Phase I Archeological Survey of the Broad Marsh Dike

New Castle, New Castle County, Delaware

prepared for

New Castle Conservation District

by

John Milner Associates, Inc.

July 2013

DRAFT

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OF THE

BROAD MARSH DIKE
NEW CASTLE, NEW CASTLE COUNTY, DELAWARE

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ABSTRACT

This report presents the purpose, goals, methods, and results of Phase I archeological survey of the Broad Marsh Dike in New Castle, New Castle County, Delaware. The investigation was undertaken by JMA (John Milner Associates, Inc.) on April 24, May 9-10, and June 6, 2013 for the New Castle Conservation District. The purpose of the survey was to assess the archeological sensitivity of the project area for the occurrence of intact precontact and/or historical archeological sites. The assessment included historic background research and an archeological survey with eleven (11) shovel tests units (STUs) and two (2) excavation units. In addition, a ground-penetrating radar survey was conducted along the southern portion of the uplands and along the top of the dike to investigate for possible archeological resources.

The results of the field work the the Broad Marsh Dike indicated considerable amounts of fill within the project area that overlaid upland, marsh and intertidal sediments. The majority of the fill encountered contained artifacts from the mid-twentieth century and later. Work conducted by JMA and others in 2012 resutling delineation of an area highly sensitive for archeological remains, including seventeenth century features and human remains

JMA's recommendation is that the Broad Marsh Dike is eligible for placement on the National Register of Historic Places (NRHP) under Criterion A for agriculture, transportation, and conservation; Criterion C as representing vernacular landscape architecture; and Criterion D for their potential to provide information important to research questions in historical archeology. JMA also recommends a finding of No Adverse Effect for proposed rehabilitation efforts. This finding is consistent with the NRHP eligibility recommendation for the Red Lion Dike offered in a May 15, 2013 letter from DNREC to the USACE (Clark to Minnichbach, May 15, 2013). Also contained in the letter was the observation that proposed rehabilitation efforts were consistent with historical repairs to preserve the dike structures, and therefore, would not constitute an adverse effect.

No additional work is necessary for the upland portions of the Broad Marsh Dike project area. An intact soil stratigraphy was located at the northern end of the dike; however, artifact concentrations were of insufficient quantity or character to constitute an archeological site. Within the current (2013) project area and the area investigated by JMA and Craig Lukezic in 2012 at the southern end of the dike is evidence of architectural demolition and filling to the east of the former shoreline. The soil layers and artifacts contained therein, however, lack context, and therefore do not constitute an archeological site. Excavation of EU 2 contained relatively clean soil deposits; however, they are believed to have derived through intertidal deposition, and therefore, any artifacts contained therein lack context. Based on the findings of both investigations, JMA prepared a map delineating an area of high archeological potential, which covers locations that may contain a seventeenth century ground surface and features related to Fort Casimir, or burials related to a former Potter's Field. JMA recommends avoidance of this area. To ensure avoidance, it is recommended that the area by cordoned off during construction in a highly visible manner. If the area cannot be avoided, Phase II investigations are recommended.

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1.0 INTRODUCTION

1.1 PURPOSE AND GOALS OF THE INVESTIGATION

This report presents the purpose, goals, methods, and results of Phase I archeological survey of the Broad Marsh Dike in New Castle, New Castle County, Delaware. The investigation was undertaken by JMA (John Milner Associates, Inc.) on April 24, May 9-10, and June 6, 2013 for the New Castle Conservation District. The purpose of the survey was to assess the archeological sensitivity of the project area for the occurrence of intact precontact and/or historical archeological sites. The assessment included historic background research and an archeological survey with eleven (11) shovel tests units (STUs) and two (2) excavation units. In addition, a ground-penetrating radar survey was conducted along the southern portion of the uplands and along the top of the dike to investigate for possible archeological resources.

JMA's. archeological investigations were conducted under Section 106 of the National Historic Preservation Act of 1966, as amended, and conformed to the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (September 1983), as well as guidelines specific to the State of Delaware, including, but not limited to, *A Management Plan for Delaware's Prehistoric Cultural Resources* (Custer 1986a), *A Management Plan for the Prehistoric Archaeological Resources of Delaware's Atlantic Coastal Region* (Custer 1987), the *Management Plan for Delaware's Historical Archaeological Resources* (De Cunzo and Catts 1990), and the *Delaware Statewide Comprehensive Historic Preservation Plan* (Ames et al. 1987). Field investigations were conducted in accordance with DESHPO guidelines (Delaware State Historic Preservation Office 1993, 1997). The project was undertaken through close coordination with the New Castle Conservation District (NCCD), the Delaware Department of Natural Resources and Environmental Control (DNREC), and the Delaware State Historic Preservation Office (DESHPO).

1.2 DESCRIPTION OF THE PROJECT AREA

The project area is located at the north end of the Town of New Castle, New Castle County, Delaware. The area encompasses the berm of the dike, and a portion of the surrounding marsh and uplands adjacent to each end (Figure 1). The Broad Marsh Dike is 1,400 feet long, and has an elevation spanning from 5 to 8 feet. The width of the dike is from 8 to 12 feet. The sluice gate is toward the southern end of the dike (City of New Castle DMAC).

The Delaware River runs along the eastern side of the Broad Marsh Dike, while the landward side is dominated by marsh. A walking path and a short section of roadway runs over the top of the dike. The majority of the length of the bank is overgrown with trees and brush, and animal burrows are common (Plates 1 and 2). Erosion suffered during Hurricane Sandy varies from severe to marginal across the length of the dike. Elevations within the project area range from 0 to 8 feet AMSL (above mean sea level).

The landscape of upland portions of the APE vary between the two ends of the dike berm. The northern end is a former agricultural field that is now wooded. At the southern end the berm slopes down to Second Street. Adjacent to the berm on the river side is the Bull Hill Yacht Club, which consists of a parking area and a dock and boat launch. On the marsh side of the berm is a sewer pump station. The proposed extension of the berm would run along flat, grassy, open ground to the rear of houses on the east side of Second Street, across the gravel portion of Chestnut Street, and tie in to higher ground adjacent to 120 The Strand.

Figure 1. The location of the Broad Marsh Dike shown on the 1993 7.5-minute USGS *Wilmington South, Delaware* quadrangle.

Plate 1. STU 2NE at the Broad Marsh Dike, showing the intact, albeit likely deflated, soil horizons.

Plate 2. STU 5 at the Broad Marsh Dike, showing the mix of upland and marsh soils used to construct the dike.

2.0 ENVIRONMENTAL AND CULTURAL CONTEXT

2.1 ENVIRONMENTAL SETTING

The project area lies in the Coastal Plain physiographic province, a relatively flat expanse of Pleistocene/Holocene-age terraces dissected by small rivers (Jordan 1964). The geology within the survey area is classified as the Scotts Corners Formation, a upper-Pleistocene aged deposit. It consists of a heterogeneous unit of light-gray to brown to light yellowish brown, coarse to fine sand, gravelly sand and pebble gravel with rare discontinuous beds of organic-rich clayey silt, clayey silt, and pebble gravel. Sands are quartzose, with some feldspar and muscovite, and laminae of heavy minerals are common. The unit underlies a terrace parallel to present Delaware River that has elevations less than 25 ft. It is interpreted to be a transgressive unit consisting of swamp, marsh, estuarine channel, beach, and bay deposits (Ramsey 2005).

The soils adjacent to the dikes consist primarily of marsh sediment (Figure 2). The USDA has classified the marshes as Transquaking and Mispillion soils (TP), which are tidal, and therefore frequently flooded. At the northern end of the Broad Marsh Dike the soil is classified as Ingleside sandy loam (IgB) with 2 to 5 percent slopes, which is deep and well-drained. IgB soils are a brown to dark brown sandy loam that transitions to a strong brown and yellowish brown sandy loam before shifting at just over a meter below ground surface to a yellowish brown loamy sand. At the southern end the soil is classified as Udorthents (UwA) with 0 to 2 percent slope and a wet substratum. UwA describes areas where the upper soil layers have been removed, filled or graded. They are moderately well-drained, gravelly and sandy soil areas located within areas of glacial fluvial deposits.

2.2 PRECONTACT CONTEXT

The precontact archeological record of the northern Delmarva Peninsula has been divided into five major periods (Custer 1989):

1) Paleo-Indian Period (ca. 14,000–8,500 years before present [B.P.]);
2) Archaic Period (8,500–5,000 years B.P.);
3) Woodland I Period (5,000–1,000 years B.P.);
4) Woodland II Period (1,000–350 years B.P.), and;
5) Contact Period (A.D. 1650–A.D. 1750).

The summaries of the precontact time periods given below are based on Custer (1986a, 1984a, 1989), the *Management Plan for Precontact Archaeological Resources of Northern Delaware* (Custer and DeSantis 1986), and Kellogg (1993).

2.2.1 Paleo-Indian Period (ca. 14,000–8,500 years B.P.)

Native Americans first inhabited Delaware sometime after 14,000 years B.P., beginning during the recession of the last glaciation, based on dates from Paleo-Indian period sites in the eastern United States (Custer 1989:81–86). Paleo-Indian peoples probably led a wandering existence in small family groups living mainly by hunting on the shifting woodland and grassland mosaics of the postglacial landscape. Game animals may have included musk ox, caribou, moose, and the extinct mastodon; however, modern game animals, such as white-tailed deer, were also present in the region (Custer 1989:95–98). The Paleo-Indian stone tool kit was designed for hunting and processing animals. Careful resharpening and maintenance of tools was common because of a preference for rare, fine-grained, and often colorful lithic material. Distinctive fluted points are diagnostic of the early Paleo-Indian period and show the preference

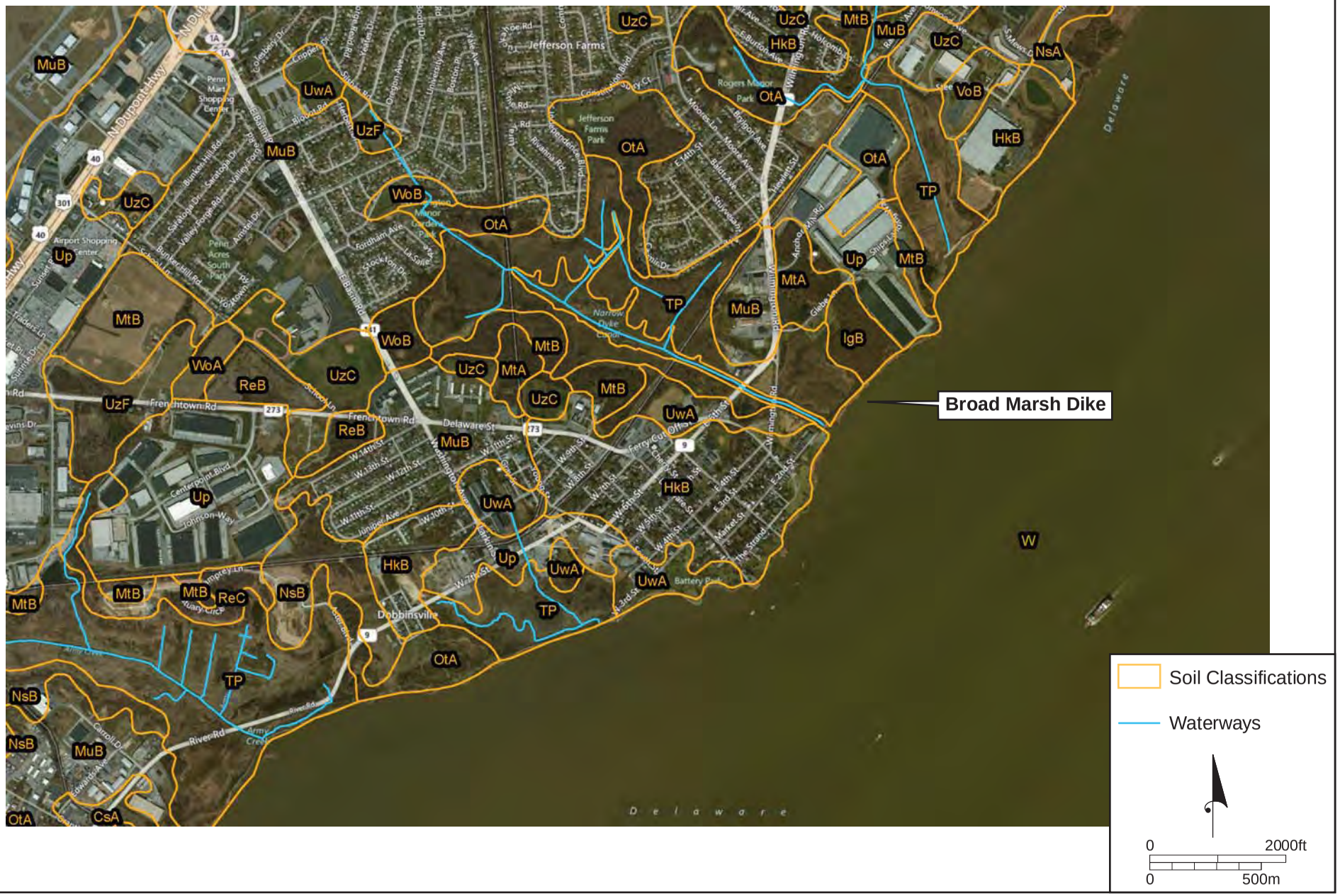


Figure 2. USDA Web Soil Survey Map showing the location of the Broad Marsh Dike.

for high-quality stone (Custer 1984b). Fresh water became a critical resource for both game animals and the hunters who stalked them as solar warmth increased in the early Holocene. Late Paleo-Indian period sites dating after 10,000 years B.P. are relatively rare in Delaware and in the Mid-Atlantic region in general. The known sites are often small and ephemeral, indicating a transitory occupation and a low population density (Custer 1989:120–121).

2.2.2 Archaic Period (8,500–5,000 years B.P.)

The beginning of the Archaic period in Delaware is marked by major changes in human adaptations (Custer 1989:122). By 9,000 years B.P., solar radiation had reached a maximum, and northern species of plants and animals had migrated northward out of the Mid-Atlantic region. Temperate plant and animal species were more common, and climatic patterns had become more like those of the present. The Blueberry Hill site in Kent County, Delaware is one of only a few well-documented, Early Archaic sites known in Delaware (Heite and Bloom 1995). The Early Archaic occupation is buried under windblown sand. Few other Archaic sites have been excavated in Delaware, so much of what is known is extrapolated from other areas (Custer 1989:127–129).

During the Archaic period, human adaptations became more generalized, and foraging for plant food resources was an important activity. Archaic tool kits were less specialized than the earlier Paleo-Indian tool kits and included a wide variety of plant-processing tools, such as grinding stones, mortars, and pestles. A seasonal, mobile lifestyle exploiting a wide range of resources and settings was probably common. Some archeological evidence suggests resources were exploited on a seasonal basis by flexible kinship-based groups (Custer 1989:129). A study of Archaic site distributions on the Delmarva Peninsula (Custer 1986b) found that despite the changes in adaptations between the Paleo-Indian and Archaic time periods, the types of places chosen for occupation were similar. Archaic sites, however, occur in a wider variety of settings. Site-distribution maps for the Delmarva Peninsula (Custer 1989:132) show that swamp settings were still preferred by people using bifurcate-base stone points that date to approximately 7,500 years B.P. Archaic-period sites appear to have been occupied for longer periods of time. Exchange of stone tools tied together people across large areas of the eastern United States, providing a basis for the more elaborate exchange networks established later (Custer 1989:140).

2.2.3 Woodland I Period (5,000–1,000 years B.P.)

The Woodland I period has been correlated with dramatic changes in local climates and environments that occurred throughout the Mid-Atlantic region (Custer 1984a:75, 1989:176–184). Although Custer considers warmer and drier conditions as one cause for the cultural changes seen, in actuality, the climate was becoming generally cooler and moister (Joyce 1988; Stevens 1991). Continued sea-level rise brought extensive brackish water marshes with high biological productivity to within the vicinity of the present coastline of Delaware (Fletcher et al. 1990; Knebel et al. 1988). Woodland I settlement patterns reflect a much more extensive use of the landscape, higher population densities, and a more sedentary lifestyle. Many sizable “macroband” base camps occupied by large numbers of people occur in many areas of the Delmarva Peninsula. The sites suggest a higher population density than earlier base-camp sites, and some sites may have been occupied year-round. From large base camps, smaller task or kin groups exploited the surrounding countryside, establishing smaller base camps and procuring and processing food. Woodland I sites are, thus, very common in the region.

Woodland I tool kits include some major new additions. Soapstone, and then ceramic, containers were added to the artifact assemblages. These durable containers allowed more efficient cooking of some types of food and also may have facilitated storage of surplus food. Plant-processing tools became increasingly more common, as well, indicating intensive wild plant harvesting for food. Chipped-stone tools changed little from the preceding Archaic period; however, broad-bladed, knife-like processing tools increased in

number. Also, the presence of nonlocal lithic raw materials indicates that regional trade and exchange systems were beginning to develop (Custer 1984c). Caching (storage) of special artifact forms may also signify the development of class, or status, differences in the societies.

2.2.4 Woodland II Period (1,000–320 years B.P.)

In some areas of the Mid-Atlantic region, agriculture and large-scale village life mark the Woodland II period (Custer 1996:263–300; Stewart 1994). In northern Delaware, subsistence patterns in the Woodland II period are similar to those of the Woodland I period, but small amounts of cultivated plants were added to the diet. In general, settlement patterns appear to have changed little from the Woodland I period, and the Management Plan Study Units for the Woodland II period are the same as for the Woodland I period (Custer and DeSantis 1986:54–58).

Changes in ceramic technologies and projectile point styles make Woodland II archeological sites recognizable. Triangular projectile points appeared in stone tool kits immediately before the beginning of the Woodland II period, and by 1,000 years B.P., triangular projectile points are the only styles found. Woodland II ceramics of northern Delaware fall within the Minguannan series (Custer 1984a:146–157). The distribution of Minguannan pottery is not well established, but it is concentrated in northern Delaware. Townsend ceramics are common in southern Delaware but apparently are rare in New Castle County (Custer 1989:302–308). The appearance of more-complex decorations, including incised lines and cord-wrapped stick impressions, distinguish Woodland II ceramic styles from Woodland I ceramics.

2.2.5 Contact Period (A.D. 1630–A.D. 1750)

The Contact period began with the first substantial European settlements in Delaware. The archeology of the Contact period is problematic. Only two possible Contact-period Native American archeological sites have been proposed for Delaware. Site 7NC-E-42 (Custer and Watson 1985) is in the Clyde Farm Historic District. No diagnostic European artifacts were found in association with aboriginal material, but stratigraphic interpretation suggested a Contact-period component (Custer and Watson 1985:114). In southern Delaware, Contact-period occupation has been reported for the Townsend site (Omwake and Stewart 1963); however, the associations between European and Native American artifacts were not well documented (Custer 1984a:177).

2.3 HISTORICAL CONTEXT

Delaware's recent past, comprising approximately three centuries, has been compartmentalized into five temporal study units, as defined by the *Delaware Comprehensive Historic Preservation Plan* (Ames et al. 1987). These units form the basis for an appropriate chronological framework for the investigation of the state's historic resources:

1) Exploration and Frontier Settlement (1630–1730);
2) Intensified and Durable Occupation (1730–1770);
3) Transformation from Colony to State (1770–1830);
4) Industrialization and Early Urbanization (1830–1880); and
5) Urbanization and Suburbanization (1880–1940).

2.3.1 Exploration and Frontier Settlement (1630–1730)

The first permanent European settlement in the area now encompassed by New Castle County occurred in 1638 when a group of Swedish settlers in the employ of the New Sweden Company constructed Fort

Christiana in what is now part of the City of Wilmington. During the century between this initial settlement and the end of the period in 1730, New Castle County was under the political, social, and economic control of three separate and distinct colonial jurisdictions: Swedish (1638–1655), Dutch (1655–1664), and English (1664 to the American Revolution). Each of these colonial experiences left their particular mark on historic settlement patterns in northern Delaware.

For the nearly decade and a half that it existed, the New Sweden colony was sporadically supported by the Swedish government. Fort Christiana, located at the confluence of the Brandywine and Christina creeks, became one of the centers of the colony (Weslager 1987). Within a decade of settlement, the homesteads of Swedish and Finnish farmers extended along both sides of the Delaware River between present-day Wilmington and Philadelphia. Despite its geographic extent, the Swedish community remained small, with an estimated population of no more than 250–300 people (Munroe 1978). The Swedes either lived in small, fortified settlements like that which developed around Fort Christiana or on widely scattered, independent farmsteads located along the Delaware River and the lower reaches of its tributaries, such as the Christina. The Delaware River and its tributaries provided the major means of transportation and communication between the isolated homesteads of the New Sweden colony.

The purpose of the New Sweden Company was commerce, and the company employees were concerned primarily with profit-making ventures such as the cultivation of tobacco and trade with the Indians for pelts and hides. For most of the years that this settlement existed, Sweden had great difficulty finding people who were willing to emigrate to the colony on the Delaware, due to war, prosperity in the homeland, and the difficulties of the Atlantic voyage. Most of the early Swedish settlers were either employees of the company, bond servants, or convicts, and few of these individuals intended to become permanent inhabitants of the Delaware River valley. By 1647, after almost a decade of settlement, the colony of New Sweden consisted of fewer than 200 people, and in the six years between 1647 and 1653 no ships, individuals, or letters arrived in the colony from Sweden (Munroe 1978:25–27). The last expedition to arrive in New Sweden in 1654 contained approximately 350 settlers and soldiers.

In an effort to coordinate the study of above-ground and archeological cultural resources, these temporal study units were adopted unaltered in the *Management Plan for Delaware's Historical Archaeological Resources* (De Cunzo and Catts 1990:119).

By 1647, the Dutch West India Company in New Amsterdam recognized that the Swedes posed a potential threat to their colonial interests along the Delaware River, especially with regard to control of the fur trade. Accordingly, they reoccupied Fort Nassau on the east side of the Delaware River and erected a new fortification, called Fort Beversreede, at the mouth of the Schuykill River in southeastern Pennsylvania (Myers 1912:43; O'Callaghan 1858:58). Essentially the Dutch claimed the land that the Swedish colony occupied — from the Schuykill River south — by right of prior discovery. In 1651, the West India Company responded to the Swedish colonization by building Fort Casimir at the Sandhook, the present site of New Castle. The Swedes, recently reinforced, retaliated by seizing the fort in 1654 and renaming it Fort Trinity (Trefaldighet). A year later, in 1655, the Dutch reacted by dispatching a large military expedition (7 ships and over 300 men) to the Delaware River valley. The expedition not only recaptured Fort Trinity, but also captured Fort Christina, the principal Swedish garrison in the colony (Dalhgren and Norman 1988). As a result, New Sweden ceased to exist as a political entity. Nonetheless, many Swedish and Finnish families remained in the region, continuing to observe and maintain their own customs and religion.

In 1657, as a result of peaceful negotiations, the City of Amsterdam acquired Fort Casimir from the West India Company, founding the town of New Amstel near the fort. This was a unique situation in American colonial history — a European city became responsible for the governance of an American colony. Two years later the Dutch erected a small fort near the mouth of the Delaware Bay (modern Lewes), known as

the Whorekil (also spelled Hoerenkil, Horekill, and Hoorekill) for the purpose of blocking English incursions. The Dutch were most concerned with English settlers from the Chesapeake and Virginia, since Lord Baltimore considered the lands on the eastern shore of the Chesapeake and extending to the western shore of the Delaware River as part of his proprietorship (De Cunzo and Catts 1990:30).

For the decade that they maintained it, the Dutch colony along the Delaware River centered on their settlements at New Amstel (present-day New Castle), and at the Whorekil. Like the Swedes, the Dutch settlers appear to have resided on dispersed, subsistence farms where they engaged in general farming and animal husbandry. New Amstel served as the religious and commercial center of Dutch settlement in the lower Delaware River valley. Villages also developed around Swedish settlement sites at the remains of Fort Christina (Wilmington), Upland (Chester), and Wiccaco (the Southwark section of Philadelphia).

English hegemony of the lower Delaware River valley began in 1664 when Sir Robert Carr, acting on behave of James Stuart, Duke of York, commanded a military expedition that attacked and captured the Dutch settlement at New Amstel. The settlement at the Whorekil was also seized and pillaged by the English. Initially, the former Dutch colonies in North America were governed by the English as a royal colony belonging to the Duke of York. The seizure of New Netherlands served to eliminate Dutch competition in the tobacco trade and to consolidate, under the control of Charles II, the Hudson and Delaware River valley settlements with those in New England and on the Chesapeake (Bridenbaugh 1976:157).

In 1682, the "Lower Counties," consisting of New Castle, Kent, and Sussex, were conveyed to William Penn and annexed to Pennsylvania (Munroe 1978). In 1704, Delaware became a separate colony with the establishment of its own assembly but retained close ties with Pennsylvania until the American Revolution. Following Penn's arrival in New Castle, the settlements along the western shore of the Delaware were incorporated into a larger English regional economy centered in Philadelphia, a commercial hub that quickly began to dominate the economic scene in the lower Delaware valley. The Lower Counties were part of Philadelphia's economic hinterland, which also included western New Jersey, northeast Maryland, and southeastern and northeastern Pennsylvania (Lindstrom 1978; Walzer 1972). Farmers in the region sent their grains to local milling and shipping centers, where wheat flour and bread were then transported to Philadelphia or shipped directly for export to the West Indies, other North American colonies, and southern Europe. Farmers in New Castle County quickly adapted to this market system, having already adopted wheat in favor of tobacco as the basic cash crop by the beginning of the eighteenth century. During this period it has been estimated that over one-half of the farmsteads in the region were located within 8 miles (or a half-day's journey) of a mill or shipping wharf (Walzer 1972:163). Other industries, notably lumber for naval stores and the mining and smelting of iron, were also begun in the county during this period, and by the start of the eighteenth century, a community of Welsh miners/settlers resided in the vicinity of Iron Hill in northwestern New Castle County.

During the 1680s, many English, Welsh, Scottish, and Irish Quaker settlers took up land in northern Delaware. Presbyterian Scottish and Scots-Irish servants began to arrive in the area after 1690 (Bridenbaugh 1976:162). Other immigrants to the valley included settlers relocating from other colonies, such as Virginia, Maryland, and New England, the Jerseys, and New York. Enslaved Africans were also brought to the lower Delaware River valley during this early period.

Under the jurisdiction of the Duke of York, the bounds of New Castle County were defined in 1673, and three years later, in 1676, the first county taxes were collected. In the vicinity of the project area, settlement on the north side of the Christina River had extended at least as far upstream as Bread and Cheese Island by 1670. By 1671, three individuals were listed as the residents of Bread and Cheese Island, and five persons were listed as inhabitants of "Christeene" (Gerhing 1977). In 1676, 65 taxables

were recorded as residents along the north shore of the Christina River, and seven years later that number had increased to 87 taxables (Scharf 1888:611–612).

During this period, dwellings and, as they were termed, "plantations," were generally situated on well-drained soils with small agricultural fields located close by. Agriculture remained the principal economic activity of the area. An agricultural system of this type suggests that plantations dating from this period will exhibit an intensive use of the land in the immediate vicinity of the dwelling and associated outbuildings, along with a patchwork of new and old fields, but with large portions of the tract kept in woodland and marsh for forage. Structures present on agricultural complexes dating to this early period would include small dwelling houses generally built of wood (log and frame), with fewer numbers constructed of brick and stone. Dwelling plans included a range of traditional options, such as hall, hall-parlor, double-cell, cross-passage, and four-room (Herman 1987:27). House foundations might occasionally be constructed of brick or stone, but more generally were of earthfast or impermanent construction, a building style that characterized much of the architecture in British North America during this period (Carson et al. 1981; Kelso 1984; Herman 1987:84). A range of outbuildings such as kitchens, tobacco and grain sheds, barns, springhouses, smokehouses, and meat houses would have been present on farmsteads (Herman 1987:61–72).

2.3.2 Intensified and Durable Occupation (1730–1770)

By the middle decades of the eighteenth century, population growth and commercial expansion spurred the growth of towns and the further development of transportation routes and industry. The continued shift in agricultural production from tobacco to marketable grain, begun in the previous period, was completed by the American Revolution, thus opening up new areas of cultivation during this period.

In New Castle County there was a tremendous influx of English and Scots-Irish immigrants during the thirty years between 1725 and 1755. The majority of these new arrivals were indentured servants but also included other Europeans as well as enslaved Africans (Munroe 1978; Bailyn 1986). By 1740 the population of New Castle County was estimated to be 6,000 (De Cunzo and Catts 1990:42).

During this period there was a renewal of town growth based on internal trade networks (Lemon 1967). Several villages, such as Newport, Christiana Bridge, and Cuckoldstown (modern Stanton), were either founded or began to prosper at this time. Willing-Town, later called Wilmington, experienced rapid growth as a market town, specializing in ships' provisions and the shipment of agricultural products to the West Indies. With the increasing export of agricultural produce, milling became an important part of the local economy. By the time of the American Revolution, millseats were found on virtually every stream in northern Delaware capable of generating a sufficient head of water to support a merchant mill (Hancock 1987; Conrad 1908).

Farming and agricultural pursuits were the most significant occupations for between 80 and 90 percent of the region's population (Egnal 1975:201). In the project area, farming took the form of mixed husbandry, combining the cultivation of grains and the raising of livestock (Bidwell and Falconer 1941:84). During the 40 years spanned by this time period, farm sizes in the Piedmont and Upper Peninsula region of New Castle County averaged 320 acres, but properties ranging from 200 to 299 acres were advertised with the greatest frequency in the county. Cleared and/or cultivated land on these farms averaged between 15 and 20 percent of the total acreage (De Cunzo and Catts 1990:47).

The shift from earlier, primarily subsistence agriculture to large-scale commercial agriculture is apparent during this period and was mirrored by alterations in the placement of farms and farmstead layouts. More fields were necessary for grain agriculture, requiring the clearing of additional land and shifts in the

locations of agricultural complexes. Beginning in the 1740s, Georgian architectural forms began to appear in the county, and more permanent methods of construction and material types were used (Carson et al. 1981; Herman 1987:26,109–110). Outbuilding types reflected the changes in agriculture, with a general disappearance of tobacco sheds, the erection of more durable granaries and barns, and the addition of structures related to home manufactures (De Cunzo and Catts 1990:49).

2.3.3 Transformation from Colony to State (1770–1830)

The American Revolution serves as a watershed for the both the end of the last period and the beginning of the new era. The Revolution had a significant impact on the economic and social lives of New Castle County's inhabitants. Maritime activities were disrupted along the Delaware River and its tributaries caused by the British blockade and by raiding activities of British foraging parties. Social and political unrest were widespread, in part caused by economic disorder but also by the pro-Loyalist outlook of some of the state's inhabitants.

Several military campaigns swirled through the project area, the first in the fall of 1777 when a large army composed of British and German auxiliaries disembarked at the head of the Chesapeake Bay and marched through Newark and Hockessin toward Philadelphia. After the battle of Cooch's Bridge (September 3, 1777), Continental troops occupied the villages of Christina, Stanton, and Newport. Shortly thereafter, British troops seized Wilmington, and during the harsh winter of 1777–1778 the port town was garrisoned first by British and then American forces (Cooch 1940). A second major, but equally brief, campaign passed through the project area in the summer of 1781, when Washington's army and its French allies headed south to besiege British troops at Yorktown, Virginia. The effects of nearly seven years of warfare and the social and economic upheavals associated with war strongly affected the general character of the project area, resulting in property damage, deterioration of overland and water transportation, destruction of agricultural crops and livestock, and diminished grain yields.

The project area and surrounding region remained predominantly agricultural during this period. However, a decline in wheat prices and increased competition for good land throughout the region were accompanied in the area by a decline in the fertility of agricultural lands. Wheat was still the dominant crop produced, but poor farming methods, erosion, and soil exhaustion from over a century of farming contributed to the economic woes of Delaware farmers. Out-migrations of frustrated farmers for newly opened western lands created a labor shortage that made cultivation of exhausted and marginal lands less profitable. In the Piedmont and Upper Peninsula areas of Delaware, a period of reorientation and reorganization of the agricultural landscape occurred, as less productive and worn-out farms were abandoned and consolidated into the larger holdings of wealthier farmers (Herman 1987).

While agriculture was in a state of decline and fluctuation, commerce and manufacturing, particularly in the Upper Peninsula and Piedmont regions of the state, flourished, and between 1790 and 1810 commerce prospered as never before (Welsh 1956). After the Revolution the region saw relatively rapid industrial and urban growth, and the loss of agricultural jobs was partly offset by the development of new sources of industrial and commercial income and employment (De Cunzo and Catts 1990:59). By 1815, the Christina River and its tributaries, Red Clay and White Clay creeks, were the power source for 46 mills or manufactories including gristmills, sawmills, cotton and woolen mills, and paper, oil, snuff, slitting, and glazing mills (Coleman et al. 1984:47).

2.3.4 Industrialization and Urbanization (1830–1880)

The economic crises of the early decades of the nineteenth century contributed to an agricultural revolution in Delaware, and farmers in the area began to diversify their production. Developments in

industrialization, urbanization, and transportation significantly affected the project area (De Cunzo and Garcia 1992:25).

Farmsteads in Delaware at the time averaged a little over 200 acres, but those in the Piedmont were generally about 100 acres in size, and by the start of the period most farmers had between 60 and 70 percent of their acreage improved. In New Castle County, farmland accounted for nearly 90 percent of the total available land in the county. Between 1830 and 1880, both the total number of farms and the number of acres of land in cultivation grew, indicating that land previously considered agriculturally marginal, such as drained marshland, was brought under cultivation (De Cunzo and Garcia 1992:26). Piedmont farms during this period were intensively cultivated, with emphasis on dairying and feeder cattle, supplemented by wheat and market truck farming. Farms tended to be family operated, with relatively little hired farm labor. The advent of farming machinery by the middle decades of the century aided in increasing output and profits from relatively small holdings (De Cunzo and Garcia 1992:64).

2.3.5 Urbanization and Suburbanization (1880–1940)

At the beginning of the twentieth century New Castle County held 59 percent of the population in the state, of which 70 percent lived in Wilmington (De Cunzo and Catts 1990:77). A large number of the population were recent Eastern and Central European immigrants (Hoffecker 1974). Between 1870 and 1900, Delawareans employed in agriculture declined from 39.5 percent to 26 percent, while the number employed in manufactures increased from 23.5 percent to over 31 percent. The value of manufactured products compared to agricultural products also increased proportionately, most notably in the Piedmont region near the industrial and commercial center of Wilmington (De Cunzo and Garcia 1992:27). The size of farms and the total farm acreage declined significantly, suggesting a period of farm abandonment or adaptation that was coincident with early suburbanization (De Cunzo and Catts 1990:78).

Large-scale industrialization occurred primarily in the Piedmont region, while small-scale manufacturing set within a largely agricultural economy was typical elsewhere in the state. Completion of the Dupont Highway in 1923 made new areas productive for agriculture, and enabled production for non-local markets to become dominant (De Cunzo and Catts 1990:84-85).

2.4 CULTURAL RESOURCES IN THE VICINITY OF THE APE

The only recorded site immediately adjacent to the APE for a dike is that of Fort Casimir (7NC-E-105E), which is located at the end of Chestnut Street, and northwest of the southerly end of the APE for the Broad Marsh Dike. Archeological investigations have been conducted at twenty additional locations within the boundary of the New Castle Historic District, for a total of twenty-one (Table 1).

In 1986 and in 2012, archeological investigations were conducted at the presumed location of the Fort Casimir (Figure 3). Heite Consulting, Inc. excavated nine units (ER 1 through ER 9) and one backhoe trench in the space between Chestnut Street and the Delaware River (Heite and Heite 1989). The units were dug with a post-hole digger. ER 6 was expanded into two 5x5 feet units (ER 6A and ER 6B) after a price of tin-glazed earthenware was recovered. They reported finding a mid-seventeenth century ditch feature in ER 6B, and concluded they had shown that the remains f the fort persisted at the location. (Heite and Heite 1989:44). In their preservation plan prepared the same year, Heite Consulting, Inc. reinterred the persistence of remains of Fort Casimir, and noted a high potential for human remains to the northeast at the former location of a Potter's Field and the former cemetery associated with Presbyterian Church (Heite and Heite 1989:29).

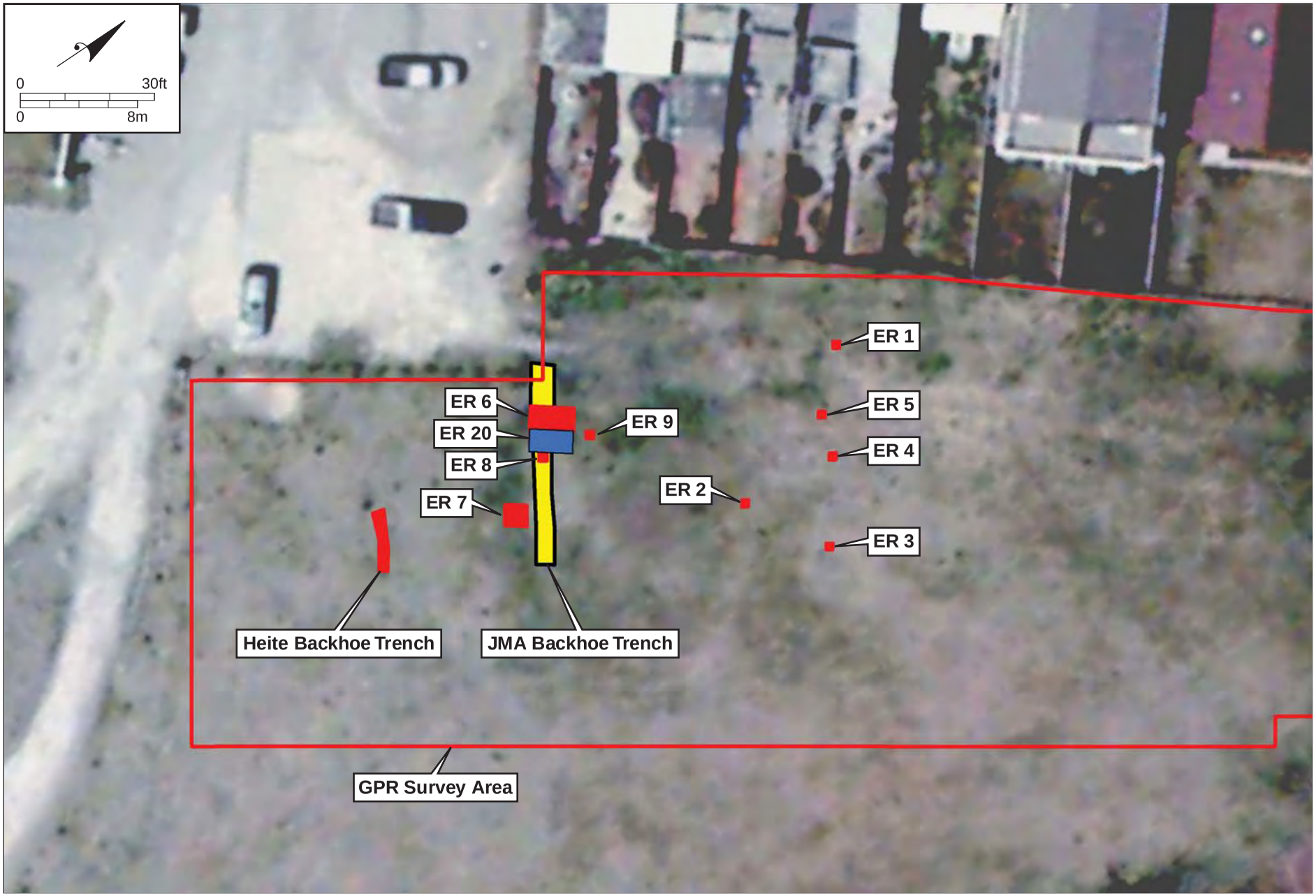


Figure 3. Locations of Heite excavation units (1986) and JMA backhoe trench (2012) in relation to GPR grids, houses and fences, and other nearby features (Leach et al. forthcoming).

Table 1: Locations of archeological investigations 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
312 Delaware Street	7NC-E-105V
8 The Strand	7NC-E-105W

The purposes of the 2012 investigations were fourfold: 1) Conduct ground-penetrating radar survey to evaluate the presence or absence of subsurface remains of Fort Casimir and of burials associated with the former Potter's Field; 2) Re-locate archeological excavation units from 1986 investigations by Heite Consulting, Inc., especially ER6 (Heite and Heite 1989); 3) Re-excavate the re-located ER6 excavation unit and evaluate its stratigraphy; and 4) Monitor a mechanically-excavated trench extending off the unit. The work in 2012 was successful in accomplishing these goals, and identified intact archeological resources dating to the mid-to-late seventeenth century, and may be associated with the fortifications that occupied this site. The 2012 field work included the excavation of two trenches (East Trench and West Trench). The East Trench was 35 feet long, extending from ER6 towards the Delaware River; The West Trench was 9.2 feet in length, and extended west towards the house lots along Second Street.

The datasets generated by JMA and Heite provided adequate information to define an area of archaeological potential within the broader JMA survey area (Figure 4). The extent of this area was 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 archaeological importance overlying likely Holocene and Pleistocene stratigraphy. To the west of ER6 and ER20 the subsurface is composed of stiff, silty subsoil containing preserved archaeological 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 archaeological features.

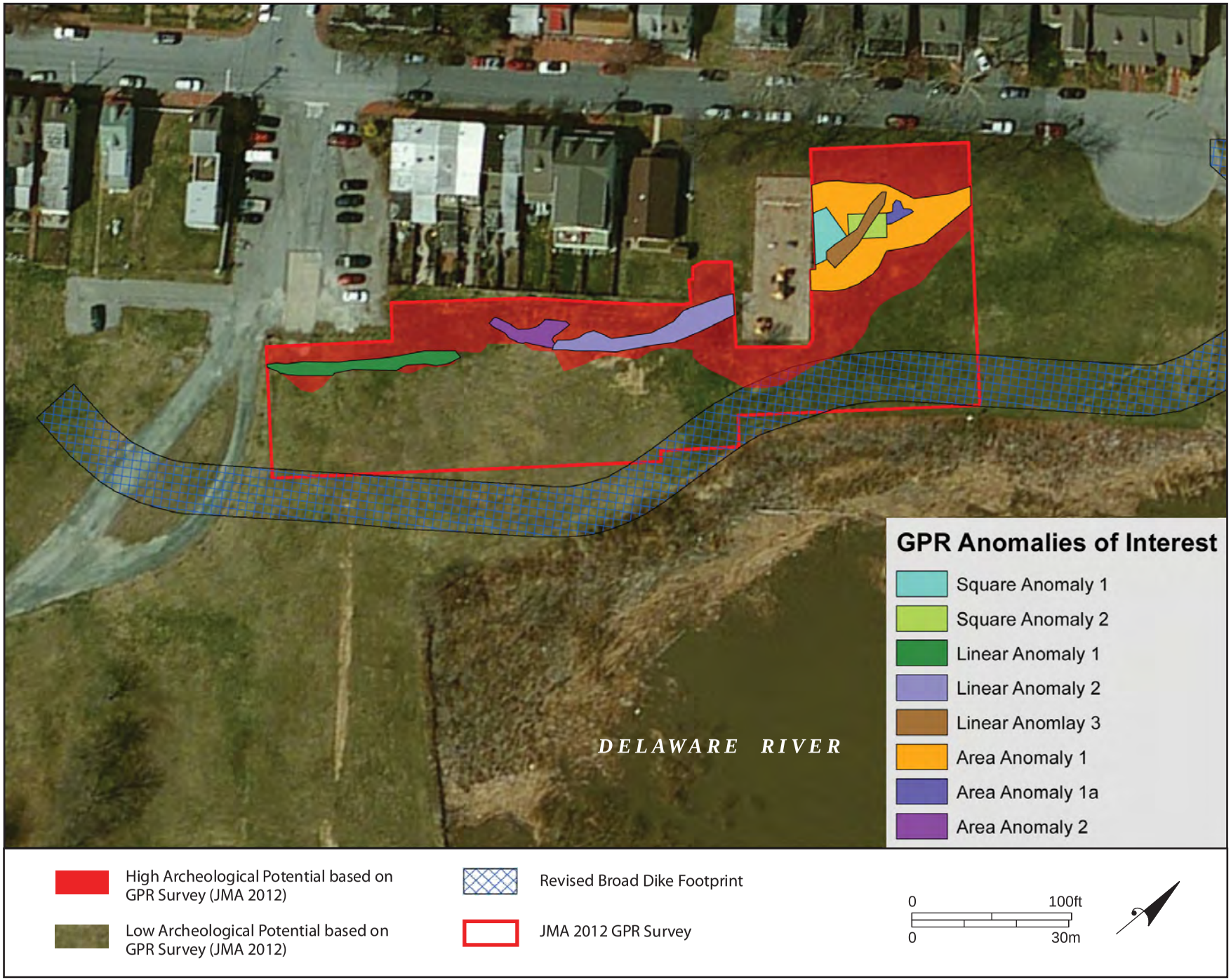


Figure 4. Map of selected GPR anomalies and zones of high and low archeological potential (Leach et al. forthcoming).

Along the southern edge of the shallow subsoil, and parallel to the modern fenceline, two long, linear anomalies (Linear Anomalies 1 and 2) of mid-amplitudes were observed in the GPR data (Figure 4). These anomalies extend along most of the 2012 project area and interfaced with the high amplitudes of the possible Bull Hill remnants near the playground. Area Anomaly 2 may also be related. This anomaly is consistent with the location of the seventeenth and eighteenth century strata identified in Heite's ER6 and JMA's ER20. The two-dimensional GPR profiles show stratified deposits associated with this anomaly that are consistent in location and depth with the stratified historical layers. Like Linear Anomalies 1 and 2, Area Anomaly 2 may represent the historical deposits, or the remnant of the historical trench that they were deposited in.

The Fort Casimir GPR data and the East Trench stratigraphy reveal strong evidence of former shorelines and likely later historical shoreline features. This evidence is consistent with vegetation patterning on the modern aerials, as well as the position of the shoreline on 1930's aerials. Significantly, these data are at odds with the shoreline shown on the 1804 Latrobe Survey, though storm events in the last quarter the nineteenth century are 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 amplitude, 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 (Figure 4).

In the vicinity of the playground, the GPR profiles 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 east toward the Delaware River. The GPR reflectors are probably the remnants of the former Bull Hill, at topographic feature supposedly comprised of sand and gravel. These reflectors appear to be truncated on the Delaware River 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. The area of high amplitudes on time slices should be considered for archaeological investigation. Two interesting rectangular anomalies to the north of the playground (one extending beneath it) appear on the deeper time slices and may represent archaeological features. Other GPR anomalies in the area also suggest potential archaeological features (Figure 4).

In the area surveyed during the Fort Casimir investigations in 2012, JMA identified no clear evidence for unmarked graves in the area formerly mapped as a "Potters Field."

2.5 PROJECT AREA HISTORIC BACKGROUND

The dike presently referred to as the “Broad Marsh Dike” historically was called the “Narrow Dyke,” the “Town Dyke,” or the “foot dyke.” (Figure 5). The earliest known reference to the dike is dated January 1675. The course of present-day Wilmington Road crosses what was historically referred to as the “broad,” “horse,” or “cart” dike (Weslager 1961:205-206, n.88; New Castle County Land Surveys, p.126). Both dikes were referenced in a June 4, 1675 order by English authorities that called for the construction of a new dike on the north end of New Castle (the historical broad dike) to enable a highway to be built. The order also called for repairs to “…the outer dyke [the historical foot dike], which runs along Mr. Hans Block’s marshland” (Gehring 1977:85-86). The outer dike, or foot dike, linked the located north of New Castle, such Swanwick, Crane Hook, and Verdrege’s Hook, with the town.

The order sparked protests among the town’s inhabitants since it was perceived that public aid would benefit private interest. The dissent was especially strong regarding the charge to work on Block’s dike. In a petition submitted to the authorities of New Castle, it was stated that the sentiment expressed in the

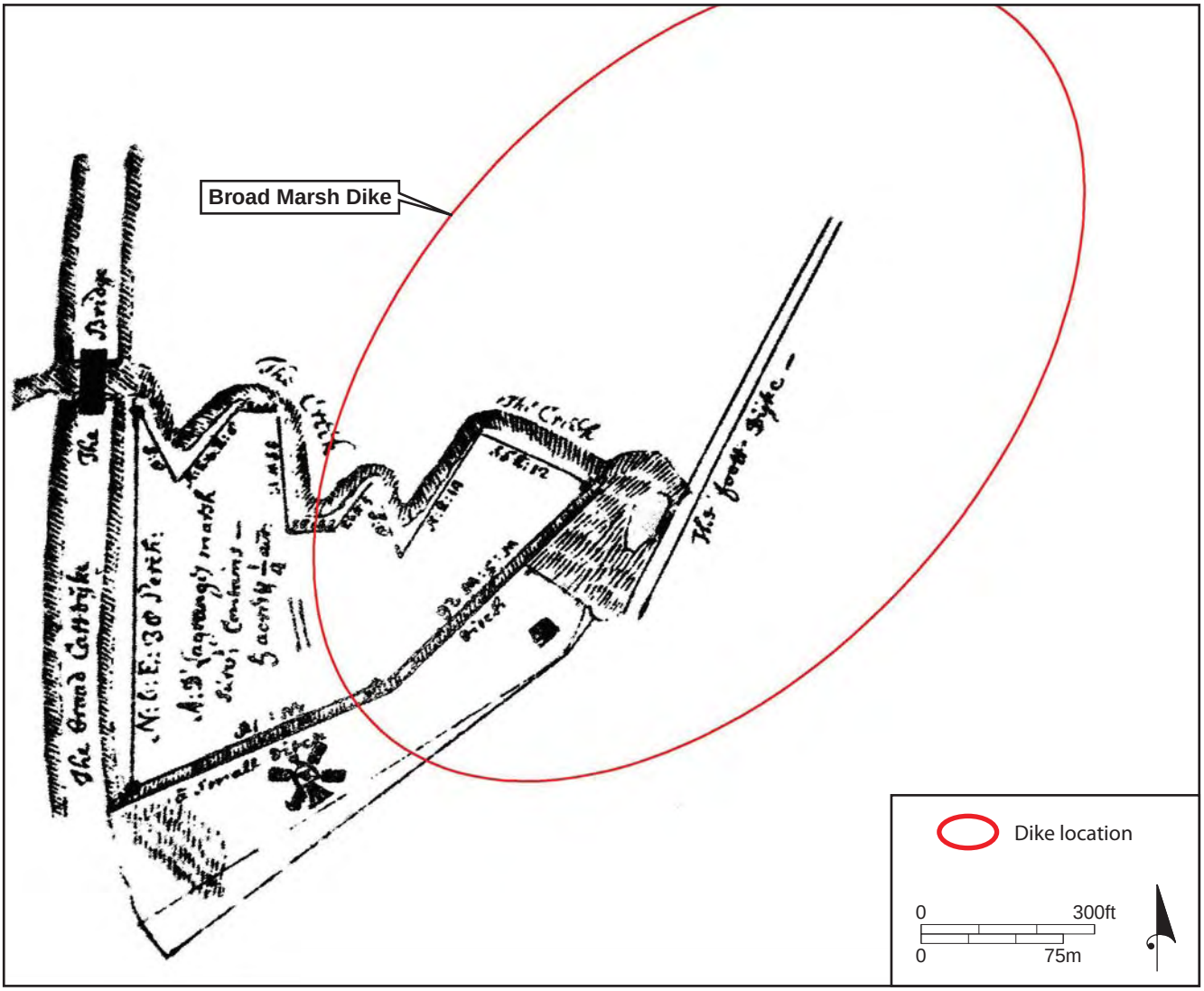


Figure 5. Survey showing the Broad Marsh Dike in 1682. At the time it was referred to as the "foot dyke," while the dike along Wilmington Road was referred to as the "Broad Cart Dyke" (Weslager 1961:Figure 2).

protest was that there was a willingness to work on the highway and associated dike, it being in the public interest. Also likely of relevance, but not stated directly in the petition, the associated marshes were to be considered a public resource. However, there was an unwillingness to serve the private interest of Block. Nonetheless, the petition closed in stating a willingness work on both dikes, since each contributed to the common good. That the work on Block's dike was in the public interest was reiterated by the town magistrates, who argued that the dike enabled a substantial reduction in the distance to be travelled to nearby Swanwick, thereby serving as a public convenience, and ensuring a speedier response to outside threats to both communities (Gehring 1977:88-89).

The outer dike's dimensions were specified by the magistrates. The dike was to be 10 feet wide at its base, five feet high, and three feet wide at the top. It was also to be furnished with "well-made and strong sluices" (Gehring 1977:86).

The Broad Dike cart road was deemed vital to develop a road system that linked villages along the Delaware. The Broad Dike crossed a marshy area variously known as Carr's Meadow, the Town Valley, and Broad Creek (Gehring 1977:76; NCCD G1:89). Carr's Meadow belonged to the heirs of Sir Robert Carr, the commander of the English military force that seized Fort Casimir and pillage the town of New Amstel in 1664. In 1675 Carr's Meadow at the north end of New Castle was described as a great nuisance, "there being no bridge or fitting way to pass, and the Town being in great ruin thereof" (Gehring 1977:76). It was the need for a way to cross Carr's Meadow that led to the near mutiny regarding Hans Block's dike.

By 1722 Carr's Meadow/Town Valley tract, described as being at "the north end of the town of New Castle," was owned by the heirs of three New Castle merchants: Robert French, John Donaldson, and the Richard Halliwell (Cario 2001:42). A dozen owners were identified who were responsible for pieces of marsh (Table 2). The value ranged from 20 shillings/acre to £7/acre, depending on the level of improvement, with a total of £342 available to support the dikes (NCCD G1:435). In 2010 dollars, that equates to more than $63,000 necessary to maintain the dikes. Each of the owners were required to maintain the sluices and dikes "in good repair," thus underscoring the collective community nature of marsh ownership.

Both the cart dike and the foot dike appeared on Latrobe's 1805 Plan of the Town of Newcastle (Figure 6). The overall plan and extent of the Broad Marsh Dike, labeled on the plan as "Little Dike," resembled that of 1682. However, Latrobe illustrated more of southwestern end of the dike, and included the Delaware River shoreline. As compared to the present condition, the extent of the dike at the southwest end has been obscured by infilling along the bank of the river, as well as within the marsh to the northwest. While not illustrated, it is reasonable to assume the sluice was located where the creek intersects with the dike. It is not clear if the current sluice is in the same location, since distortion makes it impossible to place the plan precisely on current maps and aerials. Nonetheless, it appears that its location in 1805, as well as in mid-nineteenth to early twentieth century maps, is the same vicinity as the sluice today (Figures 7 through 11).

In images where the location and extent of the dike, as well as the location of the sluice, are depicted, they appear to have remained unchanged through to the 1990s, at which time a new sluice was constructed immediately north of the existing sluice (Figures 12 through 16). Otherwise, the only change apparent from maps and aerial photographs is the progressive infilling of portions of the marshes, and periodic erosion and redeposition of sediments along the shoreline. While appearing to remain unchanged, and despite the paucity of documentation of repairs, it is certain that over time modifications occurred more frequently than documented, especially periodic replacement of a sluiceway that rotted, and reinforcement of the banks where eroded.

Figure 6. 1805 *Plan of the City of New Castle*, showing the location of the Broad Marsh Dike (Latrobe 1805).

Figure 7. 1848 Rea and Price *Map of New Castle County*, showing the location of the Broad Marsh Dike.

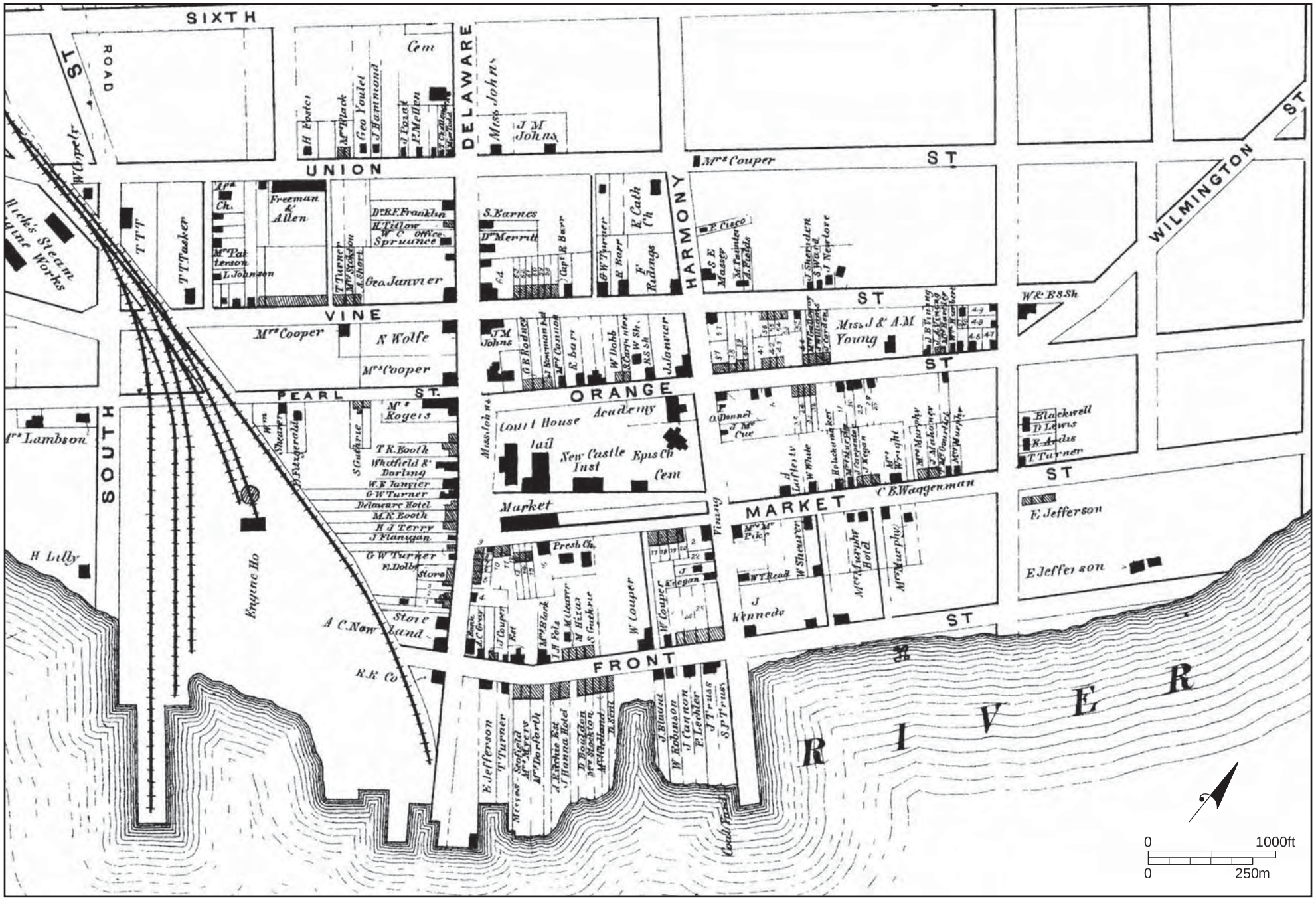


Figure 8. 1868 Beers *Atlas of the State of Delaware*, New Castle (Plate 23), showing the area immediately south of the Broad Marsh Dike, which joins the end of Second Street (Market Street).

Figure 9. 1893 Baist *Atlas of New Castle County*, Delaware, showing the location of the Broad Marsh Dike..

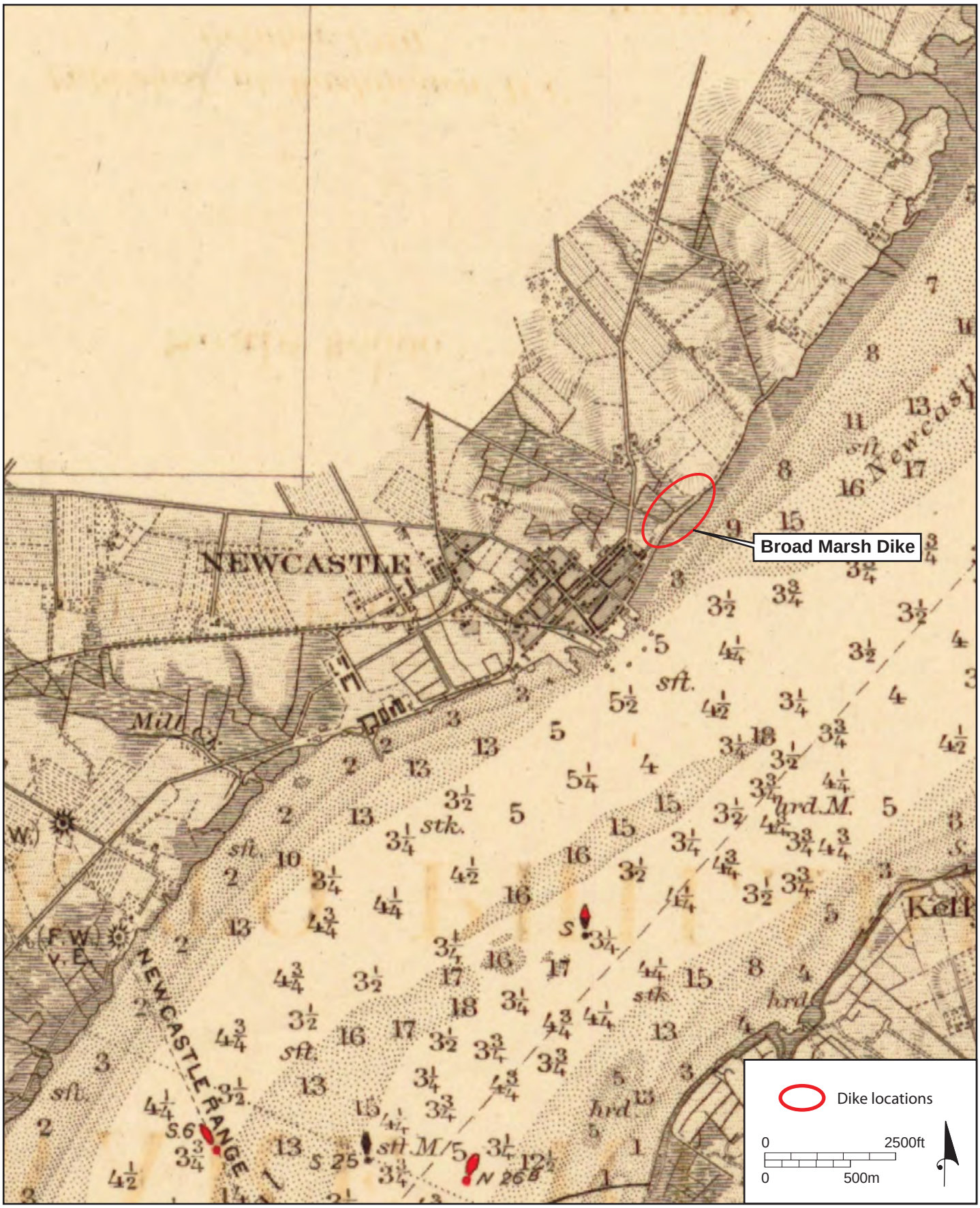


Figure 10. 1901 Coast and Geodetic Survey map showing the locations of the Broad Marsh Dike.

Figure 11. 1906 USGS *Wilmington* Quadrangle showing the location of the Broad Marsh Dike.

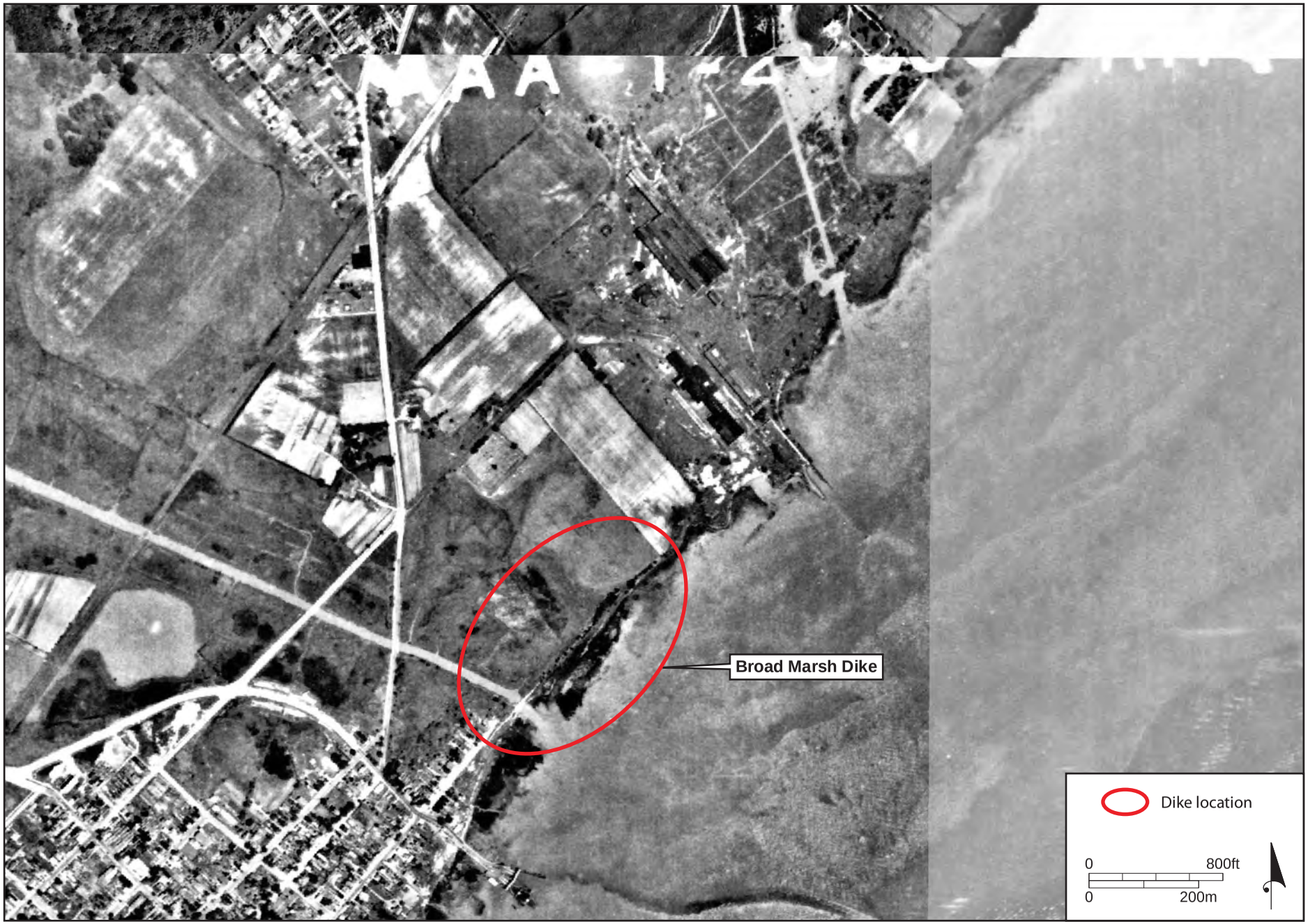


Figure 12. 1937 Aerial photograph showing the Broad Marsh Dike. (USDA 1937).

Figure 13. 1961 Aerial photograph showing the Broad Marsh Dike. (USDA 1961).

Figure 14. 1968 Aerial photograph showing the Broad Marsh Dike. (USDA 1968).

Figure 15. 1997 Aerial photograph showing the Broad Marsh Dike. (DelDOT 1997).

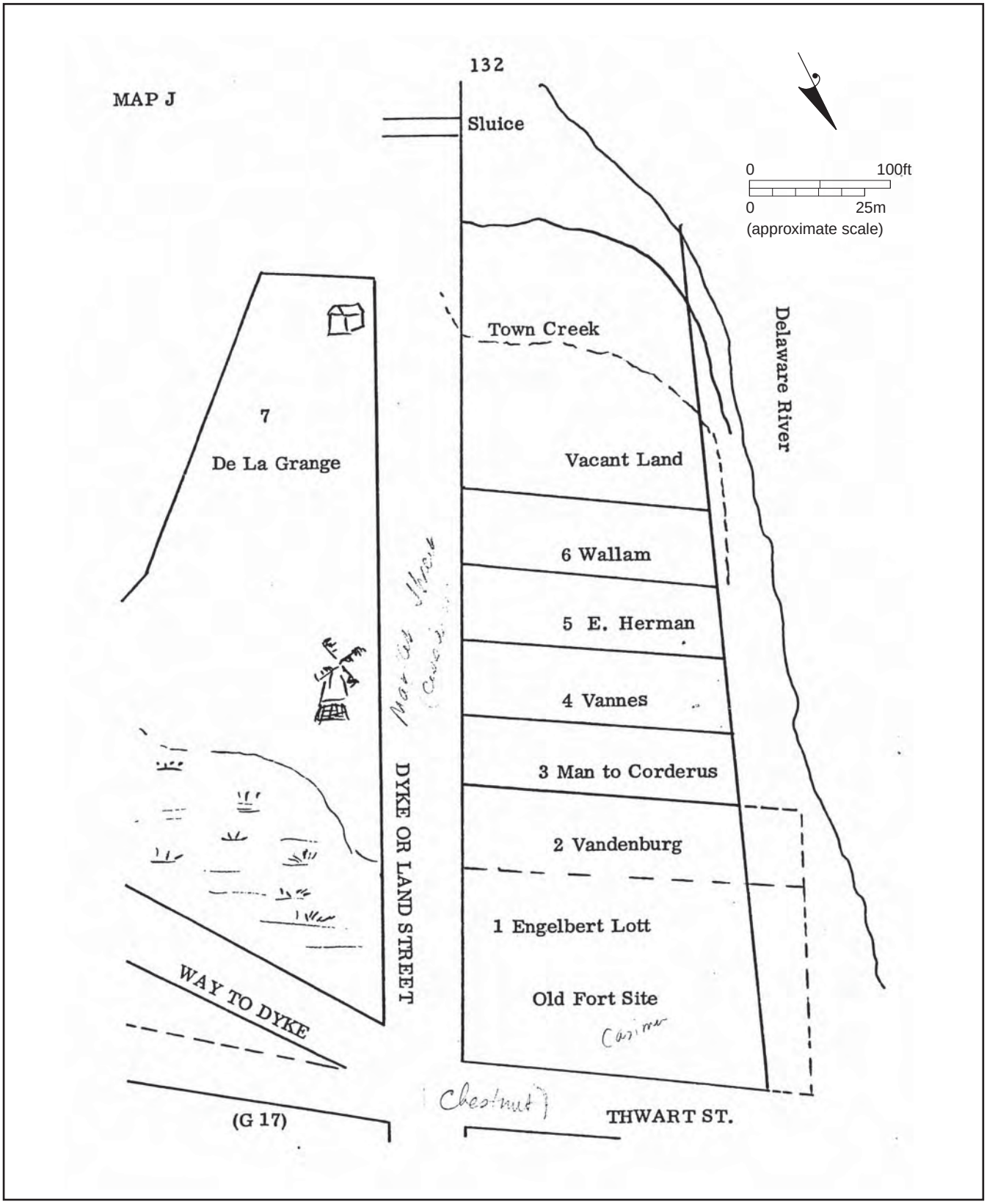


Figure 16. Map depicting property lines and parcel ownership north of present-day Chestnut Street as they occurred in the 1670s and 1680s (Heite 1978:132).

Table 2. Summary of marsh ownership, Carr's Meadow, 1722 (*aka* Broad Dike Marsh)

Name	Acreage	Value/Acre	Total
Robert French's Estate			
Improved marsh on the southwest side of the creek	5 acres	£7	£35
North side of the creek	12 acres	£3	£36
Not improved	[Not given]		£29
Major Donaldson's Estate			
Joseph Hill	4 acres	£4	£16
Daniel Mercer	2 acres	£10 [?]	£20 [?]
John Vangezell	4 acres	£4	£16
John Sylsbye	4 acres	£4	£16
Isaac Gravenraet	6 acres	£3	£18
Nathaniel Caruthers, not improved	6 acres	20 shillings	£6
Thomas Elliot	6 acres	£4	£24
The Unimproved [acreage]	[Not given]		£25
M. Halliwell's Estate			
In the hands of Mr. Ross	12 acres	£4	£48
In the hands of Mr. Ross	4 acres	£3	£12
Nicholas Meers	4 acres	£3	£12
Jonathan Savage	4 acres	£3	£12
The unimproved [acreage]	[Not given]		£30
Witness our hands this 31 July 1722. John French, Samuel Lowman, James Sykes & Jacobus Williams			

The only documentation found regarding modifications appeared in a 1954 report from the State Highway Department, and a newspaper article that commented on the work. Regarding the dikes and sluices, which are referred to as "tidal gates," the Public Works division of the Highway Department reported:

> For several years the Town of New Castle has been subject to periodic flooding of roadways, marshes and low-lying areas adjacent to and within the town. These conditions were the result of tidal waters of the Delaware River forcing their way inland through breaches and low sections in the existing dike system and through gates which were unable to perform their proper function because of structural inadequacy or breaches in adjacent dikes (DSHD1954:76).

The annual reported noted that reconstruction of a dike north of town, and one south of town were in progress (DSHD 1954:76). A news story on the work noted that the repairs were to be made to the "sluice gates at the Dyke on the north of Bull Hill and for other work to the River levee below the battery" (McIntire 1986:84). The author implied that on the north side of town, repairs were being made to the Broad, or Horse Dike, but the reference is vague. Work "below the battery" likely is a reference to the Gambacorta Dike.

Historical information for the upland portions of the APE is more plentiful for the southern portion than it is for the northern end. In her reconstruction of parcels for the period spanning the 1670s and the 1680s, historian Louise Heite depicted the Broad Marsh Dike and in relation to landowners on the southern end of the dike (Figure 16). As reconstructed by Heite no structures stood within the APE. The two structures depicted were the house and windmill on the property of Arnold De La Grange, both of which stood across Second Street from the project area. Also depicted was the parcel on which Fort Casimir once stood, which was located northwest of the APE at the southern end.

Beginning around the mid- nineteenth century houses increasingly were constructed along Second Street for its full length on the northern side, and near Chestnut Street on the southern side (Figures 8 through 18). Other than periodic filling to extend the shoreline further into the river, nineteenth and twentieth century maps depict only two resources that have a potential to fall within the APE. In 1868, two structures owned by an E. Jefferson are shown just to the east of the current playground (Figure 9). Jefferson also owns the house nearby along Second Street. In 1893, only houses along Second Street are depicted (Figure 10).

The other resource depicted is a Potter's Field (Figure 14). The map attributed to ca. 1927 that depicts the Potter's Field does not illustrate the bounds of the burial plot. Known primarily from information gathered from town residents is that the Potter's Field was on a small hill. Resident Irving Thatcher recollected that the hill was leveled in the 1940s. As the workmen removed soils, human remains were disinterred in a haphazard manner. Local boys are reputed to have collected bones, and then reburied along a fenceline at 120 The Strand, which at the time was an agricultural field. When the parcel was prepared for construction of a house, the remains were again displaced. However, Thatcher does not know what happened to them, but surmised they had been pushed toward the edge of the Delaware River (Irving Thatcher, personal communication June 6, 2013).

At the northern end of the Broad Marsh Dike maps depict the area adjacent to the dike as partly marshy ground that was reclaimed and used at least during the twentieth century as agricultural fields (Figures 10 through 14). At some time after 1968, the fields were allowed to go fallow, and revert to woods (Figure 15).

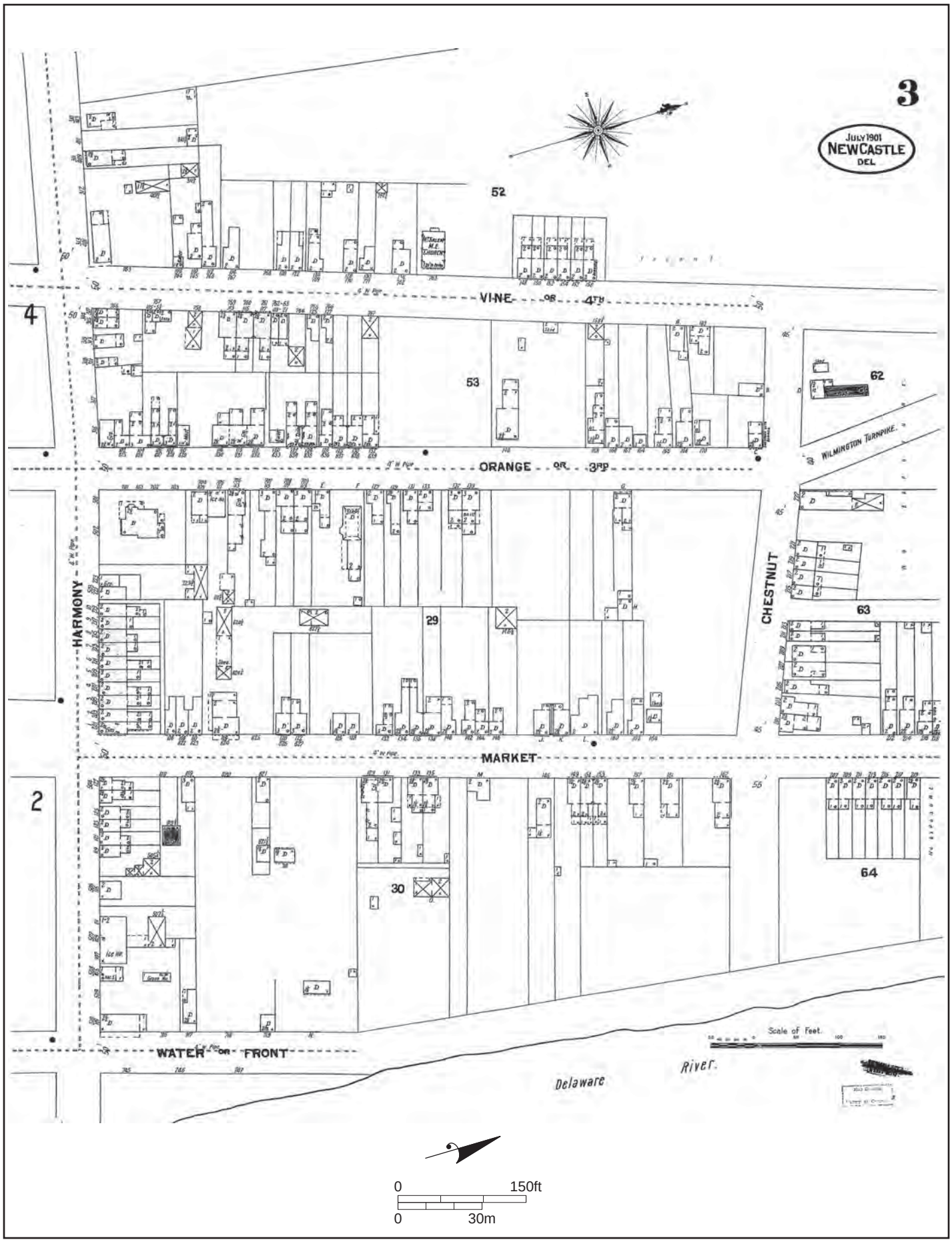


Figure 17. 1901 Sanborn Fire Insurance Map Co, showing the southern part of the APE.

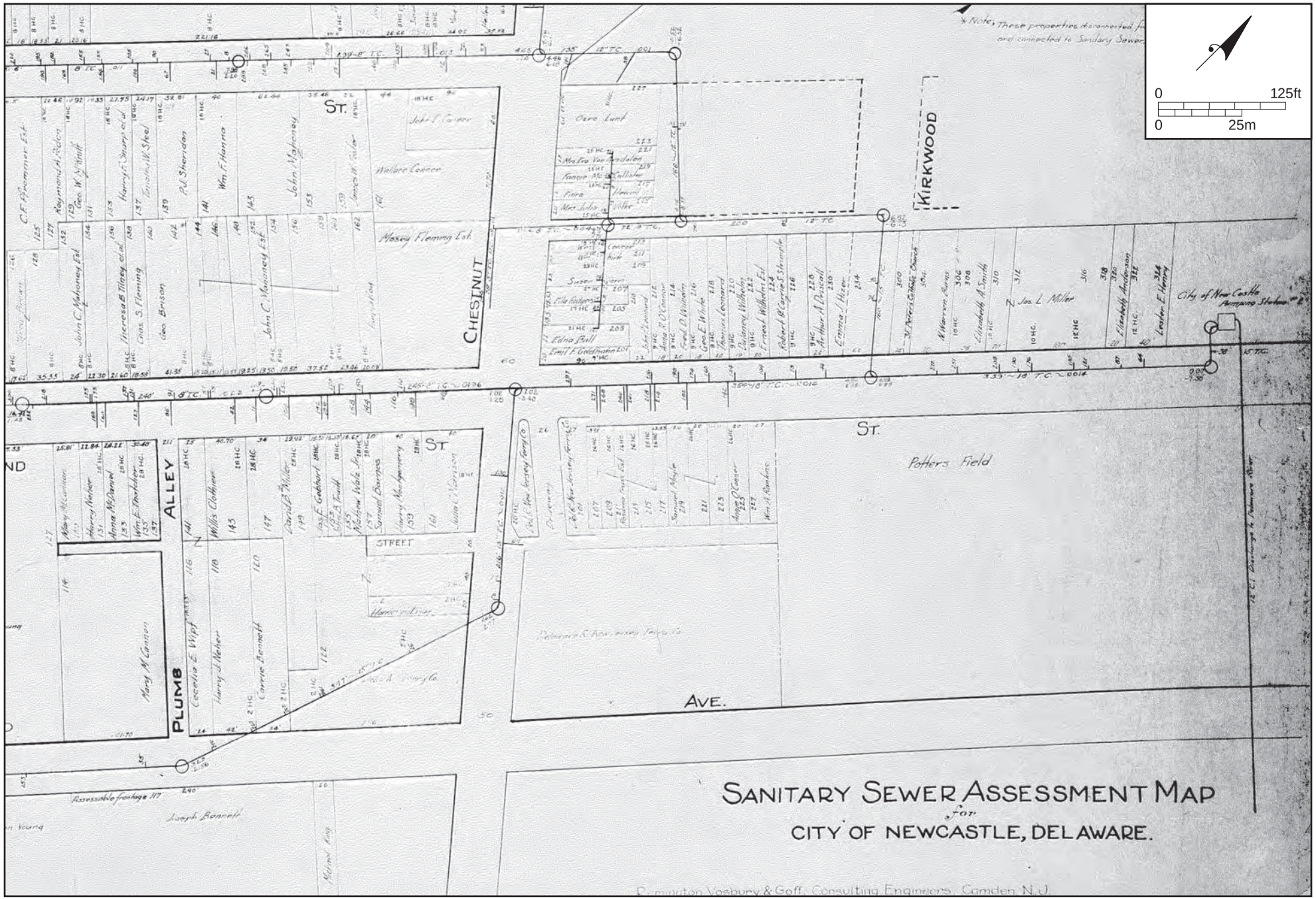


Figure 18. Sanitary Sewer Assessment Map, City of New Castle, Delaware, showing the location of the Potter's Field adjacent to the southern end of the Broad Marsh Dike.

3.0 METHODS

3.1 RESEARCH DESIGN

The research design for the project was aimed at providing cultural contexts for identifying and evaluating archeological resources, if any, that might be affected by the proposed restoration and extension project particular to each dike. The approach focuses on settlement patterns during the various cultural time periods represented in the region based on previous investigations, syntheses of regional data, and management documents for the region. The context for precontact sites focuses on the influence of landscape and/or environmental variables on precontact settlement, as well as interactions between neighboring groups and the surrounding regions. This approach is congruent with the "biosocial" perspective on culture advocated by Custer (1984a:21–22; 1986a:2–8; 1987:1–3; 1989:23–25) and by Thomas et al. (1975). The basic assumption is that past cultures adapted to combinations of natural and social constraints operating in a given area at any particular time. Contexts for historical sites were based in part on a similar approach, augmented with knowledge of transportation networks and historical maps of the project region. In addition, a fuller knowledge of social processes, trends, and patterns is available for the historic period based on manuscript documents and published histories.

Investigations of the dikes themselves relied on a context of Delaware River dikes in New Castle County titled, *"To Keep the Banks, Dams and Sluices in Repair."An Historical Context for Delaware River Dikes, New Castle County, Delaware,* which was prepared by JMA as part of the dike restoration projects being undertaken by the New Castle Conservation District (Catts and Mancl 2013). The purpose of context was to develop an understanding of the cultural and social processes associated with the construction and maintenance of dikes and their relationship to the exploitation of marsh resources in New Castle County, Delaware. Development of the context included 1) identification of the concept, time period and geographic limits of the context; 2) compilation and assessment of the existing information and data related to the context; 3) a written synthesis of the data, which identified the important patterns, events, places, and persons of the context; 4) identification and definition of property types associated with the context; and 5) identification of gaps in the existing data to support further refinement of the context.

Contexts for agricultural properties and for archeological resources within New Castle were bolster through consultation of two additional documents: *Historic Context: The Archaeology of Agriculture and Rural Life, New Castle and Kent Counties, Delaware, 1830–1940* (De Cunzo and Garcia 1992), and *Saving New Amstel: A proposed City of New Castle Archaeological Preservation Plan* (Heite and Heite 1989).

JMA's archeological research was conducted under the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (September 1983), as well as guidelines specific to the State of Delaware, including, but not limited to, *A Management Plan for Delaware's Precontact Cultural Resources* (Custer 1986a), *A Management Plan for the Precontact Archaeological Resources of Delaware's Atlantic Coastal Region* (Custer 1987), the *Management Plan for Delaware's Historical Archaeological Resources* (De Cunzo and Catts 1990), and the *Delaware Statewide Comprehensive Historic Preservation Plan* (Ames et al. 1987). Field investigations were conducted in accordance with SHPO guidelines (Delaware State Historic Preservation Office 1993, 1997).

3.2 BACKGROUND RESEARCH

Background research for the dikes included a literature review of relevant geological, ecological, archeological, and historical sources. Previous JMA reports and gathered research for various other projects in the region were consulted, and archival research was conducted.

Online resources such as the USDA's Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database and Official Soil Series Descriptions (OSDs) websites were consulted for soils information. Geologic data for the area was found on the Delaware Geological Survey website, DGS Geologic Map No. 13 (New Castle County) Dataset (Ramsey 2005). Historic maps and aerials were found from various resources including the Delaware DataMIL, Nationalmap.gov, coastal maps from NOAAs (National Oceanic and Atmospheric Administration) online Historical Map and Chart Collection, the New Castle Community History and Archaeology Program website, and other historic maps on file at the JMA office in West Chester. These were converted into digital format if necessary, and if the historic map had high enough a degree of accuracy, they were georeferenced in order to place the APE correctly on the map.

Historical archeological research consisted of consulting the *Management Plan for Delaware's Historical Archaeological Resources* (De Cunzo and Catts 1990) and *"To Keep the Banks, Dams and Sluices in Repair."An Historical Context for Delaware River Dikes, New Castle County, Delaware* (Catts and Mancl 2013), which provided the basis for areas of investigation and delineation of property types. Regional historical data was gleaned from JMA's extensive library and various archival sources. Project specific history included the gathering of information from historic maps, State of Delaware Enrolled Bills, New Castle County Road Papers, Delaware Department of Transportation Annual Reports.

3.3 GROUND PENETRATING RADAR

Ground-penetrating radar (GPR) is an active, non-invasive geophysical method that records contrasts in the dielectric properties of subsurface materials. A pulse of transmitted electromagnetic energy is reflected or absorbed by dielectric contrasts and the intensity and two-way travel-time of the response is recorded to produce a vertical profile. Reflections are generated from deviations in propagation velocity at interfaces between materials of differing relative dielectric permittivity. A two-dimensional GPR profile consists of individual traces, resulting from a single pulse of energy and the resulting reflections at a given location, that are stitched together horizontally to produce an image of dielectric contrasts. In this sense GPR is not providing a stratigraphic profile, rather it is generating a vertical representation of local 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. Clays, shale, and other high conductivity materials may attenuate or absorb GPR signals.

JMA proposes to conduct the Ground-Penetrating Radar (GPR) within the project area for the Broad Marsh Dike, and will compare the results of the GPR survey with the previous historical research related to dike features, and potential structures within the footprint of the project area. For the Broad Marsh Dike, JMA proposes to collect at least one GPR transect along the crest of the dike. In addition, at the south end beyond the current extent of the Broad Marsh Dike, JMA plans to collect a geophysical grid

within project areas that were not surveyed during previous work conducted in 2012 by JMA related to the investigation in search of Fort Casimir.

For the survey of the berm crest of the Broad Marsh Dike, JMA proposes to use a Sensors and Software Noggin 250MHz GPR System with Smart Cart and Digital Video Logger (DVL). The GPR survey of the non-dike survey area will encompass approximately 0.33 acres consisting of grass lawn and macadam. JMA proposes using a GSSI SIR 3000 system with a 400 MHz or 200 MHz antennae. Post-processing routines for the GPR data are conducted in GSSI's RADAN Software included position correction (time zero), background removal, migration, and high and low pass filtering. Anomalies identified upon processing the GPR data were examined through excavation to determine the nature of the features

3.4 ARCHEOLOGICAL SURVEY

Phase I field survey included initial surface inspection of exposed areas and the excavation of shovel test units (STUs). STUs were laid out on a 15-meter interval grid using geographic information system (GIS) software in order to ensure accuracy and to make sure testing was carried out only within the limits of the APE. The shovel test units were laid out using a sub-meter accurate Trimble GPS system. Radial STUs were laid out in the field using the GPS system at 7.5 meter intervals. Shovel test units were excavated 10 centimeters into subsoil, to one meter if subsoil was not encountered, or to the depth of the water table. Excavated soils were screened through one-quarter inch mesh screen, and any recovered artifacts were retained in bags marked with standard provenience information. Stratigraphy observed in the shovel test units was recorded on standardized forms with depth, soil texture, Munsell color, and posited depositional environment. Photographs were taken to document the setting of the study area and to illustrate the survey findings.

3.5 LABORATORY PROCEDURES AND ANALYSIS

Artifacts recovered in the course of the field investigations were cleaned and inventoried following curatorial guidelines and standards established by the Delaware State Historic Preservation Office. To the extent possible, the recovered artifacts were identified as to material, temporal or cultural/chronological association, style, and function Analysis sought patterns in the relative composition of the recovered artifact assemblages, particularly to the extent that such patterns may indicate the functional nature of the assemblages and/or the site formation processes associated with their deposition. The attributes are particularly relevant for the evaluation for the site's archeological and interpretative potential. All cultural material resulting from the project and the associated documentation will be submitted to the Delaware State Historic Preservation Office.

4.0 RESULTS

4.1 EXPECTED PROPERTY TYPES

4.1.1 Precontact Archeology

Based on the background research, expectations for archeological resources in the vicinity of the APE were developed. For precontact archeological sites the discussion is guided by predictive modeling described and presented in *Delaware Prehistoric Archaeology* (Custer 1984a) and *A Management Plan for Delaware's Prehistoric Cultural Resources* (Custer 1986), and as refined in more recent studies focusing on the State Route 1 and State Route 301corridors (Kellogg 1993; Kellogg and Custer 1994; Baublitz, et al. 2005).

Custer (1984a, 1986) proposed settlement models for each precontact period derived from data on environmental variables, which was then tested against the locations of known archeological sites and surveyed areas. In contrast, Kellogg (1993) used the environmental setting of known sites to develop a model predicting the likelihood of a location to contain a precontact site. Baubalitz et al. (2005) also used data on environmental setting in the development of a predictive model, which was then subjected to a variety of statistical methods to refine breaks in predicted site probability. A significant divergence from prior studies was the use of cost distance analysis, rather than simply distance, which they defined as a measure of the energy or time expended while moving across the landscape. In addition, they added a consideration of "microdrainages" (Baubalitz et al. 2005:49-50). Baubalitz et al. (2005:53) found that their model was not more effective at defining high and moderate probability areas; however, it was more useful in identifying low probability areas.

Custer (1986a:46-51) identified three clusters of sites dating to the Paleoindian period on the Delmarva Peninsula. The clusters outlined are located 1) in northeastern Cecil County, Maryland and northwestern New Castle County, Delaware, which coincides with the presence of outcrops of cryptocrystalline lithic material, 2) along the Eastern Shore of Maryland in the vicinity of the mouths of the Choptank and Nanticoke Rivers, and 3) along the Mid-Peninsular Drainage Divide. An isolated site is located to the south of the Red Lion Dike, a short distance north of the Chesapeake and Delaware Canal. In general, base camps might be expected in the Delaware Chalcedony Quarry Complex and the immediately outlying region, and along the Mid-Peninsular Drainage Divide, while procurement sites and stations might occur almost anywhere. For the project area, Custer (1986a:56) outlines Data quality is poor for the Paleoindian period, as all sites consist of fluted-points not found in an excavated context. Any finds of Paleoindian cultural material in the project area would be considered significant.

For the Archaic Period Custer (1986:76-82) defined four study units: 1) the Piedmont Uplands, 2) along major drainages, 3) fresh water swamps, and 4) along the Mid-Peninsular Drainage Divide. However, climatic conditions were probably drier ca. 9000 years BP (Kellogg and Custer 1994:21–24), so that Archaic sites might be expected closer to reliable or predictable water sources. Based on the locations of known Archaic Period sites in New Castle County, additional sites are predicted to be located on terraces along major and minor drainages and adjacent to fresh water marshes (Custer 1986:Table 6).

The archeology of the Woodland I and II periods is better known than that of the preceding Paleoindian and Archaic periods. By 5000 years BP, climatic conditions had attained an essentially modern character, and the rate of sea-level rise had slowed. The slowing of sea-level rise led to the development of stable and more extensive coastal environments and estuarine resources. Precontact population densities increased, and large sites representing long-term camps were established (Custer 1986a:87). Woodland I

sites are numerous in New Castle County. Five study units are defined in New Castle County for the Woodland I period (Custer 1986:130-132). The study units are: 1) Piedmont Uplands, 2) Interior Swamp, 3) Fall Line, 4) Delaware River Shore, and 5) Interior. Study Unit 4, the Delaware River Shore, applies to the project area. Anticipated site types are macro- and micro-band base camps on terraces along the Delaware River near lower-order stream confluences, and along low order tributaries.

The archeology of the Woodland II period is also well known for Delaware. The Woodland II study units are the same as for the earlier Woodland I period (Custer 1986a:159-162). A seasonal round of shifting base camps is hypothesized for the Woodland II period, with spring and summer camps near the coast and falls and winters spent farther inland (Custer 1987:52). Anticipated site types for the Woodland II are comparable to the Woodland I period (Custer 1986a:160).

Site locations for the Contact period are considered to be the same as for the Woodland II period (Custer 1986a:162-164). However, it is predicted that an increase in the duration and intensity of European settlement would result in fewer and less densely populated sites. Moreover, Contact period sites are predicted to be more likely near loci of European settlement, which for Delaware are the greater Wilmington area, and the area near Lewes.

In each of the models the environmental factors considered most relevant to precontact site location for all periods were nearness to water, moderate to well-drained soils and zero to moderate slope, which describes the portion of Red Lion Dike project area subject to archeological testing. Given this, the probability of locating a precontact site was considered high. Taking into account known site locations for each period, however, modified the range for site probability for the project area from low to high for the various time periods, with low or moderate probability for Paleoindian and Archaic sites, low to high probability for Woodland I and Woodland II sites, high probability for Woodland II sites, and low probability for Contact sites. Data quality, on the other hand, is generally considered poor or fair. Data for the Paleoindian, Archaic, and Contact periods are poor because so few sites are known. For the Woodland I and II periods, data quality is better (fair/good) because more sites are known. Relatively few sites have been excavated, however.

4.1.2 Historical Archeology

General historical archeological expectations are based more directly on the documentary sources. The state plan for Delaware's historical archeological resources (De Cunzo and Catts 1990) provides an initial basis for evaluating potential archeological sites of all time periods in the project area. In the upland portions of the APE, expected property types include: 1) Agricultural Dwelling: the residence of a farm owner-operator, tenant farmer, farm manager, or other free agricultural laborer and his or her family household. It encompasses at least one dwelling, as well as domestic outbuildings and yards, gardens, and associated activity areas (De Cunzo and Garcia 1992:251), and 2) Agricultural Outbuilding: One or more outbuildings of the same or different agricultural functions located on farms but isolated from the farmstead or agricultural complex (defined above). The outbuilding(s) also includes associated work and storage yards (De Cunzo and Garcia 1992:252).

A project-specific historical context has also been developed and will serve to guide the present investigation. In *"To Keep the Banks, Dams and Sluices in Repair. An Historical Context for Delaware River Dikes, New Castle County, Delaware"* (Catts and Mancl 2013), the authors define three primary elements of a dike and the marshland with which it is associated: banks, sluice gates, and ditches. Tools associated with the construction and maintenance of a dike and for exploitation of related marsh resources could include draining, trenching, and ditching spades, cleaners, skivers, trenching forks, drain scoops, and a variety of wet soil and drainage plows.

4.2 ARCHEOLOGICAL INVESTIGATIONS

At the north end of Broad Marsh Dike, nine STUs were excavated along a transect that extended from uplands to a short distance along the top of dike (Figure 19). The STUs on the upland portion had an intact, although likely deflated, stratigraphy that consisted of a 8 to 16 centimeter thick very dark grayish brown (10YR3/2) silty sand plowzone, underlain by a brown (10YR4/3) silty sand, then a yellowish brown (10YR5/6) clay sand (Plate 2). STU 2 held a very small flake and possible fire-cracked rock in the final soil layer. Radials were dug at 5 meters to the northwest and the northeast. The southeast and southwest radials were not dug because they fell at the base of an eroded bank. STUs excavated on the dike showed it to have been constructed from a mix of upland and marsh soils (Plate 3). Historical period artifacts recovered from the STUs indicated deposition within roughly the last one hundred years.

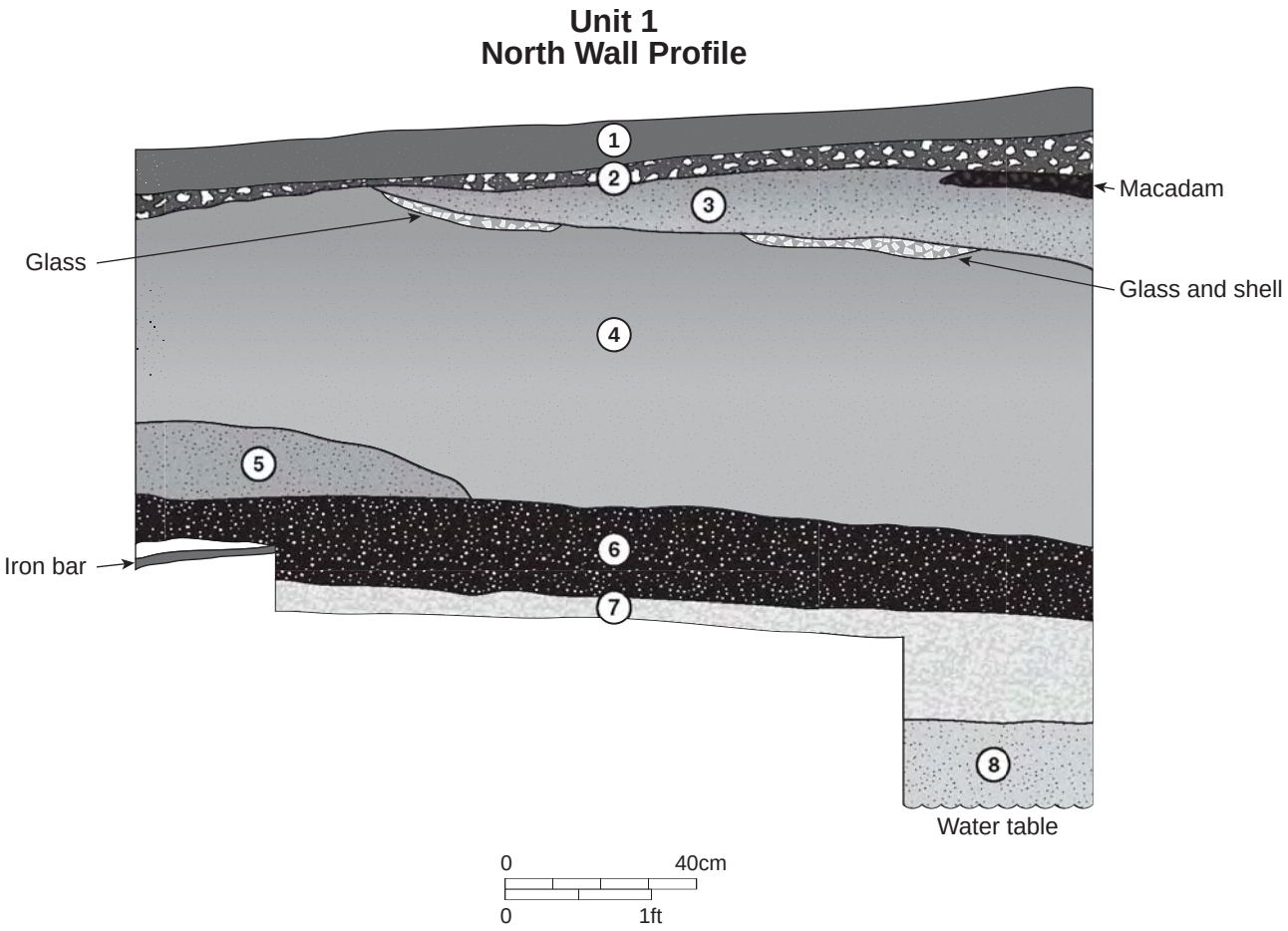
Two STUs were excavated at the extreme south end of the project area. Each STU had topsoil overlaying crushed gravel. Beneath the crushed gravel in STU 7 was a 56-centimeter thick layer of yellowish brown (10YR5/6) sand banded with dark yellowish brown (10YR4/4) silty fine sand. In STU 8, there were two fill layers with a mix of brick and glass fragments, ceramics sherds, and metal. At 52 centimeters below ground surface, layers of boiler slag and waste were encountered. Artifacts noted dated from the late nineteenth century to the present.

The GPR data generated for the Broad Marsh Dike study suggest highly disturbed soils over the majority of the area immediately south of the dike. Within the portion of the project area studied for the Broad Marsh Dike, no clear evidence of the “Potters Field” was found in the GPR data. Three additional STUs were excavated to ground-truth the GPR findings, and one EU was dug to explore what appeared in the data as a berm near the end of Second Street. STU excavations showed the portion of the project area just south of the dike to consist of fill containing primarily architectural debris and pieces of asphalt (Figure 20; Plate 4).

EU 1 consisted of fill layers to a depth of nearly one meter (Figure 21; Plate 5). Beneath a thin lens of mortar that sloped down from west to east, the fill was relatively clean. The final fill layer consisted of a black (10YR2/1) silty sand heavy with clinker, glass, ceramics and metal. The part of the unit interpreted as a berm in the GPR data appears to have been a layer at the western end consisting of a dark yellowish brown (10YR4/4) silty sandy clay containing coal. Beneath the last fill layer was a mottling of yellowish brown (10YR5/4 and 10YR5/6) coarse sand with rounded gravels. To test if this was a natural layer, a hole the size of an STU was dug at the east end of the unit. The water table was encountered at 1.4 meters in a light olive brown (2.5Y5/3) micaceous fine sand. The earliest artifacts recovered dated from the mid-nineteenth century through the early twentieth century.

At the request of DNREC, JMA returned to the field June 6, 2013 to investigate an area where the APE for the proposed berm overlapped with the area delineated as sensitive for archeological resources. A 0.5x2 meter excavation unit was excavated within the area. Excavation revealed that the first two soil layers consisted of a brown (10YR4/3) sandy silt overlaying a mottling of yellowish brown (10YR5/6) silty clay sand speckled with charcoal (Plate 5). Both layers are a common fill sequence across the Town of New Castle. The third layer extended from 21 cmbgs to 85 cmbgs. The deposit consisted of a strong brown (7.5YR5/6) soil that varied slightly in texture with depth. The upper part of the layer was a micaceous silty sand that transitioned to a micaceous very fine sandy silt with depth. Samples of the soils were screened. Recovered but not collected were clear and brown bottle glass, iron chunks, coal ash, vessel glass, nails, brick, and a white-glass prosser button. No modern materials were noted. A core was driven into the base of the unit at 85 cmbgs. Marsh sediments consisting of a very dark gray (2.5Y3/1) clay silt were encountered at 140 cmbgs.

Figure 19. The APE at the Broad Marsh Dike and the locations of STUs, EUs, and the GPR survey area shown on the 2010-2011 Microsoft® Bing™ aerial.



1 10YR 3/3 dark brown fine sandy silt

2 10YR 3/2 very dark brown fine sandy silt with rubble

3 10YR 4/3 brown grading into 10YR 4/6 dark yellowish brown fine sandy silt

4 10YR 4/3 brown grading into 10YR 4/6 dark yellowish brown fine sandy silt

5 10YR 4/4 dark yellowish brown silty fine sandy clay

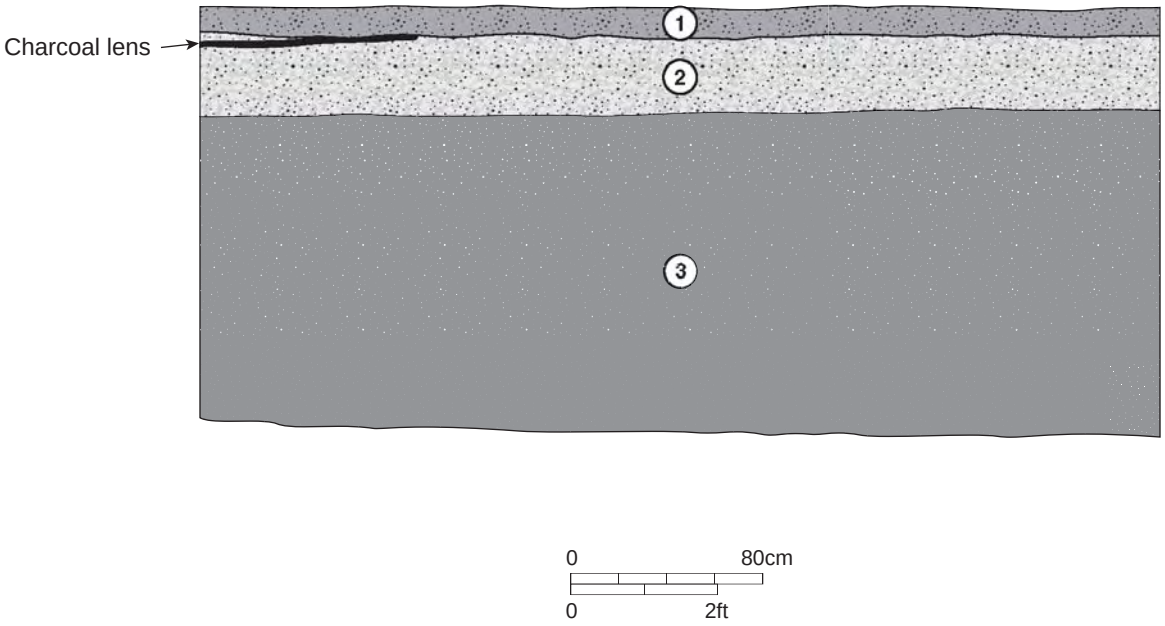
6 10YR 2/1 black silty sand

7 10YR 5/4 yellowish brown mottled with 10YR 5/6 yellowish brown coarse sand with rounded gravels

8 2.5Y 5/3 light olive brown micaceous fine sand

Figure 20. North profile of EU 1 at the Broad Marsh Dike.

Unit 2
South Wall Profile



1 10YR 4/3 brown sandy silt

2 10YR 5/6 yellowish brown mottled with 10YR 5/4 yellowish brown silty clay sand

3 7.5YR 5/6 strong brown silty sand transitioning to sandy silt with depth

Figure 21. South profile of EU 2 at Broad Marsh Dike.

Plate 3. STU A3 at the Broad Marsh Dike, showing multiple layers of fill.

Plate 4. North profile of EU 1 at the Broad Marsh Dike.

Plate 5. South profile of EU 2 at Broad Marsh Dike.

Plate 6. Thirty centimeter core sample starting at 130 cmbgs, or 54 centimeters below the base of EU 2 at Broad Marsh Dike.

5.0 SUMMARY AND RECOMMENDATIONS

5.1 SUMMARY

JMA conducted a Phase I archeological survey of the Broad Marsh Dike that include historic background research and an archeological survey. Nine STUs were excavated at the northern end of the dike, and two TTUS were excavated at the extreme southern end. A GPR survey was completed in the area south of the Bull Hill Yacht Club, which was then ground-truth through the excavation of three STUs and two EUs. Excavation of the EUs enabled further investigation for potential buried ground surfaces. Archeological testing consisting of monitoring and profile recordation will be conducted during tree removal at the Broad Marsh Dike at a future date.

The results of the field work the the Broad Marsh Dike indicated considerable amounts of fill within the project area that overlaid upland, marsh and intertidal sediments. The majority of the fill encountered contained artifacts from the mid-twentieth century and later.

5.2 RECOMMENDATIONS

JMA's recommendation is that the Broad Marsh Dike is eligible for placement on the National Register of Historic Places (NRHP) under Criterion A for agriculture, transportation, and conservation; Criterion C as representing vernacular landscape architecture; and Criterion D for their potential to provide information important to research questions in historical archeology. JMA also recommends a finding of No Adverse Effect for proposed rehabilitation efforts. This finding is consistent with the NRHP eligibility recommendation for the Red Lion Dike offered in a May 15, 2013 letter from DNREC to the USACE (Clark to Minnichbach, May 15, 2013). Also contained in the letter was the observation that proposed rehabilitation efforts were consistent with historical repairs to preserve the dike structures, and therefore, would not constitute an adverse effect.

No additional work is necessary for the upland portions of the Broad Marsh Dike project area. An intact soil stratigraphy was located at the northern end of the dike; however, artifact concentrations were of insufficient quantity or character to constitute an archeological site. Within the current (2013) project area and the area investigated by JMA and Craig Lukezic in 2012 at the southern end of the dike is evidence of architectural demolition and filling to the east of the former shoreline. The soil layers and artifacts contained therein, however, lack context, and therefore do not constitute an archeological site. Excavation of EU 2 contained relatively clean soil deposits; however, they are believed to have derived through intertidal deposition, and therefore, any artifacts contained therein lack context. Based on the findings of both investigations, JMA prepared a map delineating an area of high archeological potential, which covers locations that may contain a seventeenth century ground surface and features related to Fort Casimir, or burials related to a former Potter's Field (see Figure 4). JMA recommends avoidance of this area. To ensure avoidance, it is recommended that the area by cordoned off during construction in a highly visible manner. If the area cannot be avoided, Phase II investigations are recommended.

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Appendix I:

Artifact Inventory

Broad Marsh Dike Artifact Inventory
New Castle Dikes, Phase I
New Castle County, Delaware
JMA April-May 2013

PROV. CAT. No.	STU/EU	LEVEL	DEPTH (CMBS)	CT	DESCRIPTION	COMMENTS	DATE RANGE
1	STU 02	1	Surface	2	20th-Century Refined Earthenware: Gilt/Silver Edge	Pink Scalloped Edge Plate, Mend	
2	STU 02	2	16-33	1	Kitchen Glass: Canning Jar, Screw Top		1858-2000
2	STU 02	2	16-33	7	Machine-Made Bottle Fragment: Clear		1903-2000
2	STU 02	2	16-33	3	Decorated/Embossed Glass Fragment: Clear		
2	STU 02	2	16-33	2	Window Glass: All Thicknesses		
2	STU 02	2	16-33	1	Miscellaneous, Metal: Unidentified		
2	STU 02	2	16-33	1	Coal: Lump/Nugget		
3	STU 02	3	33-52	1	Shatter w/Cortex 36-40mm: Jasper		
4	STU 02NE	1	0-10	1	Whiteware: Plain		1810-2000
4	STU 02NE	1	0-10	1	Unidentified Bottle Fragment: Clear		
4	STU 02NE	1	0-10	1	Decorated/Embossed Glass Fragment: Clear		
4	STU 02NE	1	0-10	1	Depression Glass: Orange		
4	STU 02NE	1	0-10	1	Lamp Chimney, Glass: Crimped Edge, Machine Made	Clear	Post 1879
4	STU 02NE	1	0-10	1	Lamp Chimney, Glass: Clear		
5	STU 02NE	2	10-32	1	Domestic Gray Stoneware: Albany Slip Exterior	Mixing Bowl Rim	1805-1920
5	STU 02NE	2	10-32	1	Unidentified Nail: Cut or Wrought		
6	STU 02NW	2	13-37	3	Whiteware: Plain		1810-2000
6	STU 02NW	2	13-37	1	Machine-Made Bottle Fragment: Clear		1903-2000
7	STU 03	4	54-66	1	Window Glass: All Thicknesses		
7	STU 03	4	54-66	1	Coal: Lump/Nugget		
8	STU 03	5	66-78	1	Unidentified Bottle Fragment: Milk Glass		Post 1743
9	STU A3	8	85-100	1	Toy, Glass: Machine-Made Marble	Green	1901-2000

Broad Marsh Dike Artifact Inventory
New Castle Dikes, Phase I
New Castle County, Delaware
JMA April-May 2013

PROV. CAT. No.	STU/EU	LEVEL	DEPTH (CMBS)	CT	DESCRIPTION	COMMENTS	DATE RANGE
9	STU A3	8	85-100	1	Lamp Chimney, Glass: Milk Glass		
9	STU A3	8	85-100	1	Window Glass: 5 - 6mm Thick	Plate Glass	
9	STU A3	8	85-100	1	Wire Common Nail: 2.5 - 3 Inch Long		1850-2000
9	STU A3	8	85-100	1	Miscellaneous, Metal: Barbed Wire		1886-2000
10	EU 1	1		2	White Granite Ware: Plain		1842-1930
10	EU 1	1		1	Tile: Marble	Hexagonal	
10	EU 1	1		1	Plumbing, Ceramic: Sewer Pipe		
10	EU 1	1		2	Decorated/Embossed Glass Fragment: Clear		
10	EU 1	1		1	Unidentified Bottle Fragment: Melted/Burnt	Clear	
10	EU 1	1		1	Machine-Made Bottle Fragment: Clear		1903-2000
10	EU 1	1		1	Machine-Made Bottle Fragment: Amber		1903-2000
11	EU 1	2		2	Whiteware: Plain	Rim Sherds	1810-2000
11	EU 1	2		3	Electrical, Ceramic: Insulator	Brown Glazed Exterior, Porcelain	
11	EU 1	2		3	Kitchen Glass: Canning Jar, Screw Top		1858-2000
11	EU 1	2		10	Unidentified Bottle Fragment: Clear		
11	EU 1	2		2	Unidentified Bottle Fragment: Green		
11	EU 1	2		2	Unidentified Bottle Fragment: Cobalt Blue		
11	EU 1	2		2	Machine-Made Bottle Fragment: Amber	Stippled, Embossed Letters	1903-2000
11	EU 1	2		1	Unidentified Bottle Fragment: Light Green	Eroded	
11	EU 1	2		1	Flat Glass: Unidentified		
11	EU 1	2		1	Tile: Ceramic	Black, Square	
12	EU 1	3		1	Whiteware: Decal, Overglaze		1897-2000

Broad Marsh Dike Artifact Inventory
New Castle Dikes, Phase I
New Castle County, Delaware
JMA April-May 2013

PROV. CAT. No.	STU/EU	LEVEL	DEPTH (CMBS)	CT	DESCRIPTION	COMMENTS	DATE RANGE
12	EU 1	3		1	20th-Century Refined Earthenware: Colored Glaze	yellow, Cup Rim	
12	EU 1	3		2	White Granite Ware: Plain		1842-1930
12	EU 1	3		2	Depression Glass: Pink	Pressed, Candy Dish-Type	
12	EU 1	3		1	Depression Glass: Pink	Tumbler Rim	
12	EU 1	3		1	Machine-Made Bottle: Milk Bottle	Mouth Only	1903-2000
12	EU 1	3		1	Kitchen Glass: Canning Jar, Screw Top		1858-2000
12	EU 1	3		4	Machine-Made Bottle Fragment: Clear	Embossed	1903-2000
12	EU 1	3		1	Machine-Made Bottle Fragment: Clear	Hall-Atlas Glass Co. 1920-1964	1903-2000
12	EU 1	3		3	Machine-Made Bottle Fragment: Amber		1903-2000
12	EU 1	3		1	Machine-Made Bottle Fragment: Amber	Anchor Hocking Glass Corp. Post 1938	1903-2000
12	EU 1	3		1	Unidentified Bottle Fragment: Aqua		
12	EU 1	3		4	Unidentified Nail: Cut or Wrought		
13	EU 1	4		1	Redware: Manganese Lead Glaze	Interior/Exterior	
13	EU 1	4		1	Whiteware: Plain		1810-2000
13	EU 1	4		1	Domestic Gray Stoneware: Plain Salt Glaze		1705-1930
13	EU 1	4		1	Glass Tableware: Machine-Made Tumbler		1903-2000
13	EU 1	4		1	Decorated/Embossed Glass Fragment: Clear		
13	EU 1	4		1	Unidentified Bottle Fragment: Milk Glass		Post 1743
13	EU 1	4		2	Machine-Made Bottle Fragment: Clear		1903-2000
13	EU 1	4		2	Machine-Made Bottle Fragment: Amber		1903-2000

Broad Marsh Dike Artifact Inventory
New Castle Dikes, Phase I
New Castle County, Delaware
JMA April-May 2013

PROV. CAT. No.	STU/EU	LEVEL	DEPTH (CMBS)	CT	DESCRIPTION	COMMENTS	DATE RANGE
13	EU 1	4		1	Machine-Made Bottle Fragment: Green		1903-2000
13	EU 1	4		1	Hardware, Metal: Bolt and/or Bracket	Brass & Iron	
14	EU 1	5		3	White Granite Ware: Plain	Saucer Fragment	1842-1930
14	EU 1	5		1	Brick, Fragment: Unidentified, Unglazed		
14	EU 1	5		1	Unidentified Bottle Fragment: Aqua		
14	EU 1	5		3	Unidentified Bottle Fragment: Clear		
14	EU 1	5		1	Window Glass: All Thicknesses		
14	EU 1	5		1	Projectile: Center-Fire Cartridge		
15	EU 1	6		1	Redware: Clear Glaze With Brown Mottling		
15	EU 1	6		1	White Granite Ware: Plain		1842-1930
15	EU 1	6		1	Depression Glass: Pink	Dish Rim, Embossed Decoration	
15	EU 1	6		1	Electrical, Metal: Wire Fragment	Copper	
15	EU 1	6		1	Nail: Unidentified		
15	EU 1	6		1	Fastener, Metal: Spike		
16	EU 1	7		1	Gardening, Ceramic: Flower Pot		
16	EU 1	7		1	White Granite Ware: Plain		1842-1930
16	EU 1	7		1	Glass Tableware: Machine-Made Tumbler		1903-2000
16	EU 1	7		2	Machine-Made Bottle Fragment: Clear		1903-2000
16	EU 1	7		2	Machine-Made Bottle Fragment: Amber		1903-2000
16	EU 1	7		1	Plumbing, Metal: Pipe Cap	Copper	
16	EU 1	7		1	Miscellaneous, Metal: Pin	Copper, Wire	
16	EU 1	7		1	Writing, Metal: Pencil Part	Copper Eraser/Clip End	
16	EU 1	7		2	Unidentified Nail: Cut or Wrought		
17	EU 1	8		1	Redware: Manganese Lead Glaze	Interior Only	

Broad Marsh Dike Artifact Inventory
New Castle Dikes, Phase I
New Castle County, Delaware
JMA April-May 2013

PROV. CAT. No.	STU/EU	LEVEL	DEPTH (CMBS)	CT	DESCRIPTION	COMMENTS	DATE RANGE
17	EU 1	8		1	White Granite Ware: Plain	Cup Fragment	1842-1930
17	EU 1	8		3	Unidentified Bottle Fragment: Milk Glass		Post 1743
17	EU 1	8		1	Unidentified Bottle Fragment: Cobalt Blue		
17	EU 1	8		1	Window Glass: All Thicknesses		
17	EU 1	8		5	Unidentified Nail: Cut or Wrought		
17	EU 1	8		1	Storage, Metal: Can, Solderless	Probable, Sardine Type Can	Post 1904
17	EU 1	8		1	Unidentified Metal Object: Slag		
18	EU 1	8, West End		1	Redware: Plain, Clear Glaze		
18	EU 1	8, West End		1	Whiteware: Plain		1810-2000
18	EU 1	8, West End		2	Unidentified Nail: Cut or Wrought		
18	EU 1	8, West End		2	Faunal: Bone	1 Cut	
19	EU 1	9		2	Redware: Unglazed	Mend, Flat Rim	
19	EU 1	9		1	Redware: Plain, Clear Glaze	Overfired	
19	EU 1	9		2	Coarse Earthenware: Green Lead Glaze	Rim, Garden Urn Type	
19	EU 1	9		1	Yellowware: Rockingham/Bennington	Spittoon Fragment	1840-1910
19	EU 1	9		17	White Granite Ware: Plain	Assorted Vessel Fragments: Cup, Plate, Dish	1842-1930
19	EU 1	9		3	20th-Century Refined Earthenware: Gilt/Silver Edge	Blue Edged Cup Fragments	
19	EU 1	9		1	Domestic Brown Stoneware: Bristol Glaze	Brown	1884-1920
19	EU 1	9		2	Industrial Stoneware Bottle: Light-Brown Glaze		

Broad Marsh Dike Artifact Inventory
New Castle Dikes, Phase I
New Castle County, Delaware
JMA April-May 2013

PROV. CAT. No.	STU/EU	LEVEL	DEPTH (CMBS)	CT	DESCRIPTION	COMMENTS	DATE RANGE
19	EU 1	9		1	Depression Glass: Yellow	Oval Dish Fragment, Pressed Diamond Point Decoration	
19	EU 1	9		9	Unidentified Bottle Fragment: Amethyst	Assorted Vessels	1880-1915
19	EU 1	9		1	Unidentified Bottle Fragment: Clear	Milk Bottle Neck	
19	EU 1	9		9	Unidentified Bottle Fragment: Clear	Assorted Vessel Fragments	
19	EU 1	9		5	Unidentified Bottle Fragment: Aqua	Assorted Vessel Fragments	
19	EU 1	9		2	Machine-Made Bottle Fragment: Clear	Heinz, Post 1910	1903-2000
19	EU 1	9		1	Machine-Made Bottle Fragment: Clear	Fairmount Glass Works 1930-1945	1903-2000
19	EU 1	9		2	Kitchen Glass: Canning Jar, Screw Top	Aqua, Ball Post 1888	1858-2000
19	EU 1	9		2	Storage, Metal: Hutchinson Spring Stopper	In Aqua Bottle Neck	1879-1912
19	EU 1	9		1	Machine-Made Bottle Fragment: Amber		1903-2000
19	EU 1	9		1	Jewelry, Metal: Brooch/Pin	Yellow Paste in Brass Molded Floral Setting	
19	EU 1	9		3	Unidentified Nail: Cut or Wrought		
20	EU 1	10		1	Redware: Brown Glaze	Interior/Exterior	
20	EU 1	10		2	Redware: Glazed Interior, Unglazed Exterior		
20	EU 1	10		2	White Granite Ware: Plain		1842-1930
20	EU 1	10		2	Free-Blown Bottle Fragment: Olive Green		
20	EU 1	10		1	Unidentified Bottle Fragment: Clear		
			Total	**231**			

Appendix II:

Personnel Qualifications

TIMOTHY J. MANCL
Project Archeologist
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(610) 436-8468 (fax)
tmancl@johnmilnerasociates.com (e-mail)

EDUCATION

M.S.	Michigan Technological University	Industrial Archaeology	2003
M.A.	University of Delaware	American History	2001
B.A.	Western Connecticut State University	American Studies	1998

PROFESSIONAL CERTIFICATIONS AND SPECIALIZED TRAINING

OSHA 40-hour Hazardous Waste Operations Certification since 2004.
Registered Professional Archeologist since 2003.

EXPERIENCE PROFILE

Timothy J. Mancl is a graduate of Western Connecticut State University, and holds Master's degrees in American History from the Hagley Program at the University of Delaware and in Industrial Archeology from Michigan Technological University. Mr. Mancl specializes in the history and archeology of nineteenth century American industrial development and processes from New England to the Mid-Atlantic. He has researched and conducted archeological investigations of prehistoric, and urban, industrial, and rural historic-period sites in Connecticut, Delaware, Kentucky, Massachusetts, Michigan, New York, and Pennsylvania, and has conducted state-level documentation of engineering structures in Connecticut and Maryland.

KEY PROJECTS

2012	Project Archeologist, Archeological Investigations on a portion of the Dover Green,, Kent County, Delaware. Delaware Department of Historical and Cultural Affairs.
2012	Project Archeologist, Phase I Archeological Survey and Phase II Archeological Evaluation of the proposed Phase 2A Expansion at the Inland Bays Regional Wastewater Treatment Facility, Sussex County, Delaware. Whitman, Requardt and Associates, LLP, and the Sussex County Engineering Department.
2011	Project Archeologist, Archeological Investigations at the Old Brick Church, Dover, Kent County, Delaware. Delaware Department of Historical and Cultural Affairs.
2011	Project Archeologist, Booklet on the Wilmington, Delaware Water Works and Documentation of the Brandywine Filtration Plant. City of Wilmington, Delaware.
2011	Project Archeologist, Archeological Investigations at the Dutch House, New Castle, Delaware. New Castle Historical Society.
2010	Project Archeologist, Archeological Evaluation of Industrial Sites at Birch Hill Dam, Worchester County, Massachusetts. Army Corps of Engineers. New England District.
2010	Project Archeologist, Archeological Inventory and Assessment of the Sayers Lake Shoreline, Centre County, Pennsylvania. Army Corps of Engineers. Baltimore District.

2009	Project Archeologist, Archeological Inventory and Assessment of the Barren River Lake Shoreline, Allen and Barren Counties, Kentucky. Army Corps of Engineers. Louisville District.
2009	Project Archeologist, Phase II Archeological Evaluation of the Button Site, and the Harmons Hill Road Site, Angola Neck Sanitary Sewer District, Sussex County, Delaware. Whitman, Requardt and Associates, LLP, and the Sussex County Engineering Department.
2008	Project Archeologist, Phase II Archeological Evaluation of the Delaware Airpark Wetland Mitigation Area, Blackiston, Kent County, Delaware. The Federal Aviation Administration, the Delaware Department of Transportation, and the Delaware River and Bay Authority.
2008	Project Archeologist, Phase III Archeological Data Recovery of Dodd-Moore Site, Cheswold, Kent County, Delaware. The Federal Aviation Administration, the Delaware Department of Transportation, and the Delaware River and Bay Authority.
2007	Principal Investigator, Burial Recovery and Cemetery Delineation within the Creekside Development, Millville, Baltimore Hundred, Sussex County, Delaware. Caldera Properties.
2006-2007	Principal Investigator, Phase I and II Archaeological Testing of the Joseph Bancroft & Sons Kentmere Mills, Wilmington, New Castle County, Delaware in connection with the Rockford Falls Development Project. O'Neill Properties Group.
2004-2008	Principal Investigator, fieldworker, and editor, Phase III Mitigation of the Laban Rogers House Site, the Herring Creek Site, and the Olla White Bay Site, and delineation of the Derrickson Cemetery, Baltimore County, Delaware. Carl M. Freemen Companies.
2004	Assistant Field Director, Phase III Data Recovery at the Cruttenden Carriage Works Site, New Haven, Connecticut. Fitzgerald & Halliday, Inc., and the Connecticut Department of Transportation.
2002	Field Director, Archaeological Investigations at the Carp River Forge, Negaunee, Michigan. The Michigan Iron Industry Museum/Michigan Department of History, Arts, and Libraries.

SUMMARY OF PROFESSIONAL ACTIVITIES

Mr. Mancl is the author or co-author of over forty (40) cultural resource reports, and four (4) cultural resource studies. He has served as President of the Archaeological Society of Delaware (2006 to 2011), as a Director for the Society for Industrial Archaeology (2008-2011), and as a board member of the New Castle Historical Society (2009-2012). He currently serves on the Nominations Committee for the Society for Industrial Archaeology (2011-2014).

ELISABETH LAVIGNE
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elavigne@johnmilnerassociates.com

EDUCATION

M.A.	Boston University, MA	Geoarcheology	2009
B.A.	Wheaton College, IL	Archeology	2004

EXPERIENCE PROFILE

Elisabeth LaVigne, RPA serves JMA as a Project Geoarcheologist. She holds a Bachelor of Arts degree in Archeology from Wheaton College, IL, and a Master of Arts degree in Geoarcheology from Boston University where she specialized in micromorphology. Her training includes GIS, quantitative geomorphology, sedimentology, geochemistry, and paleoethnobotany. Before coming to JMA, she worked with the Monadnock Archeology Consulting and the State Conservation and Rescue Archeology Program in NH as a lab and field technician. She also has excavated at Gault, TX; Ashkelon, Israel; and Pompeii, Italy, and conducted sediment sample analysis from the Maya site of K'axob in Belize. Since joining JMA, she has been involved in archeological survey, deep testing and trenching projects, and topographic surveying within the Mid-Atlantic, primarily in Pennsylvania and Delaware. Elisabeth also has extensive experience with geographic information systems in archeological contexts. She has worked on numerous geospatial projects for JMA, creating and populating cultural resource geodatabases, modeling viewsheds, georeferencing historic maps, recreating historic survey data, creating archaeological survey maps, and processing field data.

LICENSES/CERTIFICATIONS/TRAINING

Registered Professional Archeologist since 2011
Section 106 Review Process workshop (Chester County Historical Society Cultural Center - 2011)
OSHA 40 Hour HAZWOPER (2011; updated)
OSHA 8 Hour Training for Supervisors (2011)
OSHA Excavation Safety training (2011)
OSHA Confined Spaces Safety training (2011)
UNH Cooperative Extension – ArcGIS 9.3 (2010)

SOFTWARE PROFICIENCIES

ESRI ArcGIS 9.0 – 10
Golden Software's SURFER
TDS Survey Works Foresight DXM
TDS Survey Works Survey Pro
Trimble Pathfinder Office
Microsoft Office Program Suite

PROFESSIONAL AFFILIATIONS

Registry of Professional Archaeologists

PROJECT EXPERIENCE (John Milner Associates, Inc.)

2012-2013 A Phase I archeological survey and GIS-based investigation at Red Lion Dike, New Castle Delaware undertaken in order to determine how the dike waas built and changed over time. A prehistoric site was also located during the survey.

2012 Phase I archeological survey at Sandy Hook, NJ for a proposed biking path.

2012 Phase I archeological survey at the Hopewell Furnace National Historic. Evidence for a historic road for the furnace was located during the survey.

2012 Phase I archeological survey for Eastern University, Radnor, PA.

2012 Phase I and II archeological survey at the historic Dover Green, Delaware which identified the likely location of a historic prison and buried living surfaces.

2012 Archeological Investigation at West Shipyard, Philadelphia, PA. Trenching and archeological excavation were utilized to investigate the remains of a 17th century shipyard.

2012 Phase I archeological survey of field near Sunset Lake, Delaware. Participated in monitoring of metal detection survey, pedestrian survey, and performed historical, GIS-based investigation through the use of historic maps, road plans, and aerials.

2012 GIS-based investigation of the French Mill complex area in East Pikeland, PA, using historic aerials, maps, and road plans. Subsequent geomorphological investigations of the mill race, the possible location of historic races, and mill locations.

2012 Investigation of the Battle at Cooch's Bridge, Delaware. Participated in monitoring of metal detection survey and performed historical, GIS-based investigation through the use of historic maps, road plans, and aerials.

2012 Phase Ib archeological survey at Gettysburg, Pennsylvania. Tested previously identified GPR anomalies and metal detection artifact clusters.

2012 Phase I Archeological Investigation and Phase II Archeological evaluation at a wastewater facility in Sussex County, Delaware.

2011-2012 Phase II Geomorphic assessment, Cobb's Creek Water Reservoir Project, Cumberland County, VA, which included deep testing, trenching, and monitoring of engineering borings; Phase II archeological survey; topographic survey; and GIS-based viewshed analysis.

2011-2012 Fort Christina investigation, Wilmington, DE. Utilized GIS to overlay historic maps in order to locate where the fort may have once been located. Volunteered to assist with the GPR investigation and topography survey at possible location of Fort Christina.

2011 Phase I archeological survey for the proposed PEMA Headquarters in Harrisburg, PA.

2011 Phase I Geomorphic Assessment, Cobb's Creek Water Reservoir Project, Cumberland County, VA. Assessment conducted through deep testing with hand-operated Eijkelkamp Edelman augers. Located two different buried paleosols with archeological potential within the floodplain project area.

2011 Topographic survey at Old Brick Church, Dover, Delaware

2011 Archeological survey at the Dutch House undertaken to investigate sub-surface anomalies detected through a GPR investigation

2011 Topographic survey at the Allee House, Bombay Hook National Wildlife Refuge, Delaware.

2010-2011 NHPA Section 110 Compliance, Cultural resources Investigations, U.S. Army Corps of Engineers American Recovery & Reinvestment Act 2009. 17 Districts of the U.S Army Corps of Engineers. Geodatabase population of cultural resource locations and attributes.

2010 Geomorphologic Assessment, Virginia Avenue Tunnel Railroad Project for the CSX Transportation, Inc. National Gateway Initiative, Washington, District of Columbia. Assessment conducted through use of a geoprobe to locate potential buried landscapes.

2010 Geomorphologic Assessment, U.S. Wildlife Refuge – Mason Neck. Soil cores taken and analyzed to locate potential buried prehistoric landscapes.

2010 Historic Structure Integrity in the Barren Lake study area. Georeferenced historic maps to determine where historic structures may still be preserved for the Army Corps of Engineers.

PROJECT EXPERIENCE (other/previous)

2010 Ground Penetrating Radar and coring project in and around the wetland areas at the Paleoindian Potter Site, Randolph, NH.

2010 Phase Ib/ III Archeological Survey and Geoarcheological Evaluation at the Tenant Swamp Paleoindian site, Keene, NH. Worked as field technician and assisted geomorphologist in the augering and recording of off-site stratigraphy to determine past geomorphic processes and their relation to the site. (Monadnock Archeology Consulting)

2010 Phase I Archeological Surveys in Concord, Effingham, Pembroke, and Newbury, NH. (Monadnock Archeology Consulting)

2010 Rescue/Phase I Archeological Survey which located Paleoindian artifacts in Jefferson, NH.

2010 Excavation and paleomagnetism core retrieval within Archaic and Late Paleoindian levels at Gault, TX.

2010 Lab technician for the NH State Conservation and Rescue Archeology Program. Cleaned, identified, and catalogued artifacts in the state archeology lab.

2008-2009 Micromorphological Analysis of sediments from the Maya site of K'axob in Belize. Found evidence for anthropological activity, past change in water flow direction, and geochemical changes within the soil due to a possible number of causes.

2008 Leon Levy Expedition, Ashkelon, Israel. Participated in the excavation of Bronze and Iron Age levels and the geoarcheological evaluation of possible Iron Age Harbor at Ashkelon. Assisted geoarcheologist to determine the absence of proposed harbor through the use of bucket augering and sediment analysis.

2008 Rowley Marsh Project: Investigated the formation and deterioration of marsh surface ponds through surveying, the analysis of vibracores, and the use of GIS to determine past pond/channel locations and depositional history.

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EDUCATION

M.S.	University of Maine, Climate Change Institute	Quaternary and Climate Studies	2007
B.A.	University of Maine	Anthropology Minor in Geological Sciences	2003

EXPERIENCE PROFILE

Peter Leach serves as Project Geoarchaeologist at John Milner Associates, Inc. Peter holds a Bachelor of Arts degree in Anthropology from the University of Maine, Orono, and a Master of Science degree in Quaternary and Climate Studies from the University of Maine, Orono's Climate Change Institute (formerly the Institute for Quaternary and Climate Studies). At the University of Maine he gained extensive experience in archeological field and laboratory methods, archeological theory, submerged prehistoric archeology, ground-penetrating radar, sedimentology and stratigraphy, geomorphology, and coastal geology. Peter specializes in submerged prehistoric archeology, geographic information systems modeling, and terrestrial geophysical methods applied to archeology. His submerged prehistory experience includes the use of geophysics and coring in marine environments for paleogeographic and paleoenvironmental reconstruction, including seismic reflection profiling, side-scan sonar, and multi-beam bathymetry. Key submerged prehistoric projects include an assessment of submerged prehistoric potential in New Bedford Harbor, Massachusetts, and an assessment of submerged archaeological potential in St. Croix River, Calais, Maine. Peter's extensive experience in the use of geographic information systems hardware and software within the context of archeological surveys ranges from mapping of field data to more complex applications such as paleogeographic reconstruction and predictive modeling of prehistoric archeological site locations. Key GIS predictive modeling projects include prehistoric archaeological sensitivity models produced for four USACE Districts (Louisville, Baltimore, Philadelphia, and St. Louis) during a recent ARRA funded project. The majority of projects Peter conducts at JMA involve ground-penetrating radar and magnetometry on historic and prehistoric archaeological sites. Key archaeo-geophysical projects include ground-penetrating radar survey at Arlington National Cemetery, and a large-scale ground-penetrating radar and magnetometer survey at the antebellum free African American village site of Timbuctoo. Peter is the author/co-author of two (2) publications, ten (10) refereed abstracts, twenty two (22) papers and posters presented at professional meetings, and author and co-author of eighteen (18) Cultural Resource Management reports.

LICENSES/CERTIFICATIONS/TRAINING

2009 – Current: Pennsylvania Historical and Museum Commission, BHP Archaeological Consultant List: Recognized Specialties: Underwater Archaeology and Geomorphology
2009 Training Course in Theory and Practice of Applying Subsurface Interface Radar in Engineering and Geophysical Investigation, Geophysical Survey Systems Inc., New Hampshire
2008 – Current: Register of Professional Archaeologists (RPA)
2008 National Park Service Workshop: Current Archaeological Prospection Advances for Non-Destructive Investigations in the 21st Century, Fargo, North Dakota
OSHA 2 Hour Excavation Safety for Competent Persons (FEBRUARY 2008)
OSHA 40 Hour HAZWOPER (MAY 2008)

2007 OSHA 8 Hour Training for Supervisors
2003 State University of New York, Stonybrook Underwater Archaeology Field School
Instructor: Daria Merwin
NAUI Open Water SCUBA Certification
PADI Advanced Open Water SCUBA Certification
PADI Rescue Diver Certification
NITROX Certification

EQUIPMENT PROFICIENCIES
GSSI SIR-3000 Ground-Penetrating Radar
Sensors and Software Noggin SmartCart Ground-Penetrating Radar
Geometrics G858-G Magnetic Gradiometer (Cesium)
Topcon GTS-239W Total Station with Recon Data Collector
Edgetech DF-1000 Side-Scan Sonar
Applied Acoustics Engineering Seismic Reflection Profiler (Boomer Source)
Trimble GeoXT/GeoXH/PROXH Handheld, Differentially-Corrected Sub-Meter Accuracy GPS
Marine Vibracore
Marsh Auger, Specifically Eijkelkamp Gouge Auger and Piston Sampler
Bucket Auger

SOFTWARE PROFICIENCIES
ESRI ArcGIS 9.0 – 9.3.1
Golden Software's SURFER 8
GSSI's RADAN GPR Software 6.6
Sensors and Software's EkkoView and EkkoMapper GPR Software
TDS Survey Works Foresight DXM
TDS Survey Works Survey Pro
Trimble Pathfinder Office
Triton Elics Marine Geophysics Software Suite
Geometrics' MagMapper
Microsoft Office Program Suite
Adobe Photoshop

PROJECT EXPERIENCE
Marine Geophysics and Submerged Prehistoric Archaeology

2010	Assessment of Submerged Prehistoric Archeological Site Potential in the Subtidal and Intertidal Portions of the Proposed Location of a Marine Infrastructure Park, New Bedford, Massachusetts.
2008	Assessment of Submerged Prehistoric Archaeological Site Potential in the Proposed Location of a Marine Trestle and Terminal, St. Croix River, Washington County, Maine
2003 – 2007	Marine Geoarchaeological Survey of Damariscotta River, Maine. Use of Shallow Marine Geophysical Equipment (Seismic Reflection Boomer Source and Side-Scan Sonar) and Vibracoring to Assess the Potential for Submerged Prehistoric Archaeology and Submerged Upland Landscapes in Damariscotta River, Maine. Master's Thesis Research.
2006	Underwater Cultural Resource Management Project, Passamaquoddy Bay, Maine Assistant to Dr. Alice Kelley, University of Maine, Orono, Maine. Interpretation and Analysis of Shallow Marine Geophysical Data to Identify Potential Submerged Prehistoric Sites and Submerged Upland Landscapes.
2003	SUNY Stony Brook Underwater Prehistoric Archaeology Field School, Sandy Hook, New Jersey, Instructor: Daria Merwin. SCUBA Survey for Prehistoric Artifacts.

Wetlands Archaeology

2008 Supplemental Phase IB Archaeological Survey of Bread and Cheese Island and Geoarchaeological Coring of Associated Marsh Areas, Newport, Delaware. Gouge Auger Coring to Locate Prehistoric Archaeological Sites Beneath a Tidal Wetland Marsh.

2007 – 2008 Geoarchaeological Coring Survey of Selected Marsh Areas, Former Koppers Company Newport Superfund Site, Newport, Delaware. Gouge Auger Coring to Locate Prehistoric Archaeological Sites Beneath a Tidal Wetland Marsh.

Notable Geographic Information Systems and Geospatial Technologies Projects

2007-Current Geospatial Duties at JMA, Including Field Collection With Differentially-Corrected Gps Units (Trimble GeoXT/GeoXH/ProXH), GIS Mapping of Field Data, Analysis of Large Geospatial Datasets and Map Generation, Predictive Modeling of Prehistoric Archaeological Sensitivity, Training of Field Crews for Differentially-Corrected GPS Use

2009-2011 NHPA Section 110 Compliance, Cultural resources Investigations, U.S. Army Corps of Engineers American Recovery & Reinvestment Act 2009. For 17 Districts of the U.S Army Corps of Engineers.

2011 GIS Predictive Modeling of Archaeological Sensitivity, Wappapello Lake, Missouri. ARRA Section 110, USACE, St. Louis District.

2010 GIS Predictive Modeling of Archaeological Sensitivity, Blue Marsh Lake, Pennsylvania. ARRA Section 110, USACE, Philadelphia District.

2010 GIS Predictive Modeling of Archaeological Sensitivity, Barren River Lake, Kentucky. ARRA Section 110, USACE, Louisville District.

2010 GIS Predictive Modeling of Archaeological Sensitivity, Raystown Lake, Pennsylvania. ARRA Section 110, USACE, Baltimore District.

2008 Geographic Information Systems (GIS) Data Processing, Van C. Cortlandt Parade Grounds. GIS Analysis of Fill Depths, Depth of Disturbance, and Impact on Archaeological Resources.

2008 Geographic Information Systems (GIS) Data Processing, Delaware Air Park.

2008 GIS Analysis of Historic Artifact Concentrations, Rockies Pipeline Project.

2006 GIS Analysis of Submerged Moraines, Wells, Maine. Use of GIS Data and Multibeam Bathymetry Data to Assess Economic Importance of Submerged Glacial Deposits Offshore of Wells, Maine.

Geomorphic Assessments

2008 Geomorphic Coring Survey at the Great Dismal Swamp National Wildlife Refuge, Suffolk County, Virginia. Paleogeographic Reconstruction and Geomorphic Assessment

2008 Archaeological Deep Testing of a Proposed Liquefied Natural Gas Pipeline, Calais LNG Project, Washington County, Maine. Coring Survey to Identify Buried Cultural Horizons.

2008 Archaeological Deep Testing of a Proposed Pipeline Reroute Corridor, Rockies Express Project, Indiana. Coring Survey to Identify Buried Cultural Horizons.

Terrestrial Geophysics

Cemeteries

2011 Ground-Penetrating Radar Investigation of Selected Portions of the Old Brick Church Cemetery, Dover, Delaware. GPR Prospection for Unmarked Graves in the Proposed Location of Walkway Improvements. GSSI SIR-3000 GPR, 400 MHz

2011 Ground-Penetrating Radar Investigation of Selected Portions of the First Presbyterian Church Cemetery, Hazen, New Jersey. GPR Prospection for Unmarked Graves in the Proposed Location of a Cemetery Wall Relocation. GSSI SIR-3000 GPR, 400 MHz

2010 Ground-Penetrating Radar Investigation Of A Selected Portion Of The First Presbyterian Church Of Oxford Property, Hazen, New Jersey. For Eclectic Architecture, LLC to examine the potential for existing graves within the footprint of a parking lot expansion for the church based on a previous archeological survey identifying one potential grave shaft. GSSI SIR-3000 GPR, 400MHz.

2010 Ground-Penetrating Radar Investigation of the Friends Meeting Burial Ground, Wayne, PA. Prospection for Potential Unmarked Burials of American Revolution Soldiers. GSSI SIR-3000 GPR, 400 MHz; Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

2009 Geophysical Prospection at Arlington National Cemetery, Arlington, VA. Project conducted for the Director and Deputy Director of ANC. Investigation of two specific grave sites with ground-penetrating radar and electrical resistance sounding. GSSI SIR-3000 GPR, 400 MHz; Sensors and Software Noggin Smart-Cart GPR, 250 MHz. Custom-built (by Leach) electrical resistance sounding device.

2009 Ground-Penetrating Radar Survey for Unmarked Graves at St. Ignace, Lac du Taureau, Quebec, Canada. Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

2008 – 2009 Ground-Penetrating Radar Investigation of the Bethel Hill Methodist Cemetery. Prospection for an 18th Century Methodist Chapel. GSSI SIR-3000 GPR, 400 MHz; Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

2008 – Current Ground-Penetrating Radar Characterization of Graves and the Correlation of Geophysical Signatures, Sediment Type, and Age of Interment. GSSI SIR-3000 GPR, 400 MHz; Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

2007 Ground-Penetrating Radar Investigation of the Andrews Site, North Cutler, Maine. Assistant to Dr. Daniel Belknap, University of Maine, Orono, Maine. Prospection for Unmarked Graves. Sensors and Software Pulse EKKO 100 MHz Unshielded Antennae.

American Revolution – Battlefields, Encampments, and Fortifications

2009-2010 Magnetic Gradiometer Survey of Monmouth Battlefield, Monmouth, New Jersey. Prospection for possible barn remains at the location of the Battle at the Parsonage. Geometrics G858-G Cesium Magnetic Gradiometer (cart-mounted).

2009-2010 Magnetic Gradiometer Survey of Selected Portions of Paoli Battlefield, Malvern, PA. Prospection for features associated with the encampment and engagement at the site of the Paoli Massacre. Geometrics G858-G Cesium Magnetic Gradiometer (cart-mounted).

2009 Geophysical Prospection at the Proposed Location of Historic Fort Wentworth, Northumberland, New Hampshire. Prospection for subsurface evidence of the fort's location. GSSI SIR-3000 GPR, 400 MHz; Geometrics G858-G Cesium Magnetic Gradiometer (cart-mounted).

2007-2008 Geophysical Assessment of Portions of the American Revolution Center Project Area, Montgomery County, Pennsylvania. Prospection for Features Associated with a Proposed Revolutionary War Campsite/ Commissary. Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

American Civil War – Battlefields, Encampments, and Fortifications

2009 Magnetic Gradiometer Survey of a Civil War Campsite, Warrenton, Virginia. Prospection for Evidence of Civil War Campsite Remains Below Plow Zone. Geometrics G858-G Cesium Magnetic Gradiometer.

2008 Geophysical Survey Comprising Gradiometry, Electrical Resistivity, and Ground-Penetrating Radar in the Potential Locations of Civil War Batteries 1 and 2, Quantico Marine Base, Quantico Virginia. GSSI SIR-3000 GPR, 400 MHz; Geometrics G858-G Cesium Magnetic Gradiometer; Geometrics OhmMapper, Capacitively-Coupled Electrical Resistivity.

2008 Geophysical Survey of a Civil War Campsite, Quantico Marine Base, Quantico, Virginia. GSSI SIR-3000 GPR, 400 MHz; Geometrics G858-G Cesium Magnetic Gradiometer

American Historic Sites

2011 Ground-Penetrating Radar Investigation of Selected Portions of the Rivertowns Square Project Area, Dobbs Ferry, New York. Prospection for Buried Historical Cultural Resources. GSSI SIR-3000 GPR, 400 MHz

2011 Ground-Penetrating Radar Investigation of the Felix Darley House Property, Claymont, Delaware. Prospection for Buried Historic Archaeological Resources. GSSI SIR-3000 GPR, 400 MHz.

2011 Ground-Penetrating Radar Investigation of the Read House and Gardens Waterfront Lot, New Castle, Delaware. Prospection for Buried Historic Archaeological Resources. GSSI SIR-3000 GPR, 400 MHz.

2010 Ground-Penetrating Radar Investigation of Selected Portions of the Dutch House Property, New Castle, Delaware. Prospection for Buried Historic Archaeological Resources. GSSI SIR-3000 GPR, 400 MHz.

2009-2010 Magnetic Gradiometer Survey at East Pikeland Township Building, East Pikeland Township, Pennsylvania. Prospection for Features in the potential locations of an American Revolution Powder Mill and a Gun Factory. Geometrics G858-G Cesium Magnetic Gradiometer (cart-mounted).

2009 Ground-Penetrating Radar and Magnetic Gradiometer Survey of Timbuctoo, New Jersey. Geophysical Prospection for Historic Archaeological Features in the core area of a Historic African-American Town. GSSI SIR-3000 GPR, 400 MHz; Geometrics G858-G Cesium Magnetic Gradiometer.

2009 Ground-Penetrating Radar Survey of the Read House and Gardens, New Castle, Delaware. Prospection for Buried Historic Archaeological Resources. GSSI SIR-3000 GPR, 400 MHz.

2009 Magnetic Gradiometer Survey of the Dodd Farm Site, Blackiston, Delaware. Prospection for 18th Century Historic Archaeological Features. Geometrics G858-G Cesium Magnetic Gradiometer.

2009 Ground-Penetrating Radar Survey of a Historic Farmstead, Graterford Prison, Graterford, Pennsylvania. Subsurface Characterization of a Potential Historic Farm Complex. GSSI SIR-3000 GPR, 400 MHz.

2008 Ground Penetrating Radar Survey of Two Historic Farmsteads in Delaware. Prospection for 18th and 19th Century Archaeological Features. GSSI SIR-3000 GPR, 400 MHz.

Native American Sites

2010 Ground-Penetrating Radar Survey of the Ewing-Bragdon Shell Midden, Sullivan, Maine. Investigation of Shell Midden Stratigraphy and Prospection for Evidence of Historic Excavations. GSSI SIR-3000 GPR, 400 MHz.

2010 Ground-Penetrating Radar Survey of the Mackowski Farm Site, Milford, Maine. Prospection for Prehistoric Archaeological Features and Significant Alluvial Stratigraphy. GSSI SIR-3000 GPR, 500 MHz., External Survey Wheel.

2009 Ground-Penetrating Radar Survey of the Holmes Point Site, Site 62-8, Machias, Maine. Prospection for Prehistoric Archaeological Features. GSSI SIR-3000 GPR, 400 MHz.

2009 Ground-Penetrating Radar Survey of the Parke Farm Site, Honey Brook, Pennsylvania. Prospection for Prehistoric Archaeological Features. GSSI SIR-3000 GPR, 400 MHz. Ground-Truthing of Magnetic and Ground-Penetrating Radar Anomalies also Conducted.

2009 Ground-Penetrating Radar Investigation of the Kauffman II Site, Chester County, Pennsylvania. Prospection for Prehistoric Archaeological Features. Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

2008-2009 Magnetic Gradiometer and Ground-Penetrating Radar Survey of the Machias Petroglyph Site, Machias, Maine. Prospection for Prehistoric Archaeological Features. GSSI SIR-3000 GPR, 400 MHz; Geometrics G858-G Cesium Magnetic Gradiometer.

2008-2009 Magnetic Gradiometry and Ground-Penetrating Radar Survey of Site 12FR336, Franklin County, Indiana. Prospection for Prehistoric Archaeological Features. Sensors and Software Noggin Smart-Cart GPR, 250 MHz; Geometrics G858-G Cesium Magnetic Gradiometer.

2008 Ground-Penetrating Radar Survey of the Waterside Shell Midden, Gouldsboro, Maine
Characterization of an Archaic Period Shell Midden Currently Under a Paved Road. Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

2006 Ground-Penetrating Radar Survey of the Glidden Point Midden, Newcastle, Maine. Subsurface Characterization of the Stratigraphy within a Large, Prehistoric Oyster Midden. Sensors and Software Pulse EKKO 100 MHz Unshielded Antennae; Sensors and Software Noggin Smart-Cart GPR, 250 MHz.

European Fortifications

2009 Ground-Penetrating Radar Investigation of Chateau Germolles, a 14th Century French Chateau, Germolles, France. Geophysical Prospection for Structural Features below the Modern Chateau Courtyard, Including Towers, Room Footprints, and the Inner and Outer Walls. GSSI SIR-3000 GPR, 400MHz.

Cave Investigation

2011 Ground-Penetrating Radar Investigation of Six Caves in the Central Yucatan, Mexico. Investigation of Sediment Depth, and Potential for Burials and Caches. Project: Central Yucatan Archaeological Caves Project. Principal Investigator: Donald Slater, Brandeis University

2010 Ground-Penetrating Radar Investigation of 10 Rockshelters in the Peruvian Andes. Investigation of Sediment Depth, Stratification, and Identification of Locations to Excavatate the Deepest Stratigraphy.
Project: Projecto Procuncho. Principal Investigator: Kurt Rademaker, University of Maine, Orono, Maine.

2009 Ground-Penetrating Radar Investigation of Cave Verpilliere II, Germolles, France. Geophysical Prospection to Identify the Morphology of a Cave in Limestone that Produced Paleolithinc Artifacts, and to Determine the Depth of Cave Sediments. Project Conducted for the University of Tubingen, Tubingen, Germany. GSSI SIR-3000 GPR, 400 and 200 MHz.

Terrestrial Archaeology

2008 Phase II Archaeological Assessment, Spread 4-Indiana, for the Rockies Express East Pipeline Project, Indiana, Natural Resource Group, Inc.

2007-2008 Phase I/II Archaeological Survey and Evaluation, Former Koppers Newport Superfund Site, Newport, Delaware.

2005 Supervision of Field School Students, Jones Cove Shell Midden, Gouldsboro, Maine, under the direction of Dr. Brian Robinson, University of Maine, Orono.

2004 Supervision of Field School Students, Mackowski Farm Site, Milford, Maine, under the supervision of Dr. Brian Robinson, University of Maine, Orono.

2001 – 2003 Cultural Resource Management Field Projects, Phase I – III, Archaeological Research Consultants, Ellsworth, Maine.

2002 Excavation of 21 Human Burials in Glenburn, Maine. Archaeolgoical Research Consultants, Ellsworth, Maine.

2002 The Fish River Drainage Archaeology Project. Six-week Archaeological Survey in Northern Maine under the Direction of Dr. Adrian Burke, University of Montreal.

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EDUCATION

Ph.D.	University of Delaware	Geology (Archeological Geology)	2000
M.A.	Temple University	Geology	1994
B.A.	University of Maine at Farmington	Geology/Geography	1990

KEY LICENSES/CERTIFICATIONS/TRAINING

Registered Professional Archeologist (National, #12322)
Licensed Professional Geologist (Utah, # 5556501-2250)
Section 106 Essentials (Advisory Council on Historic Preservation-2007)
Battlefield Grants Workshop for Contractors (NPS American Battlefield Protection Program-2010)
Theory and Practice of Applying Subsurface Interface Radar in Engineering and Geophysical Investigations (GSSI-2008)
Advances in Subsurface Exploration Methods (Geoprobe Systems-2007)
OSHA 40 Hour HAZWOPER (2001)
OSHA 8 Hour HAZWOPER Refresher (current)
OSHA 8 Hour Training for Supervisors (2001)
OSHA Hazard Communication (2002)
OSHA Excavation Safety Training for Competent Persons (2002)

KEY PROJECT EXPERIENCE

2007-2013 Phase I/II Archeological Survey and Evaluation, Former Koppers Newport Superfund Site, Newport, Delaware. Archeological survey conducted for Langan Engineering and Environmental, Inc. using hand auger equipment to identify archeological site below intertidal marshes.

2011 Ground-Penetrating Radar Prospection for Three Underground Storage Tanks (USTs) at the US Department of Homeland Security Nebraska Avenue Complex, Washington, DC. Visual and Ground-Penetrating Radar Inspection of the current conditions of recently abandoned/removed USTs.

2009-2011 NHPA Section 110 Compliance, Cultural resources Investigations, U.S. Army Corps of Engineers American Recovery & Reinvestment Act 2009. For 17 Districts of the U.S Army Corps of Engineers. Constructed, populated, and Quality Controlled SDFIE compliant ESRI geodatabase and conducted deep testing on floodplains related to specific impoundments.

2008-2010 Geospatially-Based Phase IA of Cultural Resources Related to Wind Farm Development and Potential Visual Impacts, Eastern Seaboard of the Continental USA. Mineral Management Services

2009 Geophysical Prospection at Arlington National Cemetery, Arlington, VA. Project conducted for the Director and Deputy Director of ANC. Investigation of two specific graves site with ground-penetrating radar and electrical resistance sounding.

2009 Geomorphologic Assessment, 11th Street Bridge Replacement Project, Washington and Anacostia, District of Columbia. Assessment conducted for EAC/Archaeology and District Department of Transportation to identify buried landscapes.

2009 Ground-penetrating Radar and Magnetic Gradiometer Survey of Timbuctoo, Westampton Township, New Jersey. Survey conducted for Westampton Township, New Jersey to identify archeological features related to the core area a historic antebellum African-American town.

2008 Geophysical Survey Comprising of Gradiometery, Electrical Resistivity, and Ground-Penetrating Radar in the Potential Locations of Confederate Battery 1 and Battery 2, for Quantico Marine Base, Quantico Virginia.

2007-2008 Geomorphic Assessment of Deep Testing Locations in Spread 4 – Indiana and Phase III Testing for the Rockies Express East Pipeline Project, Indiana. Assessment for Natural Resource Group, Inc. to location buried landscapes associated with stream and river crossings.

2006 Ground-Penetrating Radar Survey of Three Historic Shearith Israel Cemeteries, Manhattan, New York, New York. Project conducted for 1654 Society to identify the location of burials within three cemeteries with ground-penetrating radar.

2006 Phase I/II Archeological Evaluation of a Portion of the Macungie Jasper Quarry Site (36LH11) for the Macungie Borough Trail System Stream Bank Restoration, Lehigh County, Pennsylvania. Archeological investigations resulting from geomorphic assessment for the Borough of Macungie.

2005-2006 Geophysical Prospection and Relocation of the April, 1945 Willie Sutton Escape Tunnel at the Eastern State Penitentiary, Philadelphia, Pennsylvania. Project conducted for the Eastern State Penitentiary Historic Landmark and Museum, Philadelphia top relocate a clandestine escape tunnel up to 16 feet below ground surface.

2005 3D Laser Scanning of Valley Creek Mill Ruins, Valley Forge National Historic Park. Project conducted for the National Park Service on several foundation fragments eroding out of a floodplain of Valley Creek.

2005 Geophysical Prospection of the Deshler-Morris, Bringhurst House Property, Germantown, Pennsylvania. Prospection conducted for the National Park Service, Philadelphia identify buried yard features related to the occupation of the property.

2003-2005 GIS-based Existing Conditions, Sensitivity Analysis of Cultural Resources, and Historic Context of U.S. Highway 113, North-South Study Area, Sussex and Kent County, Delaware. Rummel, Klepper, & Kahl and Delaware State Department of Transportation.

2003-2005 Archeological Phase I Survey and Archeological Phase II Survey of Three Prehistoric Archeological Sites for the Columbia Falls and Moscow OTHB-E Radar Stations, Washington and Somerset Counties, Maine Survey conducted for the United States Air Force Air Education and Training Command.

2003 Geophysical and Phase I Archeological Survey, Bridge No. 10043 over Bens Branch, Frederick County, Maryland. Survey conducted for the Maryland Department of Transportation to location razed historic grist and saw mills and associated landscape features.

2002 Ground-Penetrating Radar Survey: Ebenezer Cemetery, MD237: MD235 to Pegg Road, St. Mary's County, Maryland. Maryland State Department of Transportation

2002 Ground-Penetrating Radar Pilot Study of Independence Square, Independence National Historical Park, Philadelphia, PA. Pilot study conducted for the National Park Service, Northeast District to determine thus utility of conducting future GPR surveys within Independence Square.

2001-2002 Stage IB Archeological Survey of the Intertidal Zone, New Bedford Harbor Superfund Site, Bristol County, Massachusetts. Intertidal archeological survey for Tetra Tech FW, Inc. and the U.S. Army Corps of Engineers, New England District using hand auger equipment to identify archeological site below intertidal marshes.

KEY PRESENTATIONS AT PROFESSIONAL MEETINGS

2012 Chadwick, W.J. Changing the Role of Ground-Penetrating Radar (GPR) in Cultural Resource Management (CRM) at JMA: A Middle Atlantic Perspective. 2012 Middle Atlantic Archeological Conference.

2011 Chadwick W.J. & Leach, P.A. Coring Methods to Locate Buried Archeological Sites and Assess Buried Landscapes during Intertidal Archeological Surveys. 2011 Society of American Archeology Annual Meeting.

2010 Chadwick, W. J., & Leach, P.A. & Balicki, J.F. Geophysical Prospection of Civil War Military Sites, Quantico, Virginia. 43rd Annual Conference on Historical and Underwater Archaeology.

2009 Leach, P.A, Chadwick, W. J., Belknap, D. F. Multiple Phases in the Marine Transgression of Coastal Archaeological Sites in Maine and Delaware. Geological Society of America Annual Meeting, Portland, Oregon. GSA Abstracts with Programs Vol. 41, No. 7, p. 76

2009 Chadwick, W. J., & Leach, P.A. Geophysical Testing at the Site of Timbuctoo, Burlington County, New Jersey. Council for Northeastern Historical Archeology Annual Meeting, Université Laval, Québec, Canada

2008 Leach, P.A. & Chadwick, W. J. Coring Methods to Assess Buried Landscapes During Intertidal Cultural Resource Management Surveys. 2008 Joint Meeting of the GSA, SSSA, ASA, CSSA, Houston, TX.. GSA Abstracts with Programs, Vol. 40, No. 6, p. 384

2006 Chadwick, W. J. & Yamin, R. Rediscovery of the 1945 Escape Tunnel at Eastern State Penitentiary Historic Site, Philadelphia. Paper presented at the Geological Society of America 2006 Annual Meeting, Philadelphia, Pennsylvania. GSA Abstracts with Programs, Vol. 38, No. 7, p. 526

2004 Catts W.P. & Chadwick, W. J. & Harris, M.D. & Ziesing, G.H. Rivers, Roads, Dirt and Documents: A GIS-based Cultural Resource Project Management Tool for Delaware Department of Transportation. Paper presented at Byways to the Past V: The Fifth Annual Conference on Historic Preservation and Transportation Projects, Indiana, PA.

2003 "Come and Get Me Copper!" or "This is a Real Pane in the Glass!": Archeological Evidence of Industrial Practices at Raritan Landing. Paper presented at Annual Meeting of the Council of Northeast Historical Archaeology, Lowell, MA. (with Wade P. Catts, Edward Morin, and Meta Janowitz)

2001 Harris, M.D. & Chadwick, W. J. "Predicting the Spatial Distribution of Prehistoric Archaeological Sites as Related to Water Resources using GIS Analysis in the Lehigh Valley, Pennsylvania." Paper presented at the Geological Society of America Northeastern Section 2001 Meeting, Burlington, Vermont.

1998 Chadwick, W. J. "Ground Penetrating Radar Reveals the Relationship Between Sea-Level Rise and the Prehistoric Occupation of Relict Recurved Spits, Cape Henlopen, Delaware." Paper presented at the Geological Society of America 1998 Annual Meeting, Toronto, Canada.

1995 Kraft, J.C. & Chadwick, W. J. “Paleogeographies of Historic and Prehistoric Archaeological Sites in the Coastal Zone.” Eastern States Archaeological Federation, 62nd Annual Meeting, Wilmington, Delaware.

1993 Chadwick, W. J. “Allocyclic Symmetry in the Hierarchic Structure of the Upper Silurian Tonoloway Formation.” Paper presented at the Geological Society of America Northeastern Section 1993 Meeting, Burlington, Vermont.

SUMMARY OF PROFESSIONAL ACTIVITIES

Dr. Chadwick is author or co-author of twenty-seven (27) papers presented at professional meetings, over seventy-five (75) Cultural Resource Management reports, and one (1) scholarly article, and was organizer of one (1) symposium on geophysics at a professional meeting.

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EDUCATION

M.A.	University of Delaware	American History	1988
B.A.	University of Delaware	History/Anthropology	1981

PROFESSIONAL CERTIFICATIONS AND SPECIALIZED TRAINING

2003	Section 106: Principles and Practice Workshop
2003	Integrating Section 106 and the National Environmental Policy Act Workshop
1999	Registered Professional Archeologist
1998	OSHA 40-hour Hazardous Waste Operations Training

MEMBERSHIPS AND AFFILIATIONS

President Elect, American Cultural Resources Association, 2011-2013
Member, Delaware Military Heritage Education Foundation, 2012-2014
Member, Middle Atlantic Archaeological Conference
Member, Society for Historical Archaeology/Council for Underwater Archaeology
Member, Council for Northeast Historical Archaeology (Board Member 1999-2001)
Member, Society for Army Historical Research (UK)
Member, Company of Military Historians
Member, Delaware Academy of Science (past President)
Member, New Castle County Historic Review Board, 1996-2009

HONORS/ASSISTANTSHIPS

1990	Graduate Assistant, Department of History, University of Delaware
1986	Member, Rotary Group Study Exchange Trip to Southeastern England, District 763
1981	Phi Alpha Theta, National History Honor Society

EXPERIENCE PROFILE

Wade P. Catts is a graduate of the University of Delaware, and he also holds a Master's degree in American History from the same institution. Prior to joining JMA (John Milner Associates, Inc.) in 1993, Mr. Catts was employed for over a decade as a research historian and archeologist at a University of Delaware-based consulting division that focused its research efforts on the history and prehistory of the Delmarva Peninsula. Since joining JMA, Mr. Catts' research efforts have included historical and

archeological data recovery investigations at the New Geneva Pottery Waster site in Fayette County, Pennsylvania, the eighteeth- century Ashcomb's Quarter site in Solomons Island, Maryland, Beverwyck Plantation in Morris County, New Jersey, New Castle Courthouse Museum in New Castle, Delaware, and Raritan Landing near New Brunswick, New Jersey. He has conducted Phase II evaluation investigations at numerous historic sites in Pennsylvania, Maryland, New Jersey, Delaware, and Virginia, and Phase I surveys throughout the Middle Atlantic region. Further, he has conducted historical background and archival research for a broad range of archeological and historical projects.

Mr. Catts' Revolutionary War historical and archeological experience spans several states. In Pennsylvania he has completed projects at Valley Forge and at the site of Camp Security, a British POW camp near York. In New Jersey he was involved in the Beverwyck Plantation project in Morris County – where Washington, his officers, and the French ambassadors were entertained – and excavations at Raritan Landing, where British forces cantoned during the winter-spring of 1777. He directed an ABPP-funded survey of the battlefield at Princeton, and managed the JMA team that completed an ABPP-funded archeological survey and draft National Register nomination for the Short Hills battlefield near Plainfield, New Jersey. In New York he managed the field component of an ABPP-funded project at Fish Creek, a portion of the Siege of Saratoga. Mr. Catts is a Registered Professional Archeologist (RPA), a member of national and regional professional archaeological organizations, and a member of both the Company of Military Historians (US) and the Society for Army Historical Research (UK). With the assistance of a McKinstry Award from the Delaware Heritage Commission, he is completing a book on the history and archeology of the Battle of Cooch's Bridge, Delaware's only Revolutionary War engagement.

Mr. Catts is a recognized historian and historical archeologist with research interests in the history of farmsteads and agricultural landscapes, urban development, military history and archeology, environmental history, African-American studies, and Middle Atlantic regional history and historic preservation.

REPRESENTATIVE PROJECTS

2012 Project Manager for the archeological mitigation planning for the site of the new Museum of the American Revolution, 3rd and Chestnut Streets, Philadelphia. The American Revolution Center.

2012 Principal in Charge of Phase I Archeological Survey of the proposed construction site of a water retention basin and dewatering system associated with the Sunset Lake project. New Castle Conservation District.

2012 Principal in Charge of geoarcheological and archeological survey of the site of seventeenth-century Fort Casimir, City of New Castle, Delaware. Delaware Division of Historical and Cultural Affairs.

2012 Project Manager for the terminal exhibits at the Delaware Airpark, Cheswold, Delaware. A series of interpretative panels relating the story to the visiting public of the Lenape Indians, the history of the village of Cheswold, the history and archeology of the Airpark, and the story of Flloyd Durham, the founder of the airpark. Delaware River and Bay Authority.

2012 Principal in Charge of historical, geoarcheological, and archeological investigations at the Cooch's Bridge Battlefield in New Castle County, Delaware. Delaware Division of Historical and Cultural Affairs.

2012 Principal in charge of historical, geoarcheological, and archeological investigations at the site of the Continental Powder Works and Gun Factory on French Creek, Chester County, Pennsylvania. An American Battlefield Protection Program (ABPP) grant. East Pikeland Township Historical Commission.

2011 Principal in charge of archeological investigations of the New Castle Green, a field project completed in advance of storm water management installation to the rear of the Arsenal Building. Delaware Division of Historical and Cultural Affairs.

2011 Managed, conducted historical research, directed archeological investigations, and co-authored the American Battlefield Protection Program (ABPP) project at the Short Hills Battlefield, New Jersey. Metuchen-Edison Historical Society.

2011 Managed, conducted historical research and archeological investigation, and co-authored a study of the Continental Powder Works site on French Creek, Pennsylvania. East Pikeland Township Historical Commission, Chester County, Pennsylvania.

2011 Project manager for the development of a traveling exhibit designed to tell the story of the archeology and history of Delaware farming. The Delaware River and Bay Authority.

2010 Managed archeological investigations and oversaw historical research associated with the study of an unmarked historic-period cemetery beneath River Road, Oak Orchard, Sussex County, Delaware. Subsequent historical research identified the site as a family cemetery on a tract called Batchelor's Lott. Sussex County Engineering Department.

2010 Managed, conducted archeological investigations, and co-authored the Fish Creek Cultural Landscape Study and archeological verification of a purported Revolutionary War earthwork. Schulyerville, New York. Funded by the American Battlefield Protection Program. Saratoga Preserving Land and Nature (PLAN).

2010 Managed, conducted historical and archeological research, and co-authored the Princeton Battlefield mapping project, funded by the American Battlefield Protection Program (ABPP). Princeton, New Jersey. Princeton Battlefield Society.

2008 Served as Principal-in-Charge of archeological and historical Phase I investigations of the Hershey Run project area, associated with the former Koppers Newport Superfund Site, Delaware. Langan Environmental.

2008 Directed archeological and historical investigations of three root cellars on the campus of Moravian College, Bethlehem, Pennsylvania. Moravian College.

2007 Managed the archeological and historical Phase I and II investigations of the former Koppers Newport Superfund Site, Delaware. The site area contains numerous prehistoric and historic archeological sites, including two seventeenth-century settlement sites. Langan Environmental.

2006 Directed the JMA team that developed a feasibility study for the Dennis Farm Charitable Land Trust, Susquehanna County, Pennsylvania, a property owned by the descendants of an African-American family for over 200 years. Dennis Farm Charitable Land Trust and Endless Mountains Heritage Region, Inc.

2006 Managed archeological investigations and historical research of the former New Castle County Almshouse, part of Section 106 requirements associated with the improvements of I-295. Rummel Klepper & Kahl, L.L.P.

2005 Managed data recovery investigations, including field investigations and historical research, at 1803 and 1805 North Market Street, two National Register-listed historic properties in Wilmington, Delaware. Wilmington Senior Center.

2005 Conducted historical research and field investigations at the location of a Revolutionary War musketry range at Valley Forge National Historical Park. Boyles, Smyth Inc.

2004 Co-authored the National Register of Historic Places nomination for the Beverwyck Plantation archeological site, Morris County, New Jersey. The site was listed to the National Register in 2004.

2003 Managed archeological investigations, including historical research and report authorship, at Old New Castle Courthouse, New Castle Delaware, as part of renovation/restoration activities. Delaware State Museums.

2003 Managed historical documentation compilation, including GIS data inventory, of the Indian River Bridge Project, Sussex County, Delaware. Rummel. Klepper & Kahl, LLP, for Delaware Department of Transportation.

2002-2003 Directed Data Recovery Investigations at two historic sites as part of the multi-consultant team at Raritan Landing Archeological District, Route 18 Extension Project, Middlesex County, New Jersey. New Jersey Department of Transportation.

2001-2003 Conducted historical research regarding British military occupation and copper processing at Raritan Landing as part of the Route 18 Extension Project, Middlesex County, New Jersey. New Jersey Department of Transportation.

2002 Conducted Historical Research for Historic Structure Report of United States Marine Hospital National Historic Landmark, Louisville, KY. City of Louisville, Louisville Development Authority.

2002 Directed Phase I and Phase II archeological and historical research at the proposed site of the Delaware National Guard Readiness Center, Smyrna, Delaware. Delaware National Guard.

2002 Directed archeological overview and assessment of Hopewell Furnace National Historic Park, Birdsboro, PA. National Park Service.

2002 Conducted historical research and assisted in the preparation of a Historic Structures Report for the U.S. Marine Hospital, National Historic Landmark. Louisville, KY.

2001 Conducted historical and archeological investigations of five eighteenth and nineteenth century historic sites of Hopewell Furnace National Historic Park, Birdsboro, PA. National Park Service.

2001 Co-directed data recovery investigations and conducted historical research of the Raritan Landing Project, New Brunswick, NJ. New Jersey Department of Transportation.

2001 Conducted historical research and assisted in developing historic commemorative contexts for seven national military parks (Chickamauga/Chattanooga, Gettysburg, Shiloh, Vicksburg, Antietam, Valley Forge, Minute Man). National Park Service.

2001 Conducted historical research and directed Phase I archeological investigations at Hopewell Furnace National Park. National Park Service.

2001 Conducted historical research and co-directed data recovery investigations for the eighteenth-century Beverwyck Plantation site, Morris County, New Jersey. New Jersey Department of Transportation.

2000 Directed archeological investigations at Block III, John Dickinson Plantation, Delaware. Delaware State Museums.

2000 Conducted historical research and assisted in preparing historic contexts for Valley Forge National Historic Park. National Park Service.

2000 Conducted historical research and Phase I archeological survey at site of Camp Security/Camp Indulgence, a British Revolutionary War Prisoner-of-War encampment, York County, Pennsylvania. Pasch Construction.

2000 Directed historical research and prepared historic context for the Blue Ball Properties Master Plan, New Castle County, Delaware. Wallace, Roberts & Todd.

2000 Directed historical research and prepared historic context for Phase IA cultural resources investigation for a proposed parking facility at the site of the eighteenth and nineteenth century Second Street Market, Lower Market Street Historic District, Wilmington, Delaware. Wilmington Renaissance Corporation.

2000 Directed historical research and developed historic context for the Triangle Woods Archeological Site, New Castle County, Delaware. Delaware Department of Natural Resources and Environmental Control. The site was the location of an early twentieth century gypsy camp.

1999 Directed and conducted historical research on the AstraZeneca Triangle Property, New Castle County, Delaware. AstraZeneca Pharmaceutical, Inc.

1999 Conducted historical research on the North Pownal Tannery, North Pownal, Vermont. Stone and Webster.

1999 Directed historical research of the Lincoln Cemetery, an African-American burial ground, Gettysburg, Adams County, Pennsylvania. Borough of Gettysburg.

1998 Conducted historical research for the Jacob M. Zook House, Exton Square Mall expansion, Chester County, Pennsylvania. The Rouse Company.

1998 Conducted historical research for Buena Vista Conference Center, former home of Senator John M. Clayton, New Castle County, Delaware. Delaware State Museums.

1998 Conducted historical research for the Diggs-Monroe and Culp-Mundorff sites, Gettysburg, Pennsylvania. The Borough of Gettysburg.

1998 Directed historical research and prepared historic context for the Joseph Carrell, Jr. Farmstead site, Street Road Commercial Development Project, Bucks County, Pennsylvania. Newman Development Group of Warrington, L.L.P.

1997 Prepared historical context and conducted historical research for Governors Island, New York Harbor. General Services Administration.

1997 Prepared historical context and conducted historical research for the Thonsville and Gabel Park Woods Sites, Lancaster Township, Lancaster County, Pennsylvania. Pennsylvania Department of Transportation, District 8-0.

1997 Prepared historical context and conducted historical research for Phase IA cultural resources investigation of sediment removal areas in the Christina River, Newport, New Castle County, Delaware. DuPont Environmental Remediation Services.

1997 Conducted historical research for Phase I archeological survey of the proposed Andorra Glen Apartment Complex, Whitemarsh Township, Montgomery County, Pennsylvania. The Andorra Group.

1996 Conducted historical research for Phase IB archeological survey of the former Koppers Company, Inc. Property, Newport, New Castle County, Delaware. Beazer East and DuPont Specialty Chemicals in association with Woodward-Clyde Consultants, Inc.

1995 Conducted historical research for Phase II evaluation of the Motts Run Water Filtration Plant Site, Spotsylvania County, Virginia. Hayes, Seay, Mattern & Mattern, Inc.

1994 Conducted historical research for Phase I archeological investigations at the Pennell House Site, Delaware County, Pennsylvania. Wawa Dairies, Inc.

1993 Prepared historical context and conducted historical research for data recovery excavations at the New Geneva Pottery Waster Dump Site, Fayette County, Pennsylvania. Pittsburgh District, U.S. Army Corps of Engineers.

1992 Prepared historical context and conducted historical research of the Mermaid Tavern Blacksmith and Wheelwright Shops, New Castle Co., Delaware, Delmarva Department of Transportation.

1991 Conducted extensive historical research for community of Christiana Bridge and the Eagle Run Tenant House Site and the William Patterson Mansion House and Boat Dock, New Castle County, Delaware. Delaware Department of Transportation.

1990 Prepared historical context and conducted historical documentary research of the Thomas Williams Site (7NC-D-130), an African American household, New Castle County, Delaware. Delaware Department of Transportation.

1990 Prepared historical context and conducted historical research for Delaware's management plan for historical archeological resources. University of Delaware and Delaware State Historical Preservation office.

1989 Prepared historic context and conducted extensive historical research for the southeast Sussex Corridor cultural resources survey, Sussex County, Delaware. Delaware Department of Transportation.

SELECTED PUBLICATIONS

Forthcoming Archaeology, Computer Technology and the Battle of Princeton as a Cross-Cultural, Trans-Atlantic Encounter. Springer Press.

2007 "Newark and Newarkers in the Era of the American Revolution", in *Histories of Newark, 1758-2008,* edited by Deborah Haskell, pgs. 18-29 (Wallflower Press, Newark, DE).

2001-2002 Research Questions for the Archaeology of Rural Places: Experiences from the Middle Atlantic. *Northeast Historical Archaeology* 30-31:143-154.

1999 "Down on the Farm": Questions, Directions and Interpretations of the Archeology of Delaware Agriculture and Farm Life, 1800-1950 (with LuAnn DeCunzo). *Bulletin of the Archaeological Society of Delaware* 36:19-27.

1993 From "White Man's Garbage" to the Study of Material Culture: A review of Historical Archaeology in Delaware (with Lu Ann De Cunzo). *Delaware History* 25(3):174-199.

1993 Small Wonder, There's Diversity! Current Historical Archaeology in Delaware (with David Grettler). *Bulletin of the Archaeological Society of Delaware* 30.

1993 "Entertained . . . at ye Tavern Close By." Historical Archaeological Inquiry at Thomas Ogle's Tavern, Ogletown (with Angela Hoseth and Ellis C. Coleman). *Bulletin of the Archaeological Society of Delaware* 30:5-16.

1991 A Report of the Archaeological Investigations at the House of Thomas Cuff, A Free Black Laborer, 108 Cannon Street, Chestertown, Kent County, Maryland (with Doug McCall). *North American Archaeologist* 12(2):155-181.

1990 Building a Framework for Research: Delaware's Management Plan for Historical Archaeological Resources (with LuAnn DeCunzo). *Northeast Historical Archaeology* 19:1-49.

1988 *Slaves, Free Blacks, and French Negroes: An Archaeological and Historical Perspective on Wilmington's Forgotten Folk.* M.A. thesis, Department of History, University of Delaware, Newark.

1986 Soil Chemistry and Historic Archaeological Site Activity Areas: A Test Case from Northern Delaware (with Jay F. Custer, Ellis C. Colman, and Kevin W. Cunningham). *Historical Archaeology* 20(2):89-94.

SELECTED PRESENTED PAPERS

2011 Archaeology, Computer Technology and The Battle Of Princeton As A Cross-Cultural, Trans-Atlantic Encounter. Presenter and Co-author a paper presented at the International Committee on Archaeological Heritage Management (ICAHM) at the International Council on Monuments and Site (ICOMOS) annual meeting, Paris, France.

2011 "We Have Allowed the Rebels too much Time in Which to Become Soldiers": Deciphering Revolutionary War American Military Formations through Historical Archeology. Paper presented at the Annual Meeting of the Council for Northeast Historical Archeology, Utica, New York.

2010 Family, Farm, and Freeedom: The Legacy of the Dennis Farm, Susquehanna County, Pennsylvania. Paper presented at the Pennsylvania Byways Conference, Harrisburg, Pennsylvania.

2010 "Built At Ye Back Side Of Ye Towne": Archeology At The New Castle Court House Museum, New Castle, Delaware. Paper presented at the annual meeting of the Society for Historical Archaeology, Ameilia Island, Florida.

2008 The Perambulations of Lieutenant Nutt's Button: Camp Security and Camp Indulgence, York County, Pennsylvania. Paper presented at the Annual Meeting of the Middle Atlantic Archeological Society, Ocean City, MD.

2008 Quakers in the Philadelphia Hinterland: The Archaeology of Public Spaces and Domestic Places. Co-authored with Rebecca Yamin. Paper presented at the annual meeting of the Society for Historical Archeology, Albuquerque, New Mexico.

2007 From the Mountains to the Sea: Using the Delaware River Watershed as a Model for Regional Farmstead Archeology. Paper presented at the annual meeting of the Society for Historical Archeology, Williamsburg, Virginia.

2007 Give Them As Much Trouble As You Possibly Can: The Battle of Cooch's Bridge, September 3rd, 1777. Paper presented to the Washington DC Revolutionary War Roundtable.

2007 "Make Sure You Aim, For One Shot Well-Pointed is Worth a Dozen Thrown Away: Archeological Evidence of a Musketry Range at Valley Forge National Historical Park, Pennsylvania, USA. Paper Presented at the Council for Northeast Historical Archeology Annual Meeting, Buffalo, NY.

2006 "A System of Easy Manuvers…" Archeological Evidence of a Musketry Range at Valley Forge National Historical Park, Pennsylvania, USA. Paper presented at the 4th Annual Fields of Conflict Conference, Leeds, UK.

2006 A Spirited Little Affair: History and Archeological Potential of the Cooch's Bridge Battlefield, New Castle County, Delaware. Paper presented at the Society of Historical Archeology Annual Meeting, Sacremento, CA.

2005 Tradition, History and the Archeological Potential of the Cooch's Bridge Battlefield, New Castle County, Delaware. Paper presented at the annual meeting of the Middle Atlantic Archeological Conference, Rehoboth Beach, DE.

2005 Wintering on the Raritan: The Private Correspondence of a British Officer. Paper presented at the annual meeting of the Council for Northeast Historical Archeology, Trenton, NJ.

2000 "We Live in a World of Company": Archeology and History of Beverwyck Plantation, Morris County, New Jersey during the American Revolution. Paper presented at the annual meeting of the Society for Historical Archaeology, Mobile, AL.

2000 "The Keep the Banks, Dams, and Sluices in Repair…": An Archaeological Study of Marsh Architecture. Paper presented at the annual meeting of the Society for Historical Archaeology, Quebec, Canada.

SUMMARY OF PROFESSIONAL ACTIVITIES

Mr. Catts is author or co-author of over sixty-five (65) cultural resources reports, fourteen (15) scholarly articles and monographs, five (5) book reviews, thirty-one (31) papers presented at professional meetings, six (6) symposia organized at professional meetings, and one (1) professional conference organized.