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UNITED STATES ARMY INSTALLATION MANAGEMENT AGENCY
NORTHEAST REGIONAL OFFICE GARRISON
PICATINNY ARSENAL, NEW JERSEY 07806-5000

October 29, 2008

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HPO L2008-114

Environmental Affairs Division

Mr. Daniel Saunders
Acting Deputy State Historic Preservation Officer
State of New Jersey Historic Preservation Office
Department of Environmental Protection
Division of Parks and Forestry
501 East State Street CN 404
Trenton, New Jersey 08625-0404

SUBJECT: HPO-H2008-102, Addendum Report: FINAL Phase I Cultural Resources Investigation for the Proposed Packaging, Handling, Shipping & Transportation Center (PHS&T), Picatinny Arsenal, New Jersey- Panamerican Consultants, Inc.

Dear Mr. Saunders,

In response to your August 18, 2008 letter, Picatinny Arsenal Garrison contracted with the Army Corps of Engineers, Mobile District and Parsons Infrastructure to have Panamerican Consultants, Inc. (PCI) perform further Phase I Cultural Resource Investigation fieldwork for the proposed Packaging, Handling, Shipping & Transportation Center (PHS&T). The PHS&T is part of the Base Realignment and Closure Report (BRAC Receiving Actions Since 2005) for Picatinny Arsenal. The enclosed FINAL report: *Phase I Cultural Resources Investigation for the Proposed Packaging, Handling, Shipping & Transportation Center, Picatinny Arsenal, Morris County, New Jersey* is ***an addendum*** to PCI's June 2008 Final report for the *Phase I Cultural Resource Survey of Eight Study Areas Totaling Approximately 215 Acres, Picatinny Arsenal, Morris County, New Jersey* (Smith et al. 2008; HPO-H2008-102, enclosed for further reference). The project area is defined as the Area of Potential Effects (APE) or study area for any identified Archaeological Properties potentially eligible for listing on the National Register of Historic Places (NRHP) within this report and consultation letter.

This APE was not shovel tested at the time of the original Phase I survey because of elevated risks of unexploded ordnance (UXO) from the 1926 Lake Denmark Naval Powder Depot explosion. Due to Explosive Safety Procedures, extensive UXO removal action investigations took place over the APE by electromagnetic metal-detecting and excavation prior to this Addendum Phase I investigation by PCI. These UXO removal excavations were performed by Malcolm Pirnie, Inc. and PIKA International, Inc. as part of a Joint Venture for the Military Munitions Response Program. These excavations resulted in the mapping and excavation of all metal (historic) anomalies. Standard Operating Procedures (SOP) were put into effect during this excavation process to have any significant historic materials brought to the Cultural Resource Manager's (CRM) attention, Jason Huggan whom meet *the Secretary of Interior's Standards as a Registered Professional Archaeologist*, upon their recovery with location coordinates. The only historic material found of reverence during these UXO removal investigations was a horseshoe. All other remaining metal anomalies were left onsite adjacent to the UXO excavation holes and their backfill piles for PCI's Addendum Phase I investigation. PCI sifted through a random selection of the UXO excavation holes and their backfill piles to assess the remaining portions of their APE. Although this UXO Joint Venture Investigation did not mitigate 100% of the UXO concerns across the APE, it did permit shovel testing digging with continued UXO support for PCI. Malcolm Pirnie and PIKA are preparing a Final report of their UXO removal action

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investigation conclusions to Picatinny. This report is approximately 2 months from completion (approximately the end of the Calendar Year).

According to PCI's report, the Phase I investigation included a review of previous research and historical maps and archaeological investigation of the APE. The archaeological investigation included the mapping of features identified in the APE, photo-documentation of site conditions and disturbances, shovel testing in a 15-meter (m) (50-ft) grid, the screening of samples of back dirt left by the UXO Joint Venture Investigation, and the surface collection of items – also likely unearthed during the UXO removal investigations. A total of 109 shovel tests were dug and 11 UXO removal investigation back soil piles were sifted.

A review of historic maps revealed two 19th -Century structures associated with George Righter possibly stood near the northern extreme of the APE. It was also near the site of the historic Middle Forge, an 18th - Century/early19th - Century facility (no longer standing) on Green Pond Brook near its confluence with Picatinny Lake, several hundred feet northwest of the APE. This area was part of the original 1880 land purchase for the U.S. Dover Powder Depot (subsequently Picatinny Arsenal). Since that time, numerous powder depot and arsenal buildings have stood within its boundaries. The APE lies between 1,000 and 2,000 ft from one of the centers of the 1926 Lake Denmark Naval Powder Depot explosion area that devastated large parts of Picatinny. As a result of this explosion series, many buildings were damaged and had to be demolished and/or rebuilt across the Arsenal. During the 1930s and 1940s, three manufacturing complexes were built that extended across parts of the APE, two of which were constructed for bag-loading of explosive powder and the other for loading tracers. Among the structures in the complexes were Buildings 448, 448A, 448B, 448C, 448D, 452, 452A, 452B, 462 and 462A, 462B, 462C and 462D. Large numbers of utilities and railroads have also extended across the APE.

As well, during PCI's Addendum Report completion, 2 additional historic maps were found within the Picatinny Historian's files. These maps are enclosed below and date to 1914 (Figure 1) and before the 1926 explosion (Figure 2), respectively. As these maps and PCI's additional historic research/maps within the enclosed report demonstrate, the Building 448 Series complex overlies the sites of prior Building 54 (millwright shop), and prior Building 396 (two-story brick storehouse originally used as a shavings bin). Furthermore, prior Building 452 lied partially atop the location of Building 118 (two-story brick main office). The fact that these parts of the APE study area have witnessed two episodes of industrial development suggests there is minimal possibility that remains related to earlier historical and prehistoric uses of the land are extant. As these and PCI's additional historic maps presented within this Addendum Report demonstrate, all of the prior surrounding buildings (pre- 448 and 452 Series Buildings) within the PHS&T APE were demolished after they were extremely deteriorated from the 1926 Lake Denmark Naval Powder Depot explosion.

Overall, no definitively pre-Arsenal artifacts were found during PCI's Addendum Phase I investigation, and only one item – a cut nail – might date to before 1900. Numerous more-recent artifacts were found, including: wire nails; unidentifiable iron fragments; an iron rasp; an iron pipe fitting; a brass piece from a clock; a piece of heavy-gauge cast iron hardware (possibly an element from a track of a tracked vehicle); an iron wrench; four enameled sheet-iron cups with rolled lips; and several pieces of clear container glass with mold-lines (some of which are embossed "Gulden's Mustard"). Three poured-concrete foundations were identified, whose locations correlate with structures on the 1922 map: the lumber shed, two-story office building, and hollow-tile magazine that was being used for office record storage. All three structures were demolished following the 1926 Lake Denmark Naval Powder Depot explosion. No deposits of historical material or structural remains from pre-Arsenal structures were identified anywhere in the project area. Also, no prehistoric artifacts or features were found. Based on these results, PCI has concluded there are no archaeological sites within the APE. As a result, the construction of the PHS&T will have *'No Effect'* on cultural resources listed, or eligible for listing, in the NRHP.

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Picatinny's plan for curating the minimal amount of artifacts, field records, and photos collected from this project is to temporarily store the materials within a curation facility area until the installation finds a more suitable long-term storage facility compliant with 36 CFR 79. This area is secure and has a separate HVAC system from its remaining building. Additionally, the collections will be stored in a separate protected environment within the room itself (with humidity monitors for climate control inspection purposes). Overall, Picatinny realizes that this curation and conservation plan does not entirely meet regulatory compliance; however, the installation does have a future preservation goal in mind based on the amount of previous collections that it has onsite and at other various Cultural Resource Management firms within the region, and also future funding allotments designed for this fiscal year and the next. Picatinny is currently in discussions with other Federal agencies, and local county and township historical organizations in the hopes of finding a long-term storage facility fully compliant with 36 CFR 79's regulations. (Note: This long-term storage facility will likely be off-post and not on the installation, as the Army is currently not funding these requirements at Picatinny.)

In conclusion, the enclosed drawing depicts the limits of disturbance for the new PHS&T. The depth of disturbance for the new PHS&T structure footings and foundation will be approximately 3ft below existing surface grade. Additionally, two (2) consultation letters were sent to your office December 12, 2007 and June 12, 2008 for the demolition of Buildings 448 and 452B with no response to date (enclosed for further reference). Both Buildings were evaluated by PCI in 1999 as 'Determined Not Eligible' for the NRHP (HPO-G99-010). Therefore, Picatinny Arsenal Garrison as the Federal Agency lead for the project has assumed your concurrence from these previous consultations. As a result, these buildings have been demolished for the PHS&T BRAC Project.

We request that your office review and concur with our *determination of no further archaeological investigations and 'No Effect' for the construction of the new PHS&T for BRAC* at Picatinny Arsenal.

Please mail your response to the following address:

Mr. Jason Huggan
Cultural Resource Manager
Chugach Industries, Inc.
Environmental Affairs Office
Bldg. 319
Picatinny Arsenal, NJ 07806

If you require further information, please feel free to contact Mr. Jason Huggan at (973) 724-3664, jason.j.huggan@us.army.mil.

Sincerely,

Thomas Solecki
Chief, Environmental Affairs Division

I concur with your finding that there are no historic properties affected within the project's area of potential effects. Consequently, pursuant to 36 CFR 800.4(d)(1), no further Section 106 consultation is required unless additional resources are discovered during project implementation pursuant to 36 CFR 800.13.

12/19/08
Date

DANIEL D. SAUNDERS
Deputy State Historic Preservation Officer

NP

ENCLOSURES FOR OFFICIAL USE ONLY

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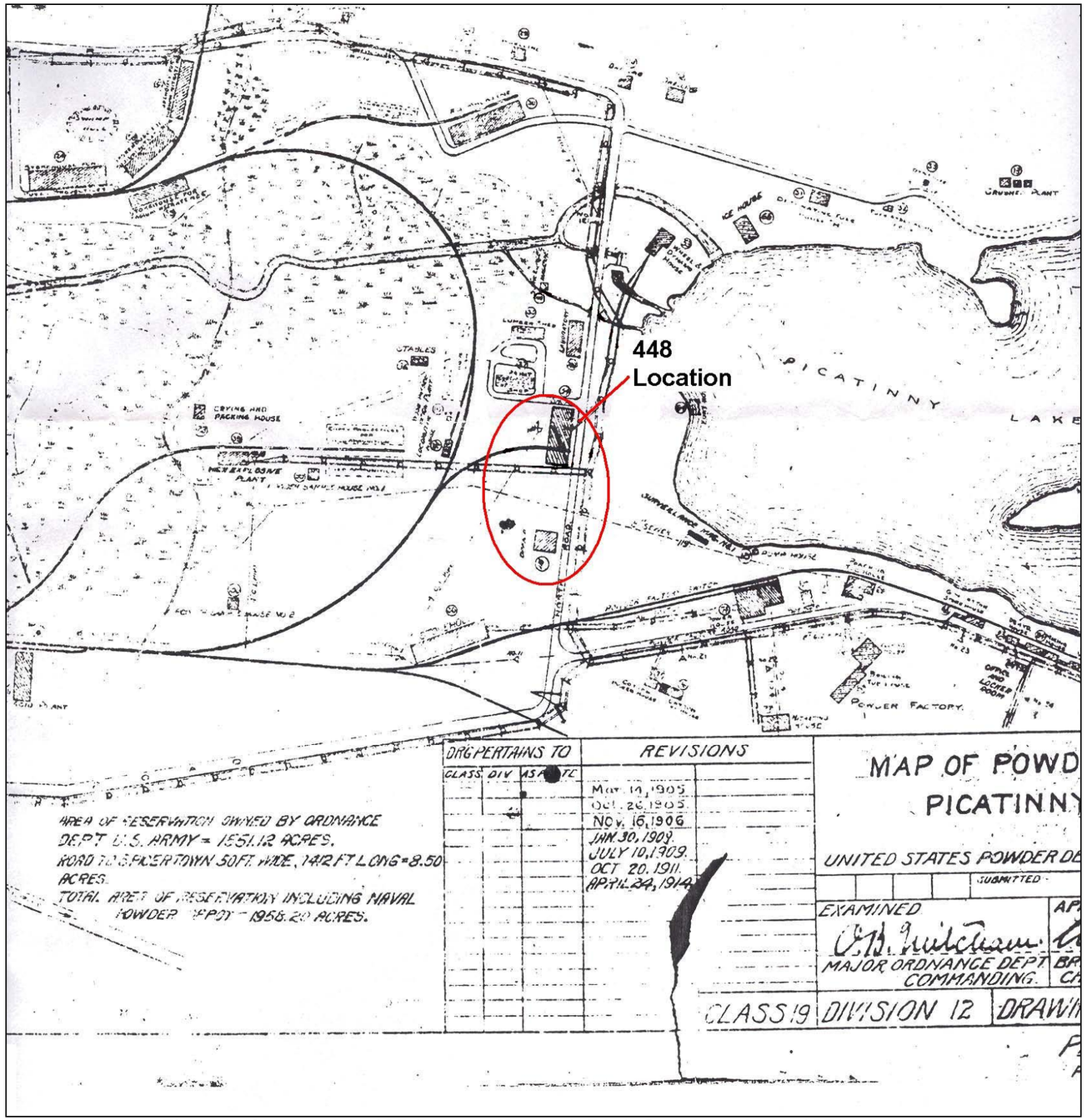

Figure 1. 1914 map of the APE (Picatinny Historian's Files). Circled area depicts APE/study area.

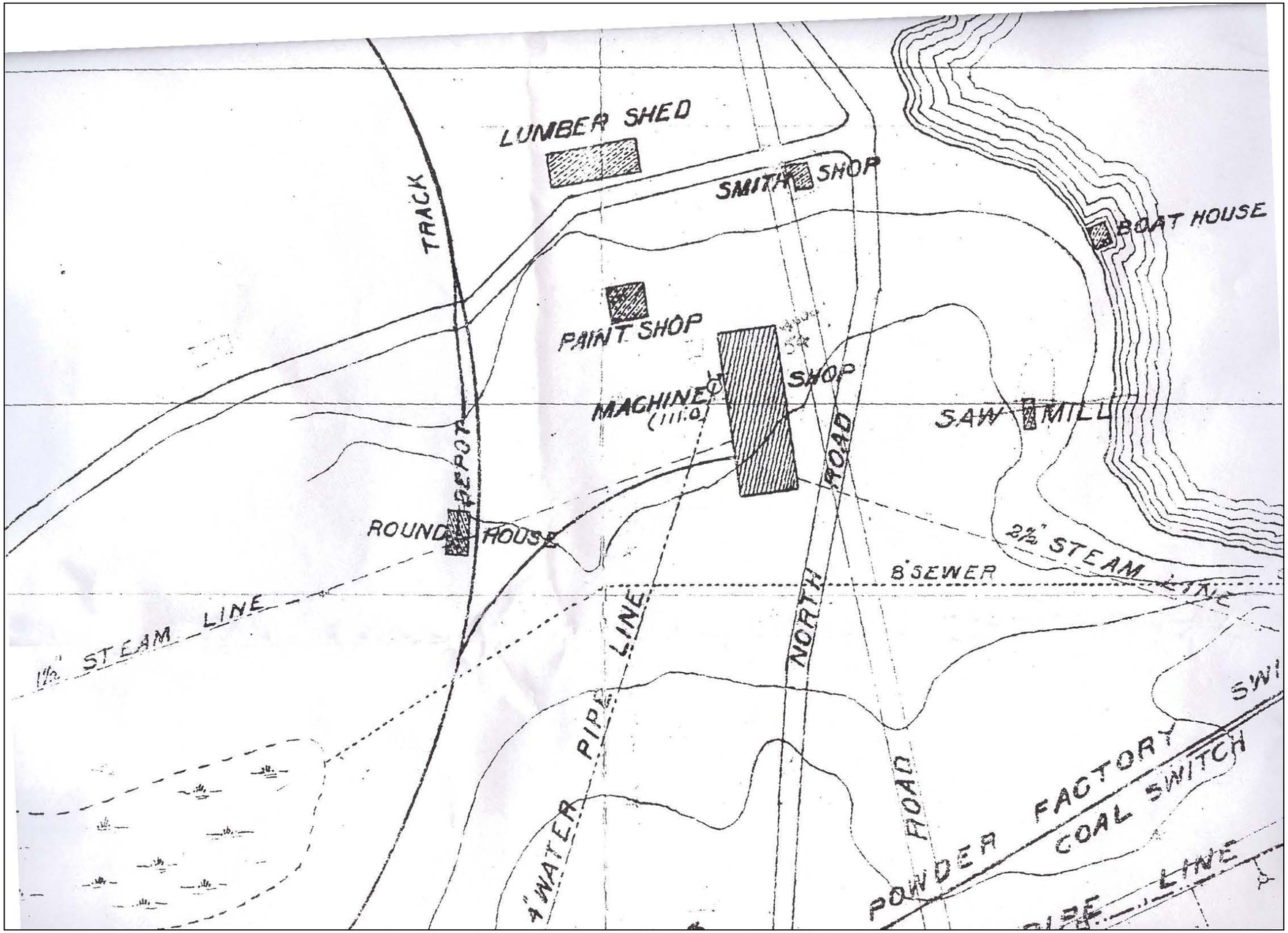

Figure 2. Pre-1926 map of the APE (Picatinny Historian's Files).

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PHASE I CULTURAL RESOURCES INVESTIGATION FOR THE PROPOSED PACKAGING, HANDLING, SHIPPING, AND TRANSPORTATION CENTER, PICATINNY ARSENAL, MORRIS COUNTY, NEW JERSEY

Prepared for:

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October 2008

PHASE I CULTURAL RESOURCES INVESTIGATION

FOR THE PROPOSED

PACKAGING, HANDLING, SHIPPING, AND

TRANSPORTATION CENTER,

PICATINNY ARSENAL, MORRIS COUNTY, NEW JERSEY

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October 2008

Executive Summary

Project Name. Phase I Cultural Resources Investigation for the Packaging, Handling, Shipping, and Transportation Center, Picatinny Arsenal, Morris County, New Jersey

Project Location and Environmental Setting. Picatinny (PICA) comprises approximately 5,850 acres in Rockaway and Jefferson Townships, Morris County, New Jersey. Located in Green Pond Brook Valley, PICA is flanked by uplands to the northwest and southeast. Rocky outcrops, steep slopes, and very stony soils are characteristic of the region.

Purpose and Goals. Panamerican Consultants, Inc. (Panamerican) was subcontracted by Parsons Infrastructure of San Antonio, Texas to identify cultural resources within the 7.1-acre area of potential effect (APE) for the Packaging, Handling, Shipping, and Transportation (PHS+T) Center to be constructed in the 400 Area of Picatinny. The PHS+T Center is an element of the Base Realignment and Closure (BRAC) 2005 receiving actions undertakings at Picatinny.

Regulatory Basis. The U.S. Army, as a federal agency, has management responsibilities concerning the protection and preservation of cultural resources on land it controls or uses. Federal statutes require the Army to identify and evaluate significant cultural resources on these properties, and include: the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et. seq) through 2000 (which includes section 106 compliance); the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4371 et. seq.); the Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historical Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as Army Regulation (AR) 200-1 Environmental Protection and Enhancement.

Cultural Resources Survey Work Completed. The investigation included a review of previous research and historical maps and archaeological investigation of the project area. Archaeological sensitivity was assessed through a review of previous research and field investigations. Areas selected for shovel testing were first scanned with a magnetometer to verify the absence of unexploded ordnance (UXO). Geographic coordinates of shovel test baselines, screened back dirt from pits dug during a previous UXO survey of the project area, disturbances, and identified cultural features were recorded with a geographic positioning system (GPS) unit.

A 215-acre portion of Picatinny that included nearly the entirety of the APE for the current project was the subject of a 2007 archaeological investigation (Smith et al. 2008). However, the PHS+T project area was not shovel tested at that time because of elevated risks from unexploded ordnance. The current study is an addendum to the 2007 investigation. A preliminary survey for UXO was completed by Malcolm Pirnie, Inc., of White Plains, New York prior to the beginning of the 2008 archaeological field work. This UXO investigation is being completed under direction of the Picatinny Arsenal Environmental Office and the U.S. Army Corps of Engineers as part of the Army's Military Munitions Response Program, which addresses sites with military munitions contamination. PIKA International and Malcolm Pirnie, Inc. conduct the UXO removal project through a Joint Venture. Although the UXO survey of the PHS+T Center project area did not mitigate 100 percent of the unexploded ordnance concerns there, it was extensive enough to permit the shovel digging needed for the Phase I cultural resource survey, with continued UXO support.

Results. There are no previously-recorded prehistoric archaeological sites in or adjacent to the study area. A review of historic maps revealed two nineteenth-century structures associated with George Righter possibly stood near its northern extreme. It was also near the site of the historic Middle Forge, an eighteenth-century/early-nineteenth century facility (no longer standing) on Green Pond Brook near its confluence with Picatinny Lake, several hundred feet northwest of the project area.

The area of investigation was part of the original 1880 land purchase for the U.S. Powder Depot (subsequently Picatinny Arsenal). Since that time, numerous powder depot and arsenal buildings have stood within its boundaries. It also lies between 1,000 and 2,000 feet (ft) from one of the centers of the 1926 Lake Denmark Naval Powder Depot explosion, which devastated large parts of Picatinny. Many buildings were damaged and had to be demolished. During the 1930s and 1940s, three manufacturing complexes were built that extended across parts of the study area, two of which were constructed for bag-loading of explosive powder and the other was for loading tracers. Among the structures in the complexes were Buildings 448, 448A, 448B, 448C, 448D, 452, 452A, 452B, 462 and 462A, 462B, 462C and 462D. Large numbers of utilities and railroads have also extended across the investigated area.

At the time of the field investigation, there was evidence of recent disturbance that extended across much of the study area. Hundreds of holes were excavated by UXO technicians during their survey and were left open allowing further inspection. Also, Buildings 448A-D, 452, and 452A had been demolished and their former sites leveled. These buildings were demolished after 1985 per a Memorandum of Agreement (MOA) with the New Jersey State Historic Preservation Office (New Jersey HPO) for the Toxic Environmental Cleanup Program and other later Section 106 consultations (HPO-L96-143).

The archaeological investigation included: the mapping of features identified in the study area; photo-documentation of site conditions and disturbances; shovel testing in a 15-meter (50-ft) grid; screening of samples of back dirt left by the UXO survey; and surface collection of items – also likely unearthed during the UXO investigation. A total of 109 shovel tests were dug and 11 UXO back dirt piles were screened. No definitively pre-Arsenal artifacts were found, and only one item – a cut nail – might date to before 1900. Numerous more-recent artifacts were found, including: wire nails; unidentifiable iron fragments; an iron rasp; an iron pipe fitting; a brass piece from a clock; a piece of heavy-gauge cast iron hardware (possibly an element from a track of a tracked vehicle); an iron wrench; four enameled sheet-iron cups with rolled lips; and several pieces of clear container glass with mold-lines (some of which are embossed “Gulden’s Mustard”). Three poured-concrete foundations were identified, the locations of which correlate with structures on a 1922 Arsenal map: a lumber shed, a two-story office building, and a hollow-tile magazine that was being used for office record storage. All three structures were demolished following the 1926 Lake Denmark Naval Powder Depot explosion. No deposits of historical material or structural remains from pre-Arsenal structures were identified anywhere in the project area. Also, no prehistoric artifacts or features were found.

Conclusions and Recommendations. Based on these results, Panamerican concludes there are no archaeological sites within the project area. The construction of the PHS+T Center will have no effect on cultural resources listed, or eligible for listing, in the National Register of Historic Places. Therefore, no further archaeological investigations are recommended.

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1.0 Introduction

Panamerican Consultants, Inc (Panamerican/PCI) was contracted by Parsons Infrastructure of San Antonio, Texas, to complete a Phase I archaeological investigation of a 7.1-acre study area at Picatinny Arsenal, Morris County, New Jersey (Figure 1.1). The project area will be impacted by the construction of a Packaging, Handling, Shipping, and Transportation (PHS+T) Center, an element of the Base Realignment and Closure (BRAC) 2005 receiving action undertakings at Picatinny Arsenal. It was designated an "archaeologically sensitive area that may be disturbed" in Panamerican's Integrated Cultural Resource Management Plan (ICRMP) for Picatinny (Cinquino et al. 2000; Schieppati and Steinback 2004), necessitating the completion of an archaeological survey prior to its development. Nearly the entirety of the area of potential effect (APE) for the PHS+T Center was part of a previous 215-acre archaeological investigation (Smith et al. 2008). However, it was not shovel tested at that time because of risks from unexploded ordnance (UXO). A preliminary survey for UXO was later completed by Malcolm Pirnie, Inc., of White Plains, New York prior to the beginning of the 2008 archaeological field work. This project is being completed under direction of the Picatinny Arsenal Environmental Office and the U.S. Army Corps of Engineers as part of the Army's Military Munitions Response Program which addresses sites with military munitions contamination. PIKA International and Malcolm Pirnie, Inc. conduct the UXO removal project through a Joint Venture. Although the survey did not mitigate 100 percent of the unexploded ordnance concerns for the PHS+T project area, it was extensive enough to permit the shovel digging needed for the Phase I cultural resource survey, with continued UXO support.

The purpose of the Phase I investigation was to locate all unrecorded cultural resources in the project area. The U.S. Army, as a federal agency, has management responsibilities concerning the protection and preservation of cultural resources on land it controls or uses. Federal statutes require the Army to identify and evaluate significant cultural resources on these properties, and include: the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 *et. seq.*) through 2000 (which includes Section 106 compliance); NEPA; the Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as AR 200-1 "Environmental Protection and Enhancement."

The current investigation included a review of previous research, historic maps, and archaeological investigation of the project area. Archaeological sensitivity was assessed through an examination of field conditions coupled with a review of previous research, particularly the 2004 Picatinny ICRMP (Schieppati and Steinbeck 2004). Portions of the project area subjected to shovel testing were scanned twice with magnetometers before digging to verify the absence of unexploded ordnance (UXO). Geographic coordinates for shovel test baselines, disturbances, and identified cultural features were recorded with a geographic positioning system (GPS) unit. The field investigation also included a pedestrian reconnaissance, photographic documentation of site conditions, and the excavation of shovel tests. The tests were dug at the standard 50-ft (15-m) interval across the project area, except for disturbed areas (e.g., driveways, intersections, ditches, road berms, and landscape grading), areas not cleared by the UXO technician, and zones with steep slope. Additionally, samples of back dirt left from the UXO Joint Venture investigation were screened for cultural remains and representative items unearthed by technicians during that survey were collected. Field investigations were conducted on September 3 and 4, 2008.

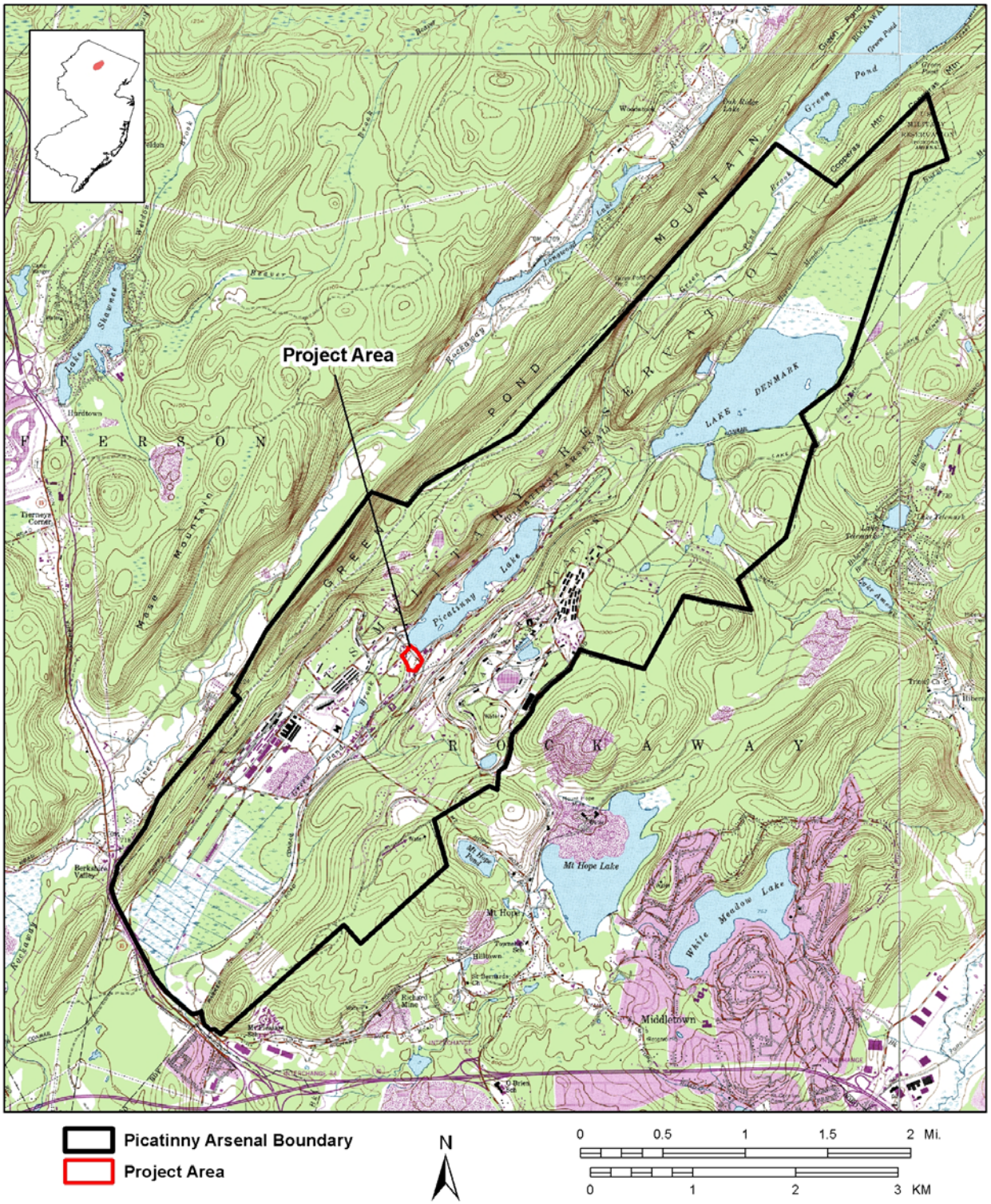


Figure 1.1. Location of the project area in Picatinny Arsenal, Morris County, New Jersey *(USGS 7.5-Minute Quadrangles: Boonton, NJ 1995; Dover, NJ 1997; Franklin, NJ 1971; and Newfoundland, NJ 1997).*

Dr. Donald Smith served as Principal Investigator. Ms. Sharon Jenkins, M.A., assisted in artifact analysis and Senior Historian Mr. Mark A. Steinback, M.A., prepared the background research. Dr. Michael A. Cinquino, RPA, served as Project Director.

2.0 Environmental Setting and Previous Research

2.1 ENVIRONMENTAL SETTING AND PROJECT AREA DESCRIPTION

Picatinny (PICA) comprises 5,850 acres within Rockaway and Jefferson townships, Morris County, New Jersey. Located in north-central New Jersey, the installation includes Lake Picatinny and Lake Denmark, both man-made impoundments. Contained within the Green Pond Brook Valley, PICA is flanked by uplands to the northwest and southeast. Steep slopes, stony soils and rocky outcrops are characteristic of the region. The Green Pond Brook drainage traverses the New Jersey Highlands physiographic province, which is characterized by mountains, hilltops, ridges, lakes, ponds, and streams. Vegetation is generally consistent with northern-type forests and is mixed oak hickory, typical of low fertility soils (Stansfield 1983:35).

Picatinny straddles the Green Pond fault, which runs roughly along the northwest edge of the Green Pond Brook valley floor. Northwest of the fault, bedrock is composed of Silurian Green Pond Conglomerate, and to the southeast it is made up of Precambrian Gneiss. Southwest of Picatinny Lake, layers of Middle Cambrian Leithsville dolomitic material and Lower Cambrian Hardyston Quartzite extend between the conglomerate/gneiss interface (Waterways Experiment Station 1995:9-10). Soils at Picatinny belong to two associations, Carlisle-Parsipanny-Preakness and Rockaway-Hibernia-Urban Land. The Carlisle-Parsipanny-Preakness soil association consists of deep, poorly drained and very poorly drained, nearly level mucks, sandy loams, and silty loams. Soils of this association overlie stratified lacustrine sand, silt, and clay, or stratified outwash sand and gravel. They occur in depressions or along low-gradient streams (Eby 1976: General Soil Map). The Rockaway-Hibernia-Urban Land soil association consists of deep, well drained to somewhat poorly drained gravelly sandy loams and stony to extremely stony loams. These soils overlie granitic gneiss on uplands (Eby 1976: General Soil Map).

The project area is at the base of Green Pond Brook Valley, about 100 ft (30 m) southwest of Picatinny Lake. Green Pond Brook, which flows out of the southwest end of Picatinny Lake and runs to the southwest through wet terrain, is roughly 400 ft (120 m) to the northwest. Land in the study area slopes gently downward from southeast to northwest. Elevation there varies between 714 and 732 ft (217 and 223 m) AMSL. Natural drainage is towards Green Pond Brook to the northwest. The U.S. Department of Agriculture classifies the soils across the entirety of the project area as Urban Land (Eby 1976:53, map 8; NRCS [Natural Resources Conservation Service] 2004). At the time of the field investigation, vegetation there consisted of low, uncut grass and medium-age to fully mature deciduous trees. Nearly all the underbrush and any young trees had been removed during the UXO investigation (Appendix A: Photograph 1).

The project area is an irregularly-shaped zone bounded primarily by a series of asphalt roads: Buffington Road to the northeast; Thirteenth Avenue to the northwest; and Eleventh Street to the southwest (Figure 2.1). Its south boundary is formed by a line that extends east from Eleventh Street along a covered walkway that connects Picatinny Buildings 462 and 462C and terminates at Building 455. Finally, the southeastern boundary runs northeast from there along Building 455 and then along a concrete sidewalk back to Buffington Road. Two additional asphalt roads cut across the project area: Whittemore (sometimes Whitmore) Avenue runs southeast to northwest near its northeastern edge and Fourteenth Avenue crosses through the middle of the study area, running southwest to northeast from Eleventh Street to Whittemore Avenue.

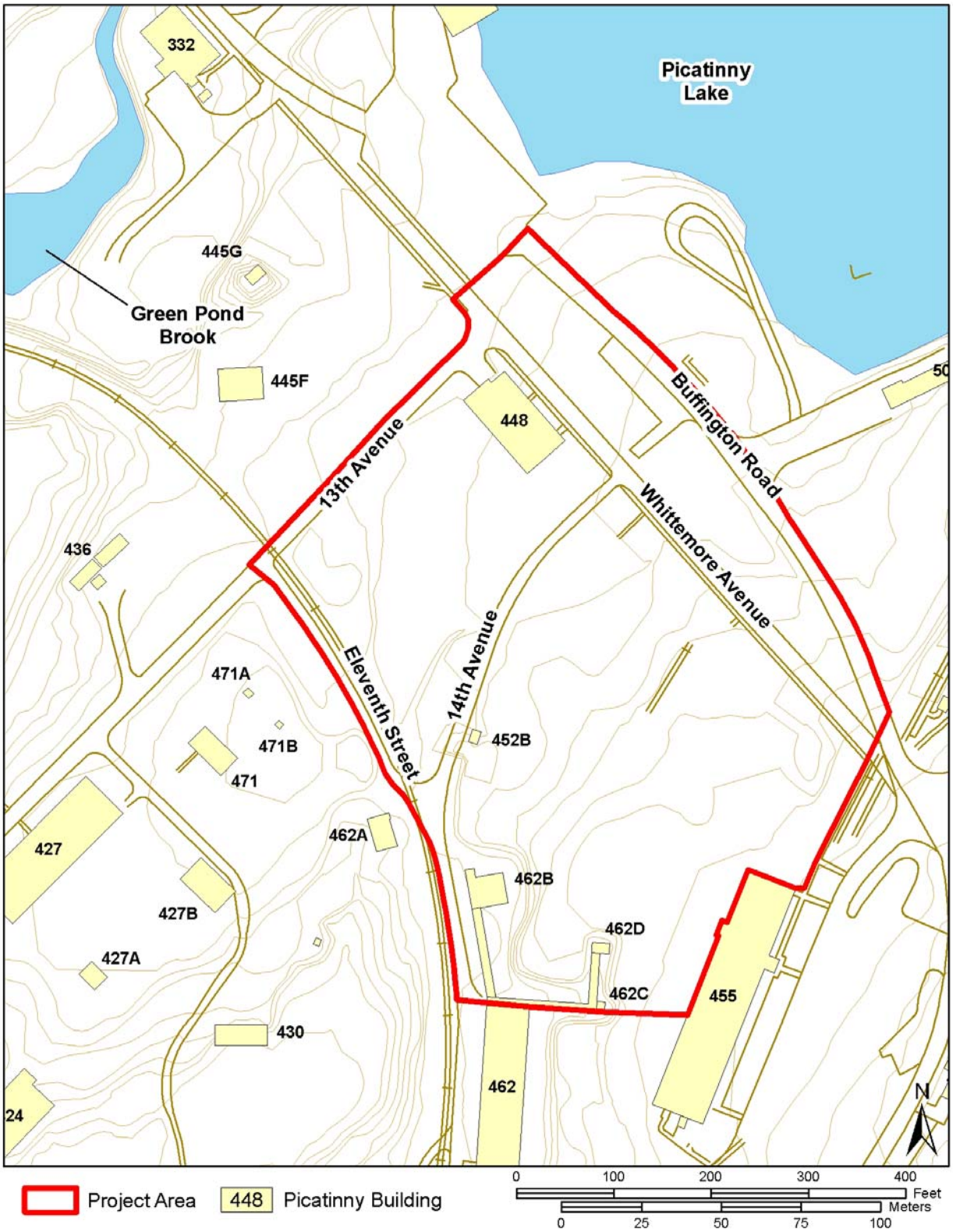


Figure 2.1. Project area showing streets and buildings overlaid on a 2-ft-interval topographic contour map *(thematic data provided by Picatinny Arsenal)*.

2.2 PREVIOUS RESEARCH

In the 1990s, Panamerican was contracted to reevaluate the architectural assessments conducted for structures within PICA, which resulted in the completion of three reports: *Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* (Nolte et al. 1999a), *Definition of Historic Districts for Picatinny Arsenal, Morris County, New Jersey* (Nolte et al. 1999b), and *Response to New Jersey Historic Preservation Office Review of Architectural Assessment of Historic Structures at Picatinny Arsenal, Morris County, New Jersey* (Nolte 1998). These reports recommended that 51 buildings and structures were eligible for listing to the National Register as contributing elements to three historic districts (Administration and Research District, 600 Ordnance Test District, and the Naval Air Rocket Test Station [NARTS], Test Area E District), and two buildings (3250 and 3316) as being individually eligible. The New Jersey Historic Preservation Office (New Jersey HPO) concurred with these recommendations (Guzzo 1999).

Panamerican completed Integrated Cultural Resources Management Plans (ICRMP) for the installation in 2000 (Cinquino et al. 2000) and in 2004 (Schieppati and Steinback 2004). Panamerican completed a National Register of Historic Places (NRHP) determination of eligibility for the Rocket Powder Propellant Plant (1400 Area), the Detonation Facility (1600 Area, "Little Picatinny"), and the NARTS, Area D, as well as the Haleite/High Explosives Plant (1000 Area), the Nitroglycerin Plant (1300 Area), Pyrotechnic Testing Facility (640 Area), and the Ammunition Testing Facilities (630 Area) (Nolte and Steinback 2004a, 2004b). NARTS, Area D was recommended for listing in the NRHP, to which the New Jersey HPO concurred (Guzzo 2004). Panamerican recently completed an evaluation of 318 buildings/structures scattered throughout the installation. By and large, at the time of this assessment, these buildings tended to be small, isolated structures that had escaped previous surveys but were still appearing on various Real Property lists. Of the 318 structures surveyed, 109 had been demolished or were so deteriorated that they had fallen down. Of the remaining 209 structures, 29 were family housing and are no longer the property of the Army. As a result of that investigation, Panamerican recommended that the Rocket Test Area, now the 1500 Area, was eligible as a district for listing in the NRHP under Criterion A, contributing to broad patterns of history, and Criterion C, architectural/engineering features, applying Criterion G. The district comprises 34 contributing buildings and seven non-contributing buildings (Nolte et al. 2007). The remaining structures were recommended as not eligible.

Panamerican also has conducted numerous archaeological investigations in PICA. These include: a survey for a proposed Soft Recovery System for Rail Guns in the 640 Area (Hanley et al. 2005); an investigation in NARTS, Test Area E (Nolte et al. 1999c, 2004); a survey for the installation of a perimeter fence (Hanley et al. 2004); investigations for the development of an installation archaeological sensitivity model (Schieppati et al. 2000, 2003); and a survey of 8 study areas totaling 215 acres (Smith et al. 2008).

The current project area was designated as archaeologically sensitive, but possibly disturbed in the ICRMP (Schieppati et al. 2000, 2003). No known prehistoric or historical archaeological sites have been documented within or adjacent to the study area (see Schieppati and Steinback 2004:3-30/3-42). A review of historical sources suggests there are potentially 2 historical archaeological sites near the project area. A late-eighteenth-early-nineteenth-century iron forge formerly stood north of the PHS+T APE and structures related to a nineteenth-century farm complex might also have been nearby (see Section 3.3).

As noted, Picatinny contains four historic districts that have been ruled eligible for inclusion in the NRHP: The Administration and Research District; the 600 Ordnance Testing District; NARTS, Test Area E; and NARTS Area D (Guzzo 1999, 2004). An additional district – the Rocket Test Area Historic District (now the 1500 Area) – has also been recommended (Nolte et al. 2007). The Navy Commanders Quarters (Building 3250) and its accompanying stable (Building 3316, now a firehouse) and the cannon gates also are eligible for the NRHP (Guzzo 1999).

3.0 Historical Background

The background material in this section includes an abbreviated review of the history of Picatinny, a discussion focused on twentieth-century industrial development in the project area, and an analysis of historical maps documenting the sequence of structures that have existed in the study area. A more complete synthesis of the history of the region around Picatinny, as well as a review of pre-contact cultural developments in northern New Jersey was presented in Panamerican's 2008 Phase I report (Smith et al. 2008) of this study area.

3.1 SYNOPSIS OF THE DEVELOPMENT OF PICATINNY

Pre-Arsenal Background. Prior to the Army's residency in the area, settlement of the Highlands, including the project area, was associated with the iron industry. Mining is reputed to have occurred at both Mount Hope mine (adjacent to Picatinny to the southeast) and Dickerson mine (west of Picatinny) as early as 1710, making these sites the oldest iron-mining operations in both New Jersey and the thirteen colonies (Rutsch and van Voorst 1991:13; Rogers 1931:2-3; Fitch and Glover 1990:B/145-146). By 1737, the northern portion of Hunterdon County (which at that time consisted of the present counties of Morris, Warren and Sussex) had an approximate population of 1,750 whites and 70 African slaves (Pitney 1914:4). During the mid-eighteenth century, three forges were established either near or within what would become the Picatinny Arsenal reservation:

- Picatinny Forge, founded about 1749 and called Middle Forge after 1772;
- Mount Pleasant Forge, founded around 1750 and subsequently known as Lower Forge; and
- Burnt Meadow or Denmark Forge, founded in 1750 and known as Upper Forge.

Although there is little agreement about the structures that may have existed at these forges, Halsey inferred that these sites were "bloomary forges," where charcoal, ore, and limestone were shoveled into a furnace to create a "bloom" or semi-molten mass of metal and slag. While still hot, this mass was hammered to remove the slag and produce wrought iron (Halsey 1882: 48-56; Rutsch 1999).

An important element to the successful operation of these establishments was that the necessary raw materials—iron ore, limestone, and charcoal—were found easily nearby. Mount Hope and Hibernia mines were located in the hills just east of these forges, while at least two limestone extraction pits were utilized within what is now the Picatinny reservation, and several charcoal kilns were adjacent to it (Rogers 1931:7; Fitch and Glover 1990:B-150; Sandy and Rutsch 1992:69; Rutsch et al. 1986:184-186).

The iron industry expanded into the Green Pond Brook valley when Jonathan Osborn (or Osbourne) erected a dam at the southern end of what is now Picatinny Lake and established one of the earliest forges in New Jersey in 1749. Within the boundaries of what is now Picatinny, Osborn's forge was called Picatinny Forge, but later became known as Middle Forge. The forge may have used ores from the nearby Mount Hope mine (Rogers 1931:7; Halsey 1882:41). Establishing his forge at the foot of Picatinny Peak near Green Pond Brook, Osborn created Picatinny Lake by damming the brook. Machinery and other implements from Middle Forge are on display at the installation museum (Rogers 1931:6; Myers 1984:7).

The following year, 1750, Colonel Jacob Ford, Sr., who had purchased Mount Hope mine about the same time, established a forge at Mount Pleasant. Since this was south of Osborn's forge, it was sometimes referred to as the Lower Forge. Ford, a leader in the colonial iron-working industry in New Jersey, constructed a dam on Burnt Meadow Brook in 1750, creating Lake Denmark in the process, in order to erect another forge. Subsequently located near the southern end of Lake Denmark, this forge is referred to as the Upper Forge, or, later, as John Harriman's Iron Works or Burnt Meadow Forge. Jacob Ford, Jr., who would continue the family business of owning numerous iron operations in the Green Pond Brook valley, reacquired Middle Forge in 1772 (Fitch and Glover 1990:B-146; Rogers 1931:6-7; Halsey 1882:41).

Known as the Denmark Tract, Jacob Ford, Jr.'s tract contained approximately 6,231 acres and was located west of Mount Hope and east of Green Pond Mountain (or in the middle of the Green Pond Brook valley). Sources reported that the property was "returned to Courtland Skinner and John Johnson" on June 21, 1774 (Halsey 1882:334; Rogers 1931:5). Skinner and Johnson appeared to have purchased it for Ford, Jr. (Sandy and Rutsch 1992:43). The substantial tract included Mount Pleasant, Washington Forge, the Spicer properties, Middle Forge, and Denmark lands. Portions remained in the Ford family until 1806, when it was purchased by Benjamin Holloway, who rebuilt the abandoned forge.

In the late eighteenth century, ironmaster John Jacob Faesch, a Swiss, formerly employed by the American Iron Company (also known as the London Company), began to dominate the valley's iron industry. Southeast of the future arsenal near the Village of Dover, he established the Mount Hope Furnace in 1772. Also in 1772, Faesch purchased a large tract of land in the Green Pond Brook valley. After demolishing two standing mills (a gristmill and a hemp mill) to construct the Mount Hope Furnace on the best location for waterpower, Faesch increased his holdings by renting contiguous properties from Jacob Ford, Jr. He purchased Middle Forge from the Ford heirs in 1778 as well as over 1,900 acres of forested land adjacent to his forges. Faesch, like the Fords, acquired other forges in the Green Pond Brook valley as well as the Mount Hope mine. Moreover, he operated his forges, including Middle Forge, in conjunction with Mount Hope mine until his death in 1799 (Rutsch et al. 1986:46-49; Fitch and Glover 1990:B-146, B-150; Rogers 1931:7; Halsey 1882:41, 53). The historical records are unclear regarding the relationship between Ford's Denmark Tract and Faesch's Tract, which, upon initial review, seem either to overlap or to be contiguous.

Faesch's various iron works played an important role in the Revolutionary War by providing the Continental Army with iron materiel, such as "cannon, shot, bar iron, shovels, axes and other iron implements" (Myers 1984:7). George Washington visited the ironworks at Mount Hope, and approved the transfer of a number of Hessian prisoners to Faesch in order to work at the facilities (Myers 1984:7; Fitch and Glover 1990:B-150; Rogers 1931:5; Rutsch et al. 1986:48). Within Picatinny's boundaries, the Walton Family Cemetery (known alternatively as the Walton Burial Ground or the Hessian Cemetery) lies near Picatinny's Mount Hope Gate and is reputed to contain graves of several of the Hessian prisoners. Since most of the graves in the cemetery are marked with fieldstones, following early custom, the Hessian connection is extrapolated from prisoner work at the local forge and those Hessians who remained in the area after the war. It is further alleged that four other Revolutionary War veterans are buried there, as well as a possible Civil War veteran, whose grave is unknown (U.S. Army Armament Research, Development, and Engineering Center [ARDEC] Historical Office nd:Item 19; Rutsch et al. 1986:55).

During the nineteenth century, the vicissitudes of the iron industry resulted in valley land changing hands often as the fires of forges burned less and less brightly (Sandy and Rutsch 1992:46-51; Halsey 1882:45, 334; Fitch and Glover 1990:B-150, B-154; Rogers 1931:5-6; Rutsch et al. 1986:59). Despite a depletion of forest timber (and subsequently charcoal), which began in the 1820s and contributed to the volatility of early nineteenth-century iron markets, the Middle and Upper forges continued to operate until the 1850s. Other factors reflecting the general volatility of the industry included frequent ownership changes and a continuous pattern of forge shutdowns and start-ups. On the other hand, providing new blood to the region's sclerotic economy, the Morris Canal was built between 1825 and 1831. Passing just south of Picatinny through Rockaway and Dover, the canal connected Jersey City on the Hudson River to Phillipsburg on the Delaware River by 1865. Constructed to carry cheap coal from Pennsylvania to the industrial centers developing along the New Jersey coast, the canal also provided coal to fuel the iron forges and furnaces in the Highlands, replacing the depleted timber supply. While anthracite coal traveled east, ore from the New Jersey Highlands was shipped westward in great quantities to newer furnaces constructed in Pennsylvania near the Delaware River (Rutsch et al. 1986:65-66; Halsey 1882:68-69; Fitch and Glover 1990:B/150-151).

By 1882, Denmark Forge was no longer in operation and was followed into inactivity five years later by the Denmark mine (Sandy and Rutsch 1992:53). By the beginning of the twentieth century, only 20 iron mines in the Highlands were in operation, including the Mount Hope mine, which had passed to the control of the Empire Steel & Iron Company. The decline of the iron industry continued through the twentieth century, and resulted in a continual ebbing of the region's population over the next forty years, to a low of 2,423 in 1940 (Fitch and Glover 1990:B-155; Sandy and Rutsch 1992:37; Rutsch et al. 1986:27-29, 35). While the Highlands' lakes continued to be popular as resorts and vacation spots, the area around Picatinny Arsenal became attractive to suburban development with improvements in the automobile and the region's transportation infrastructure. Population surged following World War II with the construction of Interstate routes 80 and 287, the development of suburban residential communities and ancillary commercial construction (Fitch and Glover 1990:B-155; Rutsch 1999).

Picatinny Arsenal. Established on September 6, 1880 as the Dover Powder Depot under the command of Major Francis H. Parker of the Ordnance Department, Picatinny's initial purpose was the storage of "powder, projectiles, and explosives, both for reserve supply and for issue; also for the preparation and issue of these stores" (Rogers 1931:53). A board of Ordnance Department officers chose the Green Pond Brook valley near Dover as the site of the depot based on several criteria: the site had to be a sparsely populated region near New York City, capable of storing a large amount of powder, and accessible by train. Between 1880 and 1881, the government acquired 1,866.12 acres from various owners for a total of $62,750, or about $34 per acre. After Major Parker requested that the installation's name be changed, the new depot became Picatinny Powder Depot on September 10, 1880, with construction beginning six days later (Fitch and Glover 1990:B-160; Rogers 1931:10-11). The portion of Picatinny that includes the APE for the PHS+T Center was part of this initial Powder Depot land acquisition.

Between 1880 and 1890, construction activities focused on the erection of storage magazines, officer's quarters, and service facilities. The first powder-storage magazine was completed in 1881 with the storage capacity of 10,000 pounds of black powder. With four powder magazines completed by November 1886, the depot received its first shipment of

powder (300,000 pounds) for storage later that month. To facilitate access to the installation and the general shipment of freight, the Morris County Railroad began building a rail line through the depot in 1886. In 1887, 23½ miles of track traversed the powder depot and connected it to the Delaware, Lackawanna & Western Railroad and the Dover Central Railroad of New Jersey at Wharton. A privately owned line called the Northern & Wharton Railroad also ran through the depot and maintained five associated stations. Seventy men were employed at the depot and 900,000 pounds of powder were stored at the facility by that time. From 1893 until 1907, the facility was known as the United States Powder Depot (Fitch and Glover 1990:B/164-166; Rogers 1931:53-54, 71; Rutsch 1999:19-21).

In June 1891, 315 acres of Picatinny Powder Depot land near Lake Denmark were ceded to the United States Navy for the establishment of a Navy powder depot. (This area is now part of Picatinny.) After vacating its powder magazine on Ellis Island in New York harbor, the Navy utilized the Lake Denmark facility as its primary depot on the East coast. Storing powder, ammunition, high explosives, and artillery shells, the Lake Denmark Powder Depot was enlarged when the Navy acquired more than 146 additional acres in two purchases in 1902. By 1892, a shell house, a storage magazine and three residential structures were completed (Rogers 1931:29-31; Fitch and Glover 1990:B/166-168; Harrell 1994:6).

Historical development within Picatinny was concentrated in the areas south and east of Picatinny Lake, which included most of the land initially purchased by the federal government in 1880-1881 (Rogers 1931:58-61, 77; Harrell 1994). Construction phases at the post dovetailed with the installation's manufacturing activities and changes in its mission over time. The initial phase of development covered the depot/storage period from 1880 until 1907. The depot’s first phase of operation involved powder storage and increasing involvement in the assembly of cannon charges. In 1897, workers at the depot assembled powder charges that included manufacturing and filling the storage bags. Between 1902 and 1906 armor-piercing shells were assembled at the depot, where projectiles were filled with explosives, such as Maximite and Explosive "D" (Rogers 1931:54; Fitch and Glover 1990:B-168; Harrell 1994:6).

A major change in the installation's mission occurred in 1907 with the construction of the first Army-owned smokeless powder factory. This activity resulted in the redesignation of the depot as Picatinny Arsenal, and marked the beginning of Picatinny's important manufacturing phase, which continued until the early years of World War II. Manufacturing increased gradually in the years before World War I as Congress approved continual expansion of the arsenal's production facilities. Picatinny maintained sole responsibility for the assembly of fixed ammunition larger than .50-caliber by 1909. By 1913, the arsenal was operating a plant for the manufacture of Explosive "D," which was used in armor-piercing projectiles. An Officer's Training School was established in late 1911 to provide training in chemistry, explosives, and ballistics, as well as ammunition manufacturing processes. When the United States entered World War I, Picatinny Arsenal saw a rapid development of its physical plant both around Picatinny Lake and Lake Denmark to meet the exigencies of preparing for war and to accentuate its storage capabilities. During this time, the development of the arsenal as a research and administrative installation also began as Picatinny personnel provided technical assistance to the private sector producing explosives for the war effort. During the 1920s, munitions experimentation and training had replaced powder production as the facility’s mission, foreshadowing its later expansion into a complete ammunition arsenal (Rogers 1931:54-56; Kaye 1978; Fitch and Glover 1990:B/168-170; Harrell 1994:7).

While the Ordnance Department was transforming Picatinny Arsenal into a center for explosives research and development through an extensive renovation and construction

program, the Navy was constructing additional powder-storage magazines at its Lake Denmark installation. On Saturday afternoon, July 10, 1926, lightning struck the 461-acre Lake Denmark Powder Depot, causing a series of fires and sympathetic explosions throughout the southwest end of the depot. These explosions killed 19 people, including 11 Marines fighting the fires, and sent shock waves throughout the Green Pond Brook valley, destroying everything within a 3,000-ft (910-m) radius of the epicenter. Beyond this radius many structures were severely damaged, both within the Navy depot and the adjacent arsenal as well as among the nearby non-military residences (Rogers 1931:Chapter IX; Fitch and Glover 1990:B/171-174). The APE for the PHS+T Center is entirely within 2,000 ft (600 m) of the explosion's center.

Once the fires were extinguished, the Navy appointed a Court of Inquiry to investigate the incident. The results of the investigation led to changes in safety and ammunition-storage procedures and standards. Since Picatinny stored material similar to that stored by the Navy at Lake Denmark and had been damaged by the explosions, a board of Army officers also investigated the incident. This commission recommended that Picatinny Arsenal not only be reconstructed but also enlarged for the purpose of consolidating the Army's ordnance activities in northern New Jersey. Devised with the safe handling of explosives as a top priority, plans for rebuilding the arsenal called for the division of the arsenal into zones based on the function or activity occurring in that zone (Rogers 1931:94-96; Fitch and Glover 1990:B/174-176). These functional zones were:

- powder and explosives production and handling;
- powder and explosives storage;
- powder and explosives testing; and
- non-hazardous manufacturing, and offices for administration and research (Rogers 1931:94).

Between 1927 and 1937 both the Navy Powder Depot and Picatinny Arsenal were completely rebuilt. With rehabilitation nearly complete in 1931, Picatinny became not only the major ammunition arsenal of the U.S. Army, but was an important center of ammunition research, development, and manufacturing, which included operation of experimental and production plants for the development of a range of propellants and explosives. By the time of the entry of the United States into World War II, the arsenal contained 567 buildings and was producing smokeless powder, high explosives, fuzes and primers, assembled rounds of artillery ammunition, bombs, grenades, and pyrotechnics (e.g., airplane flares and signal smokes), all at experimental or peace-time levels (Thurber and Norman 1983; Fitch and Glover 1990:B/177-180; Harrell 1994). In addition, the arsenal was responsible for the standardization of new designs for artillery fuzes and the development of nose and tail bomb fuzes. Arsenal personnel also improved the design of artillery primers, trench mortars and rounds of chemical and tracer ammunition. The Research and Chemical Branch developed fuze powders, primer mixtures, pyrotechnic compositions, propellant compositions, and new high explosives. Picatinny's mission also called for the development of new munition designs utilizing the latest technology and, in the event of a national emergency, to provide private industry with production plans and testing. For example, during the 1930s, researchers at DuPont and Picatinny developed flashless, non-hygroscopic (i.e., non-water absorbent) powders or FNH. DuPont developed M1 powder, and Picatinny developed M3 powder, both of which were tested for composition and specific weapons at the arsenal (Thurber and Norman 1983:29; Green et al. 1990; Kaye 1978).

During World War II, many important advances, new products or simplified methods of production were made at the arsenal in its newly constructed laboratories and testing facilities. As the importance of Picatinny's research and development (R&D) activities grew, more emphasis was placed on this R&D function, which it would retain after the war. In one year the job-training methods, research projects, and improved work developments originating at Picatinny and passed along to other plants saved the United States more than $30 million (Kaye 1978). While expanding production capabilities to meet the munitions requirements of fighting a two-front war, the arsenal continued to conduct research on tetryl manufacturing and nitrocellulose powder. It also provided explosives and powder production training to both civilian and military personnel.

The responsibility of the Mechanical Branch of the Technical Division was the development and design of ammunition and special bombs for specific jobs. During the war, a number of special components were designed and tested at Picatinny, including both aboveground and long-delay bomb fuzes. In addition, the Mechanical Branch created pyrotechnic devices, such as flares and signals (Thurber and Norman 1983:32-33; Kaye 1978; Fitch and Glover 1990:B/179-183). One of the most important bombs developed for a particular need was created to blow up the Ploesti oil fields in Romania, a vital source of oil for Nazi forces. The bombs created by Picatinny for this mission obliterated the Ploesti installations (Kaye 1978).

In addition to the development and evaluation of new explosives, the Chemical Engineering Section, part of the Technical Division, was responsible for improvements in the performance of regularly used, standard military explosives. The invention of haleite, named for Dr. George C. Hale, chief chemist at Picatinny, is regarded as its most significant accomplishment. Although just entering production at the end of the war, haleite (ethylenedinitramine or EDNA) could be press-loaded into small shells without a desensitizing agent and its derivative, ednatol, could be melt-loaded into large shells. Manufacturing problems, however, prevented haleite from being used in combat (Green et al. 1990; Thurber and Norman 1983:33). During research subsequent to the development of haleite, Picatinny's chemists created another explosive, PTX-2 (Picatinny Ternary Explosive), a combination of PETN (pentaerythritol tetranitrate), RDX ("Research Department Explosive") and TNT (trinitrotoluene). Preliminary firings at the arsenal revealed that it was adaptable to shaped-charged ammunition, although by the end of the war PTX-2 was still in the testing stage (Green et al. 1990).

During the war, Lake Denmark Powder Depot continued to operate as the Navy's propellant and projectile storage area (Fitch and Glover 1990:B/179-183). Several sources suggested that the 3400 Area of the Lake Denmark Depot was built to house prisoners-of-war, but no evidence has been located to document whether POWs were ever held there (Thurber and Norman 1983; Fitch and Glover 1990:B-183) and it appears likely that none were.

The post-war years were marked by both the Cold War with the Soviet Union and hot wars in Asia and the Middle East. During this period, Picatinny continued as a center for R&D for new weapons systems and advances in the production process. Innovations in these areas and the development of new materials had occurred consistently at the arsenal over its history. These types of innovations increased after the war and included the development of photoflash cartridges and bombs, the study of plastics and adhesives in the packaging of ammunition, the research on warheads for the NIKE, HONEST JOHN, SERGEANT, and other nuclear and conventional missile programs, and the production of a tank-piercing rocket for the 3.5-inch

bazooka, and an atomic shell for the 250-millimeter (mm) gun (Fitch and Glover 1990:B/182-184; Gaither 1997:94, 102).

After World War II, the Navy's Bureau of Aeronautics decided to establish a rocket-engine test center on the East coast, and initiated modifications to the existing facilities at Lake Denmark. On July 1, 1948, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established there. Less than two years later, the Naval Ammunition Depot was officially disestablished, and the NARL was redesignated the Naval Air Rocket Test Station (NARTS) on April 1, 1950. All physical facilities of the former Lake Denmark depot were made a part of NARTS. As it evolved, NARTS had three major work categories: qualification tests, preliminary investigations and technical services, all of which were included in its mission "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" as assigned by the Chief of Naval Operations (U.S. Department of the Navy 1997a, 1997b; Nolte et al. 1999c).

Prior to 1950, the NARL had a number of temporary test stands at which the Navy had tested the rocket engines for the Douglas SKYROCKET, the Bell X-1, and the LARK. It also had a large test stand for the development of the 20,000-lb thrust Viking engine, the Consolidated-Vultee MX-774 (a preliminary Intercontinental Ballistic Missile), and for certain other tests on the SKYROCKET. By the 1950s, the station consisted of 760 acres and represented a multimillion-dollar investment.

The history of NARTS is intimately associated with the history of Reaction Motors, Inc. (RMI). RMI was formed in 1941 and was the first enterprise devoted to the commercialization of the rocket engine (Shesta 1978; Nolte et al. 1999c). By the middle of 1946, all of RMI's activities had been transferred to Lake Denmark, where a construction program for rocket test stands was underway. By 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company (RMD). In 1956, RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15. The initial testing, including test firings, of that engine was conducted at Lake Denmark, much to the displeasure of the local residents. In 1960, the Navy decommissioned NARTS and the facilities became part of Picatinny Arsenal under the Ammunition Development Division of the Ammunition group at Picatinny. Renamed the Liquid Rocket Propulsion Laboratory, the entire facility was leased almost immediately to the Thiokol Chemical Corporation, RMD. As a result of changes in the rocket industry during the 1960s, RMD at Lake Denmark was shut down by 1972. The rocket test areas of the Lake Denmark site were abandoned to the Army and have been largely unused since, except as backdrops for training exercises (Shesta 1978; Nolte et al. 1999c; U.S. Department of the Navy 1997c).

By 1977, most production of weapons and ammunition had ceased at the arsenal and its activities focused on R&D. At that time the Army established the U.S. Army Armament Research and Development Command (ARRADCOM), headquartered at Picatinny, to be responsible for developing new and improving old weapons and munitions. In 1983, ARRADCOM was disestablished and its mission was transferred to the Armament, Munitions and Chemical Command (AMCCOM), Rock Island Arsenal, Illinois. The munitions and weapons R&D activities remaining at Picatinny were renamed the U.S. Army Armament Research and Development Center (ARDC). In 1986, ARDC was renamed the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) with its headquarters at Picatinny. ARDEC was transferred from AMCCOM to the Tank-Automotive and Armaments Command (TACOM) in 1994. Representing the technical expertise of the U.S. government in guns and

ammunition of all sizes, from pistols to howitzers, ARDEC played an essential role in developing items and technologies as diverse as warheads, gun fire controls, mines, and smart ammunition, among other responsibilities (ARDEC 1995). In the mid-1990s, over 1,000 buildings were spread out over Picatinny's nearly 6,500 acres, making Picatinny "the largest Army installation devoted solely to research and development" (STV/Lyon Associates, Inc. 1994). In 2003, ARDEC was transferred from TACOM to the U.S. Army Research, Development and Engineering Command (RDECOM). As the Army's "Center of Lethality," ARDEC at Picatinny is "the Army's principal researcher, developer and sustainer of current and future armament and munitions systems" (ARDEC 2006).

3.2 THE 400 AREA

A Historic American Building Survey/Historic American Engineering Record (HABS/HAER) assessment was completed on more than 800 structures that were 50 years of age or older at Picatinny Arsenal in the early 1980s (Ashby et al. 1984). Many have since been demolished as a result of excessive contamination as part of the Toxic Environmental Clean-Up Program (TECUP). Subsequently, a HAER was completed for Picatinny Arsenal that provided additional detail to document the historically significant structures related to various industrial processes at the facility (Thurber and Norman 1983; Ashby et al. 1984). This documentation focused on five areas: 200 Area, Shell Component Loading; 400 Area, Gun Bag Loading (part of which forms the current study area); 500 Area, Powder Factory and Power House; 600 Area, Ordnance Test Area; and the 800 Area, Complete Rounds/Melt Loading. Further, a draft Multiple Resource National Register Nomination was prepared for six historic districts at Picatinny Arsenal—the five areas listed above and a Picatinny Multiple Resources Area, a large area consisting primarily of administrative structures that runs roughly down Farley Avenue including the Cannon Gates. The six districts were cited as being eligible under Criteria A, B, C and D. The draft nomination was never finalized or submitted for consideration to the Department of the Interior (U.S. Department of the Army nd; see also Nolte 1998; Nolte et al. 1999a, 1999b).

Twenty buildings within the Gun Bag Loading portion of the 400 Area (Figure 3.1), part of which includes the current study area, have undergone HAER recordation (HAER No. NJ-36; Thurber and Norman 1983). Buildings discussed in the HAER documentation that were in the current project area include:

Building	448	Bag Loading: Howitzer and Aliquot (1930)
	448A	Storage Magazine (1930)
	448B	Rest House (1930)
	448C	Weigh and Mix (1942)
	448D	Storage Magazine (1930)
	452	Bag Loading Igniter (1942)
	452A	Storage Magazine (1930)
	452B	Storage Magazine (1930)
	462B	Storage Magazine (1941-42)
	462D	Storage Magazine (1941-42)

Panamerican later evaluated several buildings within this area, including nos. 448, 448A, 448C, 452, 452B, 462B, and 462D (Nolte 1998; Nolte et al. 2007); none were recommended eligible for the NRHP, with New Jersey HPO concurrence.

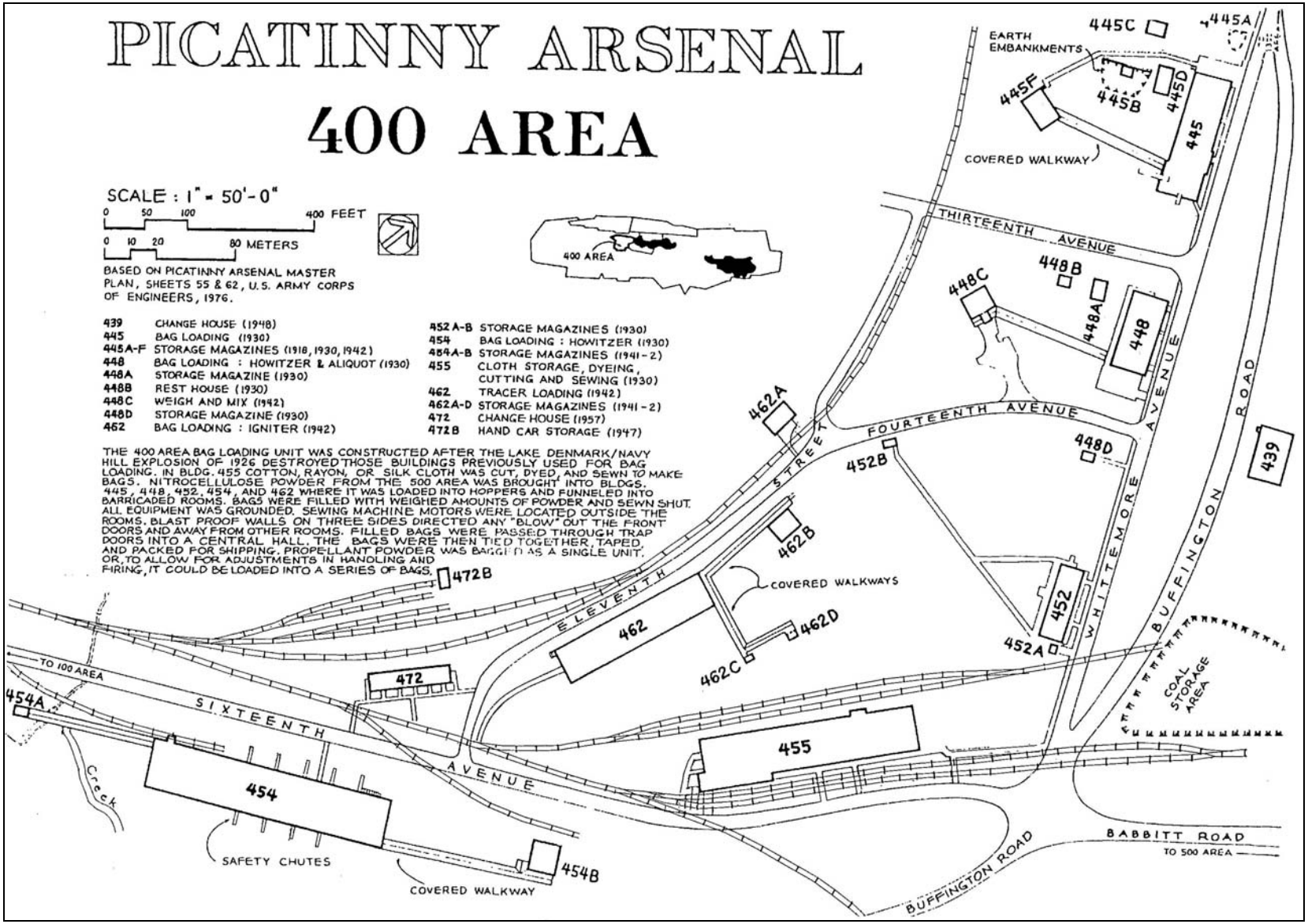


Figure 3.1. ***Picatinny Arsenal 400 Area, 1930-1948.*** **Gun Bag Loading Area, Picatinny Arsenal, NJ** *(Thurber and Norman 1983; drawn by Kliwinski 1983).*

The bag-loading activities in this portion of the 400 Area were related to the delivery of large caliber (artillery) projectiles. In its simplest arrangement, four components are required to fire an artillery weapon: the weapon, the projectile to be fired, the explosive propellant to launch the projectile, and something to ignite the propellant. Many artillery shells did not use fixed charges of propellant, relying instead on bagged powder. At the time of firing, the artillery crew would add the proper number of bags of propellant as needed to the weapon. The propellant bags were precisely that, silk (or cotton and later polyethylene) bags filled with powder propellant and sewn closed (later, the bags were heat sealed). During World War II, a worker at one of the bag-loading plants in the United States sarcastically likened the loading of propellant into a cotton bag to loading sugar into a paper bag, only propellant loading was a little more dangerous (Kuranda et al. 1997; Thurber and Norman 1983:78).

After the disastrous 1926 explosion and fires at the adjacent Lake Denmark Naval Powder Depot, the Army decided to consolidate bag-loading operations (i.e., loading propellant powder into containers) in a single area devoted to that purpose and place those activities in buildings constructed specifically for that process. From the time of the Spanish-American War to 1926, bag loading at Picatinny occurred in adapted warehouses scattered throughout the installation. The new Bag Loading Plant (the 400 Area) was sited along the southern shore of Picatinny Lake (Rogers 1931:93-94; Thurber and Norman 1983:77-78). Propellant powders were bag loaded in the 400 Area from 1930 to 1974.

As stated in the HAER documentation, the creation of a separate Gun Bag Loading Area at Picatinny was the first instance where

> safety features were considered and bag loading activities were placed in carefully segregated and barricaded areas. With the rebuilding of the bag loading facility as an integral unit, all activities were grouped according to need. Three bag loading buildings (445, 448 and 452) were built in a line along Whittemore Avenue. In each building the powder was hoisted to the top of the hopper tower and distributed to the individual loading rooms by means of galvanized tubes. Safety measures controlled the amount of powder moving through the tubes, thus limiting the possibility of flashback if a blow occurred in any loading room. For example, Building 454, on 16th Avenue was a two story structure in which each filling room was directly under its own storage room. The powder was passed from the second floor to the first where it was loaded into bags and the central hall was used to add igniters, and then sew and wrap the bags (Thurber and Norman 1983:83-84).

Black powder was the earliest propellant used in bag loading but, by the late nineteenth century, it had been replaced by nitrocellulose. To use nitrocellulose as a propellant, it was necessary to develop a system of loading the powder into bags, then attaching a primer and detonator to initiate the explosion. Different types of guns required different amounts or types of propellant powder, bagged in various sizes, to operate properly (Thurber and Norman 1983:78). Building 448, for example, has been contaminated with TNT, ammonium nitrate, RDX, and black powder—the various components it loaded through time (HDR 2008).

The nitrocellulose powder, also referred to as guncotton, was transferred to the 400 Area via rail from the 500 Area. After arrival, the powder was

> loaded into hoppers and funneled into barricaded rooms. Bags were filled with weighed amounts of powder and sewn shut. All equipment was grounded. Sewing machine motors were located outside the rooms. Blast proof walls on three sides directed any ‘blow’ out the front doors and away from other rooms. Filled bags were passed through trap doors into a

central hall. The bags were then tied together, taped, and packed for shipping. Propellant powder was bagged as a single unit, or, to allow for adjustments in handling and firing, it could be loaded into a series of bags [Kliwinski 1983].

Silk bags were commonly used to hold the powder, since they burned completely and did not leave any embers. The bags were made at the arsenal, although local women could assist by sewing bags at home in cases of emergency. During World War II as many as 500 sewing machines were used to produce silk and cotton bags. Because of the volatile nature of the powders used, even sewing was a hazardous activity. Something as small as a broken needle could cause the powder being sewn into the bag to ignite, which, in fact, happened in the late 1920s, resulting in the burning of five women – three of them seriously. By the 1960s, powder was heat-sealed into polyethylene bags (Thurber and Norman 1983:85).

The Gun Bag Loading Area originally included such buildings as a change house, bag loading houses, storage magazines, rest houses, weigh and mix houses, cloth storage as well as dyeing and cutting and sewing houses. Portions of this area are enclosed because of pollution concerns and are monitored for ground water infiltration. The buildings within the Gun Bag Loading Area have been determined to have no integrity, and therefore are not eligible for the NRHP (Guzzo 1999). Nevertheless, the Gun Bag Loading District has been HAER documented.

3.3 HISTORICAL MAP ANALYSIS

The following historical maps and images were consulted to establish a baseline approximation of the sequence of industrial development in the project area:

Source	Year	Figure	Type
Beers 1868:24	1868	3.2	map
Robinson 1887:20	1887	3.3	map
Storch 1907	1907	3.4 Map 1	map
Picatinny Arsenal Historical Office	1922	3.4 Map 2	map
Rogers 1931:73	1926	3.4 Map 3	map
New Jersey Geographic Information Network	1930s	3.4 Map 4	orthographic aerial photo
Picatinny Arsenal Historical Office	1930s	3.4 Map 5	map
Rae 1999:62	1930s	3.5	oblique aerial photo
HistoricAerials.com	1957	3.4 Map 6	orthographic aerial photo
Picatinny Arsenal Historical Office	1970s-1980s	3.6	oblique aerial photo
U.S. Army Corps of Engineers	1976	3.7	map
Kliwinski	1983	3.1	map

The earliest map consulted, from the 1868 Beers, Ellis, and Soule *Atlas of Morris Co., New Jersey*, shows the project area in a pre-arsenal context (Figure 3.2). Although the map is somewhat schematic at this scale, several details are visible. Two structures associated with George Righter are shown in proximity to the western portion of the study area. Righter was among the landowners from whom the federal government purchased tracts for the Picatinny Powder Depot in 1880 (Rogers 1931:14). Also, although the iron-forging industry in the area was in decline by the second half of the nineteenth century, several forge buildings (probably associated with Middle Forge) are present – all on the west side of Green Pond Brook. The 1887 map (Figure 3.3) illustrates the project area in an early-arsenal setting. Although very few details are perceptible, the map appears to show no buildings between Green Pond Brook and the project area, suggesting the Righter structures and Forge-related buildings in the 1868 map were absent by this time. Also of note is the railroad that runs along the east boundary of the study area.

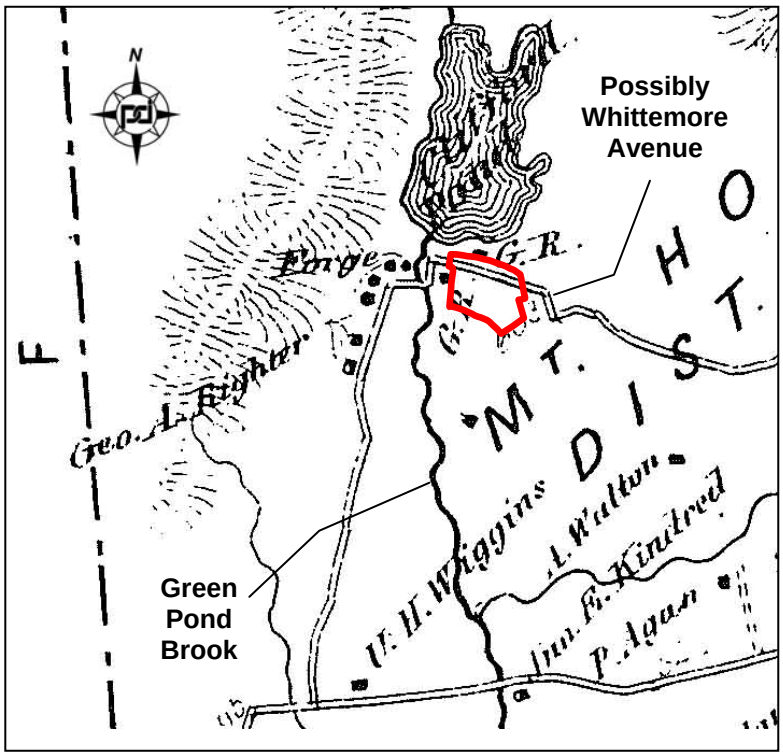


Figure 3.2. Approximate location of project area on 1868 map of the Town of Rockaway *(Beers 1868:24)*.

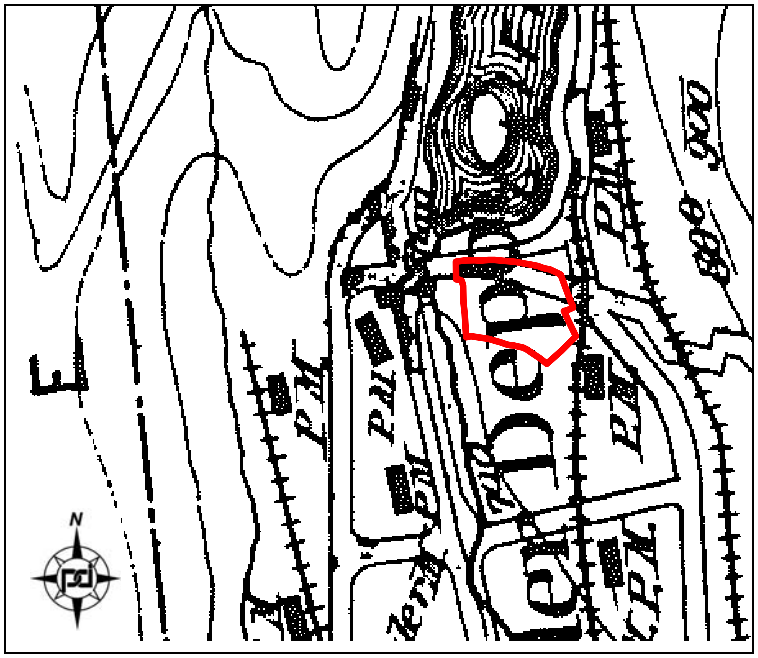
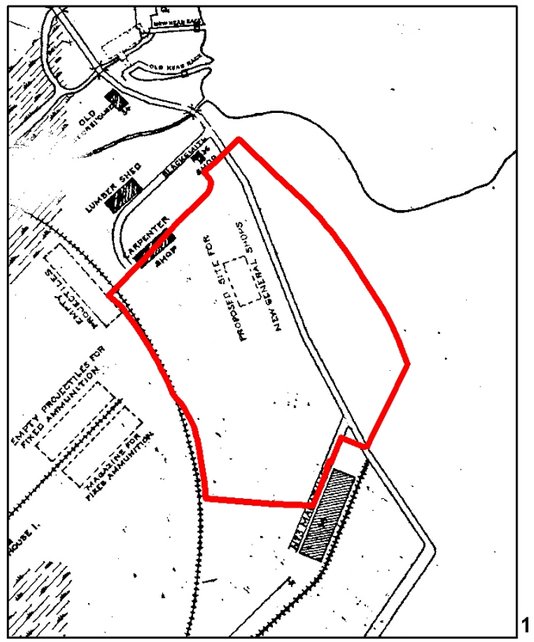


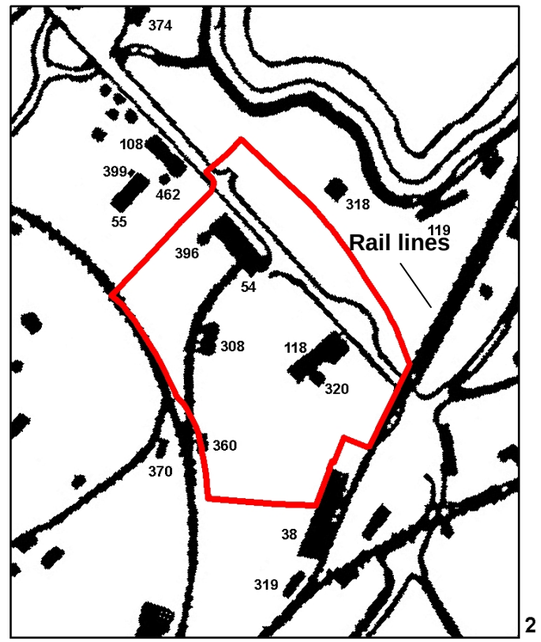
Figure 3.3. Approximate location of project area on 1887 map of Rockaway Township; PM = Powder Magazine *(Robinson 1887:20)*.

The 1907 Storch map (Figure 3.4 Map 1) shows the early (pre-explosion) arsenal configuration of facilities around the project area. A rail line extends along its western boundary and another terminates at a magazine to its south. The road that runs through its northeastern quadrant is most likely Whittemore Avenue, although its configuration is possibly inaccurate. The road with the lumber shed, carpenter shop, and blacksmith shop just northwest of the project area is shown in the wrong location. The road should actually be near its center (Building 308 in Maps 2 and 3 of Figure 3.4 is the same lumber shed illustrated on the northwest side of the road in Map 1). The proposed 'new general shops' in the 1907 map were never constructed.

The 1922 and 1926 maps (Figure 3.4 Maps 2 and 3) show the configuration of the project area just before the 1926 explosion. At least six structures are present, including: a one-story brick millwright shop (Building 54); a two-story brick office building (Building 118); the aforementioned lumber shed (Building 308); a single-story hollow-tile storage magazine being used to house office records (Building 320); a phosphorus loading shed (Building 360); and a two-story brick storehouse (Building 396). A rail siding is also shown running north of Building 308 between Building 54 and the more extensive rail line west of the study area. The rail that terminated at the magazine south of the study area in the 1907 map (Map 1) is now illustrated as extending to the northeast and is composed of more than one track. A substantial semi-circular-shaped lateral extension of Whittemore Avenue is illustrated northeast of Building 118. Also, east of Building 54 the pavement of Whittemore Avenue is shown as extending to the southwest, suggesting the road with the lumber shed in the 1907 map was still present, but was not illustrated (perhaps for clarity).



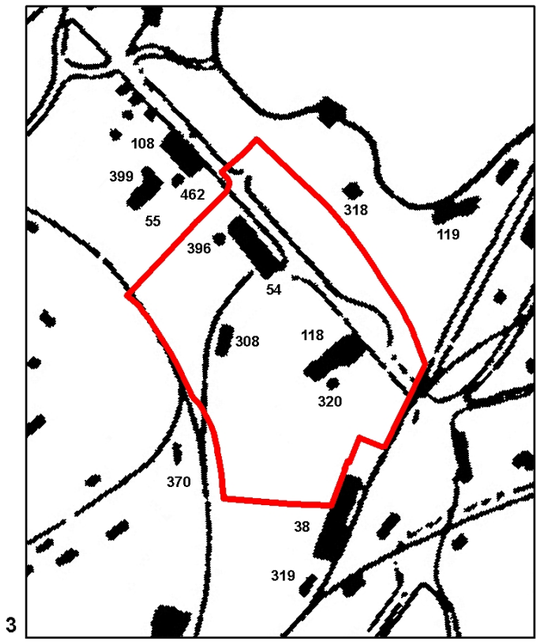
1



2

Key for Maps 2 and 3

No.	Building
38	Brick general storehouse
54	One-story brick millwright shop
55	One-story brick storehouse
108	One-story and basement brick laboratory
118	Two-story brick main office
119	One-story brick and reinforced concrete surveillance magazine no. 1
308	Lumber shed
318	One-story recreation building
319	One-story corrugated iron oil and pipe storage building
320	One-story hollow-tile storage magazine for office records
360	Phosphorus loading shed
370	Frame millwright storage (originally neutralizing headquarters)
374	One-story hollow-tile pump house
396	Two-story brick storehouse (originally shavings bin)
399	One-story frame garage
462	Corrugated iron weather-recording instrument house



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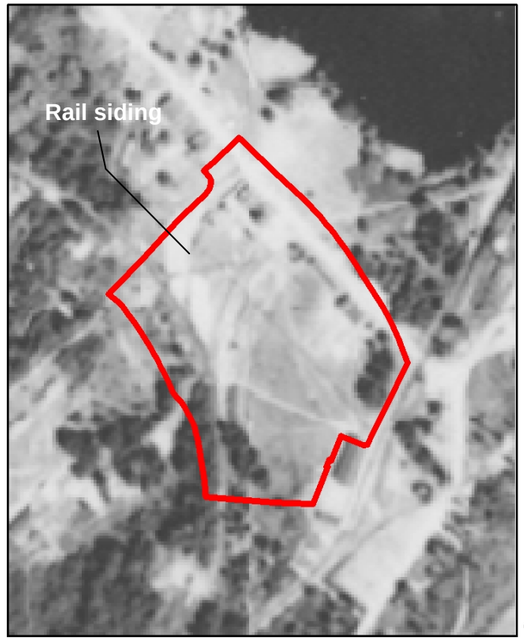

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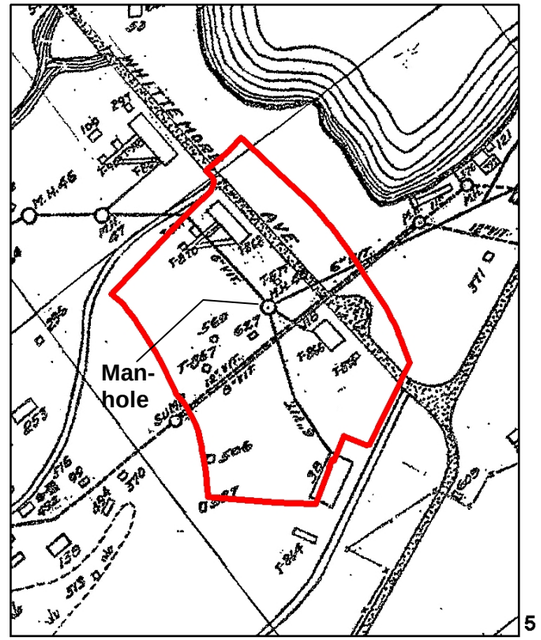

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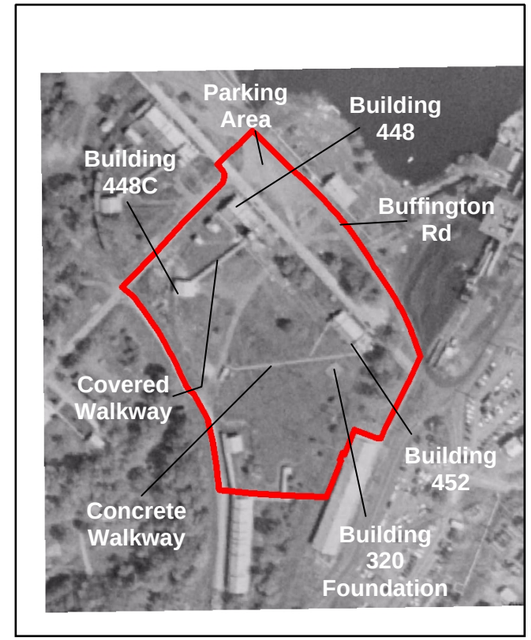

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Figure 3.4. Historical maps and aerial photographs showing changes in layout of structures in the project area.

Map	Year	Source
1	1907	Storch, "US Powder Depot, Dover, NJ"
2	1922	Picatinny Arsenal Historical Office
3	1926	Rogers 1931:73
4	1930s	New Jersey Geographic Information Network
5	1930-1950s	Picatinny Arsenal Historical Office
6	1957	HistoricAerials.com

Project Area

0 100 200 300 400 Feet

0 50 100 150 200 Meters

N

The 1930s aerial photograph (Figure 3.4 Map 4) shows the effects of the 1926 explosion and the early development in the project area that succeeded it. The study area was located between 1,000 and 2,000 ft (300 and 600 m) from the initial epicenter of the explosion. Rogers (1931:77-79) details the extensive damage to several buildings there, including the millwright shop and the two-story brick office building. By the time of the aerial photograph, all the pre-1926 buildings were demolished and Buildings 448 and 452 (elements of the bag-loading facilities discussed in Section 3.2) appear to be under construction. Building 448C, which was west of Building 448, does not appear to have been built yet, but Buildings 448A, 448B and 448D are all possibly present.

Figure 3.5 shows an oblique aerial photo from roughly the same time that illustrates several additional details. First, while it also shows that the pre-explosion buildings have been demolished, at least some of their foundations were left in place – those associated with Buildings 118, 308, and 320 are all visible in the oblique image. Additionally, another rail siding was installed that ran between the line west of the study area and the northeast side of Building 448. The siding is also visible in the orthographic aerial. Figure 3.4 Map 5, although somewhat idealized, also dates to the 1930s and shows several features not present on the other images. First, it illustrates utility lines connecting to buildings both within and adjacent to the study area. Several of the lines converge at a manhole near the center of the project area; judging from their large diameters and the presence of the manhole, the lines are probably storm or sanitary sewers. In addition to the utilities, the map suggests the presence of at least two small buildings that do not appear on the other maps. Buildings 560 and 627 are illustrated just southeast of the manhole. Two other small buildings are shown on the map near the southwest corner of the

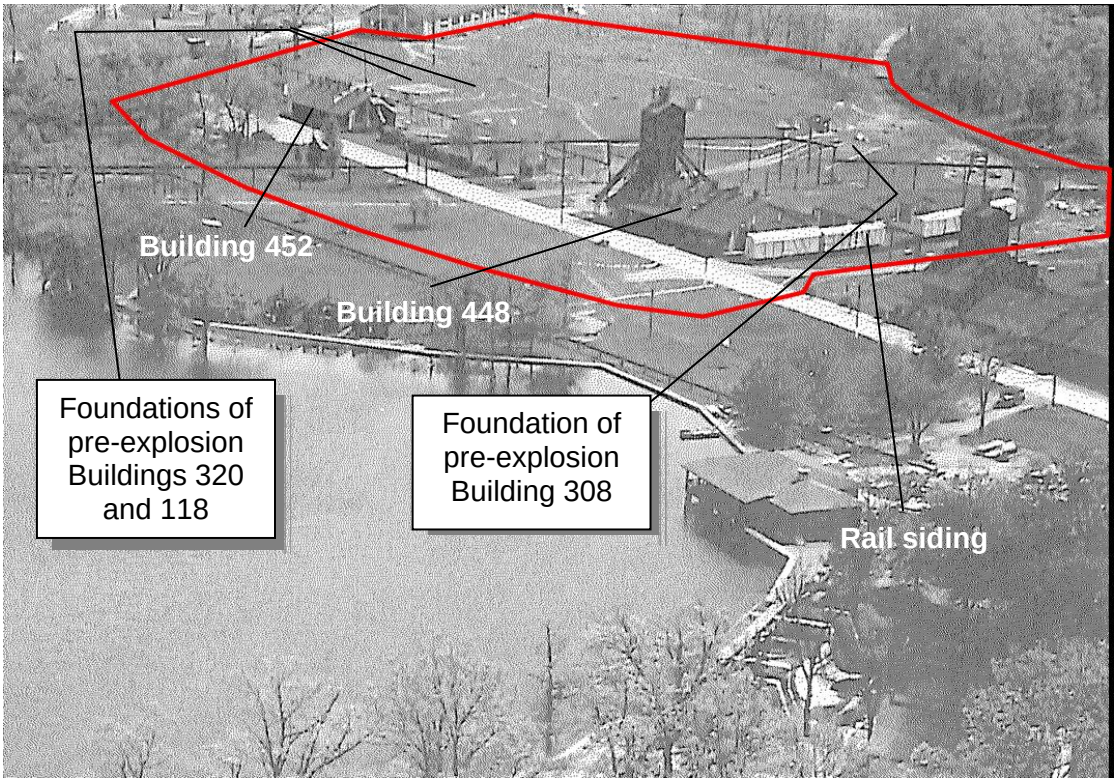

Figure 3.5. Oblique aerial view from the 1930s showing the project area. The view is from the north, facing south *(image source: Rae 1999:62)*.

study area that might correspond with structures in the 462 complex. The ‘T’ prefix for structure T-867, shown south of Building 560, implies it is a pad for an electrical transformer.

The 1957 orthographic aerial photo (Figure 3.4 Map 6) illustrates the complete 448, 452, and 462 complexes. In the image, Building 448C (built in 1942) is shown southwest of Building 448, to which it is connected via a covered walkway. A parking area extends southeast of 448C, linking it to Fourteenth Avenue. South of there, a concrete walkway runs from Building 452 west to Building 452B. The foundations for former Buildings 118 and 308 are obscured (perhaps by vegetation or image quality), but the foundation for Building 320 is visible in the eastern third of the project area (south of Building 452). Finally, Buffington Road, which did not exist when the earlier images were obtained, is present, running along the northeastern edge of the study area. Much of the zone between it and Whittemore Avenue appears to be in use as a parking area.

The oblique aerial view from the 1970s or 1980s in Figure 3.6 shows similar conditions across the project area as are present in the 1957 orthographic aerial photo. For example, there are no buildings in the oblique image that were not present in the earlier orthographic photo. However, several minor changes are visible, as are more details than can be perceived in the earlier photograph. First, the area southwest of Building 452 seems to be covered with gravel in the oblique image and was possibly being used for parking. The foundation for Building 320, which stood within this gravel-covered zone, is still present, however. Second, several elevated steam lines cross the project area that are not visible in the 1957 aerial. Also, a tall pole (likely for lightning protection) stands immediately southwest of Building 448 in the oblique image (the pole may have been present in the earlier image, but neither it, nor its shadow, can be seen). Finally, much of the land between Whittemore Avenue and Buffington Road is still in use for parking by the time of the later image, although it is not possible to ascertain the type of pavement material that covered this area.

The 1976 US Army Corps of Engineers map in Figure 3.7 shows many of the same surface conditions visible in the 1957 orthographic aerial photo and the more recent oblique photograph. Beyond this, however, it illustrates the numerous buried utilities running through the study area, which include water, steam, storm sewer, and dry lines. It also shows several hydrants and post indicator valves (PIVs) connecting to the underground utilities. Beyond shedding light on the configuration of utilities, the map also shows details concerning the rail lines near the southeast edge of the study area. While the earlier maps and images (e.g., Figure 3.4 Maps 2-6) show several tracks running southwest-to-northeast just outside the study area to the southeast, the USACE map shows an additional pair of rail lines inside the study area. The lines enter the project area just west of Building 455 and run to the northeast. They merge into a single line south of Building 452, which crosses Whittemore Avenue and Buffington Road and terminates just outside the project area to the northeast.

In sum, the historical maps and aerial images suggest that portions of the study area have been disturbed during twentieth-century development at Picatinny, particularly that which occurred after the 1926 Naval Powder Depot explosion. The impacts of post-1926 construction are most intense in 2 parts of the study area. The zone between Thirteenth Avenue and Fourteenth Avenue was the site of the Building 448 complex, which comprised at least 4 buildings, a covered walkway, 2 rail sidings, and a small paved parking lot. Southeast of the complex, the area along the southwest side of Whittemore Avenue was occupied by 3 other post-1926 buildings, nos. 452, 452A, and 448D, as well as several sidewalks/walkways and buried utility lines. These two zones of intense post-1926 development are largely coterminous with the locations of earlier mapped Picatinny structures. The Building 448 complex overlies the

Figure 3.6. Oblique aerial view from the 1970s or 1980s showing the project area. The view is from the north, facing south – the same angle as shown in Figure 3.5 *(Picatinny Arsenal Historical Office)*.

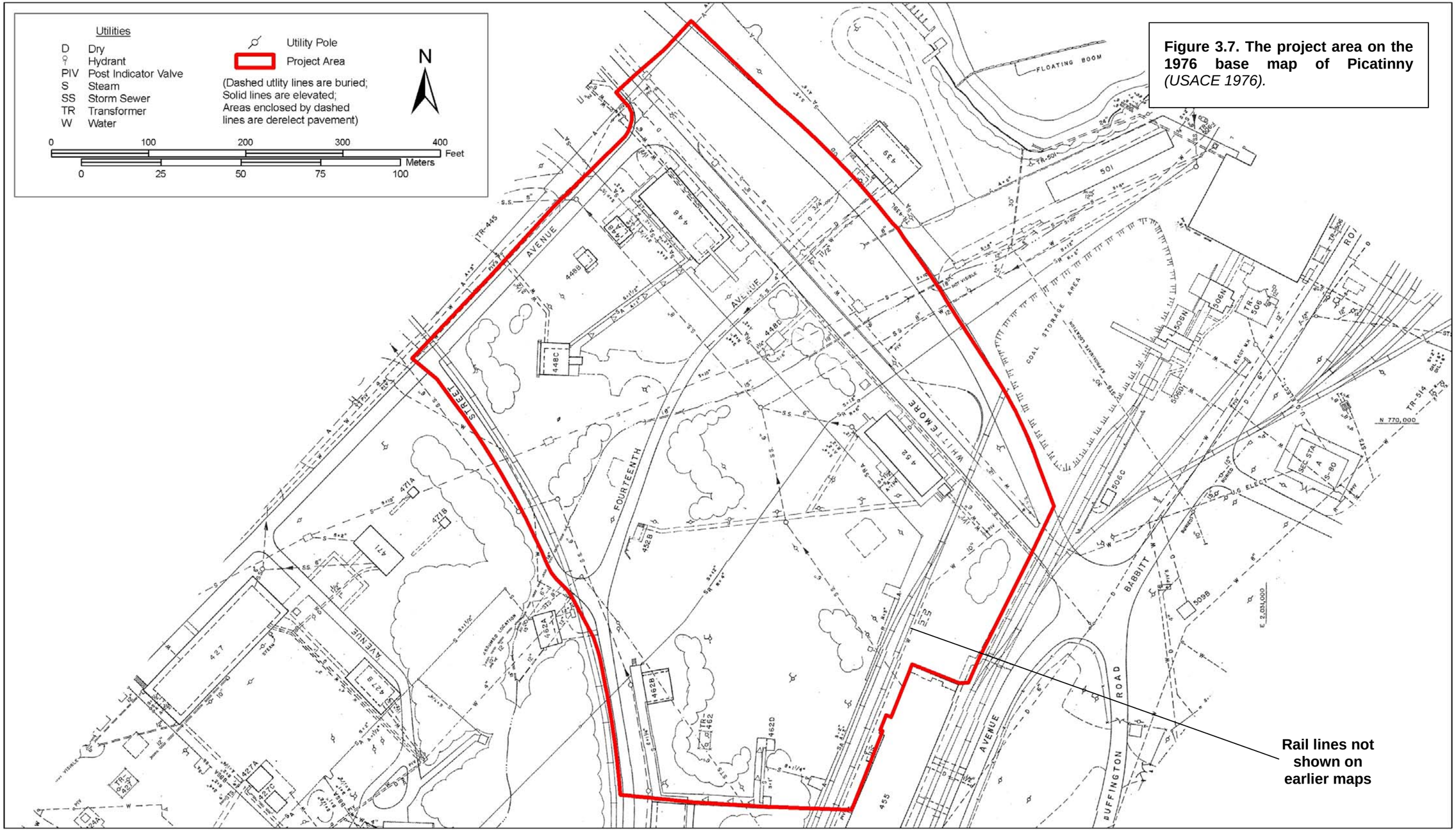

Figure 3.7. The project area on the 1976 base map of Picatinny *(USACE 1976).*

sites of Building 54, the millwright shop, and Building 396, the two-story brick storehouse originally used as a shavings bin. Building 452 lies partially atop the location of Building 118, the two-story brick main office. The fact that these parts of the study area have witnessed two episodes of industrial development suggests there is minimal possibility that remains related to earlier historical and prehistoric uses of the land are extant. Elsewhere in the project area, the historical images suggest that disturbances are more isolated and are primarily related to rail and utility lines, as well as roads and other paved surfaces. Thus, the conditions documented in the maps and aerial images indicate there is a high degree of probability that some parts of the study area have been disrupted by Picatinny's recent industrial past. However, while the maps provide a detailed framework against which to interpret the material record within the study area, they are also not definitive enough in themselves to preclude a field investigation.

4.0 Methodology, Field Investigation, and Results

4.1 METHODOLOGY

4.1.1. Field Methodology. Relevant previous investigations were reviewed and background research was conducted to assess the archaeological sensitivity of the project area (see Sections 2.2 and 3). The 7.1-acre area was previously designated as an 'Archaeologically Sensitive Area that may be Disturbed' in Panamerican's Picatinny ICRMP (Schieppati and Steinback 2004). Although the historical map analysis suggests the entirety of the study area was disturbed during the development of the arsenal, the possibility remained that undocumented prehistoric sites or features related to the Righter farmstead or the Middle Forge were present. Because of this, the entirety of the PHS+T project area was subjected to archaeological investigation. The survey included pedestrian reconnaissance, photographic documentation, shovel testing, and screening of back dirt piles left from the UXO investigation. Shovel testing was necessary because the presence of vegetation – and possibly of unexploded ordnance – precluded the use of plowing and surface collection. Digital photographs were taken to document environmental conditions and pertinent views (e.g., cultural features, disturbances).

Shovel tests were excavated at 50-ft (15-m) intervals over the APE unless prevented by exposed bedrock, steep slopes, large disturbances (such as graded areas), or the possible presence of unexploded ordnance (UXO). The interval was increased to bypass locations that could not be tested. The areas selected for shovel testing were first scanned with a magnetometer to verify the absence of UXO. Shovel test pits (STPs) averaged 40 cm (16 inches [in]) in diameter and were excavated to at least 10 cm (4 in) into culturally sterile soil unless precluded by an impasse (e.g., bedrock). Soil colors were recorded using Munsell® color chart designations. All excavated soils were sieved through quarter-inch hardware screens and backfilled to original landscape contour upon completion. All field information for shovel tests—provenience, pertinent stratigraphic data, natural or manmade disturbances, and the presence or absence of cultural materials—was recorded on shovel test forms.

The samples of back dirt from the UXO investigation were selected from piles scattered across the study area. The UXO technicians dug their pits in locations where electromagnetic metal-detecting equipment indicated the presence of metallic items. Because of this, the pits and their adjacent back dirt piles were not systematically distributed and their density varied greatly from one part of the project area to another. An expedient system was employed in the field to minimize spatial bias resulting from the unsystematic distribution of available back dirt. Specifically, the project area was divided into quadrants and material from at least one back dirt pile per quadrant was sieved through quarter-inch hardware screens.

A Garmin® GPS unit was used to record the UTM (North American Datum [NAD] 83) coordinates of surface finds, the screened UXO back dirt, and other pertinent features. Recovered artifacts were stored in plastic bags, on which all provenience information was recorded with waterproof marker. General archaeological procedures for artifact cleaning and storage were followed, with provenience information retained with the materials at all times. The complete shovel test log is included as Appendix B.

4.1.2. Analytical Methodology. Cultural materials found during archaeological investigations are stored at Panamerican's Buffalo Office for processing and analysis and follow guidelines elaborated in 36 CFR Part 79 (Curation of Federally-Owned and Administered

Archaeological Collections). Standard archaeological procedures of cleaning and storage are also followed, with provenience information kept with artifacts at all times. Final disposition of artifacts will be coordinated with PICA. The artifact catalog is included in Appendix C.

Lithic Analysis. Lithic tools and tool manufacturing byproducts (debitage) were closely inspected with the aid of an illuminated magnifying lens (175 percent [1.75x] magnification). Projectile point morphological descriptions used in this investigation conform to those presented by Ritchie (1989:10-11), and the diagnostic attributes used to infer age and or "cultural complex" affiliations are those established in his projectile point typology. Other tool types are described in standard terminology (e.g., end scraper, side scraper) used for lithic technology (see Crabtree 1972 Part II:31-98). General definitions of the following terms for lithic debitage (by-products of stone tool manufacturing) used in this report are presented below and generally correspond with those presented by Ritchie and Funk (1973:30):

The purpose for this method of description is to help distinguish tool manufacture and tool maintenance activities (i.e., whether the assemblage represents a workshop or a camp) in an effort to characterize site use and settlement patterns. Although these descriptive terms are most applicable to biface production, they are helpful to differentiate all debitage through morphological characteristics (e.g., size of flake, size of platform, dorsal scarring, cortex). Therefore, it is important to note that this system of artifact classification is not used exclusively for debitage resulting from biface production and acknowledge that debitage also results from other tool manufacturing techniques (e.g., forms of blade production such as bi-polar technique).

Historic Artifacts. Historic artifact analysis typically entails the categorization of artifacts by broad material class (e.g., ceramic, glass, metal), with further subdivision into artifact types based on manufacturing characteristics, form, and function. These identifications are based on the New York State Museum artifact catalog (NYSM 2004), published guides such as Miller (2000), Munsey (1970), Noël Hume (1969), and South (1977), and well established web sites (e.g., Stelle 2001). The data is recorded in an artifact catalog, which includes provenience, material class, artifact type, count, secondary type (e.g., color of decoration on ceramics), description (e.g., portion of vessel if a fragment, description of maker's mark), and the beginning and ending dates of manufacture. The initial purpose of the classification is to identify the general time period to which the assemblage dates. With larger assemblages, artifacts are also classified by functional category, which typically include household/kitchen, structural/ architectural, industrial, and personal. Functional categories enable archaeologists to characterize site use and the human activities which formed the archaeological assemblage at the site.

4.2 PROJECT AREA DESCRIPTION

At the time of the field investigation (September 2008), there were five numbered Picatinny buildings standing within the study area: nos. 448, 452B, 462B, 462C and 462D (Figure 4.1). All were built in the 1930s and 1940s and were associated with ammunition loading (Thurber and Norman 1983; see Section 3). Building 448 is near the north corner of the project area, south of the intersection of Thirteenth and Whittemore avenues. Along with all the other buildings in the project area, it was documented in the 1983 HAER survey (Thurber and Norman 1983). It is a 1.5-story structure with a tower built of hollow ceramic tile, reinforced concrete and corrugated steel that was used for loading propellant into cloth bags to be used in large-caliber guns. A pair of steel evacuation safety chutes extend from the southeast side of the building's tower (Appendix A: Photograph 2). The building was no longer in use at the time of the

investigation and is scheduled for demolition. Building 452B is a small (96 sq-ft) structure east of Fourteenth Avenue built as a storage magazine. It is constructed from hollow ceramic tiles and has a corrugated steel roof. It is adjacent to an earthen blast barrier supported by timbers (Appendix A: Photograph 3). A concrete stairway adjacent to the north wall of the building ascends a small grade on the southeast side of Fourteenth Avenue. It is also scheduled for demolition as part of the PHS+T Center project (personal communication, Jason Huggan, 2008). Buildings 462B, 462C and 462D are all near the south boundary of the study area (Appendix A: Photographs 4, 5 and 6). They are constructed of hollow ceramic tiles and have corrugated steel roofs. A concrete walkway covered by a wooden superstructure connects the three structures with one another, as well as with Building 462, which is just outside the project area to the south.

The remaining buildings in the project area that appear on the 1983 HAER map of the 400 Area (see Figure 3.1; see also Figures 3.6 and 3.7), including nos. 448A, 448B, 448C, 448D, 452 and 452A, have since been demolished as part of the TECUP Program and MOA. Building 452 formerly stood near the eastern corner of the study area, on the southwest side of Whittemore Avenue, and had a 2,610 sq-ft footprint. Like Building 448, it was also used for bag loading explosive propellant. According to the HAER documentation (Thurber and Norman 1983), it was a single-story building with walls made from hollow ceramic tiles and reinforced concrete. It had a corrugated steel roof. Building 452A was immediately southeast of the building (see Figure 4.1). It measured only 144 sq. ft in extent and was also built of hollow ceramic tiles, reinforced concrete, and corrugated steel (Figure 4.2). Building 452 appears on a 2002 aerial photograph (Figure 4.3). Buildings 452 and 452A were demolished some time after 2004 (HPO-A2004-94). This is apparent at their former location, where little vegetation grows and the ground is littered with boulders and small-sized construction debris, such as concrete fragments and pieces of ceramic tiles (Appendix A: Photograph 7). The concrete walkway between Buildings 452 and 452B (visible in Figure 3.4 Map 6) was extant at the time of the field investigation (Appendix A: Photograph 8).

Buildings 448A, 448B and 448C formed a small complex southwest of Building 448 (Figures 4.4 and 4.5). According to the HAER report, Building 448A was built as a storage magazine in 1930, 448B was a ‘rest house’ also built in 1930, and 448C was a weigh and mix building that dated to 1942. As noted in Section 3.3, Building 448C was connected to 448 by a walkway covered with a wood-frame superstructure (visible in Figure 4.4; see also Figure 3.6). The three buildings were demolished by the time of the 2002 aerial photo (see Figure 4.3), probably in the late 1990s (HPO-L96-143). No indications of the structures were identified during the field investigation (Appendix A: Photograph 9).

Numerous utility lines and other services were observed across much of the study area during the field investigation, including elevated steam lines, utility poles, and concrete transformer pads (Appendix A: Photograph 10; see also Photograph 1). The 1976 USACE map (see Figure 3.7) also indicates the presence of underground utilities, including water, sewer, and steam lines (Appendix A: Photographs 11, 12 and 13). Among them is a buried drainage pipe that varies from 15 to 18 inches in diameter and runs through the study area from the southwest to the northeast, cutting under Fourteenth Avenue (see Figure 4.1). In places, the pipe has been removed and the resulting trench left open (Appendix A: Photograph 14). This utility was associated with gun cotton manufacturing at a plant west of the project area and parts of it were removed prior to 1976, probably because it “inadvertently received nitrocellulose (NC), referred to as guncotton” (Picatinny Arsenal, New Jersey Army Defense Environmental Restoration Program Installation Action Plan 2006:44).

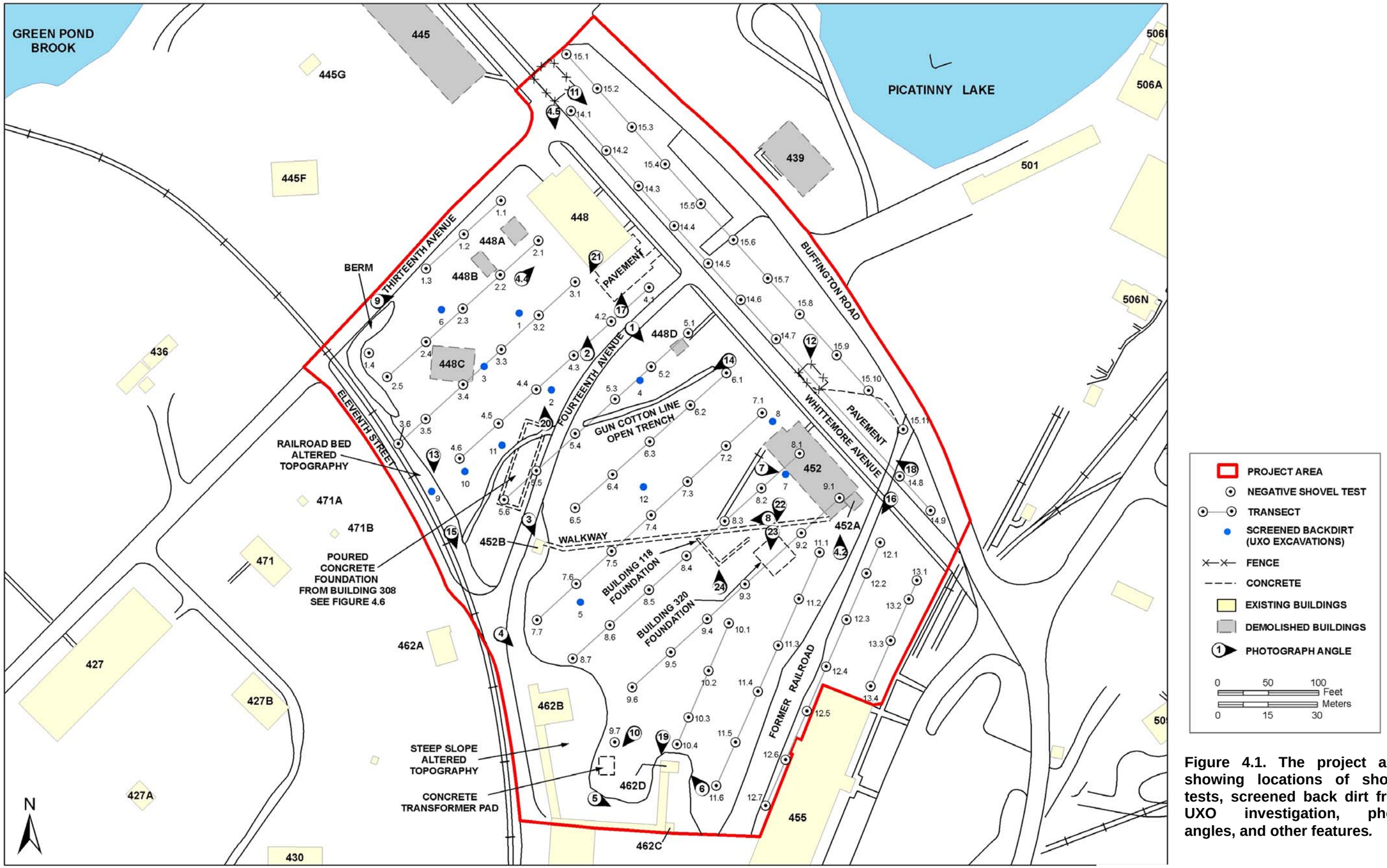

Figure 4.1. The project area showing locations of shovel tests, screened back dirt from UXO investigation, photo angles, and other features.

Figure 4.2. Building 452 (from the 1983 HAER documentation), facing north. The small structure at the right of the evacuation safety chute is Building 452A *(Thurber and Norman 1983)*.

Figure 4.3. Recent aerial photograph of the project area *(New Jersey Image Warehouse 2002)*.

Indications of several rail lines were also observed in the study area. The track running along the southwestern edge of the project area as early as 1907 (see Figure 3.4 Map 1) was visible at the surface (Appendix A: Photograph 15). The rails extending through its southeastern quadrant in the maps from the 1920s (Figure 3.4 Maps 2 and 3) were not present at the surface, but the extremely low vegetation in this portion of the investigated area suggests at least their beds are still present (Appendix A: Photograph 16). Much of the rail siding that wrapped to the north around Building 308 in the 1922 and 1926 maps (Figure 3.4 Maps 2 and 3) is not visible; however a portion of this rail was identified southeast of Building 448, running along a concrete-paved surface beneath the building's safety chutes (Appendix A: Photograph 17).

In addition to sidewalks and asphalt roads, three other paved surfaces were observed during the field investigation: the concrete-paved area with rail tracks southeast of Building 448; an asphalt parking area measuring about 100 ft by 30 ft in the zone between Whittemore Avenue and Buffington Road; and a semicircle-shaped concrete surface northwest of Whittemore Avenue, opposite the former site of Building 452 (Appendix A: Photograph 18). The last of these three surfaces appears on the 1922 map of the arsenal (Figure 3.4 Map 2) and probably serviced the now-demolished Building 118. The asphalt parking lot does not appear on any image prior to the 2002 aerial photograph (see Figure 4.3), although larger parking areas of different shapes are shown in the same location on the 1957 orthographic aerial photo and the 1970s-1980s oblique aerial photo (see Figure 3.4 Map 6 and Figure 3.6)

Another type of disturbance related to the construction of buildings was seen to extend across the southernmost portion of the study area. Here, the natural slope of the land surrounding Buildings 462B, 462C and 462D has been altered so the bases of these structures are at the same elevation as one another, as well as with Building 462 to the south. The result is that a large portion of rising terrain has been removed, totaling roughly one-half acre (Figure 4.1; Appendix A: Photograph 19).

In addition to alterations to the landscape related to the construction and demolition of buildings, roads, railroads, and other utilities, there were numerous isolated recent disturbances from the UXO Joint Venture Investigation. The UXO technicians employed electromagnetic metal-detecting equipment to locate metallic anomalies, which they removed either with shovels or a backhoe. Several hundred of their excavations (which averaged about 1 m in diameter and 50 centimeters [cm] in depth), along with their adjacent back dirt piles, were scattered across the study area (Appendix A: Photographs 20 and 21). Visual inspection of the pits did not reveal any architectural remains or other features. Besides these excavations, the UXO technicians also removed most of the underbrush and small trees from the study area prior to their investigation.

Figure 4.4. Building 448 complex (from the 1983 HAER documentation), facing northeast. Building 448 is in the background. The small structure at left is Building 448A and the covered walkway at right connects Buildings 448 and 448C (*Thurber and Norman 1983*).

Figure 4.5. Building 448 (from the 1983 HAER documentation), facing south. Buildings 448A and 448B are visible at right (*Thurber and Norman 1983*).

4.3 FIELD INVESTIGATION

A total of 109 shovel tests were dug across the project area and 11 samples of back dirt from the UXO investigation were screened (see Figure 4.1). Ninety-five of the shovel tests were excavated at a 50-ft (15-m) interval along 15 transects (Transects 1-15). Transects 1-13 were southwest of Whittemore Avenue. Transects 1-9 ran along a bearing of 225°, roughly perpendicular to the axis of that road; Transects 10-13 were oriented at a bearing of 205°, approximately parallel to the southeast boundary of the study area. Transects 14 and 15 were between Whittemore Avenue and Buffington Road. They ran along a bearing of 140°, roughly parallel to Whittemore. To accommodate the narrow shape of this part of the study area, the two transects were spaced 10 m apart. The remaining 14 shovel tests were dug at a close- (5-m) interval along three transects (Transects S1, S2, and S3) around a poured concrete foundation identified northwest of Fourteenth Avenue (Figure 4.6).

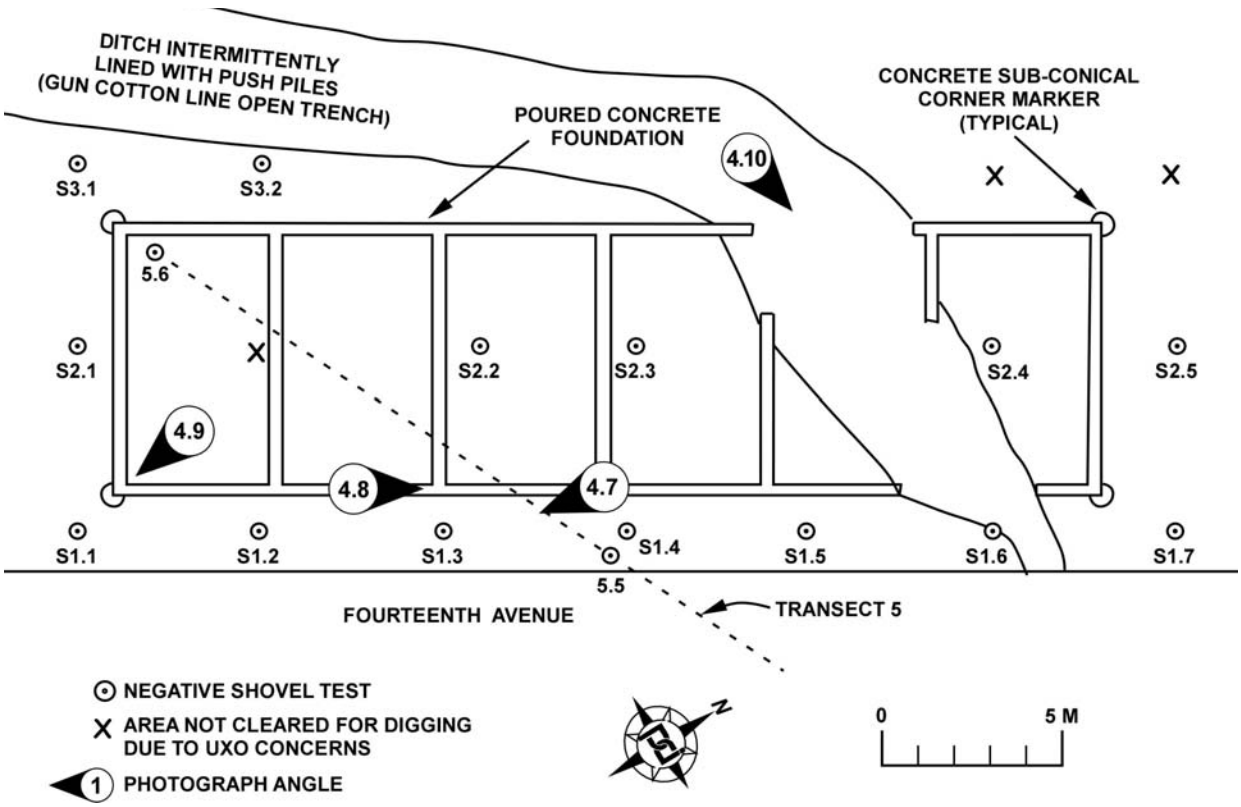

Figure 4.6. Close-interval shovel testing around the poured-concrete foundation identified west of Fourteenth Avenue.

The qualities of soils identified in the shovel tests varied substantially across the study area. Two soil strata were found in 83 tests; excavation in a further 21 tests was terminated due to the presence of rock or gravel impasses before a second stratum was encountered; one test was dug in a disturbed context and only yielded coal ash and iron slag; and three soil strata were identified in four shovel tests. The upper soil stratum ranged in color from brown to gray and dark grayish brown and its texture varied from sand to silt loam. In the tests in which two soil strata were encountered, it varied between 10 and 35 cm in thickness and reached a mean depth of 20.8 cm. The tests that were terminated due to impasses before reaching a second

stratum extended to depths between 8 and 50 cm and reached an average of 23.3 cm below the surface. The soil layer underlying the upper stratum was similarly variable across the study area. It ranged in texture from silt loam to sand and its color varied from yellowish brown to light gray and red. In the tests where two soil strata were identified, its excavated portion varied from 3 to 19 cm in thickness and it had an average vertical extent of 10.3 cm (excavation of 19 of these tests was terminated because of impasses before it had reached 10 cm into the second stratum). The tests with two soil strata were dug to a mean total depth of 31.1 cm. Qualities of the soils in the four STPs in which three strata were identified varied substantially from one test to another. These tests were excavated to an average total depth of 35.8 cm.

Numerous architectural and industrial artifacts were found in the shovel tests, including: fragments of concrete; iron slag; gravel; coal; coal ash; brick; flat glass; hollow architectural ceramic tiles; redware pipe; mortar; wire nails; unidentified metallic objects (both iron and brass); and a glass electrical insulator. Because they were non-diagnostic and were industrial and/or architectural in origin, none of the items were collected. No prehistoric artifacts or features were found.

Backdirt from a total of 12 pits dug during the UXO investigation was screened for cultural material (see Figure 4.1; Table 4.1; Appendix C). As was the case with the shovel tests, numerous historical artifacts, most of which were industrial and architectural (e.g., hollow ceramic tiles, mortar, concrete, flat glass, and bricks), were recovered. Most of this material was not collected, but samples were retained from three pits (nos. 2, 8 and 17). UXO Pit 2, located northwest of Fourteenth Avenue, yielded 12 items, including: a fragment of aqua container glass; a piece of clear glass from a paneled container; 2 wood screws; 6 wire nails; a cut nail; and a piece from a sheet iron strap. A total of five items were collected from UXO Pit 8, southwest of Whittemore Avenue, just northwest of the former location of Building 452. They include: a piece of milk glass; 3 fragments of aqua flat glass (of which one is plain, one is relatively thicker and contains a safety wire, and one is from a privacy window); and a wire nail. Eight items were collected from UXO Pit 12, which was southeast of Fourteenth Street near the center of the study area, among which are: a whole Gulden's mustard jar with a screw top and mold lines; a small whole clear glass paneled bottle; 2 clear glass container bases from square paneled vessels; a fragment from a clear glass bottle with an oval cross section; a cast iron specialty tool; a fragment from a clock movement made from sheet brass; and a glass pipette.

Table 4.1. Items noted in screened back dirt from UXO pits

UXO Pit Number	Cultural Material
1	brick, mortar (not collected)
2	numerous items – see discussion in text and Appendix C
3	no cultural material
4	brick (not collected)
5	wire nails, brick, iron slag, flat glass (not collected)
6	flat glass, container glass, brick, unidentified iron fragment, iron slag, coal (not collected)
7	no cultural material
8	numerous items – see discussion in text and Appendix C
9	iron slag (not collected)
10	no cultural material
11	brick (not collected)
12	numerous items – see discussion in text and Appendix C

An additional 37 items recovered by the UXO technicians were also collected, although their contexts were unfortunately not recorded (Appendix C). (A report is pending to Picatinny from PIKA International, Inc. and Malcolm Pirnie, Inc. concluding their Military Munitions Response Program work.) The objects collected during the UXO survey include: a base from a clear glass Gulden's mustard jar with mold lines and a screw top; a nearly complete Gulden's mustard jar, also with mold lines and a screw top; 2 fragments from clear glass containers, both with mold lines; a base from an aqua glass canning jar; 2 fragments from shallow jars with mold lines and screw tops, that also had small isolated interior compartments (the jars were possibly for a two-part epoxy); 4 enameled sheet iron cups (in one of which was found 4 sheet iron fragments, 2 fragments of iron wire paper clips, 2 wire tacks, a possible pencil lead, a whole brass straight pin, 2 brass straight pin fragments, and a small piece of clear glass); a pencil fragment; an iron strap clamp for a pipe; an unidentifiable iron fitting; an unidentifiable heavy gauge piece of cast iron; a brass pipe fragment; a cast iron handle; an iron rasp; 3 pieces of rebar; a sheet iron pipe flange, a 2-in diameter iron tube fragment; and a piece of cast iron hardware, possibly from a tracked vehicle.

Three poured-concrete foundations were identified during the field investigation, which correspond with pre-1926 Lake Denmark Naval Powder Depot explosion Buildings 118 (a two-story brick office building), 308 (a lumber shed), and 320 (a one-story hollow-tile storage magazine; see Figure 3.4 Maps 2 and 3). The Building 320 foundation is an elevated concrete pad with a square plan measuring roughly 30 ft on a side (Appendix A: Photographs 22 and 23). It rests on a surface that slopes moderately up towards the south-southeast. Near its north corner, the upper surface of the pad is about 3 ft above the ground, while its south corner is only about 4 inches from the ground surface. The exposed lateral edges of the northern third of the foundation have a decorative profile that probably continues along the buried edges of the remainder of the structure. About 4 ft of the foundation's north corner have been destroyed, probably as a result of grading that accompanied the installation of the walkway that connected Building 452 and 452B. The foundation for Building 118 was identified on the surface southwest of the former location of Building 452, roughly 10 ft northwest of the Building 320 foundation pad. Much of the foundation for Building 118 had been disrupted by the construction of Building 452 and the Building 452-452B walkway (Appendix A: Photograph 24). Only two partial foundation walls near the south corner of the building remain. The walls are composed of 12-inch thick poured concrete.

The Building 308 (lumber shed) foundation was identified on the northwest side of Fourteenth Avenue, about 100 ft northeast of its intersection with Eleventh Street. It is made up of a series of 12-inch thick poured-concrete walls and measures roughly 88-by-25 ft (27-by-7.5 m), with its long axis oriented parallel to Fourteenth Avenue (Figure 4.7; referenced on Figure 4.6). Its interior is divided into six equally-sized bays separated from one another by additional poured-concrete walls. The outer edge of the foundation walls are lined with a protective iron lip, suggesting they were at least partially exposed in the original structure (Figure 4.8). Iron tie-downs for a superstructure are also present. The corners of the foundation each have a concrete sub-conical marker (Figure 4.9). The trench associated with the gun cotton plant utility line cuts through the foundation near its northeastern end and its walls there have been disrupted (Figure 4.10). The structure's origins were unknown at the time of the survey and so it was investigated with close-interval (5-m) shovel tests. A total of 14 STPs were arranged around the foundation walls along three transects oriented parallel to the major axis of the building (see Figure 4.6). The qualities of the soils in the shovel tests are not distinct from those found elsewhere in the project area and they are included with the quantitative summary for the STPs given above. Items collected from the shovel tests are limited to architectural and

industrial materials, including iron slag, gravel, brick fragments, ‘drain’ tile (possibly architectural hollow tile), coal, concrete, and a glass insulator. No domestic artifacts or deposits of historical material, nor any prehistoric artifacts or features, were found in the STPs around the foundation.

Figure 4.7. Southeast wall of the foundation from demolished Building 308, the lumber shed, facing south. Fourteenth Avenue is at left *(PCI 2008)*.

Figure 4.8. Detail of the Building 308 foundation wall, facing northeast; note the protective iron lip on the right of the wall and the superstructure attach-points near the center of the image *(PCI 2008)*.

Figure 4.9. Sub-conical corner marker for the Building 308 foundation, facing south from inside the foundation. Building 452B is in the background *(PCI 2008)*.

Figure 4.10. The trench from the gun cotton utility line passing through the Building 308 foundation, facing east. The view is from northwest of the building *(PCI 2008).*

4.4 CONCLUSIONS AND RECOMMENDATIONS

No historical or prehistoric archaeological resources were identified in the APE for the PHS+T Center. Much of the project area has been disturbed by the post-1880 industrial development of this part of the arsenal. No architectural remains associated with either the Middle Forge or the Righter buildings (see Section 3.3) were identified. Although the degree of disturbance suggested by the historical maps and images, the effects of the UXO investigation, and the conditions encountered during the archaeological investigation was extensive across much of the APE, it was particularly acute in the northern quadrant – the zone closest to the documented locations of the pre-Arsenal structures. This area has been significantly impacted by numerous Arsenal facilities: first by Buildings 54 and 396 (the millwright shop and brick storehouse, respectively; see Figure 3.4 Maps 2 and 3), and subsequently by the Building 448 complex, as well as its associated rail sidings (see Figure 3.4 Map 6 and Figures 3.5 and 3.6). The intensity of twentieth-century development in the project area is also reflected in the artifact assemblage; numerous post-1900 items were found, nearly all of which were industrial or architectural artifacts. In some cases, items can be directly related to the 448/452 building complexes. For example, the brass straight pin fragments found in the enameled sheet iron cup collected during the UXO investigation are probably associated with the bag-loading activities conducted in those buildings. Only one item – the cut nail recovered from UXO pit 2 – likely dates to the nineteenth century. The proximity of the pit in which the nail was found to the Building 308 foundation suggests the nail was from that structure. Because the study area was within 2,000 ft of the center of the 1926 Lake Denmark Naval Powder Depot explosion, the possibility exists that the nail (and probably at least some other artifacts) were thrown there by that event. The fact that no historical ceramics of any kind were found also underscores the industrial character of the project area. No prehistoric artifacts or features were found.

Based on these results, Panamerican concludes there are no intact archaeological sites or significant deposits in the project area. Therefore the construction of the PHS+T Center element of the Base Realignment and Closure 2005 receiving action undertakings at Picatinny Arsenal will have no impacts on any potentially National Register-eligible archaeological cultural resources. No further archaeological investigations are recommended for the project.

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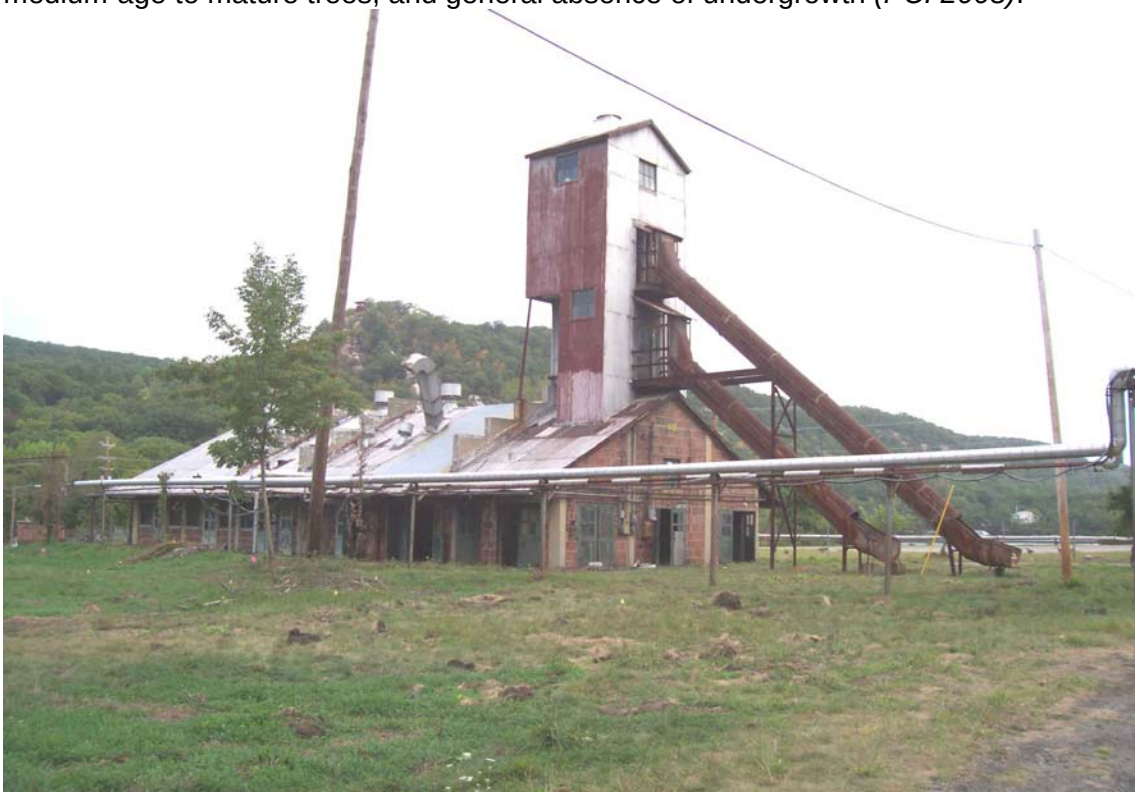
Appendix A
PHOTOGRAPHS

Photograph 1. Typical field conditions in the study area, showing low uncut grass, medium-age to mature trees, and general absence of undergrowth *(PCI 2008)*.



Photograph 2. Building 448, located near the northern corner of the project area. The view is from Fourteenth Avenue facing north (*PCI 2008*).

Photograph 3. Building 452B, showing the adjacent earthen blast barrier (at right) and concrete stairway, facing southeast *(PCI 2008)*.

Photograph 4. Building 462B, near the southwest corner of the study area, facing southeast. Building 462 is in the background at right *(PCI 2008).*

Photograph 5. Building 462C, located on the south edge of the study area, facing southeast. The view is from the northwest; the walkway on the right connects with Building 462 to the west *(PCI 2008)*.

Photograph 6. Building 462D, near the south boundary of the study area, facing northwest. The covered walkway at left connects with Building 462C to the south *(PCI 2008).*

Photograph 7. The former site of Buildings 452 and 452A, facing east *(PCI 2008).*

Photograph 8. The concrete walkway that formerly connected Buildings 452 and 452B, facing west *(PCI 2008)*.

Photograph 9. Site of the former complex made up of Buildings 448A, 448B and 448C, facing east. Building 448 is in the background. Thirteenth Avenue is in the foreground (*PCI 2008*).

Photograph 10. Concrete transformer pad, near the south boundary of the project area, facing southwest. Building 462 is in the background at left *(PCI 2008).*

Photograph 11. The study area between Whittemore Avenue (at right) and Buffington Road, facing southeast. Note discolored vegetation indicating the presence of a buried utility line *(PCI 2008)*.

Photograph 12. Buried utility (steam line) access point in the northeastern quadrant of the study area, facing south; Whittemore Avenue is in the background *(PCI 2008)*.

Photograph 13. Evidence of buried utilities near the southwestern boundary of the study area, facing south. The concrete box provides access to a buried steam line. Eleventh Street is in the background *(PCI 2008).*

Photograph 14. The open trench formerly housing the gun cotton plant discharge line. The view is from Whittemore Avenue, facing southwest *(PCI 2008).*

Photograph 15. Rail line along the southwestern boundary of the study area, facing southeast. Eleventh Street is at right *(PCI 2008).*

Photograph 16. The site of buried rail lines in the southeastern portion of the project area, facing southwest from Whittemore Avenue. Building 455 is visible in the background *(PCI 2008).*

Photograph 17. Rail lines passing through a concrete pad southeast of Building 448, facing north *(PCI 2008).*

Photograph 18. Concrete-paved area on the north side of Whittemore Avenue, opposite the former site of Building 452, facing northwest *(PCI 2008).*

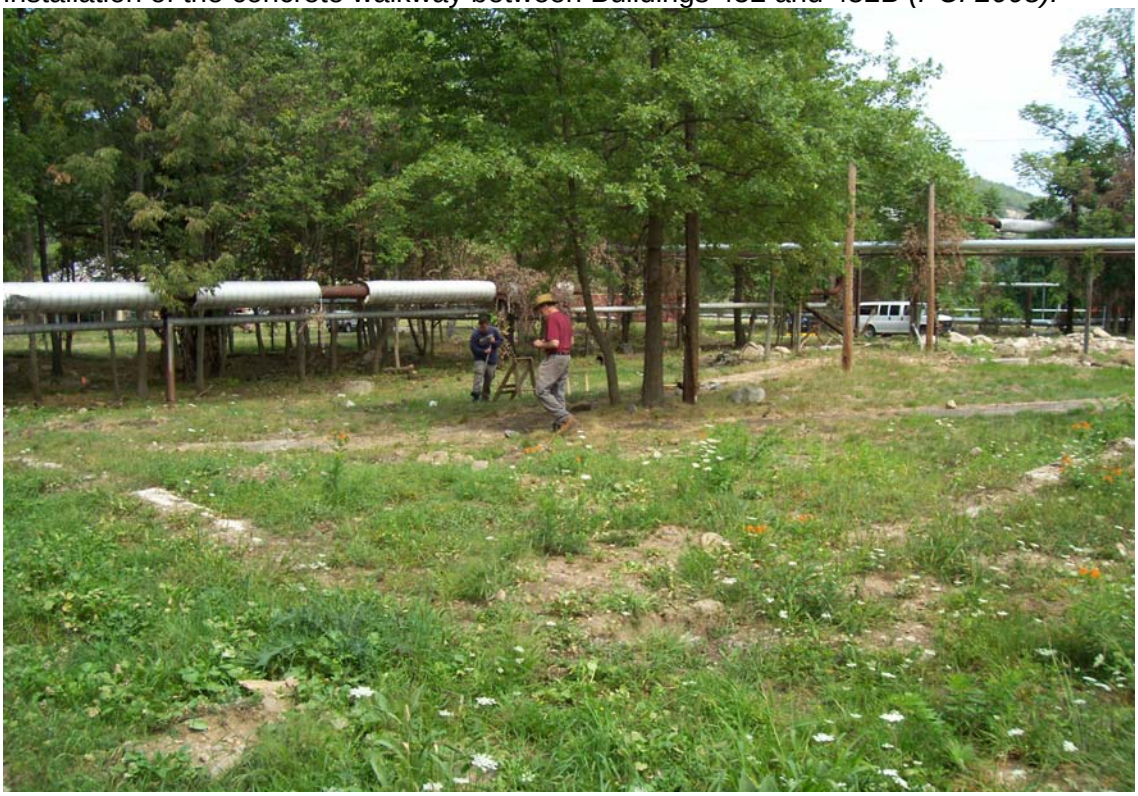
Photograph 19. Typical altered topography in the southern portion of the study area, facing south; Building 462D is in the center of the image *(PCI 2008).*

Photograph 20. Typical UXO survey excavation with adjacent backdirt pile *(PCI 2008)*.

Photograph 21. Distribution of UXO investigation excavations southwest of Building 448. The view is from the tower on the building. Eleventh Street is in the background *(PCI 2008).*

Photograph 22. Foundation of Building 320, facing south. The walkway that formerly connected Buildings 452 and 452B is in the foreground *(PCI 2008)*.

Photograph 23. North corner of the Building 320 foundation, showing decorative detail. The corner of the foundation (at left) has been destroyed, presumably during the installation of the concrete walkway between Buildings 452 and 452B *(PCI 2008).*



Photograph 24. Foundation walls of demolished Building 118 (in foreground), facing north. The walkway betweem Buildings 452 and 452B is in the background *(PCI 2008).*

Appendix B
SHOVEL TEST LOG

Shovel Test Log for Picatinny PHS+T, Phase I

Transect/ STP	Stratum	Depth (cm)	Munsell	Soil Color	Soil Description	Comments
1.1	1	0-30	10YR 4/3	BR	SA SI	brick fragments (discarded); gravel
1.1	2	30-36	10YR 4/6	DK YL BR	SA SI	NCM; gravel; rock impasse at 36cm
1.2	1	0-25	10YR 4/3	BR	SA SI	NCM
1.2	2	25-32	10YR 4/6	DK YL BR	SA SI	NCM; gravel; rock impasse at 32cm
1.3	1	0-24	10YR 4/3	BR	SA SI	drainage tile (discarded)
1.3	2	24-35	10YR 4/6	DK YL BR	SA SI	NCM
1.4	1	0-12	10YR 4/2	DK GR BR	SA SI	slag (discarded); 50m interval
1.4	2	12-28	7.5YR 5/6	STRONG BR	SA SI	NCM
2.1	1	0-28	10YR 4/2	DK GR BR	SA LO	brick fragment (discarded); rocky; rock impasse at 28cm
2.2	1	0-17	10YR 4/2	DK GR BR	SI LO	NCM; rocky
2.2	2	17-29	10YR 4/6	DK YL BR	SI LO	NCM; rocky
2.3	1	0-23	10YR 4/2	DK GR BR	SI LO	brick fragment (discarded); rocky
2.3	2	23-29	10YR 4/6	DK YL BR	SI LO	NCM; rocky; rock impasse at 29cm
2.4	1	0-35	10YR 4/2	DK GR BR	SI LO	NCM; on pushpile; gravel
2.4	2	35-45	10YR 4/6	DK YL BR	SI LO	NCM; gravel; rock impasse at 45cm
2.5	1	0-22	10YR 4/2	DK GR BR	SI LO	slag; charcoal; gravel; disturbed; 30m interval due to surface boulders; on railroad bed
2.5	2	22-32	10YR 3/2	V DK GR BR	SA LO	NCM; gravel
3.1	1	0-26	10YR 5/3	BR	SI LO	brick; glass; mortar; metal bracket (all discarded)
3.1	2	26-37	10YR 4/4	DK YL BR	SA LO	NCM
3.2	1	0-20	10YR 5/3	BR	SI LO	brick (discarded); rock impasse at 20cm
3.3	1	0-20	10YR 5/3	BR	SI LO	NCM
3.3	2	20-31	10YR 4/4	DK YL BR	SA LO	NCM
3.4	1	0-17	10YR 5/3	BR	SI LO	NCM
3.4	2	17-30	10YR 4/4	DK YL BR	SA LO	NCM
3.5	1	0-18	10YR 5/3	BR	SI LO	NCM
3.5	2	18-31	10YR 4/4	DK YL BR	SA LO	NCM
3.6	1	0-16	10YR 5/3	BR	SI LO	NCM
3.6	2	16-32	10YR 4/4	DK YL BR	SA LO	NCM
4.1	1	0-12	10YR 4/3	BR	SA SI	NCM; adjacent to railroad bed; concrete pad at 12cm
4.2	1	0-27	10YR 4/3	BR	SA SI	concrete; brick; glass; slag (all discarded)
4.2	2	27-39	10YR 4/4	DK YL BR	SA SI	NCM
4.3	1	0-26	10YR 4/3	BR	SA SI	brick; slag (all discarded)
4.3	2	26-38	10YR 4/4	DK YL BR	SA SI	NCM
4.4	1	0-12	10YR 4/2	DK GR BR	SA SI	slag (discarded)
4.4	2	12-30	2.5YR 5/6	RD	SA SI	NCM
4.5	1	0-17	10YR 5/2	GR BR	SA SI	NCM
4.5	2	17-30	10YR 6/3	PALE BR	SA SI	NCM
4.6	1	0-19	10YR 5/2	GR BR	SA SI	brick fragment (discarded)
4.6	2	19-30	10YR 6/3	PALE BR	SA SI	NCM
5.1	1	0-21	10YR 4/1	DK GR	SA SI	NCM
5.1	2	21-33	10YR 6/3	PALE BR	SA SI	NCM
5.2	1	0-18	10YR 4/1	DK GR	SA SI	NCM
5.2	2	18-25	10YR 6/3	PALE BR	SA SI	NCM; rock impasse at 25cm
5.3	1	0-18	10YR 4/1	DK GR	SA SI	NCM
5.3	2	18-31	2.5YR 5/6	RD	SA SI	NCM
5.4	1	0-22	10YR 4/1	DK GR	SA SI	NCM
5.4	2	22-34	2.5YR 5/6	RD	SA SI	NCM
Key	**Soil Color:** BR = brown, DK = dark, GR = gray, LT = light, V = very, YL = yellow					
	Soil Description: CL = clay, LO = loam, SA = sand, SI = silt					
	Comments: NCM = no cultural material					

Shovel Test Log for Picatinny PHS+T, Phase I

Transect/ STP	Stratum	Depth (cm)	Munsell	Soil Color	Soil Description	Comments
5.5	1	0-45	10YR 3/2	V DK GR BR	SA SI	coal (discarded); rock impasse at 45cm
5.6	1	0-21	10YR 4/1	DK GR	SA SI	coal; slag (discarded)
5.6	2	21-32	10YR 5/2	GR BR	SA SI	NCM
6.1	1	0-20	10YR 4/3	BR	SI	NCM
6.1	2	20-33	7.5YR 5/6	STRONG BR	SA SI	NCM
6.2	1	0-28	10YR 3/2	V DK GR BR	SI LO	slag; modern pipe (all discarded)
6.2	2	28-35	10YR 4/3	BR	SA SI	NCM
6.2	3	35-48	10YR 4/6	DK YL BR	SA SI	NCM
6.3	1	0-25	10YR 4/2	DK GR BR	SA SI	NCM
6.3	2	25-36	7.5YR 5/6	STRONG BR	SI	NCM
6.4	1	0-17	10YR 5/2	GR BR	LO SA	NCM; rocky
6.4	2	17-30	10YR 5/6	YL BR	LO SA	NCM; rocky
6.5	1	0-8	10YR 4/2	DK GR BR	SA SI	NCM; gravel; rock impasse at 8cm
7.1	1	0-10	10YR 4/3	BR	SI LO	NCM
7.1	2	10-25	7.5YR 5/6	STRONG BR	SA SI	NCM
7.1	3	25-30	10YR 3/2	V DK GR BR	SI	NCM; rock impasse at 30cm
7.2	1	0-34	10YR 3/2	V DK GR BR	LO SA	unidentified ferrous object; wire; nails; slag; mortar; brass; glass
7.2	2	34-49	10YR 4/3	BR	LO SA	NCM
7.3	1	0-28	10YR 4/2	DK GR BR	SI LO	tile; plastic (discarded)
7.3	2	28-33	10YR 5/6	YL BR	SA SI	NCM; rock impasse at 33cm
7.4	1	0-27	10YR 4/2	DK GR BR	SA LO	NCM
7.4	2	27-37	10YR 4/6	DK YL BR	SA LO	NCM
7.5	1	0-26	10YR 4/2	DK GR BR	SA LO	concrete; concrete impasse at 26cm
7.6	1	0-26	10YR 4/2	DK GR BR	SA LO	slag
7.6	2	26-37	10YR 4/6	DK YL BR	SA LO	NCM
7.7	1	0-25	10YR 4/3	BR	SI LO	NCM
7.7	2	25-37	7.5YR 5/6	STRONG BR	SI LO	NCM
8.1	1	0-19	10YR 4/2	DK GR BR	SA SI	NCM
8.1	2	19-31	10YR 6/3	PALE BR	SA SI	NCM
8.2	1	0-16	10YR 4/2	DK GR BR	SA SI	brick; glass (all discarded)
8.2	2	16-27	10YR 6/3	PALE BR	SA SI	NCM
8.3	1	0-24	10YR 4/2	DK GR BR	SA SI	slag; coal; brick; concrete (all discarded)
8.3	2	24-34	10YR 6/3	PALE BR	SA SI	NCM
8.4	1	0-27	10YR 4/2	DK GR BR	SA SI	brick; sewer tile (all discarded)
8.4	2	27-37	10YR 6/3	PALE BR	SA SI	NCM
8.5	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM
8.5	2	15-25	10YR 4/6	DK YL BR	SA SI	NCM
8.6	1	0-24	10YR 4/2	DK GR BR	SA SI	NCM
8.6	2	24-35	10YR 4/6	DK YL BR	SA SI	NCM
8.7	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM
8.7	2	15-26	10YR 4/6	DK YL BR	SA SI	NCM
8.8	1	0-10	10YR 4/2	DK GR BR	SA SI	NCM; 7.5m interval due to slope
8.8	2	10-29	10YR 6/2	LT BR GR	SA SI	NCM
9.1	1	0-25	10YR 4/2	DK GR BR	SA LO	brick; plastic; glass
9.1	2	25-35	10YR 5/3	BR	SA SI	NCM
9.2	1	0-15	10YR 4/2	DK GR BR	SI LO	concrete chunks
9.2	2	15-20	10YR 5/3	BR	SI LO	NCM; rock impasse at 20cm
9.3	1	0-24	10YR 3/3	DK BR	SI	NCM; 22.5m interval due to concrete foundation; gravel
9.3	2	24-31	7.5YR 4/4	BR	SI LO	NCM; rock impasse at 31cm
9.4	1	0-33	10YR 3/3	DK BR	SI LO	NCM
9.4	2	33-45	7.5YR 5/6	STRONG BR	SI LO	NCM
9.5	1	0-25	10YR 4/1	DK GR	SI LO	NCM
9.5	2	25-37	10YR 5/6	YL BR	SI LO	NCM

Shovel Test Log for Picatinny PHS+T, Phase I

Transect/ STP	Stratum	Depth (cm)	Munsell	Soil Color	Soil Description	Comments
9.6	1	0-23	10YR 4/2	DK GR BR	SI LO	NCM
9.6	2	23-35	10YR 5/6	YL BR	SI LO	NCM
9.7	1	0-25	10YR 4/2	DK GR BR	SA	slag; 7.5m from 9.6
9.7	2	25-31	10YR 5/3	BR	SA	NCM; rock/concrete impasse at 31cm
10.1	1	0-18	10YR 4/2	DK GR BR	SA SI	NCM; rock impasse at 18cm
10.2	1	0-17	10YR 4/2	DK GR BR	SA SI	NCM
10.2	2	17-29	10YR 5/6	YL BR	SA SI	NCM
10.3	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM
10.3	2	15-18	10YR 5/6	YL BR	SA SI	NCM; rock impasse at 18cm
10.4	1	0-17	10YR 4/2	DK GR BR	SA SI	NCM
10.4	2	17-28	10YR 5/6	YL BR	SA SI	NCM
11.1	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM
11.1	2	15-30	10YR 4/6	DK YL BR	SA SI	NCM
11.2	1	0-18	10YR 4/2	DK GR BR	SA SI	plastic (discarded)
11.2	2	18-28	10YR 4/6	DK YL BR	SA SI	NCM
11.3	1	0-27	10YR 4/2	DK GR BR	SA SI	concrete (discarded); rock impasse at 27cm
11.4	1	0-17	10YR 4/2	DK GR BR	SA SI	NCM
11.4	2	17-30	10YR 4/6	DK YL BR	SA SI	NCM
11.5	1	0-18	10YR 4/2	DK GR BR	SA SI	NCM
11.5	2	18-28	10YR 4/6	DK YL BR	SA SI	NCM
11.6	1	0-17	10YR 4/2	DK GR BR	SA SI	NCM
11.6	2	17-27	10YR 4/6	DK YL BR	SA SI	NCM
12.1	1	0-18	10YR 3/1	V DK GR	SA LO	NCM
12.1	2	18-28	10YR 4/6	DK YL BR	SA CL	NCM
12.2	1	0-20	10YR 3/1	V DK GR	SA LO	tile fragment (discarded)
12.2	2	20-32	10YR 4/6	DK YL BR	SI LO	NCM
12.3	1	0-26	10YR 4/2	DK GR BR	SA LO	coal; rock impasse at 26cm
12.4	1	0-21	10YR 4/2	DK GR BR	SA LO	NCM
12.4	2	21-24	10YR 6/1	GR BR	SA SI	NCM; rock impasse at 24cm
12.5	1	0-17	10YR 4/2	DK GR BR	SA LO	NCM
12.5	2	17-24	10YR 4/6	DK YL BR	SA LO	NCM; rock impase at 24cm
12.6	1	0-15	10YR 4/2	DK GR BR	SA LO	NCM
12.6	2	15-20	10YR 4/6	DK YL BR	SA LO	NCM; rock impasse at 20cm
12.7	1	0-25	10YR 4/2	DK GR BR	SA LO	brick frag (discarded)
12.7	2	25-36	10YR 4/6	DK YL BR	SA LO	NCM
13.1	1	0-10	10YR 4/2	DK GR BR	SA SI	NCM
13.1	2	10-20	10YR 5/6	YL BR	SA SI	NCM
13.2	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM
13.2	2	15-25	10YR 5/6	YL BR	SA SI	NCM
13.3	1	0-14	10YR 4/2	DK GR BR	SA SI	NCM
13.3	2	14-25	10YR 5/6	YL BR	SA SI	NCM
13.4	1	0-17	10YR 4/2	DK GR BR	SA SI	NCM
13.4	2	17-27	10YR 6/1	GR	SA SI	NCM
14.1	1	0-22	10YR 4/1	DK GR	SA SI	NCM; gravel
14.1	2	22-32	10YR 5/6	YL BR	SA SI	NCM
14.2	1	0-15	10YR 4/1	DK GR	SA SI	NCM; gravel; rock impasse at 15cm
14.3	1	0-20	10YR 4/1	DK GR	SA SI	NCM
14.3	2	20-31	10YR 5/6	YL BR	SA SI	NCM
14.4	1	0-15	10YR 4/3	BR	SA SI	NCM
14.4	2	15-20	10YR 5/6	YL BR	SA SI	NCM; rock impasse at 20cm
14.5	1	0-24	10YR 5/1	GR	SA SI	NCM; gravel
14.5	2	24-28	10YR 5/6	YL BR	SA SI	NCM; rock impasse at 28cm
14.6	1	0-20	10YR 5/1	GR	SA SI	NCM; gravel
14.6	2	20-31	10YR 5/6	YL BR	SA SI	NCM
14.7	1	0-15	10YR 4/3	BR	SA SI	NCM; rock impasse at 15cm
14.8	1	0-15	10YR 4/1	DK GR	SA SI	NCM

Shovel Test Log for Picatinny PHS+T, Phase I

Transect/ STP	Stratum	Depth (cm)	Munsell	Soil Color	Soil Description	Comments
14.8	2	15-30	10YR 5/6	YL BR	SA SI	NCM
14.9	1	0-42	10YR 5/1	GR	SA SI	slag (discarded); rock impasse at 42cm
15.1	1	0-24	10YR 4/1	DK GR	SA SI	NCM
15.1	2	24-34	10YR 4/6	DK YL BR	SA SI	NCM
15.2	1	0-14	10YR 4/1	DK GR	SA SI	NCM; rock impasse at 14cm
15.3	1	0-16	10YR 4/1	DK GR	SA SI	NCM; rock impasse at 16cm
15.4	1	0-18	10YR 7/1	LT GR	SA	NCM
15.4	2	18-28	10YR 4/2	DK GR BR	SA SI	NCM; rock impasse at 28cm
15.5	1	0-17	10YR 4/2	DK GR BR	SA SI	NCM
15.5	2	17-28	10YR 4/6	DK YL BR	SA SI	NCM
15.6	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM; rock impasse at 15cm
15.7	1	0-27	10YR 4/1	DK GR	SA SI	coal; brick; slag (all discarded); rock impasse at 27cm
15.8	1	0-15	10YR 4/1	DK GR	SA SI	NCM; rock impasse at 15cm
15.9	1	0-15	10YR 4/2	DK GR BR	SA SI	NCM
15.9	2	15-25	10YR 5/6	YL BR	SA SI	NCM
15.10	1	0-24	10YR 4/1	DK GR	SA SI	coal (discarded)
15.10	2	24-34	10YR 4/6	DK YL BR	SA SI	NCM
15.11	1	0-8	10YR 5/6	YL BR	SA LO	slag (discarded)
15.11	2	8-20	10YR 3/2	DK BR	SI LO	slag (discarded)
15.11	3	20-34	10YR 4/1	DK GR	SA SI	coal; slag (all discarded)
S1.1	1	0-16	10YR 4/1	DK GR	LO SA	NCM; 90% gravel; brick fragment; drain tile (both discarded)
S1.1	2	16-20	10YR 3/2	DK BR	SA	NCM; 90% gravel
S1.1	3	20-31	10YR 5/6	YL BR	SA	NCM; 90% gravel
S1.2	1	0-17	10YR 4/1	DK GR	LO SA	NCM; 90% gravel; slag (discarded); rock impasse at 17cm
S1.3	1	0-26	10YR 4/1	DK GR	LO SA	NCM
S1.3	2	26-31	10YR 7/1	LT GR	SA	NCM; rock impasse at 31cm
S1.4	1	0-27	10YR 4/1	DK GR	LO SA	NCM
S1.4	2	27-33	10YR 7/1	LT GR	SA	NCM; 90% gravel; rock impasse at 33cm
S1.5	1	0-29	10YR 4/1	DK GR	LO SA	NCM
S1.5	2	29-34	10YR 7/1	LT GR	SA	NCM; rock impasse at 34cm
S1.6	1	0-25	10YR 4/1	DK GR	LO SA	NCM; rock impasse at 25cm
S1.7	1	0-29	10YR 4/1	DK GR	LO SA	NCM; very rocky; rock impasse at 29cm
S2.1	1	0-25	10YR 4/2	DK GR BR	SA SI	NCM
S2.1	2	25-35	10YR 4/6	DK YL BR	SA SI	NCM; coal; slag (all discarded)
S2.2	1	0-60			COAL ASH	NCM. 10m interval due to UXO
S2.3	1	0-23	10YR 4/2	DK GR BR	SA SI	slag; concrete (all discarded); 10m interval due to trench
S2.3	2	23-35	10YR 5/2	GR BR	SA SI	NCM
S2.4	1	0-50	10YR 4/2 10YR 4/6	DK GR BR DK YL BR	SA SI	coal; slag; unidentified metal object (all discarded); disturbed; adjacent to trench; rock impasse at 50cm
S2.5	1	0-26	10YR 4/2	DK GR BR	SA SI	glass insulator; concrete; slag (all discarded)
S2.5	2	26-37	10YR 4/6	DK YL BR	SA SI	NCM
S3.1	1	0-20	10YR 4/2	DK GR BR	SA SI	slag (discarded)
S3.1	2	20-25	10YR 5/6	YL BR	SA SI	NCM
S3.2	1	0-23	10YR 4/2	DK GR BR	SA SI	NCM
S3.2	2	23-35	10YR 5/6	YL BR	SA SI	NCM

Appendix C
ARTIFACT CATALOG

Artifact Catalog for Picatinny PHS+T, Phase I

Context	Stratum	Material	Count	Description	Comments
Back dirt location 2	Back Dirt	Glass	1	Container glass, aqua, body	Excavation by UXO
Back dirt location 2	Back Dirt	Glass	1	Clear glass paneled container base fragment, embossed on sides, "YORK" on 1 side; "…R", "...TURING", and "...MPANY" on other	Excavation by UXO
Back dirt location 2	Back Dirt	Metal	2	Iron wood screw	Excavation by UXO
Back dirt location 2	Back Dirt	Metal	6	Wire nail	Excavation by UXO
Back dirt location 2	Back Dirt	Metal	1	Cut nail	Excavation by UXO
Back dirt location 2	Back Dirt	Metal	1	Sheet iron fragment, .75-in strap, punched hole	Excavation by UXO
Back dirt location 8	Back Dirt	Glass	1	Milk glass	Excavation by UXO
Back dirt location 8	Back Dirt	Glass	2	Flat glass, aqua, 1 thin, 1 thick with safety wire fragment	Excavation by UXO
Back dirt location 8	Back Dirt	Glass	1	Flat glass, aqua, privacy window	Excavation by UXO
Back dirt location 8	Back Dirt	Metal	1	Wire nail	Excavation by UXO
Back dirt location 12	Surface	Glass	1	Clear glass jar, whole, embossed base "GULDEN'S MUSTARD…REG. U.S. PAT. OFF. … BOTTLE 15", screw top, mold lines	Excavation by UXO
Back dirt location 12	Surface	Glass	1	Clear glass paneled bottle, whole, small (2.5 in x 1.5 in x .75 in), cap attached, maker's mark embossed on side, "McK&R" inside oval ring, screw top, mold lines	Excavation by UXO
Back dirt location 12	Surface	Glass	2	Clear glass container bases, square section, 1 with embossing on side, "3/10 OZ NET", mold lines	Excavation by UXO
Back dirt location 12	Surface	Glass	1	Clear glass bottle fragment, neck and shoulder, oval section, mold lines, possibly melted	Excavation by UXO
Back dirt location 12	Surface	Metal	1	Cast iron specialty wrench (resembles pipe wrench)	Excavation by UXO
Back dirt location 12	Surface	Metal	1	Sheet brass clock movement fragment	Excavation by UXO
Back dirt location 12	Surface	Glass	1	Pipette fragment, clear, curved dropper	Excavation by UXO
	Unprovenienced within project area	Glass	1	Clear glass jar base, mold lines; Embossed label "Gulden's Mustard", "Reg. U.S. Pat. Off.", and "BOTTLE 12"	Excavation by UXO
	Unprovenienced within project area	Glass	1	clear glass jar, nearly complete, embossed "GULDEN'S MUSTARD…REG U.S. PAT. OFF. … BOTTLE 10", mold lines, screw top	Excavation by UXO
	Unprovenienced within project area	Glass	1	Clear glass jar fragment, base or shoulder, mold line	Excavation by UXO
	Unprovenienced within project area	Glass	1	Clear glass bottle fragment, neck and shoulder, square section, screw top, mold lines	Excavation by UXO
	Unprovenienced within project area	Glass	1	Aqua glass jar base, canning jar, embossed "ATLAS E Z SEAL"	Excavation by UXO
	Unprovenienced within project area	Glass	2	Clear container glass, short vessel (ca. 2 in), ca. 3.5-in diameter, 1 embossed "…[R]USSIA CEMEN[T]..." AND "MASS"; 1 embossed "…T CO LEP…" AND "GL…", screw top, circular section, each has isolated compartment, possibly from epoxy containers	Excavation by UXO

Artifact Catalog for Picatinny PHS+T, Phase I

Context	Stratum	Material	Count	Description	Comments
	Unprovenienced within project area	Metal	2	Sheet iron cup with rolled lip, enamel coated, 3.2 in diameter; 1 with missing base; base of other has punched hole	Excavation by UXO
	Unprovenienced within project area	Metal	2	Sheet iron cup with rolled lip, enamel coated, 4.5 in diameter, riveted handle (missing)	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Metal	2	Sheet iron metal strap with linear impressions parallel to lateral edges	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Metal	2	Sheet iron fragments, unidentifiable	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Metal	2	Iron wire paper clip	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Metal	2	Iron wire tacks	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Metal	1	Possible pencil lead	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Metal	3	Brass straight pin (2 fragments, 1 whole)	Excavation by UXO
	Unprovenienced within project area (found inside 3.2-in diameter sheet iron cup)	Glass	1	Clear glass, possibly container glass	Excavation by UXO
	Unprovenienced within project area	Compound	1	Pencil fragment, metal eraser enclosure with lead and charred wood	Excavation by UXO
	Unprovenienced within project area	Metal	1	Iron strap pipe clamp, adhered screw	Excavation by UXO
	Unprovenienced within project area	Metal	1	Iron, unidentifiable fitting (plumbing)	Excavation by UXO
	Unprovenienced within project area	Metal	1	Cast iron, heavy gauge, unidentifiable	Excavation by UXO
	Unprovenienced within project area	Metal	1	Brass pipe, medium-gauge, 1-in diameter, one end threaded	Excavation by UXO
	Unprovenienced within project area	Metal	1	Cast iron machine handle, 8-in length	Excavation by UXO
	Unprovenienced within project area	Metal	1	Iron rasp, whole, 14-in length	Excavation by UXO
	Unprovenienced within project area	Metal	3	Heavy gauge iron bar, .5-in diameter, heavily corroded, possibly rebar	Excavation by UXO
	Unprovenienced within project area	Metal	1	Sheet iron pipe flange, 10.5-in diameter	Excavation by UXO
	Unprovenienced within project area	Metal	1	Medium-gauge iron tube, 2-in diameter, 12-in length, possibly from a fence post	Excavation by UXO
	Unprovenienced within project area	Metal	1	Cast iron hardware, possibly a track element from a tracked vehicle	Excavation by UXO