deposits or the trench that they were deposited in.

The GPR data reveal strong evidence of former shorelines and likely later historical shoreline features (Appendix III), which are consistent with vegetation patterning on the modern aerials (Figure 2) as well as the position of the shoreline on 1930's aerials (Figure 5). These data are at odds with the shoreline shown on the 1804 Latrobe Survey (Figure 3), though storm events during the nineteenth century are

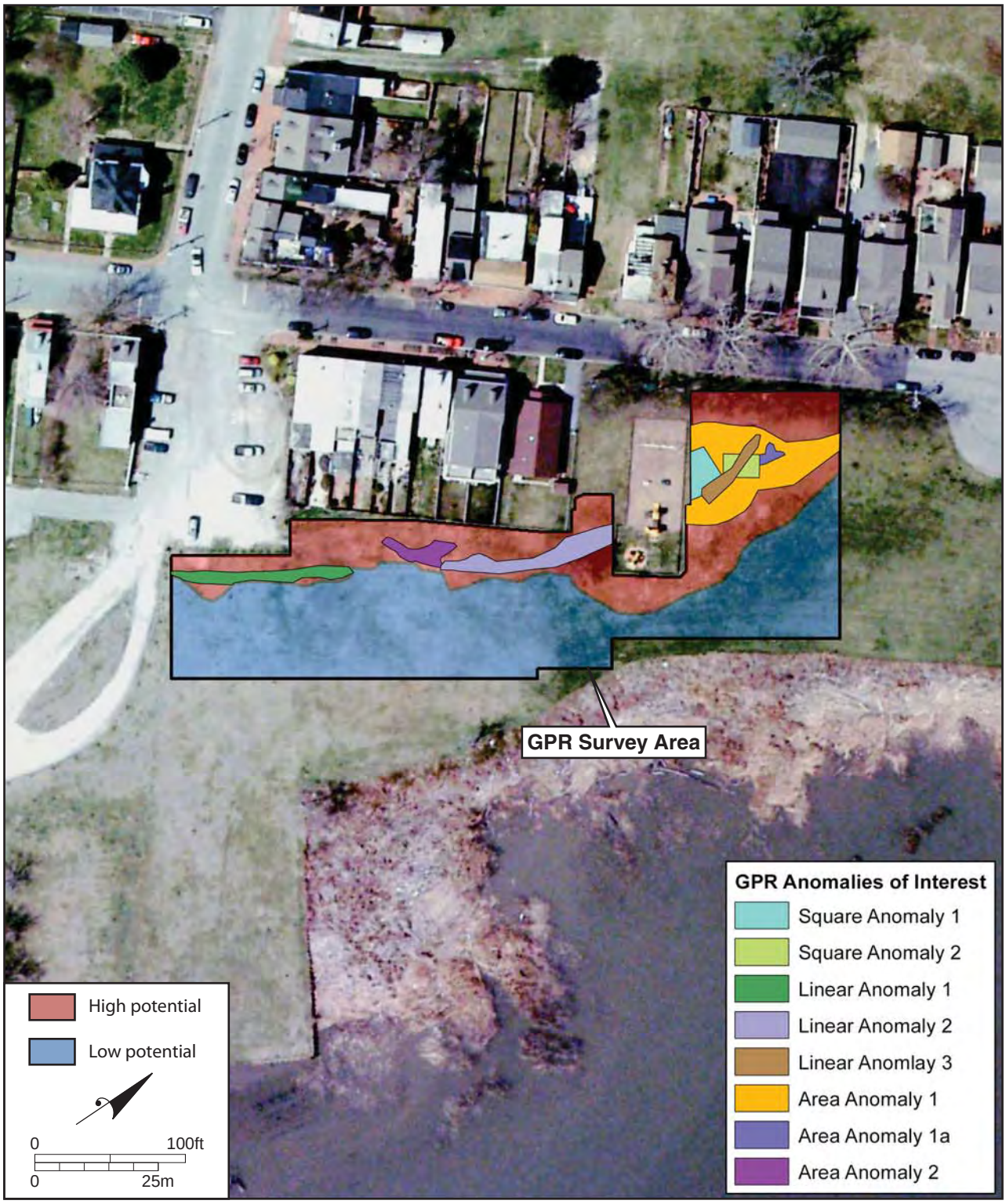


Figure 10. Map of selected GPR anomalies and zones of high and low archeological potential.

likely responsible for much of this discrepancy. Though the GPR data cannot directly reveal the ages of shorelines, the correlation of these data with historical maps and aerials provides a strong baseline for chronological considerations. GPR time slices show the extents of filled areas as linear and somewhat geometrical areas of high amplitudes (Appendix III), while the two-dimensional GPR profiles revealed high-amplitude reflectors that dipped toward the Delaware River and appeared to have been truncated, suggesting erosive events at former shorelines.

The GPR profiles in the playground vicinity are considerably different than those from the southern project area. Immediately to the north of the playground are high-amplitude, stacked and mounded reflectors that dip steeply toward the Delaware River. The GPR reflectors are probably the remnants of Bull Hill, which was supposed to have been a hill comprised of sand and gravel. These reflectors appear to be truncated on the Delaware side and likely represent a former shoreline position. This former shoreline, quite likely that of the early twentieth century, is consistent with areas of darker vegetation seen on modern aerial photographs (Figure 2). This area of high amplitudes on time slices (Appendix III) should be considered for archeological investigation. Two interesting rectangular anomalies to the north of the playground (one extending beneath it) appear on the deeper time slices and may represent archeological features (Figure 10). Other GPR anomalies in the area also suggest potential archeological features. JMA identified no clear evidence for unmarked graves in the area formerly mapped as a "Potters Field". Should this area be affected by development activities, JMA recommends close-interval geophysical survey, including GPR and magnetometry. Electrical resistance may also prove valuable, as well as additional investigation of historical records and georectification of additional historical maps.

4.2 RE-EXCAVATION OF HEITE'S ER6

The archeological fieldwork began with the relocation of the Heites unit ER6. The project team (consisting of JMA archeologists, DHCA archeologist Craig Lukezic, University of Delaware professor Lu Ann de Cunzo, and several volunteers) used the Heite's report maps, the GPR data, and surface evidence to focus excavation efforts. Using a sub-meter GPS the field team navigated to the likely location of ER6. The modern root mat was carefully stripped by shovel where the GPR had identified an anomaly consistent with an excavation unit. A long strip of sod was removed to find the sides of ER6. Immediately below the sod was a thin layer of gray finely crushed gravel. This layer exhibited an abrupt disturbance where it had been previously cut through. Continued sod removal revealed the northwestern edge of ER6, and further lateral expansion of the excavation uncovered the western and northern corner nails for ER6, placed by the Heites in 1986. The field crew moved eastward, and promptly uncovered the eastern wall of ER6 (Plates 6 and 7). The surface was cleaned and leveled, and re-excavation of ER6 commenced without delay.

The field crew carefully excavated the backfill from ER6 and quickly discovered that the Heites had left numerous items on the floor of the trench, including the blade from a steel tape measure, steel tent pegs, and a scrap of plywood that had deformed to match the floor profile (these items were also referenced in Heite's manuscript field notes). The northwestern half of ER6 comprised the shallowly buried and steeply-dipping subsoil mentioned by Heite, with a clear trench running northwest to southeast across the unit and into the eastern unit wall (Plates 7-9). The Heites had apparently removed the sewer pipe to excavate beneath it. The excavation of backfill did not extend much farther to the northeast as excavators were not interested in disturbing the balk the Heites had retained between quadrants of ER6 (Figure 11).

4.3 EAST TRENCH AND ER20

Two mechanically-excavated, coterminous trenches were placed to the southeast and northwest of Heite's ER6 (Figure 12). The first, designated as the East Trench, began roughly one foot to the southeast of the

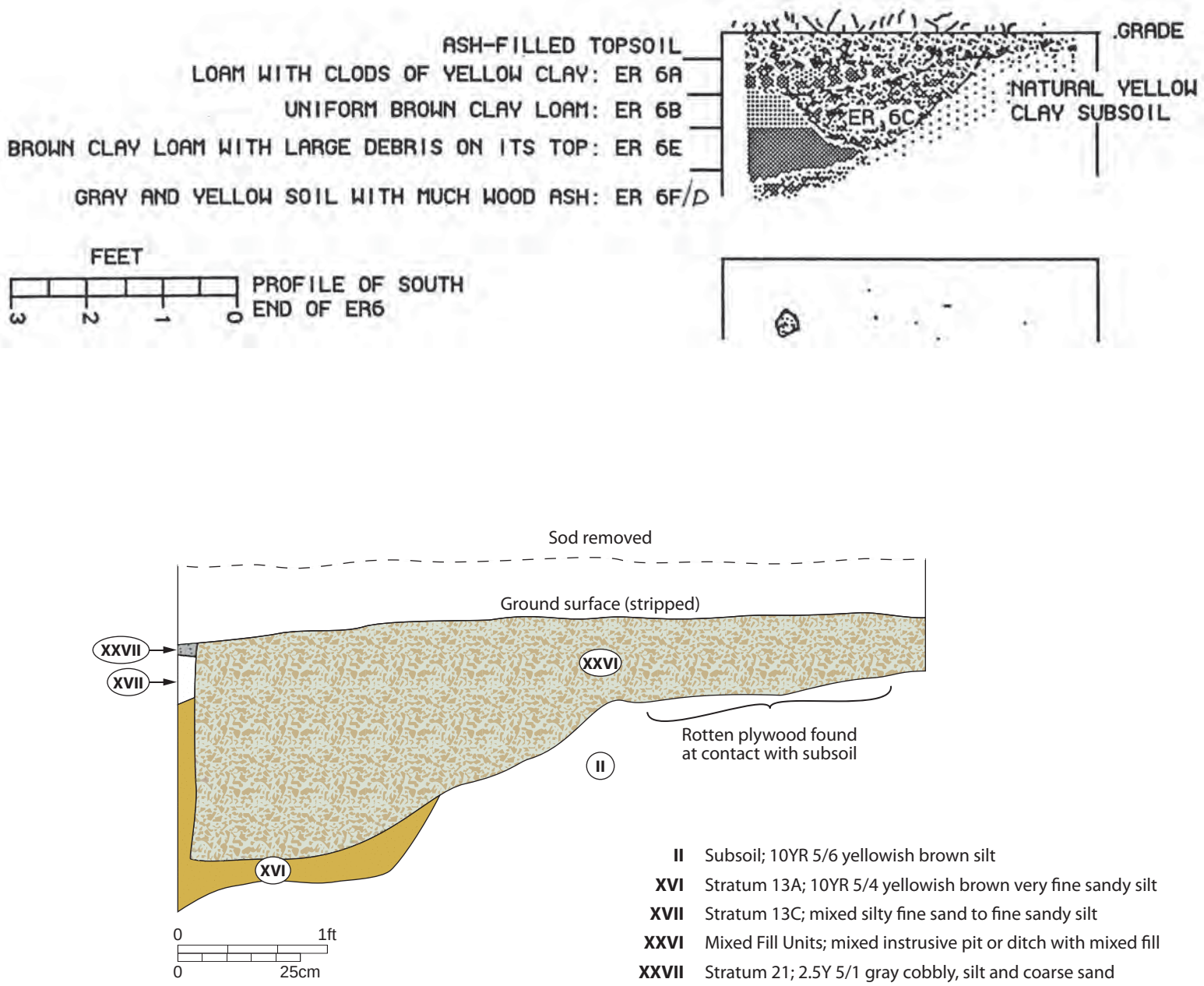


Figure 11. South wall profile of ER6. Top: Heite's original drawing; Bottom: 2012 re-excavation of ER6.

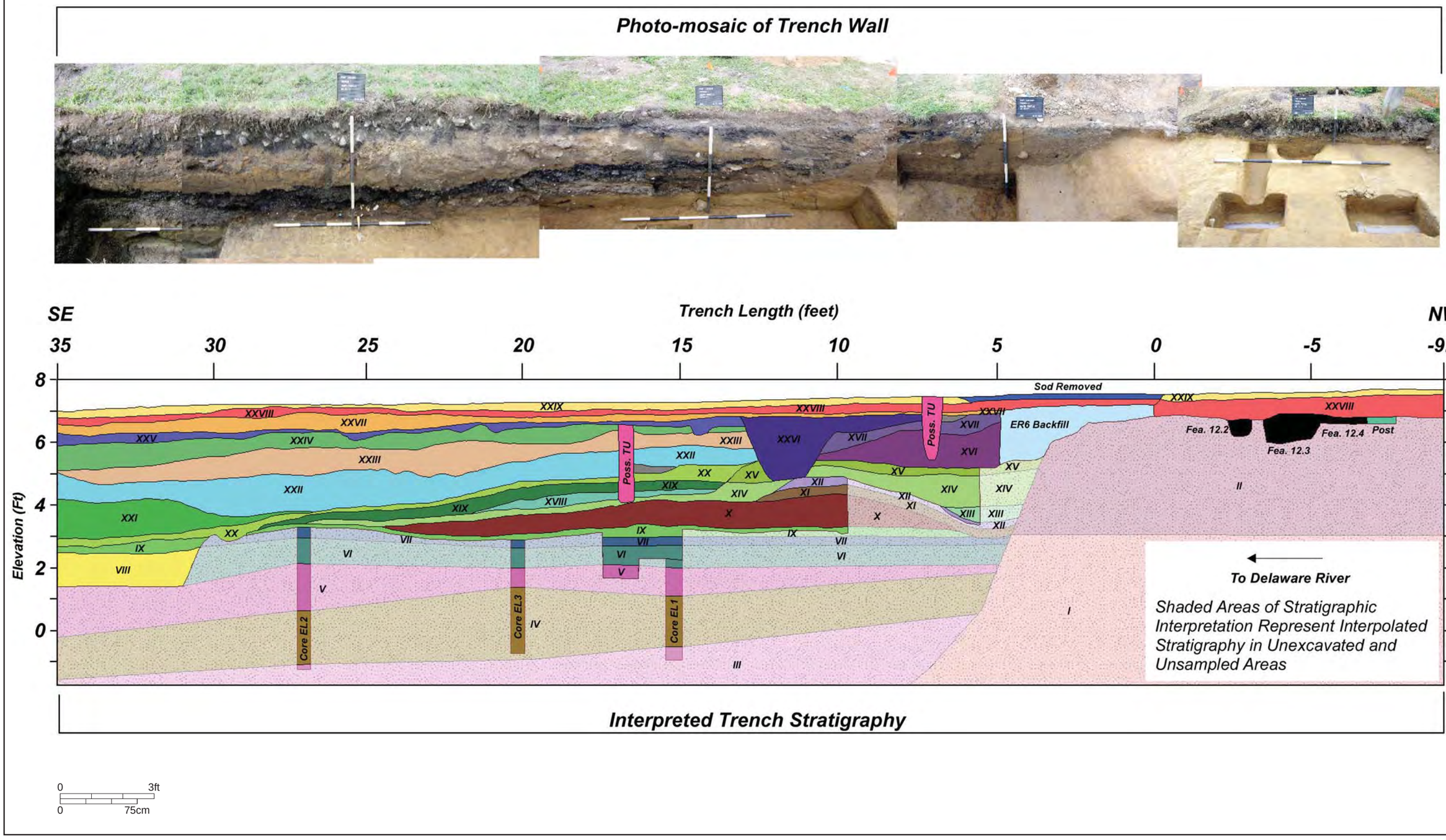


Figure 12. Photomosaic of JMA backhoe trenches and numbered interpretation of stratigraphy.

Plate 6. Heite's ER6 in the process of re-excavation.

Plate 7. Heite's ER6 re-excavated, view of east wall.

Plate 8. Floor of Heite's ER6 re-excavated, view to east wall.

Plate 9. Floor of Heite's ER6 re-excavated, view to south wall.

ER6 East wall (Plate 10). Coordinates for the East Trench began at the grid Southwest corner nail of ER6 (discovered during the initial re-excavation) and were assigned position "0" (zero). All measurements in the trench were in English units. From this point the East Trench extended a total of 35 feet to the southeast (Plate 11). The trench was 5.2 feet wide at ER6 (position 0) and tapered to 4.1 feet wide at its southeastern end (position 35). Heite's ER6 extended 4.9 feet into the East Trench, and was not perfectly aligned with the southern trench wall resulting in an error of a few inches. Additionally, re-excavation of ER6 resulted in the removal of 0.6ft of previously unexcavated deposits (from strata XXIX, XXVIII, XXVII, XVII, XVI). Unit ER20 began at 5.5 feet into the trench and extended to 9.7 feet. The next 2.5 feet, from 9.7 to 12.2 feet, were hand-excavated after the backhoe had a excavated a stepped removal of approximately the top 1 to 1.5 feet of sediment. The remaining 22.8 feet of the trench were excavated various depths with the backhoe.

ER20 was a hand-excavated test unit measuring 5x5-feet in size, located east of and immediately adjacent to ER6, and immediately west of the East Trench (Figures 12 and 13). The goal of the excavation of ER20 was to investigate the apparently intact early historical deposits identified in ER6, and to integrate the stratigraphy of that test unit with the East Trench. The excavation and stratigraphy of ER20 will be included in the discussion of the East Trench (Plate 12).

In the East Trench four excavations were extended to depths below the bottom of the backhoe trench in order to preserve the integrity of the walls and to maintain safe trench depths. A small 2x2ft excavation (unnumbered) was excavated from 15.5 to 17.5 feet into the trench to investigate certain micaceous strata (V, VI, VII). Core EL1 was extracted immediately to the NW of this small unit. Two other cores were extracted, including Core EL3 at 20 feet into the East Trench, and Core EL2 at 27 feet. An excavation "well" was opened with the backhoe in the extreme southeastern end of the East Trench to provide a larger exposure of deeper stratigraphy. No personnel were allowed to enter this portion of the trench unless they were standing on stable boards well above the bottom; even then their time was limited.

Analysis of trench stratigraphy revealed 29 distinct strata (Figure 12). Cultural materials were encountered during trench excavation and while recording stratigraphic information; these materials were bagged when their provenience could be established. Table 4 provides a key to field numbering and final stratigraphic designations, as well as summary descriptions of each stratum including color and texture. Where available, cultural materials collected from each stratum are listed along with an interpretation of the age of the deposit.

Strata I through XI are likely middle to late Pleistocene in age and associated with the Scotts Corner or Lynch Heights Formations (Figure 14). These strata represent Pleistocene fluvial, estuarine, and marine depositional systems and range from loose and unconsolidated sand to stiff silts. Also within these strata are high concentrations of mica, presumably eroded from schist beds north of the project area (Stratum VI). Strata I and II are composed of stiff silts and exhibit a yellow-brown color typical of shallow subsoil horizons. Heite noted during excavation of ER6 that the subsoil dipped sharply to the southeast; JMA confirmed this assessment through our excavations. Interestingly, the stiff silt was not observed southeast of ER6, suggesting that it is cut quite steeply. Whether this slope is the product of erosion or human activity is unclear. The youngest Pleistocene stratum is a pebbly/gravelly sand that exhibits a oxidized, weathered, and rather compact upper boundary likely relating to an ancient land surface. Though their northwestern limits were not directly sampled, it seems that these coarser strata onlap onto Strata I and II, suggesting later Pleistocene marine transgression of middle Pleistocene units.

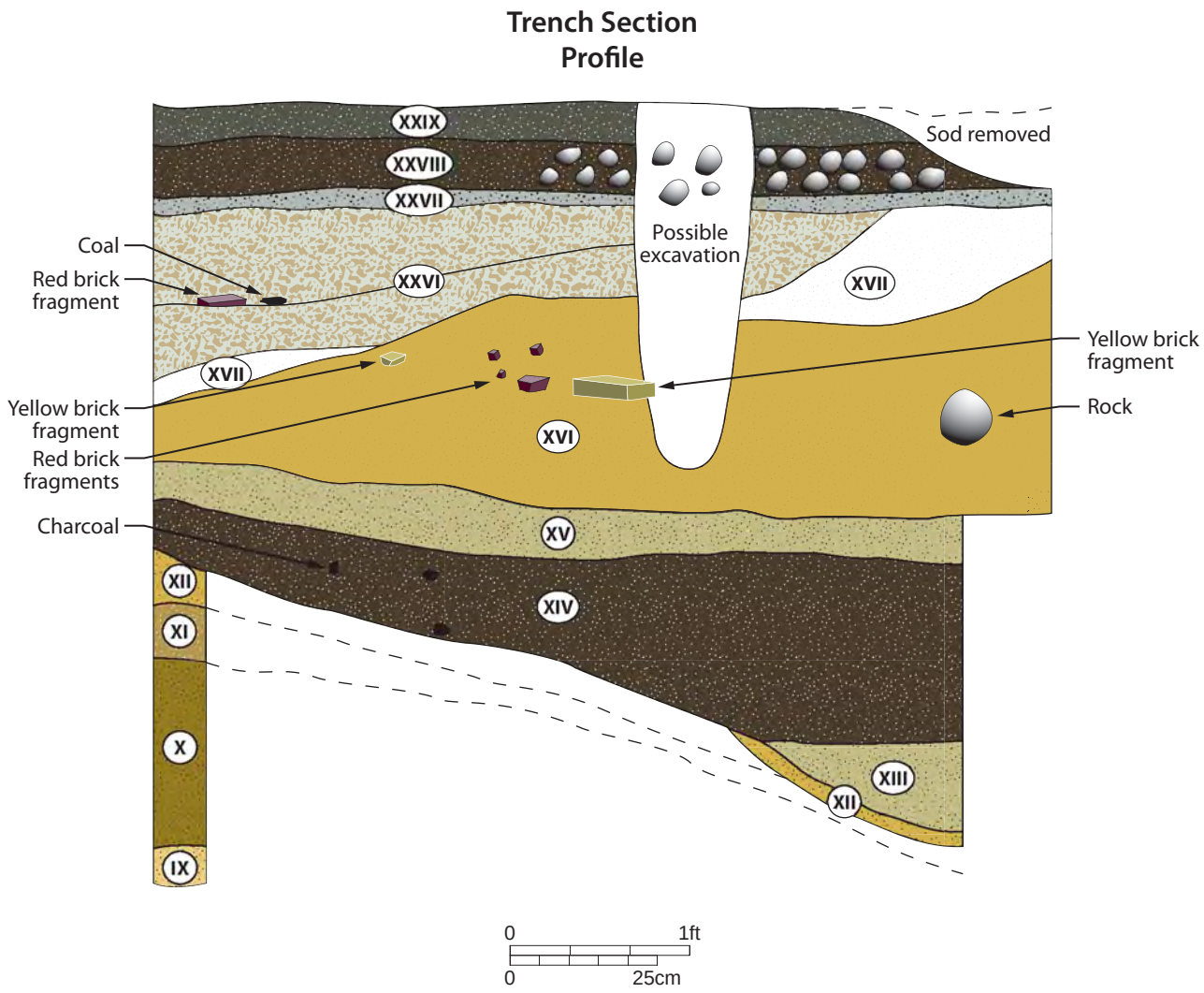
Above the Pleistocene deposits are likely Holocene sands that may be dunes or other coastal features (Strata X, XI, XII) representing Holocene marine transgression (Figure 14). These strata dip toward ER6 and form a shallow trench with the steeply dipping Strata I and II to the northwest. These strata also dip to

Table 4. Cataloged artifacts recovered from the trenches and ER excavations at Fort Casimir, 2012

Feature No.	Location	Depth	Munsell Color	Texture	Description	Interpretation
12.1	ER6, ER20, West Trench	Variable; Approximately 0.7ft bgs on average	10YR 4/6	Clay Loam	Linear trench cut through subsoil, terra cotta pipe uncovered	Late Nineteenth early Twentietch Century Sewer/Drainage Pipe
12.2	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Trench-like, flat-bottomed, contains possibly circular internal features (0.3ft diameter on average) and some quadrilateral and triangular. Appears to have been cross-cut by Feature 12.1, in which case it would be related to Feature 12.6	Possible palisade or paling line, fenceline, or trench for unknown purpose. Internal features may be driven posts.
12.2a	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Appears to be a roughly circular feature.	Possible post stain
12.2b	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Appears to be a roughly circular feature.	Possible post stain
12.2c	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Appears to be a roughly circular feature.	Possible post stain
12.2d	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Appears to be a roughly circular feature.	Possible post stain
12.2e	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Appears to be a roughly triangular feature.	Possible post stain
12.2f	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Appears to be a roughly quadrilateral-shaped feature.	Possible post stain

Table 4. Cataloged artifacts recovered from the trenches and ER excavations at Fort Casimir, 2012

12.3	West Trench	0.7ft bgs	10YR 5/6	Silt Loam	Possible archaeological feature with charcoal flecking. Relatively flat-bottomed, irregular outline.	Unknown
12.4	West Trench	0.8ft bgs	2.5Y 4/3	Silt Loam	Unexcavated. Appears to be a linear soil stain, though it's outline is irregular. May be cross-cut but Feautre 12.1, in which case it would be related to Feature 12.7.	Unknown
12.5	West Trench	0.7ft bgs	2.5Y 4/3	Silt Loam	Square feature, unexcavated.	Possible post-related stain
12.6	West Trench	0.7ft bgs	10YR 5/6	Silt Loam	Mottled w/ yellow and whitish gray pockets, contains some charcoal. Trench-like, flat-bottomed, contains quadrilateral and triangular soil stains. Appears to have been cross-cut by Feature 12.1, in which case it would be related to Feature 12.2	Possible palisade or paling line, fenceline, or trench for unknown purpose. Internal features may be driven posts.
12.7	West Trench	0.8ft bgs	2.5Y 4/3	Silt Loam	Bottom of feature is irregular, stepped, contains small charcoal and brick flecks. 1.6ft wide, 0.5-0.6ft deep. Feature 12.1 bisects this feature. Feature may be related to Feature 12.4.	Possible palisade or paling line, fenceline, or trench for unknown purpose.



IX Stratum 11; 10YR 4/6 dark yellowish brown to 5Y 7/4 pale yellow very fine sandy silt

X Stratum 12; 2.5Y 4/4 olive brown slightly silty fine sand

XI Stratum 12A; 10YR 4/6 dark yellowish brown slightly silty fine to medium sand with pea gravel

XII Stratum 13B; 10YR 5/6 yellowish brown with dark mottling silty fine sand

XIII Stratum 12B; 2.5Y 5/4 light olive brown silt with traces of very fine sand

XIV Stratum 13; 2.5Y 3/2 very dark grayish brown silty fine sand

XV Stratum 13D; 2.5Y 5/4 light olive brown very fine sandy silt

XVI Stratum 13A; 10YR 5/4 yellowish brown very fine sandy silt

XVII Stratum 13C; mixed silty fine sand to fine sandy silt

XXVI Mixed Fill Units; mixed instrusive pit or ditch with mixed fill

XXVII Stratum 21; 2.5Y 5/1 gray cobbly, silt and coarse sand

XXVIII Stratum 22; 2.5Y 3/2 very dark grayish brown silty fine sand

XXIX Stratum 23; 2.5Y 3/1 very dark gray silty fine sand

Figure 13. South wall profile of ER20.

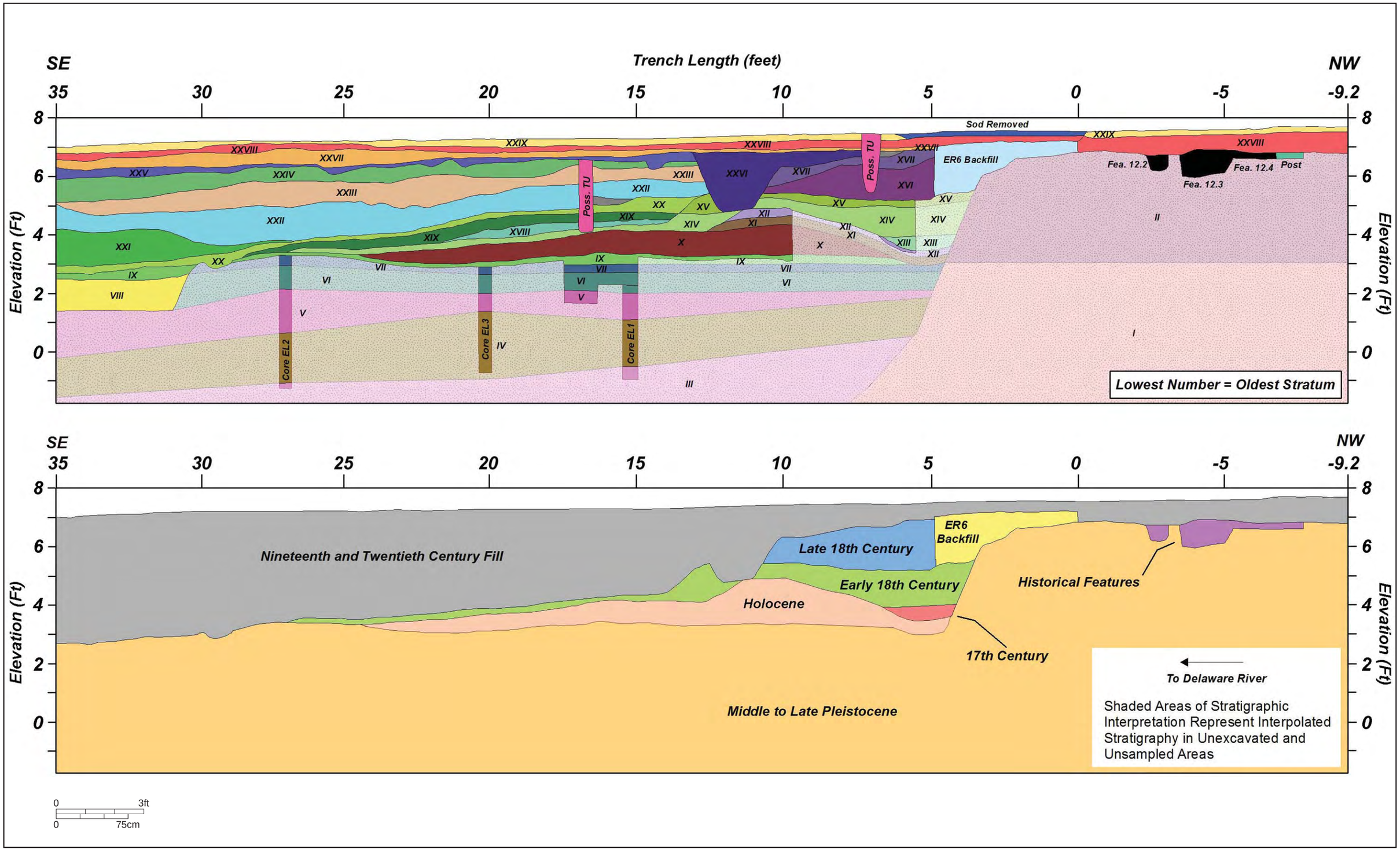


Figure 14. Numbered interpretation of East and West Trench stratigraphy, simplified stratigraphy, and interpreted age of strata.

Plate 10. JMA backhoe trench, view to northwest from southeastern end of East Trench.

Plate 11. Opening of East Trench, view to southeast. ER6 is in the foreground.

Plate 12. Excavation of ER20 in progress, view to west.

the southeast, where they lens out after 10 to 15 feet. The profile of these strata gives the impression that they represent either a discrete convex landform element or that the northwestern portion has been excavated (through erosion or human activity) leaving a shallow trench. The upper boundary, represented by Stratum XII, is a yellowish-brown silty fine sand with dark mottling. Stratum XII likely represents portions of a late Holocene or early historical period soil profile weathered into older sediments. No cultural materials were recovered from this stratum. Above Stratum XII is Stratum XIII, the bottom layer of the likely trench fill units, which presumably overlies the Pleistocene silts to the northwest. This massive, light olive-brown silt stratum produced a seventeenth century clay pipe bowl and a heavily weathered metal object that x-ray analyses suggest might be a grenade. A large fragment of a redware plate was recovered from the interface of Stratum XIII and the overlying Stratum XIV. It is unclear whether this stratum was deposited *in situ* or represents materials transported elsewhere and used to fill the depression. However, it is obvious that this stratum represents the oldest sealed archeological context found during our investigations (Figure 14).

Strata XIV, XV, and XVI seem to represent a major change in depositional history and appear to have been truncated by an erosive event, or sequence of events, to the southeast of ER20 (Figure 14, Plates 13 and 14). The lower strata (XIV, XV) produced cultural materials from the mid-to-late seventeenth to early eighteenth centuries, which transitioned into early nineteenth century artifacts by the upper portions of Stratum XVI (Plates 15 and 16). Cultural materials from Strata XVII (directly above XVI) were dated to the nineteenth and twentieth century, suggesting that the erosive event took place sometime in the late 1800's or early 1900's. This date range would be consistent with a number of devastating hurricanes that hit Delaware. The much younger fill units above were likely brought in to fill the damage from one or more storms (Plates 13 and 14). The sewer pipe that extends through a portion of the east trench could either have been broken off by a storm event, or more likely the end of the pipe indicates a contemporary, late nineteenth century shoreline location. During the twentieth century more fill units were added for installation, modification, and expansion of the ferry terminal. After abandonment the area has since been landscaped.

4.4 WEST TRENCH

An additional section of mechanically excavated trench extended northwest from the grid west wall of ER6 (Figures 12 and 14). The decision to open this trench was made toward the end of the fieldwork effort, and was aimed at further characterization of the shallowly buried, compact subsoil seen in ER6. This trench extended 9.2 feet to the northwest and was named the West Trench. Coordinates for this trench were from zero to -9.2; the coordinates were negative numbers to conform to the designations from the East Trench. The backhoe removed the sod and topsoil from the trench, and the area was then scraped by hand with trowels. It was immediately obvious that the entire West Trench contained a thin layer of modern sediment (approximately 0.7ft) over a presumably truncated, yellow-brown subsoil. This stratum was extremely compact and rather difficult to excavate by hand. However, once scraped clean with trowels, a number of interesting soil stains were encountered. These features were named and mapped by hand and with a total station (Figure 15; Plate 17).

A total of seven discrete features were identified in the West Trench (Figures 15 and 16). Table 4 contains details for each feature, including color, texture, and general descriptions. A trench containing a terra cotta pipe (Feature 12.1) ran through the entire West Trench and continued through ER6 and into ER20. This feature was identified by Heite during his excavation of ER6, though it was not assigned a feature number at that time. Heite apparently excavated it and removed the pipe to excavate beneath it. We excavated down to the pipe in two different places along Feature 12.1 to confirm that the pipe was present throughout the feature. Two fragments of potentially seventeenth-century ceramics were recovered from

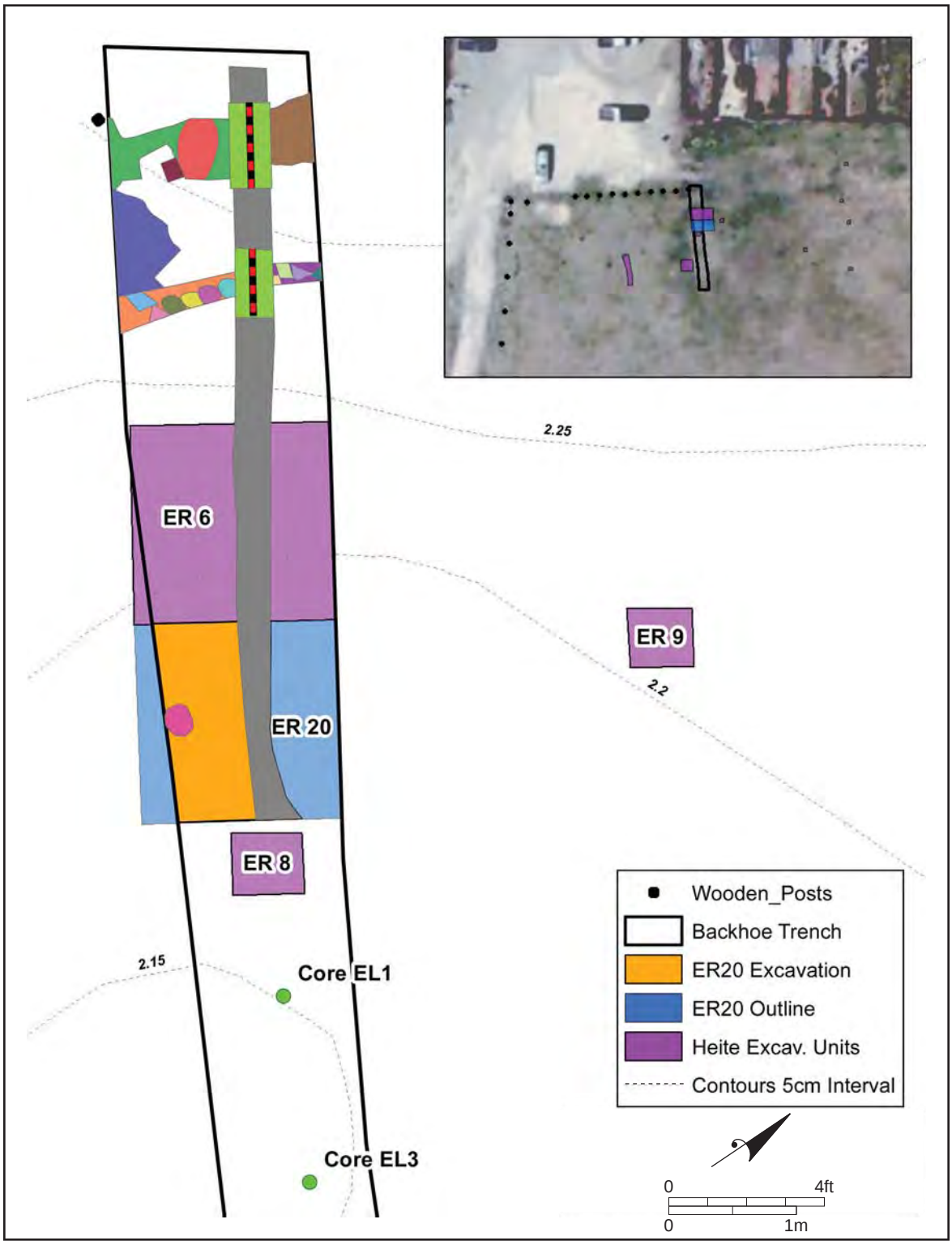
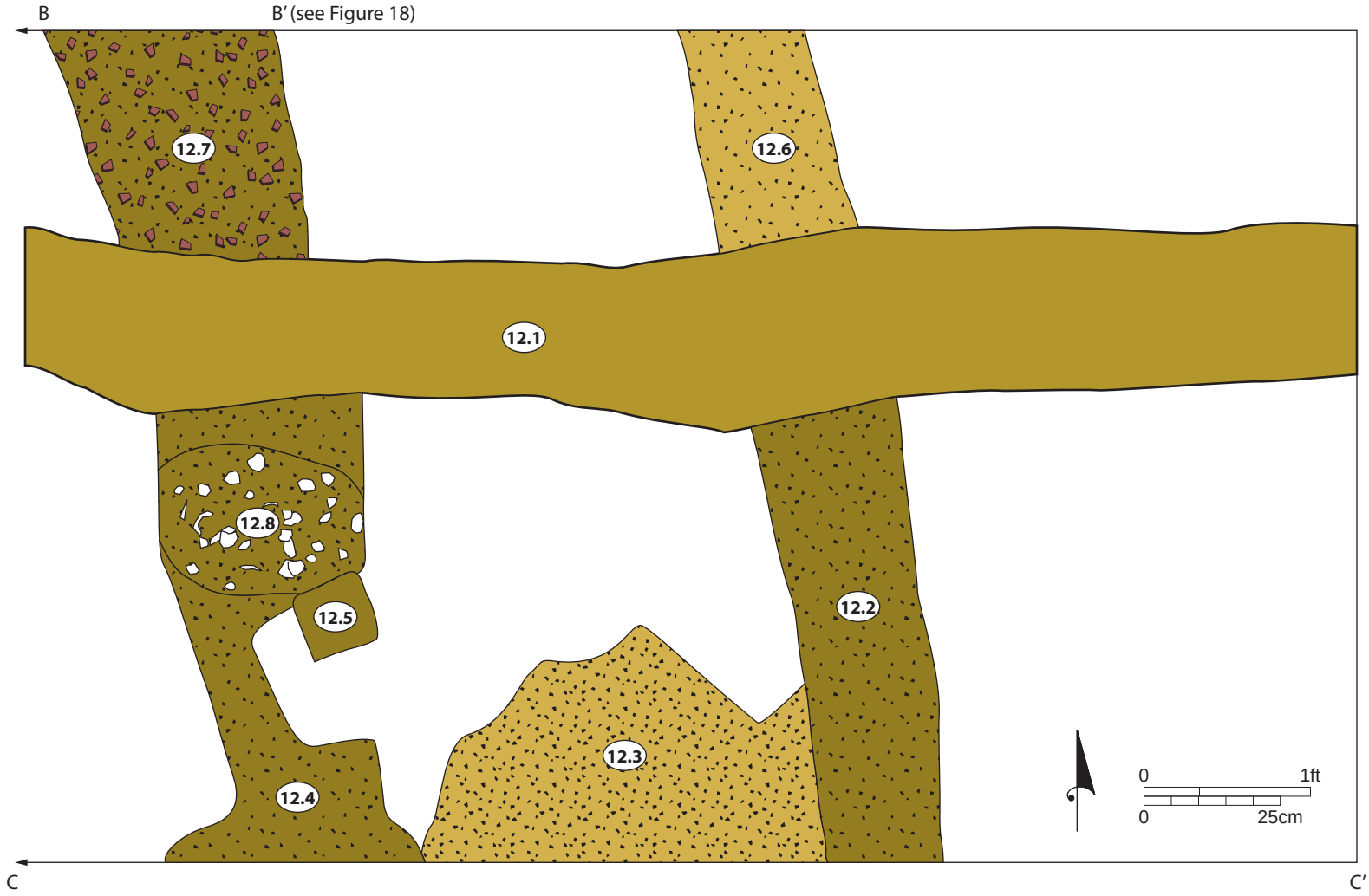


Figure 15. Archeological features uncovered during excavation of the West Trench and relationship to Units ER6 and ER20.



Fea. 12.1 10YR 4/6 dark yellowish brown clay loam; modern pipe/sewer trench
Fea. 12.2 2.5Y 4/3 olive brown silt loam mottled with some charcoal
Fea. 12.3 10YR 5/6 yellowish brown silt loam with charcoal flecks
Fea. 12.4 2.5Y 4/3 olive brown silt loam mottled with yellow-whitish gray pockets, some charcoal
Fea. 12.5 2.5Y 4/3 olive brown silt loam
Fea. 12.6 10YR 5/6 yellowish brown silt loam mottled with some charcoal
Fea. 12.7 2.5Y 4/3 olive brown silt loam with some small charcoal and brick flecks
Fea. 12.8 concentration of concrete fragments in 2.5Y 4/3 olive brown silt loam mottled with yellow-whitish gray pockets, some charcoal

Figure 16. West Trench plan, prior to excavation.

Plate 13. East Trench wall stratigraphy at 20 to 30 feet into trench, view to southwest.

Plate 14. East Trench wall stratigraphy at 10 to 20 feet into trench, view to southwest.

Plate 15. Sequence of seventeenth to eighteenth century strata at the base of ER20, view to west.

Plate 16. Sequence of seventeenth to eighteenth century strata at the base of ER20, view to southwest.

Plate 17. Archeological features uncovered and excavated in West Trench, view to southeast.

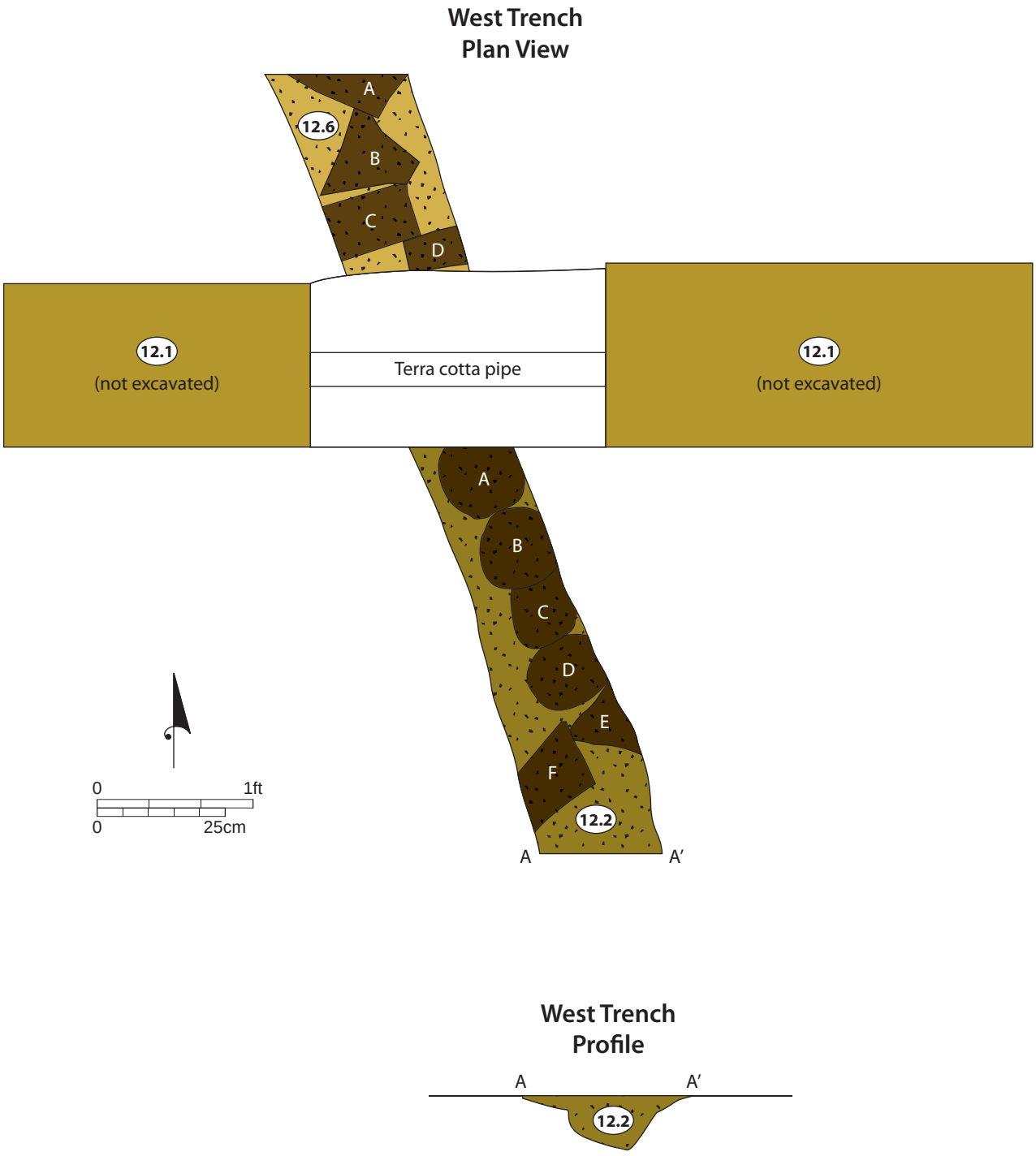
within Feature 12.1; one fragment of tin-glazed earthenware, and one fragment of green-glazed refined earthenware, possibly Borderware or Saintonge.

Features 12.2 and 12.6 (likely related) are linear, trench-like features containing roughly circular, quadrilateral, and triangular internal features (Figure 17). Once excavated, the bottom of Features 12.2 and 12.6 were observed to be relatively flat. These two features may represent palisade or paling lines and the internal features may be related to set (not driven) posts. While no artifacts were recovered from these features thus making temporal designations problematic, the lack of artifacts suggests that these two features date to an early period of site occupation. Further, these features were cross-cut by Feature 12.1, and therefore date to a period prior to the installation of the terra cotta pipe.

Two other features (Features 12.4 and 12.7) may also represent a possible palisade or paling line (Figure 18). They were bisected by Feature 12.1 and are likely related. Feature 12.5, a square possible post stain, was observed along the eastern side of Feature 12.4 and may be related. None of these three features were excavated. Feature 12.3 was an irregularly-shaped soil stain with no defining characteristics; it was excavated and was relatively flat-bottomed with sloping sides. With the exception of the two ceramic fragments recovered from the terra cotta pipe trench (mentioned above), no other artifacts were found in the West Trench features.

4.5 BACKFILLING OF THE TRENCHES, ER6, AND ER20

After the stratigraphy of the trenches and excavation units was recorded and photographed, JMA laid tarps down over ER20 and ER6, then covered the tarps with backdirt (Plate 18). Modern materials were left in the bottom of the East Trench, including plastic water bottles, pin flags, and a large iron bar from the trench backdirt. The trench was then mechanically backfilled by others. Table XX provides Northings and Eastings (in meters for NAD 1983 UTM Zone 18N, and in feet for NAD 1983 Delaware State Plane) for the outline of the trench.



Fea. 12.1 10YR 4/6 dark yellowish brown clay loam; modern pipe/sewer trench
Fea. 12.2 2.5Y 4/3 olive brown silt loam mottled with some charcoal
Fea. 12.6 10YR 5/6 yellowish brown silt loam mottled with some charcoal

Fea. 12.6 (A-D) possible remnant post stains
Fea. 12.2 (A-F) possible remnant post stains

Figure 17. West Trench plan and profile of features 12.1, 12.2, and 12.6.

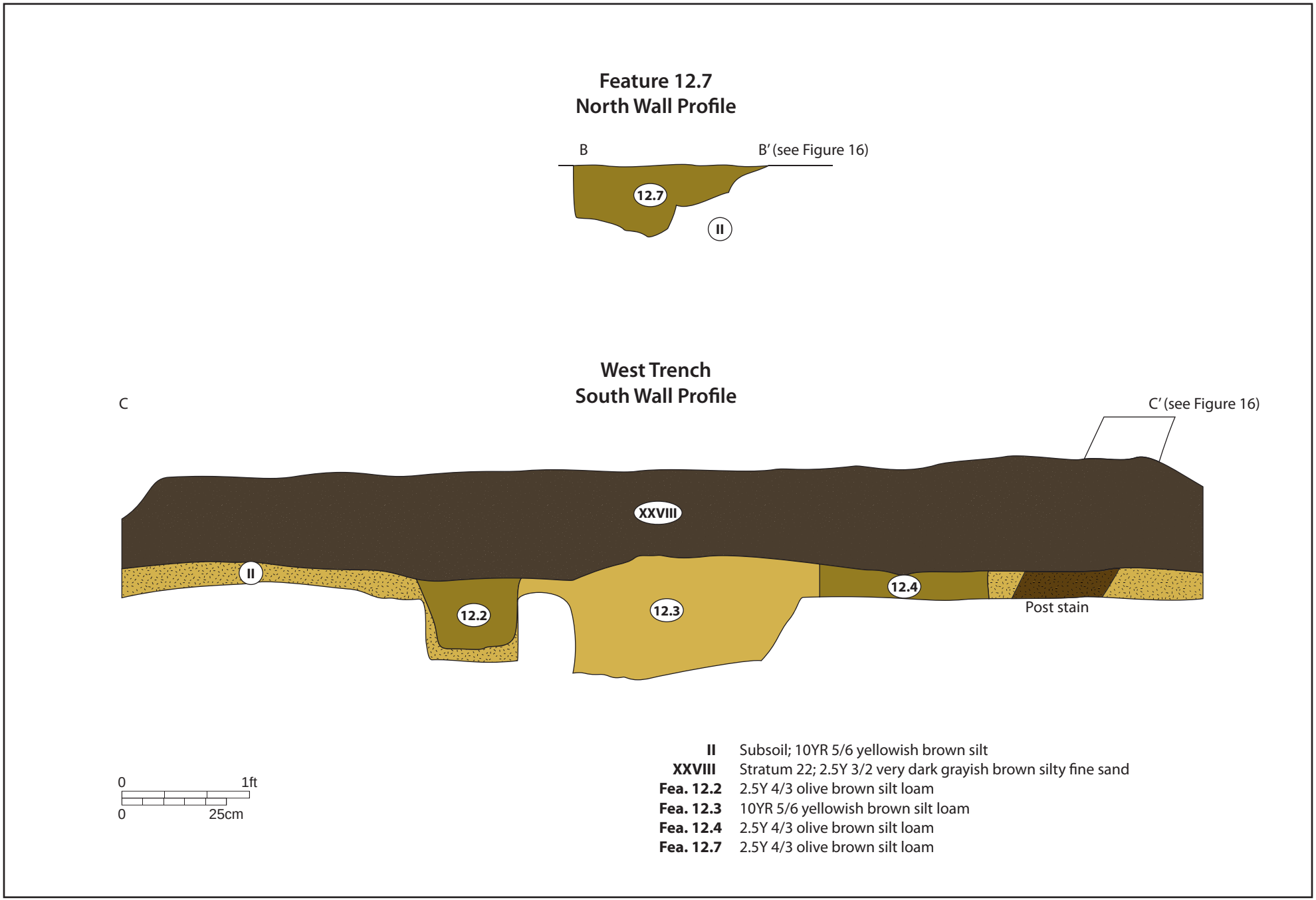


Figure 18. West Trench, profile of south wall, and profile of Feature 12.7, north wall.

Plate 18. JMA backhoe trench prior to backfilling.

5.0 ARTIFACT ANALYSIS

The artifact assemblage collected during the trenching and hand excavations was intended principally to serve as a method of dating the East Trench, but the recovery of early colonial artifacts from the lower strata of ER20 also helped the research team to confirm the intact presence of a mid-to-late seventeenth century infilled trench. As directed by the DHCA staff, the artifact analysis presented here will focus primarily on the earlier artifacts deposits.

Brick and Tile

Fifteen nearly whole yellow bricks were retrieved during the excavations, along with a large number of brick fragments (Plate 19). The total weight of recovered yellow brick was 4,860 grams (Table 5). Four of the bricks were nearly complete, with an additional eleven partial bricks of various sizes.

The bricks recovered from the excavation of the trench appear to be of a small brick type of Dutch origin referred to as *drielingen*. This type of brick was specified in an early seventeenth-century law as a standard size for buildings in Amsterdam, and *drielingen* were soon used in other parts of the Netherlands and New Netherlands. Standardized measurements for *drielingen* were 6 x 3 x 1 inches (current measure), and the nearly complete bricks found in the Fort Casimir excavations are extremely close to those measurements (Table 5). Other categories of Dutch yellow brick, such as the larger *moppen* and *Vecht* or *Utrecht*-sized bricks were not present in the assemblage (Blackburn and Piwonka 1988:127). *Drielingen* are the most frequently reported type of Dutch brick found on seventeenth-century archeological sites in Delaware, and have also been reported in Maryland, Pennsylvania, New York, Virginia, and the Caribbean (Veit 2000:70). The brick was relatively water resistant, resists wear and frost damage, and allows mortar to cure more fully. Overall, yellow brick was an excellent brick for exterior construction of building facades, roadways, and footpaths (Blackburn and Piwonka 1988; Meeske 1998:212-214). Similar brick has been recovered from excavations at other locations in New Castle, notably at the New Castle Courthouse Museum (Catts and Tobias 2006:71).

Table 5. Summary of yellow brick recovered from Fort Casimir excavations

Lot	Area	Provenience	Level	#	(w)grams	Description
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	704	Almost Whole; 16x8.5x3.5 cm
8	Excavation Unit	ER 20	XXI (E1)	1	615	Almost Whole; 18x8.5x3.5 cm
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	582	Almost Whole; 14x8x3.5 cm
12	Eastern Area of Trench	Random Grabs	Backdirt	1	422	Fragment; 19x8x3.5 cm
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	373	Fragment; 10x7x3.5 cm
14	Excavation of Heite's Unit	ER 6	SE Corner	1	304	Fragment; 10x8x3.5 cm
9	Excavation Unit	ER 20	XXI (E2)	1	226	Fragment; 6.5x8.5x3.5 cm
14	Excavation of Heite's Unit	ER 6	SE Corner	1	225	Fragment; 5x7.5x3.5 cm
9	Excavation Unit	ER 20	XXI (E2)	1	200	Fragment; 6.5x8.5x3.5 cm
8	Excavation Unit	ER 20	XXI (E1)	55	195	Fragments
10	Excavation Unit	ER 20	XIV-XV (E/F)	5	157	Fragments
14	Excavation of Heite's Unit	ER 6	SE Corner	5	139	Fragments
8	Excavation Unit	ER 20	XXI (E1)	1	124	Fragment; 12x4x3 cm
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	119	Fragment; 6x4x3.5 cm; Red Paint?
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	99	Fragment; 6x6x3.5 cm

Lot	Area	Provenience	Level	#	(w)grams	Description
9	Excavation Unit	ER 20	XXI (E2)	1	98	Fragment; 6x5x3.5 cm
8	Excavation Unit	ER 20	XXI (E1)	1	89	Fragment; 5x4x3.5 cm
15	Excavation Unit	ER 20	"ER 6B"	87	64	Fragments
12	Eastern Area of Trench	Random Grabs	Backdirt	1	49	Fragments
8	Excavation Unit	ER 20	XXI (E1)	1	43	Fragment; 4.5x3.5x3.5 cm
16	Excavation Unit	ER 20 - Pipe Trench	Fea 12.1	5	16	Fragments
13	Excavation of Heite's Unit	ER 6	Backfill	1	10	Fragment
17	Western Area of Trench	Pipe Trench	Fea 12.1	5	7	Fragments
	Total Weight				**4860**	

Several fragments of red ceramic tile were recovered from strata XVI (E1 and E2), and XVI-XV (E/F) and are roofing tile or pantile. Historical references to the use of roof tile at the fort are found in 1658 when Jacob Alrichs reports the construction of a bakery with a tile roof, and later in 1671 when the English Capitan John Carr orders the fort dismantled along with all its tiles, brick, and iron material. Pantile fragments and yellow brick were recovered by the excavation of ER 6 in 1986 (Heite and Heite 1989:118-119).

Ceramics **(Table 6)**

Six fragments of white undecorated tin-glazed earthenware were recovered in the excavations. One was retrieved from Level XXI (E1) of ER20, a second fragment from Feature 12.1 (pipe trench), and a third from east of ER20. Three additional fragments were found in soils in re-excavation of ER6. A large fragment of a redware early charger form with a glazed interior and unglazed exterior was found in Level XIV-XV (E/F) or ER20 (Figure 19), along with a fragment of Rhenish stoneware. From Feature 12.1 a small fragment of green-glazed earthenware was retrieved, which is tentatively interpreted as either Borderware or Saintonge. The Heite's reported the recovery of similar ceramics from the excavation of ER6 (Heite and Heite 1989:37-42) (Plates 20 and 21).

Table 6. Summary of Ceramics

Lot	Area	Provenience	Level	#	Description	Comments	Date Range
8	Excavation Unit	ER 20	XXI (E1)	1	Tin-Glazed Earthenware: Plain White Glaze		1640-1800
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Imported Gray Stoneware: Westerwald Stamped Blue	Rhenish Stoneware	1640-1775
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Redware: Glazed Interior, Unglazed Exterior	Early Charger Form	
13	Excavation of Heite's Unit	ER 6	Backfill	3	Tin-Glazed Earthenware: Plain White Glaze		1640-1800
17	Western Area of Trench	Pipe Trench	Fea 12.1	1	Early Refined Earthenware: Green Lead Glaze	Either Borderware or Saintonge	
17	Western Area of Trench	Pipe Trench	Fea 12.1	1	Tin-Glazed Earthenware: Plain White Glaze		1640-1800
18	East of ER 20	East of ER 20	"Lvl E3"	1	Tin-Glazed Earthenware: Plain White Glaze		1640-1800

Figure 19. Photograph and profile of red earthenware vessel recovered Level XIV-XV (E/F) of ER20.

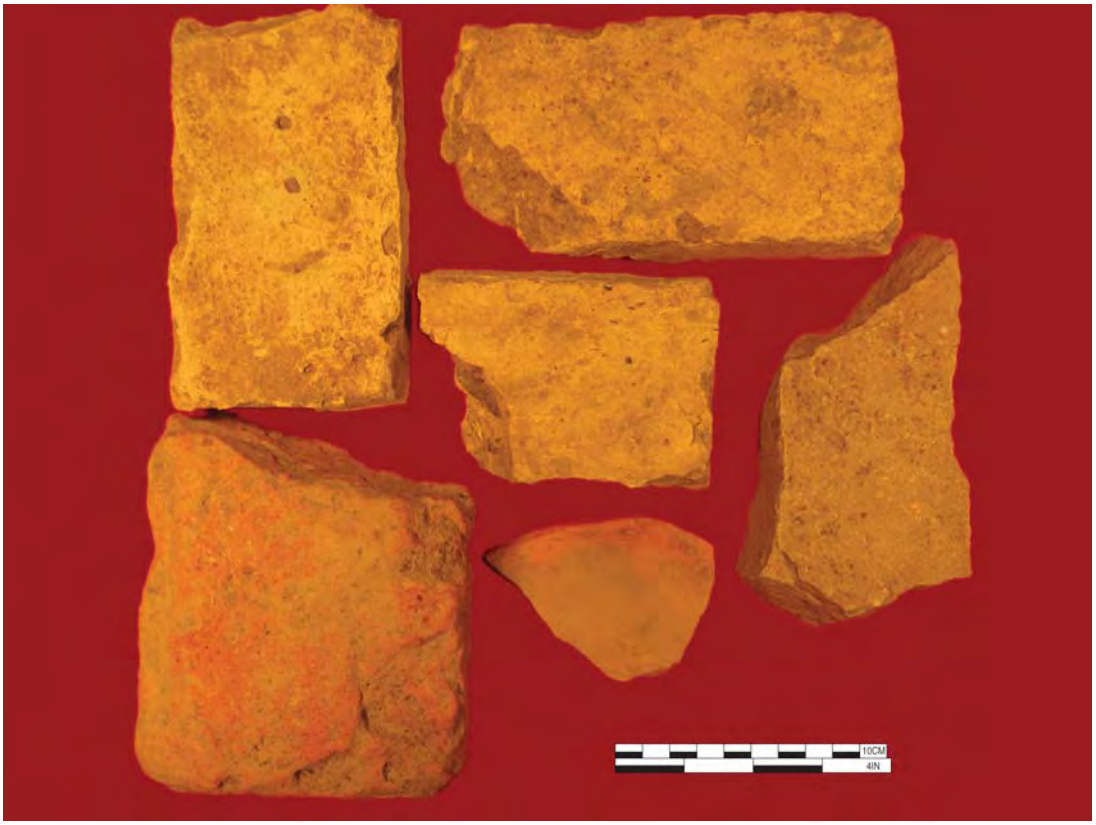


Plate 19. Sample of brick and tile recovered from ER20, XIV-XV (E/F).

Plate 20. Ceramics, glass, and tobacco pipe fragments, ER20 XIV-XV (E/F).

Plate 21. Sample of artifacts recovered from ER20, XIV-XV (E/F), showing brick, tile, teeth, tin-glazed ceramic.

Plate 22. Glass fragments, including roemer glass (r), ER20 XIV-XV (E/F).

Glass

Several glass fragments were recovered from ER20. More than thirty fragments of window glass were found in level XIV-XV (E/F), and two drinking glass rim fragments were also recovered from the same level (Plate 22). One of these is a clear, fluted glass rim, and the second appears to be a roemer (or römer) glass fragment (Willmott 2002: 53-54). Likely made in the Low Countries or Northern Germany (and less likely Venetian), roemer stemmed glasses were common drinking vessels often found on Northern European sites. Based on their presence in continental art of the period, they appear to have been used in the consumption of white wine. As one English researcher has commented, the prevalence of roemer glasses "in Dutch, and to a lesser extent German, art suggest that they were important cultural icons"(Willmott 2002:53).

Tobacco Pipes

A small number of white clay pipe fragments (bowl and stems) were found in ER20 (Plate 23). While this number is not sufficient to provide an accurate date for the assemblage, the bore diameters for these pipes are consistent with the fort's period of occupation (Table 7). Pipe fragments were also recovered during the Heite excavations in 1986.

Table 7. Summary of white clay pipe fragments

LOT	AREA	Unit	LEVEL	CT	ARTIFACT DESCRIPTION	DATE RANGE
9	Excavation Unit	ER 20	XVI (E2)	1	Pipe Stem: 6/64th-Inch Ball Clay	1680-1710
9	Excavation Unit	ER 20	XVI (E2)	1	Pipe Stem: 6/64th-Inch Ball Clay	1680-1710
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Pipe Stem: 6/64th-Inch Ball Clay	1680-1710
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Pipe Stem: 7/64th-Inch Ball Clay	1650-1680
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Pipe Stem: 6/64th-Inch Ball Clay	1680-1710
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Pipe Stem: 7/64th-Inch Ball Clay	1650-1680
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	Pipe Stem: Fragment	Bore missing
11	Excavation Unit	ER 20	XIII (G)	1	Pipe Bowl: Decorated Ball Clay	1650-1680
Total				**8**		

Munitions

Three artifacts that may be associated with the military function of the fort were recovered during the investigations.

A lead musket ball was found in ER 20 ("ER6B" location). A dropped ball (that is, not fired or impacted), it measures 0.612" diameter (15.545mm), and weighs 20.6g. The size and weight of this bullet suggest that it is either a pistol or possibly a carbine bullet (Foard 2012:57; 64).

A hollowed iron ball was retrieved from the base of ER21 (XIII). The ball may be an iron hand grenade (Plates 24 and 25). Hand grenades of the period could be made of glass, earthenware or iron. Ceramic examples have been recovered from siege sites and battlefields, such as the English Civil War siege of Leicester (Courtney and Courtney 1992:69-76), Newcastle upon Tyne (Harrington 2004:1120, and Gloucester (Atkin and Howes 1993:33-34), and on the battlefield of Aughrim in Ireland (1691),

Plate 23. Tobacco Pipe bowl, ER 20, XIII (G).

Plate 24. Possible iron grenade, ER20, XIII (G), prior to conservation.

Plate 25. Possible hand grenade, as found in the field.

Killcrankie (Scotland 1689), Sedgemoor (England 1685). The example from Aughrim is made of iron and is similar to the specimen found at Fort Casimir (Foard 2012:92). The iron ball has been x-rayed by the Maryland Archeology Laboratory at Jefferson Patterson Park and Museum (Plate 26).

An iron cannon ball was also recovered from the excavations of ER21, level XXI (E2). The ball weighs six pounds, and contains a metal spike driven through the center (Plate 26). This is an example of bar shot, or cross-bar shot. Ten examples of cross bar shot have been recovered from a circa 1590s shipwreck in Alderney, excavated since 1993 by the Alderney Maritime Trust (http://www.alderneywreck.com/index.php/the-alderney-maritime-trust) (Figure 20). Crossbar shot was intended for use as an incendiary shot, with propellant-soaked rags or clothes attached to the bar, so that upon firing, the shot would hit a wooden surface, stick to it, and ignite. Bar shot also consisted of two iron balls linked by a bar, with a use intended for removing ships rigging or masts.

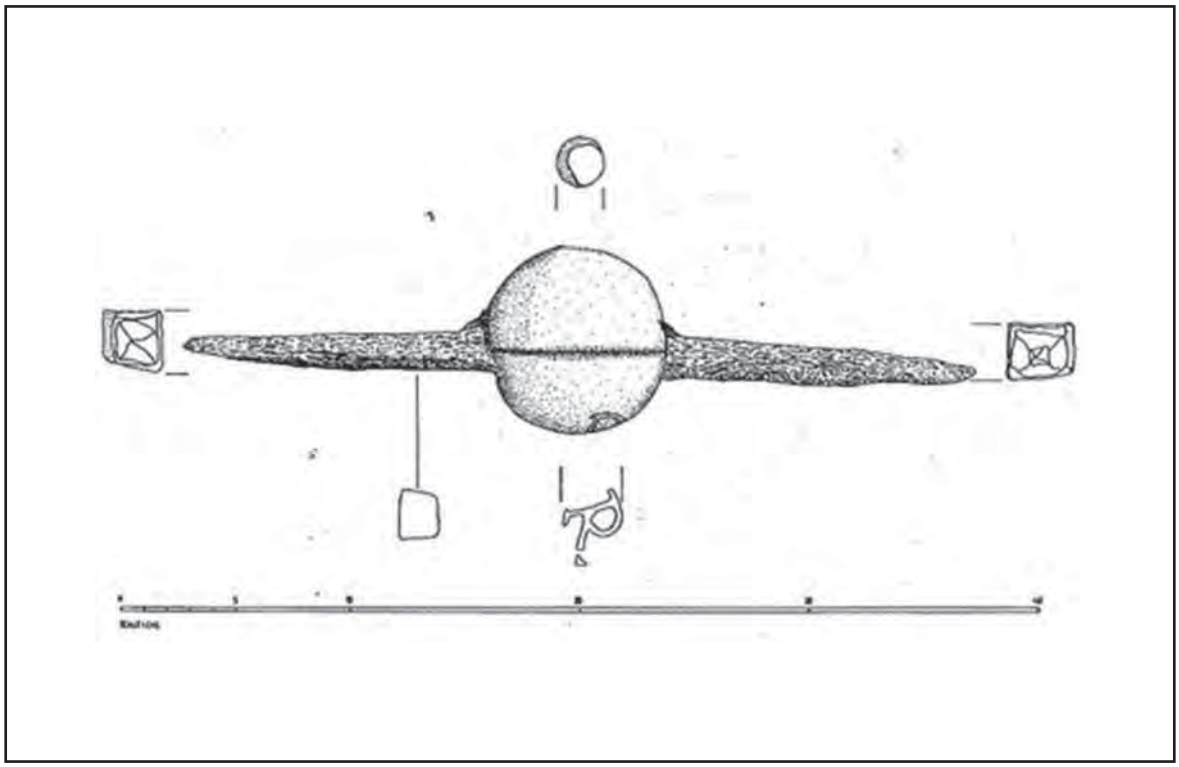


Figure 20. Drawing of crossbar shot, from Alderney shipwreck (Alderney Maritime Trust).

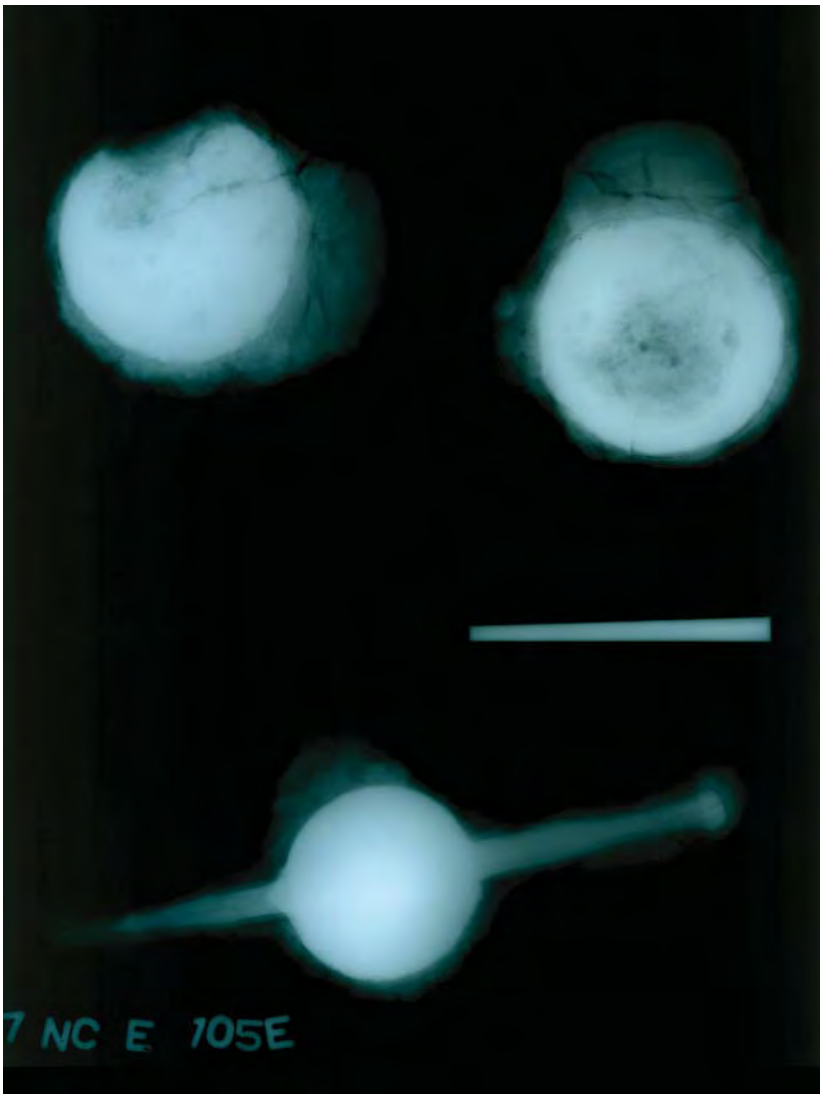


Plate 26. X-ray of grenade (upper images) and cross bar shot (lower image). Courtesy of Maryland Archeology Laboratory.

6.0 SUMMARY, INTERPRETATIONS, AND RECOMMENDATIONS

In the summer of 2012, a limited amount of archeological and geophysical field investigations were undertaken at the purported site of Fort Casimir (7NC-E-105E). The field work was intended to follow on the earlier investigations conducted in 1986 by Edward "Ned" Heite and Louise Heite. Building on and augmenting the earlier work through the application of geophysical survey and GIS mapping, the 2012 investigations included a ground-penetrating radar survey (GPR), the excavation of a former test unit (ER6), excavation of two mechanical trenching (East Trench and West Trench), and limited excavations (ER20 and several features) to further investigate the deposits first discovered and reported by the Heites.

The results of the 2012 survey were both expected and remarkable. The expected results included the relocation of the Heites excavation units through the application of GPR, and the verification of clearly seventeenth-century deposits in the earlier test unit (ER6) as well as in the East and West Trenches and in ER20. The results were remarkable in that 1) they confirm the Heite's findings, but also show that their excavations only literally scratched the surface of an infilled trench or ditch likely associated with the former forts Casimir, Trefaldighet, and/or Amstel. They were remarkable too, in that besides the infilled ditch two other features were discovered only a few inches below the ground surface that may represent the remnants of palisade lines. Whether these features are associated with the forts remains to be determined.

The modern topography reveals much about the layout of the property, especially the former shoreline position, likely that of circa 1930. Earlier aerials support this conclusion as well, as do the GPR time slices that revealed coarse fill deposits under made land, and the excavation and stratigraphy of the East Trench. The West Trench is directly beneath the location of a former structure that a few local informants described as a two-story office building. This structure is visible on aerial photographs, including a few oblique aerials, from the 1930's to the 1950's. The excavations in the West Trench uncovered two possible palisade trenches and revealed no anomalies suggestive of twentieth century origins other than the terra cotta drainage pipe.

It is clear from the investigations that prior to the 1930s considerable shore erosion had occurred. Indeed, Alexander Cooper in his early twentieth century attempt to located Fort Casimir was convinced that little if anything remained of the fort. Based on his own inspection of the property, he noted that

> "Front or Water Street, at this point, has been…entirely washed away — and also much of the fast land, — and it is not at all improbable, from the lay of the land now, that the precise spot of ground on which the Fort stood has been submerged.
>
> A few days ago [Cooper] visited the and carefully viewed the ground, and he estimates that at the point where the Fort stood (exclusive of the bed of Front or Water street) at least 150 feet of fast land has been washed away since the Fort was built. Thus reducing the size of the lot from its original dimensions, — of about 120 feet on the Front or Water street, with a depth of 268 feet to Market street, — to about 120 feet on the river and a depth of 100 feet on Market street. Which further strengthens [Cooper's] belief that most, if not all of the soil whereon the Fort stood is now buried beneath the ceaseless ebb and flow of the tide (Cooper 1905:20).

Cooper's accompanying sketch of where he placed the fort may be at odds with the research undertaken by the Heites and the GIS mapping completed as part of this study. Cooper places the fort not on the parcel owned by Engelbert Lott but too far to the northeast, while the GIS overlays completed for this work place the fort closer to the intersection of Chestnut and Second Streets. The mapping completed by Len Tantillo in 2011, which relied on the Heites archeological report, places Fort Casimir too far to the

northwest, almost on top of what would have been Bull Hill (Figure 21). This placement does not fit with the 1681 plat map of the windmill, which depicts the "fort lot" as situated a short distance southeast. Therefore, while we know that there is a seventeenth-century archeological component in the area that is likely associated with one or more of the fortifications (Casimir, Trefaldighet, or Amstel), at this time we do not know precisely which portion of the fort(s) we have encountered – curtain walls, exterior ditch, water battery area, firing step, shore line, and so on (Figure 22). Further archeological investigations focused on the ditch feature and the possible palisade lines may be beneficial in providing verification of what part of the site is in this area. Additional GPR in the parking area at the foot of Chestnut Street may also be useful. Based on the historical record and mapping, this is the lot purchased by Engelbert Lott that contained the fort. While disturbance did occur here as a result of the ferry terminal, the GPR has the potential to identify possible anomalies associated with the fort(s), and this could provide further evidence of what parts of the fortifications are still archeologically present.

The munitions artifacts recovered during the investigations of Fort Casimir may be associated with the 1664 seizure of the fort by the English. Sir Robert Carr's flotilla consisted of the *Guinea* (mounting at least 36 guns) and the 10-gun *William Nicholas*, and an infantry force of nearly 130 soldiers. In mid-autumn 1664 the warships fired two broadsides into the walls and structures of Fort Casimir, at that time mounting 14 guns and garrisoned by thirty men. The assault included not only ships broadsides, but an infantry attack from the land side of the fort. The Dutch garrison was overpowered, and nearly one-third of the garrision were casualties of the attack (Tantillo 2011:76; Weslager 1967:189-190).

Truncated remnants of Bull Hill likely remain in the vicinity of the playground. This area may be a good target for future field investigations. Local informants have suggested that Bull Hill was mined for its sand resources, and during the process human burials were discovered and relocated. These claims have not been substantiated, though two cemeteries are plotted in the vicinity on historical maps, including an early draft of the Latrobe Survey. At this time JMA has no documented evidence to suggest whether there were human interments in this area or not; the cemetery on the early maps could have been placed there for planning purposes, just as streets were depicted that were never actually built. Though JMA's GPR survey identified no clear evidence for unmarked graves in the area formerly mapped as a "Potters Field", JMA recommends close-interval geophysical survey, including GPR and magnetometry should this area be affected by future development activities. Electrical resistance may also prove valuable, as well as additional investigation of historical records.

The datasets generated by JMA and the Heites provided adequate information to define an area of archeological potential within the broader JMA survey area (Figure 10). The extents of this area were carefully considered based on all available evidence and were necessarily conservative in their delineation in GIS. In the ER6 vicinity, it is clear from the GPR data and the East Trench stratigraphy that shoreward portions of the project area (specifically east of ER6 and ER20) comprise later historical fill units of minimal archeological importance overlying likely Holocene and Pleistocene stratigraphy. To the west of ER6 and ER20 the subsurface is composed of stiff silty subsoil containing preserved archeological features. While the topsoil has been stripped from these areas it does not appear that the subsoil has been heavily disturbed. This suggests the potential for preservation of additional archeological features.

Tracing the extent of the seventeenth-century deposits was based on the GPR data and the limited ground-truthing provided by comparison with the trench stratigraphy. JMA's interpretation of the GPR data, combined with the 1986 field data and the archeological data collected by the project team, suggests high potential for additional seventeenth-century deposits within the project area. These deposits quite likely extend at least few meters to the southwest of ER6 and ER20, and likely continue for a greater distance to the northeast. Additional mechanical trenching may be useful, though the excavations to date have demonstrated that the archeological deposits of interest are well within the reach of standard excavation

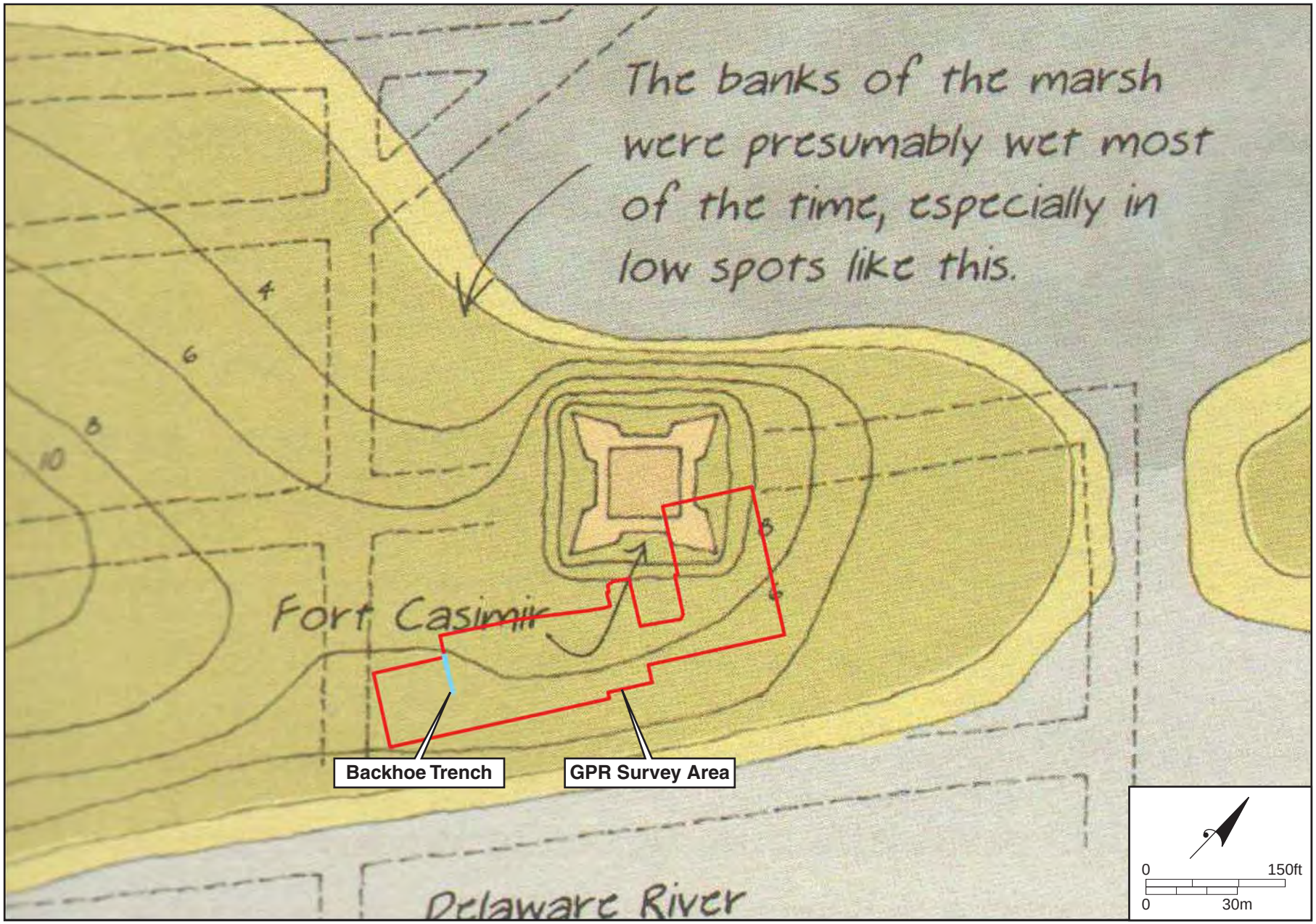


Figure 21. Location of 2012 survey area superimposed on Tantillo's hypothetical location of Fort Casimir (Tantillo 2011:67).

Figure 22. Potential historical identifications of archeological elements discovered at 7NC-E-105E that could be associated with Fort Casimir (based on artists' reconstruction by Len Tantillo, The Edge of New Netherland 2011, page 71).

units. A field effort comprising small-diameter coring on a grid would be an efficient, and quite informative, next step for further field investigation.

JMA recommends writing off areas of deep fill in favor of focusing efforts on delineating the oldest archeological strata in the vicinity of ER6 and ER20. Furthermore, archeological investigation in the vicinity of the playground should be undertaken before any ground-disturbance in the area, as this location has potential for human burials and possibly features related to Fort Casimir (7NC-E-105E). Appendix I provides descriptions and locational data (Northing, Easting, Elevation) for significant total station survey points, including GPR grid nodes, centroids and outlines of archeological features, corners of ER6 and ER20, and points along the outside of the East and West Trenches. This appendix should facilitate future high-resolution re-location of JMA's survey areas.

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APPENDIX I.

TOTAL STATION DATA

Appendix I. Total Station Data

Name and Description	Elevation (m)	Elevation (ft)	Northing (UTM m)	Easting (UTM m)	Northing (StPl ft)	Easting (StPl ft)	Point Type
Edge	2.378	7.802	4390414.802	452009.917	605421.588	615964.639	Point along Edge of Feature
Edge	2.284	7.495	4390416.007	452010.951	605425.559	615968.014	Point along Edge of Feature
Edge	2.299	7.543	4390414.441	452013.153	605420.454	615975.267	Point along Edge of Feature
Edge	2.237	7.338	4390412.273	452016.011	605413.380	615984.680	Point along Edge of Feature
Edge	2.262	7.421	4390411.005	452017.868	605409.248	615990.793	Point along Edge of Feature
Edge	2.250	7.383	4390409.607	452020.265	605404.697	615998.683	Point along Edge of Feature
Edge	2.223	7.294	4390408.269	452022.165	605400.334	616004.938	Point along Edge of Feature
Edge	2.134	7.001	4390407.246	452021.442	605396.964	616002.580	Point along Edge of Feature
Edge	2.205	7.235	4390408.923	452018.991	605402.431	615994.509	Point along Edge of Feature
Edge	2.212	7.257	4390410.094	452017.128	605406.247	615988.377	Point along Edge of Feature
Edge	2.298	7.539	4390411.650	452014.658	605411.314	615980.250	Point along Edge of Feature
Edge	2.186	7.171	4390413.044	452012.366	605415.855	615972.703	Point along Edge of Feature
Bottom Fea. 12.1	1.821	5.976	4390414.593	452011.830	605420.933	615970.921	Point along Edge of Feature
Bottom Fea. 12.1	1.821	5.976	4390414.787	452011.972	605421.570	615971.385	Point along Edge of Feature
Bottom Fea. 12.1	1.818	5.966	4390414.524	452012.383	605420.713	615972.737	Point along Edge of Feature
Bottom Fea. 12.1	1.807	5.928	4390414.289	452012.221	605419.939	615972.210	Point along Edge of Feature
Core EL1	1.005	3.298	4390411.233	452016.558	605409.976	615986.489	Discrete Point
Core EL2	1.040	3.413	4390409.313	452019.587	605403.722	615996.461	Discrete Point
Core EL3	0.982	3.221	4390410.480	452017.817	605407.524	615990.634	Discrete Point
ER20 East Corner	2.182	7.159	4390413.604	452016.626	605417.757	615986.679	Discrete Point
ER20 South Corner	2.172	7.126	4390411.217	452014.816	605409.898	615980.775	Discrete Point
ER6 E, ER20 NW Corner	2.200	7.218	4390414.523	452015.388	605420.755	615982.599	Discrete Point
ER6 North Corner	2.254	7.395	4390415.446	452014.157	605423.768	615978.545	Discrete Point
ER6 SE, ER20 SW Corner	2.197	7.208	4390412.148	452013.569	605412.933	615976.667	Discrete Point
ER6 SW Corner	2.240	7.349	4390413.097	452012.337	605416.029	615972.607	Discrete Point
Feature 12.1	----------	----------	4390413.856	452012.953	605418.530	615974.618	Centroid
Feature 12.1 Excavated Area	----------	----------	4390414.549	452012.091	605420.793	615971.777	Centroid
Feature 12.1 Excavated Area	----------	----------	4390415.203	452011.234	605422.924	615968.955	Centroid

Appendix I. Total Station Data

Name and Description	Elevation (m)	Elevation (ft)	Northing (UTM m)	Easting (UTM m)	Northing (StPl ft)	Easting (StPl ft)	Point Type
Feature 12.2	----------	----------	4390413.974	452011.792	605418.898	615970.807	Centroid
Feature 12.2a	----------	----------	4390414.367	452011.986	605420.192	615971.437	Centroid
Feature 12.2b	----------	----------	4390414.224	452011.935	605419.722	615971.272	Centroid
Feature 12.2c	----------	----------	4390414.089	452011.882	605419.280	615971.101	Centroid
Feature 12.2d	----------	----------	4390413.953	452011.820	605418.833	615970.898	Centroid
Feature 12.2e	----------	----------	4390413.814	452011.801	605418.374	615970.840	Centroid
Feature 12.2f	----------	----------	4390413.779	452011.641	605418.256	615970.315	Centroid
Feature 12.3	----------	----------	4390414.041	452011.295	605419.113	615969.175	Centroid
Feature 12.4	----------	----------	4390414.726	452010.891	605421.355	615967.837	Centroid
Feature 12.5	----------	----------	4390414.611	452011.000	605420.978	615968.198	Centroid
Feature 12.6	----------	----------	4390414.858	452012.233	605421.809	615972.242	Centroid
Feature 12.6a	----------	----------	4390414.981	452012.345	605422.213	615972.606	Centroid
Feature 12.6b	----------	----------	4390414.878	452012.252	605421.874	615972.302	Centroid
Feature 12.6c	----------	----------	4390414.797	452012.160	605421.605	615972.002	Centroid
Feature 12.6d	----------	----------	4390414.703	452012.181	605421.297	615972.073	Centroid
Feature 12.7	----------	----------	4390415.522	452011.360	605423.975	615969.366	Centroid
Feature 12.8	----------	----------	4390414.872	452010.990	605421.834	615968.161	Centroid
GPR Grid Node	2.259	7.412	4390394.987	451997.723	605356.371	615924.922	Discrete Point
GPR Grid Node	2.320	7.611	4390414.789	452011.281	605421.568	615969.116	Discrete Point
GPR Grid Node	2.184	7.165	4390435.408	452025.509	605489.457	616015.500	Discrete Point
GPR Grid Node	2.058	6.752	4390421.177	452046.139	605443.064	616083.424	Discrete Point
GPR Grid Node	1.895	6.217	4390441.788	452060.343	605510.924	616129.728	Discrete Point
GPR Grid Node	1.950	6.396	4390442.928	452058.652	605514.642	616124.161	Discrete Point
GPR Grid Node	2.519	8.263	4390455.985	452039.725	605557.207	616061.842	Discrete Point
GPR Grid Node	2.228	7.311	4390468.325	452048.165	605597.834	616089.356	Discrete Point
GPR Grid Node	2.127	6.979	4390465.528	452052.360	605588.719	616103.166	Discrete Point
GPR Grid Node	1.845	6.054	4390458.730	452062.186	605566.557	616135.519	Discrete Point
GPR Grid Node	1.812	5.945	4390455.314	452067.088	605555.419	616151.659	Discrete Point
GPR Grid Node	1.846	6.057	4390471.917	452071.285	605609.977	616165.179	Discrete Point
GPR Grid Node	1.982	6.501	4390478.737	452061.413	605632.209	616132.677	Discrete Point
GPR Grid Node	2.363	7.753	4390490.081	452044.916	605669.189	616078.362	Discrete Point
GPR Grid Node	2.382	7.815	4390525.040	452047.172	605783.958	616085.231	Discrete Point
GPR Grid Node	1.970	6.465	4390503.458	452078.455	605713.601	616188.231	Discrete Point

Appendix I. Total Station Data

Name and Description	Elevation (m)	Elevation (ft)	Northing (UTM m)	Easting (UTM m)	Northing (StPl ft)	Easting (StPl ft)	Point Type
GPR Grid Node	1.799	5.901	4390496.668	452088.312	605691.469	616220.686	Discrete Point
GPR Grid Node	2.429	7.969	4390500.240	452030.094	605702.305	616029.560	Discrete Point
GPR Grid Node	2.283	7.491	4390514.843	452061.887	605750.716	616133.681	Discrete Point
GPR Grid Node	2.035	6.677	4390400.584	452031.933	605375.259	616037.114	Discrete Point
GPR Grid Origin	2.070	6.791	4390380.814	452018.326	605310.167	615992.757	Discrete Point
Heite Backhoe Trench	----------	----------	4390399.529	452014.082	605371.526	615978.542	Centroid
Heite ER 1	----------	----------	4390432.654	452020.716	605480.344	615999.811	Centroid
Heite ER 2	----------	----------	4390421.376	452026.102	605443.412	616017.658	Centroid
Heite ER 3	----------	----------	4390424.455	452031.802	605453.604	616036.321	Centroid
Heite ER 4	----------	----------	4390428.125	452026.851	605465.573	616020.015	Centroid
Heite ER 5	----------	----------	4390429.139	452024.072	605468.857	616010.879	Centroid
Heite ER 6	----------	----------	4390413.801	452013.862	605418.363	615977.601	Centroid
Heite ER 7	----------	----------	4390408.008	452017.895	605399.411	615990.926	Centroid
Heite ER 8	----------	----------	4390411.784	452015.670	605411.771	615983.569	Centroid
Heite ER 9	----------	----------	4390415.282	452016.227	605423.262	615985.343	Centroid
Heite ER6 Corner Nail N	2.254	7.396	4390413.080	452012.319	605415.974	615972.548	Discrete Point
Heite ER6 Corner Nail SW	2.224	7.296	4390415.377	452014.237	605423.542	615978.809	Discrete Point
Heite ER8 (Found During Trenching)	1.534	5.033	4390411.782	452015.668	605411.764	615983.562	Discrete Point
Heite Post Hole (Original ER6)	1.800	5.906	4390411.949	452014.374	605412.294	615979.310	Centroid
Outline Fea. 12.1	2.075	6.808	4390415.461	452010.651	605423.761	615967.037	Point along Edge of Feature
Outline Fea. 12.1	2.050	6.726	4390414.999	452011.267	605422.257	615969.066	Point along Edge of Feature
Outline Fea. 12.1	2.029	6.656	4390414.628	452011.754	605421.046	615970.671	Point along Edge of Feature
Outline Fea. 12.1	2.026	6.646	4390414.077	452012.455	605419.249	615972.981	Point along Edge of Feature
Outline Fea. 12.1	2.026	6.646	4390414.065	452012.462	605419.209	615973.005	Point along Edge of Feature
Outline Fea. 12.1	1.973	6.472	4390413.705	452012.893	605418.033	615974.425	Point along Edge of Feature
Outline Fea. 12.1	1.826	5.992	4390413.566	452013.034	605417.581	615974.890	Point along Edge of Feature
Outline Fea. 12.1	1.664	5.458	4390413.289	452013.429	605416.676	615976.188	Point along Edge of Feature
Outline Fea. 12.1	1.621	5.320	4390412.852	452013.966	605415.251	615977.959	Point along Edge of Feature

Appendix I. Total Station Data

Name and Description	Elevation (m)	Elevation (ft)	Northing (UTM m)	Easting (UTM m)	Northing (StPl ft)	Easting (StPl ft)	Point Type
Outline Fea. 12.1	1.754	5.756	4390412.360	452014.681	605413.645	615980.313	Point along Edge of Feature
Outline Fea. 12.1	1.739	5.705	4390412.521	452014.799	605414.177	615980.697	Point along Edge of Feature
Outline Fea. 12.1	1.621	5.317	4390413.064	452014.131	605415.949	615978.497	Point along Edge of Feature
Outline Fea. 12.1	1.748	5.733	4390413.662	452013.398	605417.899	615976.084	Point along Edge of Feature
Outline Fea. 12.1	1.986	6.515	4390413.937	452013.054	605418.797	615974.949	Point along Edge of Feature
Outline Fea. 12.1	2.026	6.649	4390414.416	452012.511	605420.360	615973.158	Point along Edge of Feature
Outline Fea. 12.1	2.040	6.694	4390414.933	452011.834	605422.048	615970.931	Point along Edge of Feature
Outline Fea. 12.1	2.053	6.736	4390415.679	452010.845	605424.480	615967.673	Point along Edge of Feature
Outline Fea. 12.2	1.999	6.558	4390414.483	452011.924	605420.573	615971.231	Point along Edge of Feature
Outline Fea. 12.2	1.999	6.557	4390414.093	452011.732	605419.290	615970.607	Point along Edge of Feature
Outline Fea. 12.2	2.039	6.691	4390413.799	452011.574	605418.322	615970.092	Point along Edge of Feature
Outline Fea. 12.2	2.074	6.804	4390413.623	452011.780	605417.747	615970.771	Point along Edge of Feature
Outline Fea. 12.2	2.020	6.627	4390413.998	452011.908	605418.979	615971.188	Point along Edge of Feature
Outline Fea. 12.2	1.991	6.533	4390414.347	452012.062	605420.129	615971.687	Point along Edge of Feature
Outline Fea. 12.2a	1.990	6.529	4390414.380	452011.962	605420.235	615971.358	Point along Edge of Feature
Outline Fea. 12.2b	2.004	6.576	4390414.258	452011.920	605419.834	615971.224	Point along Edge of Feature
Outline Fea. 12.2c	2.018	6.621	4390414.125	452011.870	605419.398	615971.061	Point along Edge of Feature
Outline Fea. 12.2d	2.018	6.620	4390414.008	452011.772	605419.011	615970.741	Point along Edge of Feature
Outline Fea. 12.2e	2.028	6.653	4390413.847	452011.771	605418.481	615970.739	Point along Edge of Feature
Outline Fea. 12.2f	2.027	6.651	4390413.838	452011.640	605418.451	615970.308	Point along Edge of Feature
Outline Fea. 12.6	2.035	6.676	4390414.946	452012.387	605422.098	615972.743	Point along Edge of Feature
Outline Fea. 12.6	2.018	6.621	4390414.806	452012.337	605421.640	615972.583	Point along Edge of Feature
Outline Fea. 12.6	2.018	6.620	4390414.686	452012.212	605421.244	615972.175	Point along Edge of Feature
Outline Fea. 12.6	2.016	6.615	4390414.785	452012.079	605421.565	615971.735	Point along Edge of Feature
Outline Fea. 12.6	2.016	6.615	4390414.904	452012.167	605421.958	615972.023	Point along Edge of Feature
Outline Fea. 12.6	2.030	6.660	4390415.015	452012.256	605422.325	615972.312	Point along Edge of Feature
Outline Fea. 12.6a	2.030	6.659	4390414.938	452012.302	605422.072	615972.465	Point along Edge of Feature
Outline Fea. 12.6b	2.021	6.631	4390414.892	452012.222	605421.919	615972.205	Point along Edge of Feature
Outline Fea. 12.6c	2.021	6.631	4390414.812	452012.168	605421.655	615972.028	Point along Edge of Feature
Outline Fea. 12.6d	2.010	6.593	4390414.754	452012.162	605421.464	615972.009	Point along Edge of Feature
Pipe in Fea. 12.1	1.821	5.973	4390414.670	452011.859	605421.184	615971.014	Point along Center of Feature
Pipe in Fea. 12.1	1.824	5.985	4390414.524	452012.085	605420.710	615971.760	Point along Center of Feature
Pipe in Fea. 12.1	1.820	5.971	4390414.386	452012.284	605420.260	615972.415	Point along Center of Feature

APPENDIX II.

GPR TIME SLICE DATA


GPR Survey Area
True North
0 25 50 100 Feet
0 10 20 40 Meters

GPR Survey Area

True North

0 25 50 100 Feet

0 10 20 40 Meters

GPR Survey Area

True North

0 25 50 100 Feet

0 10 20 40 Meters

GPR Survey Area

True North

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GPR Survey Area

True North

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0 10 20 40 Meters

GPR Survey Area

True North

0 25 50 100 Feet

0 10 20 40 Meters

GPR Survey Area

True North

0 25 50 100 Feet

0 10 20 40 Meters

APPENDIX III.

ARTIFACT INVENTORY

Artifact Inventory
Fort Casimir (7NC-E-105E)
New Castle, Delaware
Date JMA

LOT	AREA	PROVENIENCE	LEVEL	CT	WT (G)	ARTIFACT DESCRIPTION	COMMENTS	DATE RANGE	Rec No
1	East Section of Trench 1	Trench Strata	XIV	1	0	Brick, Fragment: Unidentified, Unglazed			1
1	East Section of Trench 1	Trench Strata	XIV	1	0	Unidentified Metal Object: Slag			2
2	East Section of Trench 1	Trench Strata	XIX	2	0	Nail: Unidentified			3
2	East Section of Trench 1	Trench Strata	XIX	2	0	Brick, Fragment: Unidentified, Unglazed			4
2	East Section of Trench 1	Trench Strata	XIX	2	0	Window Glass: All Thicknesses			5
2	East Section of Trench 1	Trench Strata	XIX	2	0	Unidentified Bottle Fragment: Clear			6
2	East Section of Trench 1	Trench Strata	XIX	1	0	Unidentified Bottle Fragment: Cobalt Blue	"…WYET…"		7
2	East Section of Trench 1	Trench Strata	XIX	1	0	Glass Tableware: Milk Glass	Light Blue	1743-2000	8
2	East Section of Trench 1	Trench Strata	XIX	2	0	Machine-Made Bottle: Clear		1903-2000	9
2	East Section of Trench 1	Trench Strata	XIX	2	0	Machine-Made Bottle Fragment: Aqua	"…HA…", "…D…"	1903-2000	10
2	East Section of Trench 1	Trench Strata	XIX	2	0	20th-Century Refined Earthenware: Molded			11
2	East Section of Trench 1	Trench Strata	XIX	1	0	Domestic Gray Stoneware: Albany Slip Exterior		1805-1940	12
2	East Section of Trench 1	Trench Strata	XIX	1	0	Domestic Gray Stoneware: Albany Slip-Both Sides		1805-1940	13
2	East Section of Trench 1	Trench Strata	XIX	1	0	Domestic Gray Stoneware: Salt-Glazed Exterior/Alkaline Interior			14
2	East Section of Trench 1	Trench Strata	XIX	3	0	White Granite Ware: Plain		1842-1930	15
2	East Section of Trench 1	Trench Strata	XIX	2	0	Faunal: Shell/Snail			16
2	East Section of Trench 1	Trench Strata	XIX	1	0	Unidentified Metal Object: Indeterminate			17
2	East Section of Trench 1	Trench Strata	XIX	1	0	Unidentified Metal Object: Slag			18
3	East Section of Trench 1	Trench Strata	XX	3	0	Electrical, Metal: Wire Fragment			19
3	East Section of Trench 1	Trench Strata	XX	1	0	Yellowware: Annular/Banded	Dendritic Pattern	1830-1930	20
3	East Section of Trench 1	Trench Strata	XX	1	0	Stoneware, Unspecified: Sherd			21
3	East Section of Trench 1	Trench Strata	XX	1	0	Miscellaneous Stoneware: Unidentified	Bottle Fragment		22
3	East Section of Trench 1	Trench Strata	XX	4	0	20th-Century Refined Earthenware: Molded			23
3	East Section of Trench 1	Trench Strata	XX	1	0	Machine-Made Bottle Fragment: Aqua	"ATL…/…AS…"	1903-2000	24
3	East Section of Trench 1	Trench Strata	XX	1	0	Machine-Made Bottle Fragment: Aqua	Bottle Mouth	1903-2000	25
3	East Section of Trench 1	Trench Strata	XX	3	0	Unidentified Bottle Fragment: Clear			26
3	East Section of Trench 1	Trench Strata	XX	1	0	Glass Tableware: Milk Glass		1743-2000	27
3	East Section of Trench 1	Trench Strata	XX	1	0	Unidentified Metal Object: Slag			28
3	East Section of Trench 1	Trench Strata	XX	5	0	Unidentified Metal Object: Indeterminate			29
3	East Section of Trench 1	Trench Strata	XX	1	0	Accessory, Glass: Eyeglass Lens	Lens		30
4	East Section of Trench 1	Trench Strata	XXI	1	0	Whiteware: Gilded		1880-2000	31

Artifact Inventory
Fort Casimir (7NC-E-105E)
New Castle, Delaware
Date JMA

LOT	AREA	PROVENIENCE	LEVEL	CT	WT (G)	ARTIFACT DESCRIPTION	COMMENTS	DATE RANGE	Rec No
4	East Section of Trench 1	Trench Strata	XXI	1	0	Unidentified Metal Object: Slag			32
4	East Section of Trench 1	Trench Strata	XXI	2	0	Coal: Lump/Nugget	Anthracite		33
5	East Section of Trench 1	Trench Strata	XXII	1	0	Kitchen Glass: Milk Glass Jar	Fragment of Lip		34
5	East Section of Trench 1	Trench Strata	XXII	2	0	Coal: Lump/Nugget	"Coke"		35
5	East Section of Trench 1	Trench Strata	XXII	2	0	Unidentified Metal Object: Slag			36
6	East Section of Trench 1	Trench Strata	XXIII	1	0	Window Glass: All Thicknesses			37
6	East Section of Trench 1	Trench Strata	XXIII	1	0	Hard-Paste Porcelain: Plain			38
6	East Section of Trench 1	Trench Strata	XXIII	1	0	Unidentified Bottle Fragment: Amber			39
6	East Section of Trench 1	Trench Strata	XXIII	1	0	Coal: Lump/Nugget	Anthracite		40
6	East Section of Trench 1	Trench Strata	XXIII	1	0	Faunal: Shell/Snail			41
7	East Section of Trench 1	Trench Strata	XXIV	3	0	Brick, Fragment: Unidentified, Unglazed			42
7	East Section of Trench 1	Trench Strata	XXIV	1	0	Wire Common Nail: Fragment		1850-2000	43
7	East Section of Trench 1	Trench Strata	XXIV	2	0	Unidentified Bottle Fragment: Clear			44
7	East Section of Trench 1	Trench Strata	XXIV	1	0	Toy, Ceramic: Glazed Earthenware Marble		1880-1920	45
7	East Section of Trench 1	Trench Strata	XXIV	1	0	Miscellaneous, Metal: Unidentified	Flat and Corroded		46
8	Excavation Unit	ER 20	XXI (E1)	1	0	Tile: Ceramic	Pantile; Roofing Ceramic		47
8	Excavation Unit	ER 20	XXI (E1)	1	0	Unidentified Nail: Cut or Wrought	Bent or Clinched		48
8	Excavation Unit	ER 20	XXI (E1)	20	105	Brick, Fragment: Unidentified, Unglazed			49
8	Excavation Unit	ER 20	XXI (E1)	1	615	Brick: Handmade, Unglazed	Yellow Brick Almost Whole; 18x8.5x3.5 cm		50
8	Excavation Unit	ER 20	XXI (E1)	1	124	Brick: Handmade, Unglazed	Yellow Brick Fragment; 12x4x3 cm		51
8	Excavation Unit	ER 20	XXI (E1)	1	89	Brick: Handmade, Unglazed	Yellow Brick Fragment; 5x4x3.5 cm		52
8	Excavation Unit	ER 20	XXI (E1)	1	43	Brick: Handmade, Unglazed	Yellow Brick Fragment; 4.5x3.5x3.5 cm		53
8	Excavation Unit	ER 20	XXI (E1)	55	195	Brick: Handmade, Unglazed	Yellow Brick Fragments		54
8	Excavation Unit	ER 20	XXI (E1)	2	0	Redware: Unglazed			55
8	Excavation Unit	ER 20	XXI (E1)	1	0	Redware: Plain, Clear Glaze	Glazed Interior, Wash Exterior		56
8	Excavation Unit	ER 20	XXI (E1)	1	0	Tin-Glazed Earthenware: Plain White Glaze		1640-1800	57
8	Excavation Unit	ER 20	XXI (E1)	4	0	Coal: Lump/Nugget			58
8	Excavation Unit	ER 20	XXI (E1)	1	0	Faunal: Shell/Snail			59
8	Excavation Unit	ER 20	XXI (E1)	1	0	Coal: Lump/Nugget	Dating Sample		61
9	Excavation Unit	ER 20	XXI (E2)	10	19	Brick, Fragment: Unidentified, Unglazed			62

Artifact Inventory
Fort Casimir (7NC-E-105E)
New Castle, Delaware
Date JMA

LOT	AREA	PROVENIENCE	LEVEL	CT	WT (G)	ARTIFACT DESCRIPTION	COMMENTS	DATE RANGE	Rec No
9	Excavation Unit	ER 20	XXI (E2)	1	231	Brick, Fragment: Unidentified, Unglazed	7.5x5x4.5 cm		63
9	Excavation Unit	ER 20	XXI (E2)	1	200	Brick: Handmade, Unglazed	Yellow Brick Fragment; 6.5x8.5x3.5 cm		64
9	Excavation Unit	ER 20	XXI (E2)	1	226	Brick: Handmade, Unglazed	Yellow Brick Fragment; 6.5x8.5x3.5 cm		65
9	Excavation Unit	ER 20	XXI (E2)	1	98	Brick: Handmade, Unglazed	Yellow Brick Fragment; 6x5x3.5 cm		66
9	Excavation Unit	ER 20	XXI (E2)	61	273	Brick: Handmade, Unglazed			67
9	Excavation Unit	ER 20	XXI (E2)	6	0	Tile: Ceramic	Pantile; Roofing Ceramic		68
9	Excavation Unit	ER 20	XXI (E2)	13	0	Nail: Unidentified			69
9	Excavation Unit	ER 20	XXI (E2)	4	0	Window Glass: All Thicknesses			70
9	Excavation Unit	ER 20	XXI (E2)	1	0	Redware: Unglazed			71
9	Excavation Unit	ER 20	XXI (E2)	1	0	Free-Blown Bottle Fragment: Clear			72
9	Excavation Unit	ER 20	XXI (E2)	2	0	Unidentified Bottle Fragment: Clear			73
9	Excavation Unit	ER 20	XXI (E2)	1	0	Pipe Stem: 6/64th-Inch Ball Clay		1680-1710	74
9	Excavation Unit	ER 20	XXI (E2)	1	0	Coal: Lump/Nugget	"Coke"		75
9	Excavation Unit	ER 20	XXI (E2)	35	0	Coal: Lump/Nugget			76
9	Excavation Unit	ER 20	XXI (E2)	2	0	Coal, Wood: Charcoal	2 Bags		77
9	Excavation Unit	ER 20	XXI (E2)	5	0	Unidentified Metal Object: Indeterminate			78
9	Excavation Unit	ER 20	XXI (E2)	1	0	Unidentified Metal Object: Indeterminate	Canon ball (6 lbs) Iron ball with spike through It (reference: *Weapons of Warre: The Armaments of the Mary Rose*		79
9	Excavation Unit	ER 20	XXI (E2)	1	0	Pipe Stem: 6/64th-Inch Ball Clay		1680-1710	80
9	Excavation Unit	ER 20	XXI (E2)	2	0	Miscellaneous: Leather			81
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Tile: Ceramic	Pantile; Roofing Ceramic		82
10	Excavation Unit	ER 20	XIV-XV (E/F)	38	0	Flat Glass: Unidentified	Green		83
10	Excavation Unit	ER 20	XIV-XV (E/F)	2	0	Nail: Unidentified			84
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	833	Brick, Fragment: Unidentified, Unglazed	Almost Whole; 13x11x4.5 cm		85
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	1	Brick, Fragment: Unidentified, Unglazed			86

Artifact Inventory
Fort Casimir (7NC-E-105E)
New Castle, Delaware
Date JMA

LOT	AREA	PROVENIENCE	LEVEL	CT	WT (G)	ARTIFACT DESCRIPTION	COMMENTS	DATE RANGE	Rec No
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	704	Brick: Handmade, Unglazed	Yellow Brick Almost Whole; 16x8.5x3.5 cm		87
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	582	Brick: Handmade, Unglazed	Yellow Brick Almost Whole; 14x8x3.5 cm		88
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	373	Brick: Handmade, Unglazed	Yellow Brick Fragment; 10x7x3.5 cm		89
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	119	Brick: Handmade, Unglazed	Yellow Brick Fragment; 6x4x3.5 cm; Red Paint?		90
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	99	Brick: Handmade, Unglazed	Yellow Brick Fragment; 6x6x3.5 cm		91
10	Excavation Unit	ER 20	XIV-XV (E/F)	5	157	Brick: Handmade, Unglazed	Yellow Brick Fragments		92
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	570	Stone: Building	Roughly Width and Height of Bricks		93
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Imported Gray Stoneware: Westerwald Stamped Blue		1700-1775	94
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Redware: Unglazed			95
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Redware: Glazed Interior, Unglazed Exterior	Early Charger Form		96
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Free-Blown Bottle Fragment: Clear	Slight Ridges Perpendicular to Finished Edge		97
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Free-Blown Bottle Fragment: Clear	Fine Ridges Parallel to Finished Edge; Suggested to be Venetian		98
10	Excavation Unit	ER 20	XIV-XV (E/F)	5	0	Coal: Lump/Nugget			99
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Faunal: Bone	In Bag		100
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Pipe Stem: 6/64th-Inch Ball Clay		1680-1710	101
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Pipe Stem: 7/64th-Inch Ball Clay		1650-1680	102
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Pipe Stem: Fragment			103

Artifact Inventory
Fort Casimir (7NC-E-105E)
New Castle, Delaware
Date JMA

LOT	AREA	PROVENIENCE	LEVEL	CT	WT (G)	ARTIFACT DESCRIPTION	COMMENTS	DATE RANGE	Rec No
11	Excavation Unit	ER 20	XIII (G)	1	0	Unidentified Metal Object: Indeterminate	Hand grenade, iron ball with Hole in It		104
11	Excavation Unit	ER 20	XIII (G)	1	0	Pipe Bowl: Decorated Ball Clay	Stippled Ring Around End of Bowl; No Maker's Mark; 17th Century Form (Hume)		105
11	Excavation Unit	ER 20	XIII (G)	1	0	Flotation: Soil Sample (Unprocessed)	Bag with Contents of Pipe Bowl		106
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Flotation: Heavy Fraction			107
10	Excavation Unit	ER 20	XIV-XV (E/F)	1	0	Flotation: Light Fraction			108
			Total:	387					