Phase IA Archaeological Predictive Model
I-80 Reconstruction Project
Monroe, Pennsylvania

ER# 2013-8131-089

Prepared for:

pennsylvania
DEPARTMENT OF TRANSPORTATION

Engineering District 5-0
1002 Hamilton Street
Allentown, PA 18101

and

AECOM

1700 Market Street, Suite 1600
Philadelphia, PA 19103

Prepared by:

McCormick Taylor
Engineers & Planners Since 1946

5 Capital Drive, Suite 400
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Allison Brewer, MA
Charles A. Richmond, MA
Steven E. Barry, MA
5 Capital Drive, Suite 400
Harrisburg, Pennsylvania 17110

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Abstract

The Pennsylvania Department of Transportation, in cooperation with the Federal Highway Administration and the Northeastern Pennsylvania Alliance Metropolitan Planning Organization, is proposing a highway widening project within Stroudsburg Borough, East Stroudsburg Borough, and Stroud Township, Monroe County, Pennsylvania. The project includes the evaluation of a section of Interstate 80 (I-80) within Monroe County that extends from Exit 303 to Exit 307 of I-80 and along adjacent sections of S.R. 611 and PA 209 (S.R. 0209). The project includes the I-80 right-of-way and associated transportation infrastructure improvements to improve traffic and access. Proposed improvements to the current alignment include widening in association with improvements to on- and off-ramps, side streets, intersections, highway alignment, and shoulder improvements. The proposed improvements will consist of approximately 60 acres of ground disturbance. Proposed alternatives within the corridor are under development.

In order to reduce the expenditure of time and resources that field testing of all the proposed alternatives would require, a predictive model has been developed to identify areas of archaeological sensitivity and assist in the alternative creation and selection process. Due to the utilization of both state and federal funding for the proposed I-80 Reconstruction Project, these efforts were designed and completed in order to ensure compliance with both Section 106 of the National Historic Preservation Act (36 CFR 800) and the State History Code.

McCormick Taylor developed a GIS-based archaeological predictive model with the intent of delineating areas of high, medium, and low archaeological potential for both pre-contact and historic archaeological resources within the archaeological APE. For the purposes of the predictive model, the APE includes 515 acres which is comprised of alluvial, upland, and urban settings. The model for pre-contact archaeological resources was developed using the existing literature on pre-contact settlements models in the region, topographic characteristics of previously recorded pre-contact archaeological sites within the watershed, geomorphological testing within the archaeological APE, and pedestrian reconnaissance. The model for historic archaeological resources was based on historic background information, including historic maps and existing literature on the history of the area, and pedestrian reconnaissance.

Multiple Phase I Archaeological Identification and Geomorphological Surveys have been previously conducted within and immediately adjacent to the archaeological APE; however, there are no previously recorded archaeological resources within the archaeological APE. Multiple architectural resources, unmapped historic resources, historic cemeteries, and one historic district have been identified within the archaeological APE and similar resources have been identified within the immediate vicinity of the APE.

Based upon the pre-contact predictive model, McCormick Taylor has identified 506.83 acres (98.2%) as having low probability for containing intact pre-contact resources, 5.88 acres (1.1%) as having medium probability for containing intact pre-contact resources, and 3.58 acres (0.7%) as having high probability for containing intact pre-contact resources within the archaeological APE. Based upon the historic predictive model, McCormick Taylor has identified 388.04 acres (75.4%) as having low probability for containing intact historic resources, 58.65 acres (11.4%) as

having medium probability for containing intact historic resources, and 68.07 acres (13.2%) as having high probability for containing intact historic resources within the archaeological APE.

The predictive model will be applied to the project APE. In conjunction with other environmental and design concerns, the predictive model will assist in the selection of a preferred alternative by determining the amount of potential archaeological impacts to each alternative. Once the preferred alternative is chosen, McCormick Taylor recommends that areas contained within it be subjected to archaeological survey according to the designated probabilities. All areas designated as having high and medium probability to contain pre-contact archaeological resources should be subjected to subsurface survey. Due to the steep slopes and severe disturbance present within the current APE from residential, commercial, and transportation-related development, as well as the results of the geomorphological survey, no subsurface testing is recommended within the majority of the designated low probability areas. However, McCormick Taylor recommends that a percentage of the low probability areas that do not display evidence of prior disturbance be tested at the high probability interval in order to assess the effectiveness of the model. It is also recommended that the preferred alternative be subjected to a pedestrian reconnaissance to delineate any pre-contact contexts that may fall within low probability areas but warrant high-probability testing, such as rockshelters, overhangs, tool-grade lithic outcrops, benches, and springheads. For historic archaeological resources, McCormick Taylor recommends that property-specific deed and property research be undertaken prior to the Phase I survey in order to assess the historic value and integrity of areas designated as having high probability for containing historic archaeological resources. Following this additional research, it is recommended that areas identified as having a high probability for historic archaeological resources as well as the potential to provide significant information be subjected to subsurface survey.

Table of Contents

Appendices

Figures

Photographs

Tables

I. Introduction

The Pennsylvania Department of Transportation, in cooperation with the Federal Highway Administration and the Northeastern Pennsylvania Alliance Metropolitan Planning Organization, is proposing a highway widening project within Stroudsburg Borough, East Stroudsburg Borough, and Stroud Township, Monroe County, Pennsylvania. The project includes the evaluation of a section of Interstate (I-80) within Monroe County that extends from Exit 303 to Exit 307 of I-80 and along adjacent sections of S.R. 611 and U.S. 209 (S.R. 0209) ***(Figure 1)***. The project includes the I-80 right-of-way and associated transportation infrastructure improvements to improve traffic and access. Proposed improvements to the current alignment include widening in association with improvements to on- and off-ramps, side streets, intersections, highway alignment, and shoulder improvements. The proposed improvements will consist of approximately 60 acres of ground disturbance.

Five preliminary alternatives were developed for the I-80 Section 17M corridor. The five preliminary alternatives were combined to create an overall study area based on the extent of their combined edges of pavement (EOP). The current Area of Potential Effects (APE), developed in consultation with the District Archaeologist, was derived by creating a 250 foot buffer from the combined EOPs. The current Area of Potential Effects (APE) represents the greatest possible extent of the archaeological Area of Potential Effects based on the five proposed alternatives. Once a project alternative has been selected and design advanced, a final APE will be chosen.

Among the environmental and engineering constraints to be considered in the course of preliminary alternative designs is a determination of impacts potential alternatives may have on archaeological resources. In order to reduce the expenditure of time and resources that field testing of all the proposed alternatives would require, a predictive model has been developed to identify areas of archaeological sensitivity. The model is intended to assist in the alternative creation and selection process. Through the application of this model, the project team will be able to gauge the relative impacts each alternative is likely to have on archaeological resources within the study area. At the beginning of the endeavor, McCormick Taylor assumed that approximately 80% of the archaeological area of potential effects (APE) would have been previously disturbed due to previous roadway construction, residential development, and commercial development or would have slopes of greater than 15%. For the purposes of the predictive model, the APE includes 515 acres which is comprised of alluvial, upland, and urban settings.

McCormick Taylor developed a GIS-based archaeological predictive model with the intent of delineating areas of high, medium, and low archaeological potential for both pre-contact and historic archaeological resources within the archaeological APE. The model for pre-contact archaeological resources was developed using the existing literature on pre-contact settlements models in the region, topographic characteristics of previously recorded pre-contact archaeological sites within the watershed, geomorphological testing within the archaeological APE, and pedestrian reconnaissance. The model for historic archaeological resources was based on historic background information, including historic maps and existing literature on the history of the area, and pedestrian reconnaissance.

This work was designed to meet the requirements of all applicable federal and state mandates that apply to the project, which include the following: the National Environmental Policy Act of 1969, the Federal Aid Highway Act of 1966 as amended, the National Historic Preservation Act of 1966 as amended, Executive Order 11-593, the Archaeological and Historic Preservation Act of 1974, and Commonwealth of Pennsylvania Acts 1970-120 and 1978-273. All work was conducted in accordance with the Pennsylvania Historical and Museum Commission's (PHMC's) *Cultural Resource Management in Pennsylvania: Guidelines for Archaeological Investigations* (2008). All archaeological work was conducted by or under the direct supervision of a person meeting the Secretary of the Interior's Professional Qualifications Standards for Archaeologists (48 FR 44738-9). All GIS work was completed by a professional GIS analyst who has received Geographic Information Systems Professional (GISP) certification.

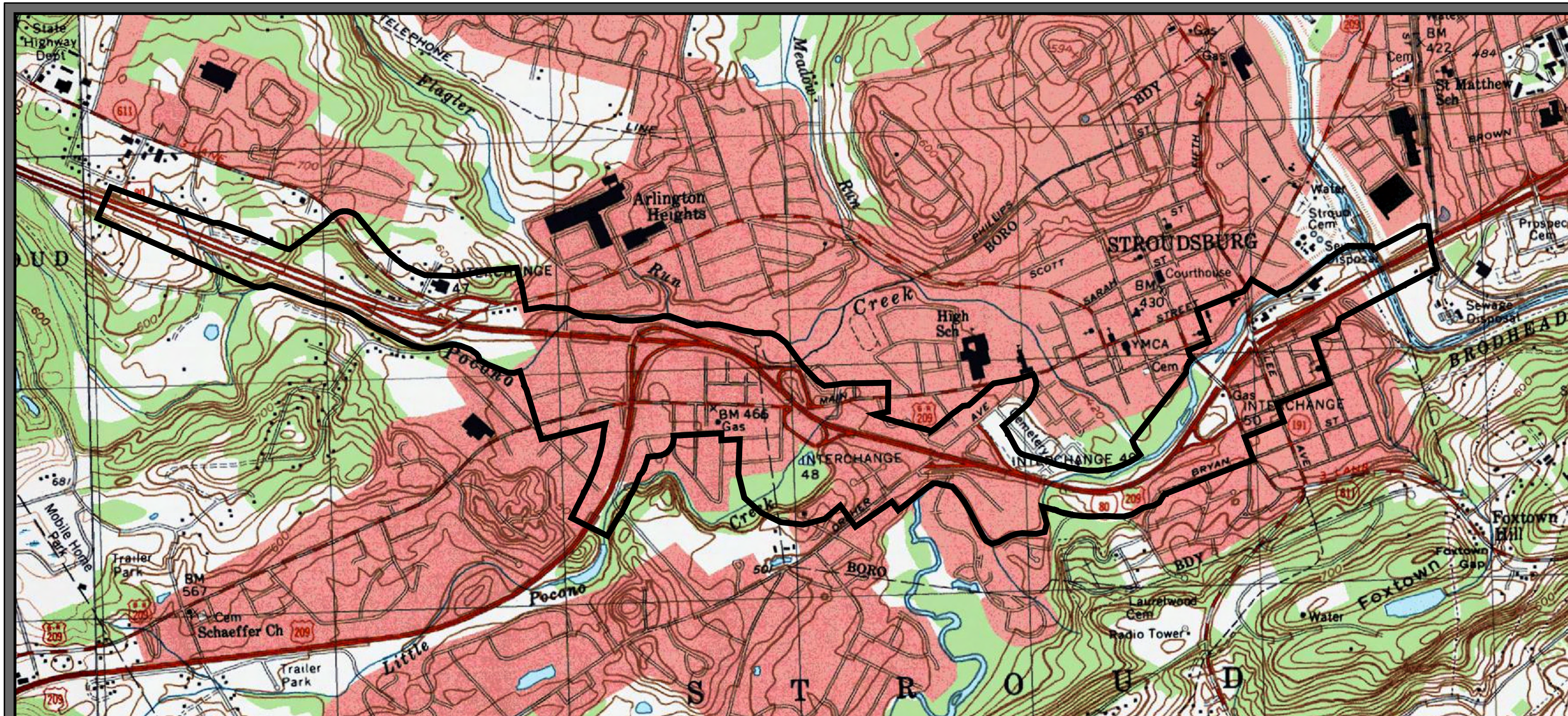
The APE for a project is defined as the geographic area within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking [36 CFR 800.16(d)]. The APE for archaeological resources includes all areas in which ground-disturbing activities are proposed. The area in which ground-disturbing activities are proposed is equivalent to the project limits as described above.

Multiple Phase I Archaeological Identification and Geomorphological Surveys have been previously conducted within and immediately adjacent to the archaeological APE. However, there are no previously recorded archaeological resources within the archaeological APE. Multiple architectural resources, unmapped historic resources, historic cemeteries, and one historic district are within the archaeological APE. Similar resources have been identified within the immediate vicinity (1000 feet) of the APE.

Geomorphological testing was completed by Dr. Frank Vento and John Stiteler, MS of Quaternary Geological and Environmental Consultants, LLC. Geomorphological testing within the APE was undertaken in order to evaluate the structure of the soils on representative alluvial settings for which previous disturbance could not be documented. Hand auger probes were examined in order to characterize the depositional history of the alluvium and other soils within the APE, identify areas in which previous disturbance had occurred, and identify the depth to which pre-contact archaeological deposits are likely to extend.

McCormick Taylor archaeologists conducted a pedestrian reconnaissance for the archaeological APE to confirm areas that appeared to have been disturbed through the literature examination, identify additional areas of disturbance, and identify any foundations or other visible archaeological features. As a result of the pedestrian reconnaissance, McCormick Taylor archaeologists identified the presence of additional historic resources not previously identified on historic mapping.

Allison Brewer, MA served as the Principal Investigator for the creation of the Archaeological Predictive Model. The geomorphological evaluation was completed by Dr. Frank Vento and John Stiteler, MS of Quaternary Geological and Environmental Consultants, LLC. Ms. Brewer completed the pre-contact background research and Charles Richmond, MA completed the historic background research. Shannon Silsky served as a field technician for the pedestrian reconnaissance. GIS analysis was performed by Michael Goeckel, GISP. Graphics were produced by John Watson and Mr. Goeckel. Steven Barry, MA, RPA provided technical assistance. Qualifications of key personnel are located in ***Appendix A.***



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Archaeological Area of Potential Effects

0 1,000 2,000 4,000 Feet

0 240 480 720 960 1,200 Meters

N S W E

McCormick Taylor
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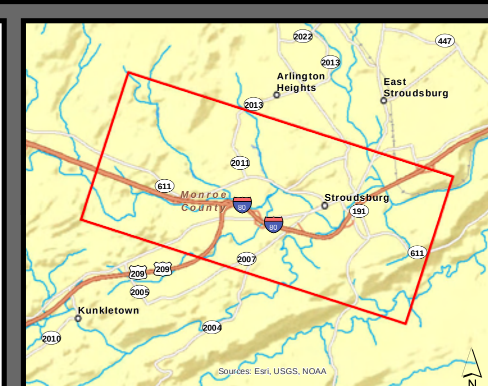


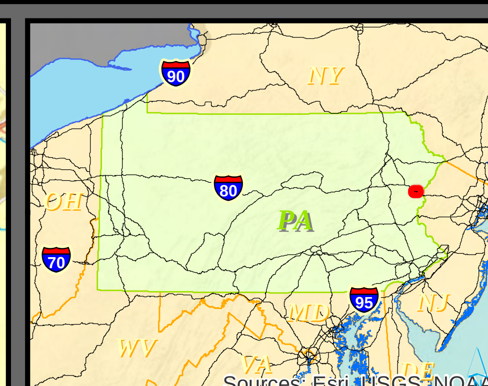


Figure 1: Archaeological Area of Potential Effects

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Stroudsburg, PA 7.5' USGS Quadrangle, 1999

II. Physical Description and Environmental Setting

The project is located at the boundary between the Glaciated Poconos Plateaus Section of the Appalachian Plateaus physiographic province and the Blue Mountain Section of the Ridge and Valley Physiographic Province. Though located within the Blue Mountain Section, the APE displays characteristics of the adjacent Glaciated Poconos Plateau Section which has been scoured by glacial ice. Glacial landforms composed of glacial till (moraines), glaciofluvial drift (outwash terraces, kames, kame terraces), and glacio-lacustrine deposits are abundant in this part of Monroe County, Pennsylvania. The Allegheny Front is the division between the more gently folded lithologies of the Appalachian Plateaus and the more complexly folded Ridge and Valley physiographic province. Subsections east of the Appalachian Plateaus in the Delaware Valley region include the Echo Lake Lowland (Upper Delaware Valley), Wallpack Ridge, "Lower" Delaware Valley, and the Kittatinny Mountains. The Ridge and Valley province is subdivided into two sections, the Appalachian Mountain section and the Great Valley section. The alternating ridges and valleys that make up the Appalachian Mountain section have developed due to folded and faulted rock. Blue Mountain, the first major ridge north and west of the Great Valley, forms much of the southern and eastern boundary of the section. The Blue Mountain Section is characterized by linear ridges and shallow valleys. Ridges within the Blue Mountain section range from 1,600 to 2,400 feet. The lowest elevations in the section are at the Susquehanna River Water Gap through Blue Mountain and the Delaware Water Gap through Kittatinny Mountain, ranging between 300 and 480 feet. The Delaware Water Gap, which extends from eastern Pennsylvania to New Jersey, was created due to variations in the folded bedrock within the Appalachian mountain ridge (Epstein 1966; Sevon 2000; Thompson and Wilshusen 1999: 816-817; Way 1999:352-361).

The APE for this project is drained by multiple second, third, and fourth order tributaries of Brodhead Creek. At the western end of the APE, Little Pocono Creek flows into Pocono Creek. Pocono Creek flows into McMichael Creek. McMichael Creek flows into Brodhead Creek, which is a tributary of the Delaware River. The confluence of Brodhead Creek and the Delaware River is approximately 2.35 miles east of the archaeological APE.

A. Geology, Landforms, and Soils

Bedrock within and immediately adjacent to the APE is mapped as the Devonian-age Hamilton Group (Dh), comprised of the Marcellus Formation (Dm) and Mahantango Formation (Dmh), and the Buttermilk Falls Limestone through Esopus Formation, undivided (Dbe), which includes Buttermilk Falls Limestone, Palmerton Sandstone, the Schoharie Formation, and the Esopus Formation (USDA State Soil Survey Database 2005).

The Marcellus Formation consists of black carbonaceous shale and the Mahantango Formation consists of gray, brown, and olive shale and siltstone. The Buttermilk Falls Limestone through Esopus Formation, undivided consists of a range of siliceous sandstone, argillaceous siltstone, silty shale, fossiliferous limestone, and black chert. Cherts utilized for tool manufacture are also present in the nearby Ridgeley Formation and Coeymans Formation, as well as the Cambrian-Ordovician Kittatinny Supergroup common to eastern Pennsylvania and northwestern New Jersey.

According to soil surveys conducted by the United States Department of Agriculture Natural Resources Conservation Service (http://websoilsurvey.nrcs.usda.gov), there are twenty-three soil mapping units within the archaeological APE ***(Figure 2)***. Descriptions of the soil series/mapping units are provided in ***Table 1***. Soils designated as hydric soils include Sheffield Silt Loam, Rexford Gravelly Silt Loam (0 to 3 Percent Slopes and 3 to 8 percent slopes), Holly Silt Loam, and Chippewa and Norwich extremely stony soils (0 to 8 percent slopes).

B. Natural Resources

Monroe County is contained in Braun's (1950) Oak Chestnut Region of the Temperate Deciduous Forest Biome. In general, overstory species present at the time of European settlement would have been dominated by oak, chestnut, and hickory, with white pine, beech, elm, walnut, ash, tulip poplar, maple, cherry cedar, sycamore, and willow as secondary elements. The composition of any particular forest patch would have been dependent on local edaphic conditions. Well-drained soils may have promoted the growth of more mesic species like oak, chestnut, hickory and pine, while more poorly drained areas would have been conducive to sycamore and willow. A review of pollen data for eastern Pennsylvania suggests that with the exception of a decline in hemlock ca. 4,700 B.P., little vegetational change occurred from about 8,000 B.P. to the early Historic period (King 1994).

Except for species extirpated during the Historic period, Pennsylvania's modern faunal composition is thought to have developed by the Middle Holocene, ca. 8,000 B.P. (Toomey and Fay 1994). Mammal species important to aboriginal groups for subsistence and raw materials included whitetail deer, elk, moose, black bear, beaver, and eastern cottontail rabbit. Moose occur only sporadically in accounts from the late eighteenth and early nineteenth centuries, suggesting that these animals were thinly distributed in Pennsylvania prior to European contact, likely in the northern third of the state (Merritt 1987). Furbearers included beaver, fox, otter, mink, muskrat, martin, and fisher. The latter two of these, along with elk, mountain lion, and wolf were extirpated from the Commonwealth by the late nineteenth century (Doutts *et al*. 1966, Merritt 1987). Upland bird species included turkey, grouse, mourning dove, passenger pigeon (extinct), and quail, while aquatic habitats included various species of ducks and geese. Fish available in streams near the project area would have included brook trout, various species of catfish, and suckers. Anadromous fish species (American shad, gizzard shad, and Atlantic sturgeon) were dense, seasonal resources that had great economic importance for Native American and Euro-American people, but their spawning runs were likely restricted to the Delaware and its larger tributary streams (Chittenden 1974).

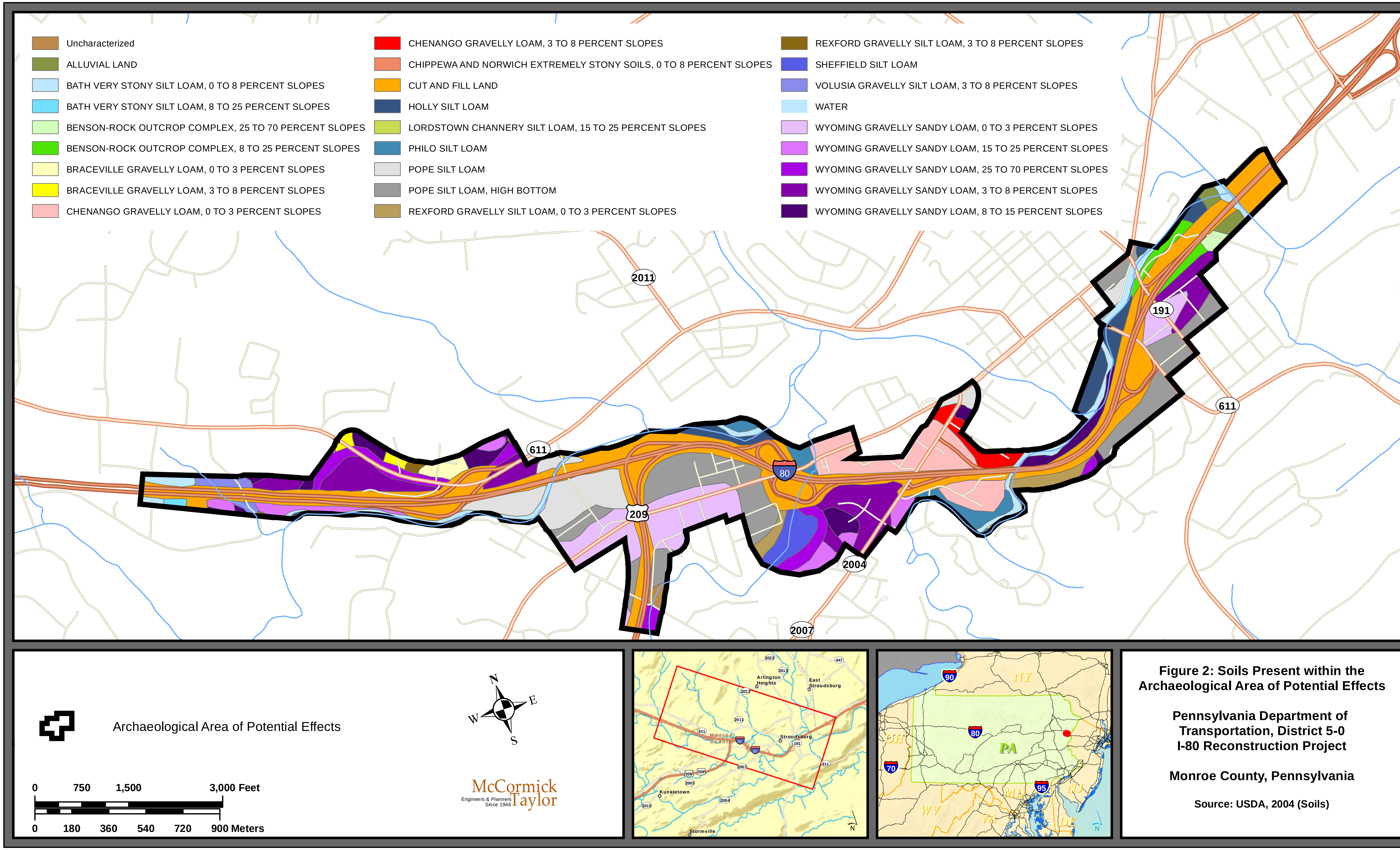


Figure 2: Soils Present within the Archaeological Area of Potential Effects

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: USDA, 2004 (Soils)

Table 1: Soils Present within the Archaeological Area of Potential Effects

Map Symbol	Mapping Unit	Soil Series Description
BbB	Bath Very Stony Silt Loam, 0 to 8 Percent Slopes	The Bath series consists of very deep, well drained soils formed in loamy till derived largely from gray and brown siltstone, sandstone and shale. These soils are found on uplands on nearly level to steep slopes. Slope ranges from 0 to 60 percent.
BbC	Bath Very Stony Silt Loam, 8 to 25 Percent Slopes	
BeC	Benson-Rock Outcrop Complex, 8 to 25 Percent Slopes	The Benson-Rock Outcrop Complex is a combination of the Benson soil series and exposed bedrock. The Benson soils and Rock outcrop are mapped together because they occur in such intricate patterns that it is not practical to map them separately. Approximately 15% of the complex is Rock outcrop. Soils of the Benson series are somewhat excessively and excessively drained soils on glaciated uplands. The soils formed in loamy till underlain by limestone or calcareous shale bedrock. Benson soils are nearly level to very steep soils on glaciated uplands. They are present on broad plains and on the tops and side slopes of hills, ridges, knolls, and mounds. Slope ranges from 0 to 70 percent. Permeability is moderate.
BeF	Benson-Rock Outcrop Complex, 25 to 70 Percent Slopes	
BrA	Braceville Gravelly Loam, 0 to 3 Percent Slopes	The Braceville series consists of very deep, moderately well drained soils formed in glacial outwash of stratified sand, silt, and gravel. Braceville soils are found on terraces, benches, fans, and moraines. Slopes range from 0 to 25 percent. Permeability is moderately slow to slow.
BrB	Braceville Gravelly Loam, 3 to 8 Percent Slopes	
ChA	Chenango Gravelly Loam, 0 to 3 Percent Slopes	The Chenango series consists of very deep, well and somewhat excessively drained soils formed in water-sorted material or drift on outwash plains, kames, eskers, terraces, moraines, and alluvial fans. Slope ranges from 0 to 60 percent.
ChB	Chenango Gravelly Loam, 3 to 8 Percent Slopes	
CnB	Chippewa and Norwich Extremely Stony Soils, 0 to 8 Percent Slopes	The Chippewa and Norwich series consists of very deep, poorly drained and very poorly drained soils formed in till deposits with dominantly sandstone, siltstone, and shale rock fragments. Chippewa soils are found in upland depressions. Norwich soils have redder hues of 7.5YR through 2.5YR throughout the fragipan and are found in low relief till plains, depressions, and seeps. Slope ranges for both soil types range from 0 to 8 percent.
Hy	Holly Silt Loam	The Holly series consists of very deep, very poorly and poorly drained soils formed in loamy alluvium on flood plains. Saturated hydraulic conductivity is moderately high through high in the mineral soil. Holly soils can be found on broad flat areas and in slight depressions on flood plains receiving alluvium from upland areas of low-lime drift and noncalcareous sandstone and shale. Slope ranges from 0 through 3 percent.

LsD	Lordstown Channery Silt Loam, 15 to 25 Percent Slopes	The Lordstown series consists of moderately deep, well drained soils formed till and cryoturbated material derived from siltstone and sandstone on bedrock controlled landforms of glaciated dissected plateaus. They are nearly level to very steep soils on hillsides and hilltops in glaciated bedrock controlled uplands. Slope ranges from 0 to 90 percent.
Ph	Philo Silt Loam	The Philo series consists of very deep, moderately well drained soils on flood plains. They formed in recent alluvium derived mainly from sandstone and shale. Permeability is moderate to moderately rapid. Slope ranges from 0 to 6 percent.
Po	Pope Silt Loam	The Pope series consists of very deep well drained soils formed in alluvium on flood plains. Pope soils are formed in alluvium weathered from Pennsylvanian aged acid sandstone, siltstone, and shale. Permeability is moderate or moderately rapid. Slopes range from 0 to 4 percent.
Pp	Pope Silt Loam, High Bottom	
ReA	Rexford Gravelly Silt Loam, 0 to 3 Percent Slopes	The Rexford series consists of very deep, somewhat poorly drained to poorly drained soils on terraces and moraines. They formed in glacial outwash or stream terraces derived mainly from sandstone and shale. Slopes range from 0 to 15 percent.
ReB	Rexford Gravelly Silt Loam, 3 to 8 Percent Slopes	
Sh	Sheffield Silt Loam	The Sheffield series consists of deep, poorly drained soils that formed on large flats and depressions in glacial till and on till plains. Permeability is moderately slow above the fragipan and is very slow in the fragipan. Slopes range from 0 to 3 percent.
VoB	Volusia Gravelly Silt Loam, 3 to 8 Percent Slopes	The Volusia series consists of very deep, somewhat poorly drained soils developed in firm basal till derived from siltstone, sandstone and brittle shale or slate. . These soils are located in glaciated upland areas and occupy long uniform slopes ranging from 0 to 35 percent. Volusia soils are present on lower valley sides and on broad divides of maturely dissected glaciated plateaus. They are underlain by lacustrine materials in some areas.
WyA	Wyoming Gravelly Sandy Loam, 0 to 3 Percent Slopes	The Wyoming series consists of very deep, somewhat excessively drained soils formed in gravelly, water-sorted material derived from red and gray sandstone, siltstone, and shale. Wyoming soils are nearly level to very steep soils found on outwash terraces, moraines, kames, eskers, and valley trains. Slopes range from 0 to 45 percent. Permeability is rapid.
WyB	Wyoming Gravelly Sandy Loam, 3 to 8 Percent Slopes	
WyC	Wyoming Gravelly Sandy Loam, 8 to 15 Percent Slopes	
WyD	Wyoming Gravelly Sandy Loam, 15 to 25 Percent Slopes	
WyE	Wyoming Gravelly Sandy Loam, 25 to 70 Percent Slopes	

III. Methodology

A. Background Research

McCormick Taylor conducted background research in order to provide a cultural context and design direction for the archaeological predictive model, as well as develop a context for the pre-contact, contact, and historic periods. The background research included a literature review of materials housed at the State Historic Preservation Office, Pennsylvania State Archives, National Register of Historic Places, Monroe County Historical Association, the Easton Public Library, East Stroudsburg State College, and East Stroudsburg University. Historic and modern aerial photographs, historic and contemporary atlases and maps, and historic documents were examined in order to identify and evaluate areas that have been previously disturbed. An Archaeological Sensitivity map was created in order to depict areas of known disturbance as well as areas that were likely to have the potential to contain historic and pre-contact resources. Features incorporated in the archaeological sensitivity map included documented historic Native American pathways, floodplains, wetlands, hydric soils, areas with >15% slope, historic districts, extant historic structures identified by historic resource surveys, areas subjected to previous archaeological survey, areas subjected to previous disturbance from residential and commercial development, and historically mapped roadways, cemeteries, railroads, canals, and waterways ***(Figure 3)***.

A number of previous studies and predictive models (Berge et al. 1991; Botwick and Wall 1992 and 1994; Bush 1992; Coppock and Heberling 2001; Corrie 1984; Curtain 1981; Duncan 2002; Duncan et al. 1995 and 1999; Duncan and Schilling 1999a and 1999b; Fortugno and Beadenkopf 2010; Glenn 2010; Hay 1993; Hay and Hatch 1980; Katz et al. 2002; Kittatinny Archaeological Research, Inc. 1993; Knepper and Petraglia 1994; Kuznar 1984; Lawrence et al. 2003; McIntyre 2009; Miller 2001; Miller and Kodlick 2006; Neusius and Neusius 1989; Neusius and Watson 1991; Perazio 1994; Stevenson 1982; Stewart and Kratzer 1989; Wadleigh 1981; Wall 1981; and Wood 1993) were reviewed in an effort to identify appropriate criteria to use in the design of the predictive model.

Cultural and topographic characteristics of all previously recorded archaeological resources within the watershed (1E) were obtained from the State Historic Preservation Office/CRGIS. Though limitations of the database, regarding reporting and data entry accuracy, have been discussed in the above referenced reports, some of these problems have been remedied by the recent PASS form updates completed by McCormick Taylor, Inc. as part of a separate project for the PHMC, completed in November 2013. Updates to incomplete and outdated PASS forms were completed for archaeological sites on which Phase II Archaeological Evaluation Investigations and Phase III Data Recovery/Mitigation Investigations have been completed. The project involved updating PASS forms regarding environmental data, investigation data, and eligibility and concurrence from the BHP. The updated PASS form information was entered into the Cultural Resources Geographic Information System (CRGIS). Though no updates have been completed for sites on which only Phase I work has been completed, the data employed in the creation of the current predictive model represents the most updated information provided by the CRGIS.

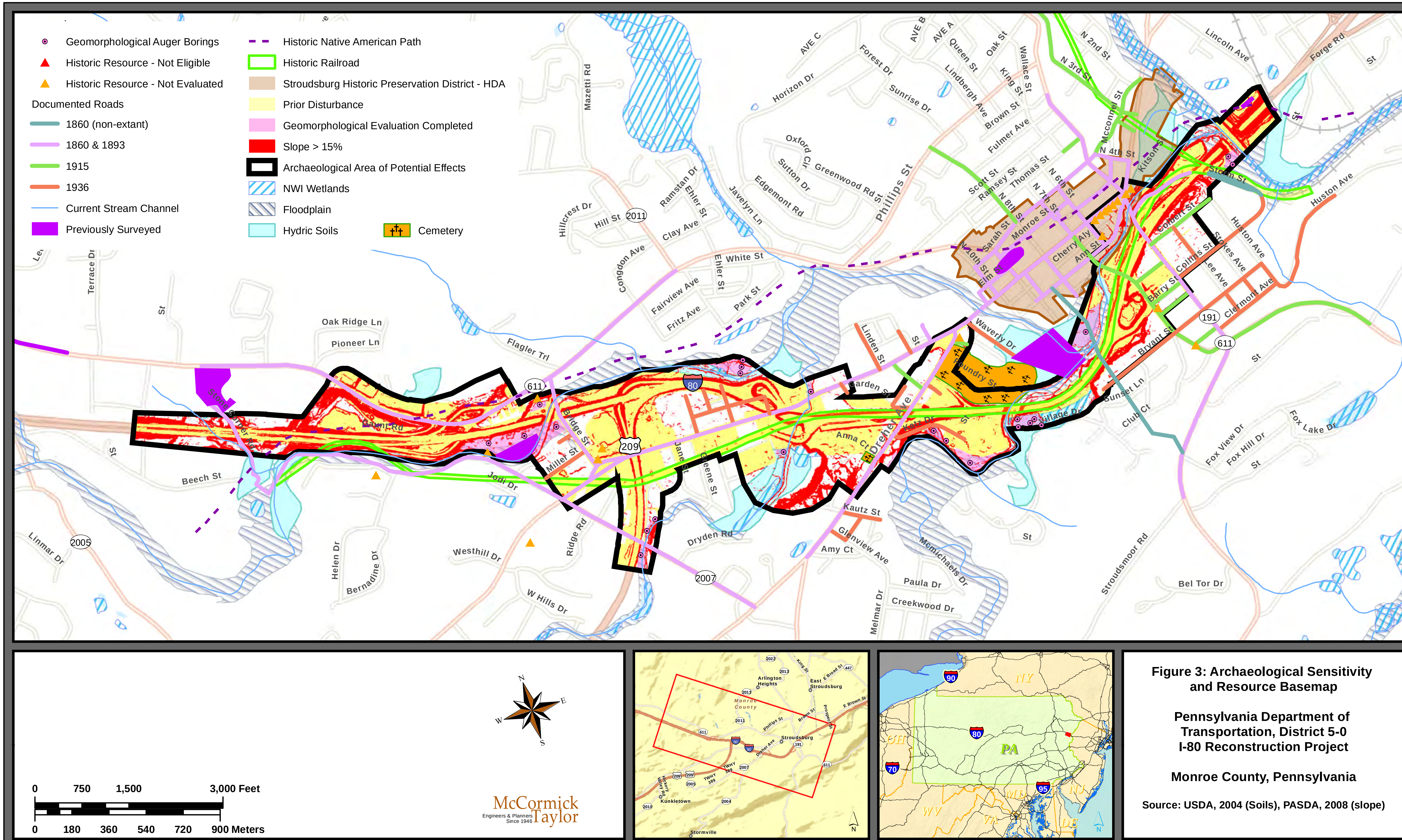
B. Geomorphological Evaluation

Geomorphological studies were undertaken by Dr. Frank J. Vento (President, Quaternary Geological and Environmental Consultants, LLC) and John Stiteler, MS (Consultant, Quaternary Geological and Environmental Consultants, LLC) in order to evaluate the structure of the soils on representative alluvial settings within the archaeological APE for which previous disturbance could not be documented. The geomorphologists also examined a sample of areas which were believed to have been previously disturbed in order to confirm the disturbance. The geomorphologists examined hand auger probes in order to characterize the depositional history of the alluvium and other soils within the APE, identify areas in which previous disturbance had occurred, and identify the depth to which pre-contact archaeological deposits are likely to extend. Based on the recommendations of the geomorphological testing, the examined areas were identified as containing high, medium, or low potential for containing pre-contact archaeological deposits. The results of the geomorphological evaluation are located in ***Appendix B.***

C. Pedestrian Reconnaissance

A pedestrian reconnaissance was conducted for the entire archaeological APE to confirm areas that appear to have been disturbed through the literature examination, identify additional areas of disturbance, and identify any foundations or other visible archaeological features.

After completion of the geomorphological survey and pedestrian reconnaissance and during the report writing process, the APE for the I-80 Reconstruction Project continued to progress. Approximately 66 acres were added to the project APE. The expanded project APE includes additional areas immediately adjacent to the current I-80 alignment, along historic roadways, and immediately adjacent to areas already described during the geomorphological evaluation. The recent additions were not subjected to additional geomorphological evaluation and were not reviewed first-hand as part of the pedestrian reconnaissance as it was deemed unnecessary considering the information already obtained. Instead, the predictive model, as built and applied to the 463 acres of the original APE, was applied to the portions of the expanded APE to evaluate their potential to contain historic and pre-contact archaeological resources. Historic resources identified within the expanded APE were included in the overall review of historic archaeological/architectural resources identified within the APE (see Previously Identified Resources).


Geomorphological Auger Borings
Historic Resource - Not Eligible
Historic Resource - Not Evaluated
Documented Roads
1860 (non-extant)
1860 & 1893
1915
1936
Current Stream Channel
Previously Surveyed
Historic Native American Path
Historic Railroad
Stroudsburg Historic Preservation District - HDA
Prior Disturbance
Geomorphological Evaluation Completed
Slope > 15%
Archaeological Area of Potential Effects
NWI Wetlands
Floodplain
Hydric Soils
Cemetery
0 750 1,500 3,000 Feet
0 180 360 540 720 900 Meters
N
E
S
W
McCormick Taylor
Engineers & Planners Since 1946
Figure 3: Archaeological Sensitivity and Resource Basemap
Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project
Monroe County, Pennsylvania
Source: USDA, 2004 (Soils), PASDA, 2008 (slope)
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IV. Cultural Context

McCormick Taylor conducted background research in the files in the Survey Room, Bureau for Historic Preservation, Pennsylvania Historical and Museum Commission, Harrisburg. The files in the Archaeology Section, State Museum of Pennsylvania, Harrisburg were also researched. Other facilities where research was conducted include The Pennsylvania State Archives, Harrisburg; the Monroe County Historical Society, the Easton Public Library, East Stroudsburg State College, and East Stroudsburg University. Recently updated data from the Pennsylvania Archaeological Site Survey (PASS) files was also utilized during the preparation of the context.

A. Pre-Contact Context

1. Pre-Clovis (ca. 16,000 to 11, 500 B.P.)

The presence of Pre-Clovis peoples in the Americas remains controversial, with the Chilean site of Monte Verde, Meadowcroft in Pennsylvania, and Cactus Hill in Virginia offering the most robust evidence for Late Pleistocene occupation. Accepting, for the purposes of this review, that Meadowcroft and Cactus Hill represent Pre-Clovis sites, their assemblages and dates are briefly discussed. Lithic technology from lower and middle Stratum IIa (seven dates average to 15,950 B.P.) at the Meadowcroft Rockshelter in Washington County has been characterized as a combination of later-stage core and biface reduction, with both local and extra-local lithic raw materials (e.g. Flint Ridge flint, Hardyston jasper) represented. Although no cores were recovered from this stratum, prismatic blades and blade fragments suggest the use of small, prepared cores. A single, unfluted lanceolate biface (typed “Miller Lanceolate") recovered from Stratum IIa was bracketed by dates of 11,300 ± 700 B.P. and 12,800 ± 870 B.P. Floral remains from this stratum suggest that elements of a deciduous forest were present near the site. Meadowcroft’s earliest inhabitants are thought to have been more generalized foragers than succeeding Clovis groups (Adovasio *et al*. 1982).

The Cactus Hill site in Virginia’s coastal plain has produced blade cores, blade tools, and thinned, lanceolate bifaces with an associated radiocarbon date of 15,070 ± 70 B.P. This assemblage is distinctive in material and technology from the overlying Clovis component dated 10,920 ± 250 B.P. and is vertically separated by 0.07 to 0.20 meters (0.2 to 0.7 feet) of sand (McAvoy and McAvoy 1997:167). If the radiocarbon assays from Cactus Hill and Meadowcroft accurately date the respective artifact assemblages, a hypothesis which is supported by pedological analysis at Cactus Hill (Wagner and McAvoy 2004), the lithic technology of Pre-Clovis peoples appears qualitatively different from that of Clovis peoples.

2. Paleoindian (ca. 11,500 to 10,000 B.P.)

King’s (1994) interpretation of pollen cores from ponds and bogs in eastern Pennsylvania provides a broad picture of changing vegetation communities from the Late Glacial (15,000-10,000 B.P.) to the Late Holocene. During the Late Glacial period, as early as 14,000 yr B.P., ice had recently withdrawn and sedimentation begun within the Blue Mountain Section. Based on data collected from Tannersville Bog, the area was a sparsely vegetated, treeless landscape with pioneer herbs, among which sedges may have been especially prominent. Within the Delaware Valley, much contrast exists between the development of the Upper, Middle, and Lower Delaware Valley, as evidenced by studies conducted at Tannersville Bog and Longswamp. At Longswamp, outside the glacial limit, grass and tundra plants dominate. At Tannersville, on the outermost Wisconsin moraine, sedge-dominated communities prevail. The presence of areas of impeded drainage, created by the presence of the raw moraine, exposed rock, and buried ice mass, created favorable conditions for growth of sedges. However, the drier moraine surfaces of the uplands may have taken some time to be colonized. New plant associations evolved in the area from vegetation south of the glaciated region. In contrast to the deglaciated region, the periglacial area had experienced a long period of stable climate and soil to which plant communities had adapted, creating a tundra zone within 45 to 100 kilometers (30 to 62 miles) of the ice front. By this time, the unglaciated region had a developed drainage system and probably lacked large swampy areas in which sedge-dominated communities could develop. By 13,300 yr B.P., an increased presence of spruce, juniper, and aspen pollen mark the stabilization of slopes around the TannersvilleBog (Watts 1979). After 12,000 B.P., eastern Pennsylvania supported a mosaic of boreal-like forests, open habitats where willow and alder were present, extensive wetlands, and areas of grassland. Throughout the latter part of the Late Glacial, the stable yet cold Polar Frontal Zone was present over Pennsylvania, which promoted the closing of boreal forests that is suggested by pollen data from Tannersville Bog, Panther Run, and Bear Meadows (Delcourt and Delcourt 1994). Minor deciduous components were present in these Ridge and Valley settings by ca. 10,000-9,000 B.P., which may imply that Blue Mountain settings would have also contained deciduous elements.

Pennsylvania experienced the most dramatic changes in faunal composition toward the end of the Late Glacial period. Prior to this transition, faunal communities were characterized by the association of species that are now either extinct, or regionally extinct, with those that have persisted into the modern period. Thirteen mammal species that became extinct during the Late Glacial have been recovered from Pennsylvania paleontological sites. In addition, ten mammal species were present in the Late Glacial that occupy more northerly or westerly ranges today, the most economically important of which may have been caribou (Toomey and Fay 1994: 25- 26). The co-occurrence of these species has been termed "non-analogous" and the most common explanation advanced for this situation is decreased seasonal variation during the Late Pleistocene (Lundelius *et al*. 1983). The variety of Pennsylvania's Late Glacial fauna also suggests a mosaic of ecological settings that included grasslands, deciduous and boreal forests, and tundra-like habitats (Toomey and Fay 1994), which compliments environmental reconstructions based on pollen frequencies.

Paleoindian sites are most commonly identified by the presence of distinctive, fluted bifaces. Other parts of the toolkit include formal flake tool types and large bifacial cores. In general, Paleoindian toolkits are marked by a conspicuous use of high-quality cryptocrystalline lithic materials that often originate at considerable distances from their point of discard. The former characteristic is inferred to result from a need for durability over numerous episodes of intensive use at locations distant from sources (Goodyear 1989), while the distances from sites to sources have been used to estimate maximum travel distances ranging from 75 to 400 kilometers (47 to 250 miles) for eastern North America (Custer and Stewart 1990). Carr and Adovasio (2002) note that while western fluted point occupations are often associated with the remains of extinct megafauna, eastern Paleoindian subsistence is more poorly understood. As discussed below, a mosaic of environments would have been available to Paleoindian groups, including wetlands, closed coniferous forests, and restricted patches of mast-bearing species. Paleoindian toolkits do not include the specialized tools for plant processing that became common during the Archaic period, a fact that has been interpreted to signify limited reliance on gathered foodstuffs. A greater emphasis on hunting has also been proposed on theoretical grounds (Kelly and Todd 1988, Waguespack and Surovell 2003).

Nevertheless, fruit seeds and fish remains from Shawnee-Minisink suggest that more generalized foraging adaptations were practiced (Dent and Kauffman 1985). The Paleoindian artifact assemblage from Shawnee-Minisink is also instructive in that 91 percent of the lithic artifacts are composed of locally available black chert (Marshall 1985). These characteristics support Dent's observation that Paleoindian adaptations were likely to have been highly variable within the eastern United States (2002). Currently, Shawnee-Minisink has the distinction of having produced the only radiocarbon assays for a Paleoindian component in the Delaware drainage, as well as one of the earliest and most accurately dated Clovis assemblages in the East. A date of 10,590 ± 300 B.P. was secured on wood charcoal from a hearth excavated by Kline, and a date of 10,750 ± 600 B.P., also from wood charcoal derived from a hearth, was returned on American University's excavations at the site (McNett 1985:87). A date of 10,940 ± 90 B.P. was received on archival hawthorn plum seeds from one of the Paleoindian hearths originally excavated by Kline in 1972 (Dent 1999 and 2002:55-56). Since 2003, new excavations have been conducted at the Shawnee-Minisink site (Gingerich 2004, 2006a, 2006b, 2007a, 2007b), yielding over 15,000 new artifacts, including one new fluted point, over 60 scrapers, 15 cores, and numerous utilized flakes. The most recently reported dates of 10,820+/-50, 10,915+/-25, and 11,020+/-30 radiocarbon years ago, were received from hawthorn seeds from an excavated hearth. These dates correlate well with the assays run by Dent and provide a mean age of 10,935+/-15 RCYBP for the Clovis occupation of Shawnee-Minisink (Gingerich 2006b, 2007a, 2007b; Gingerich and Waters 2007). Research regarding the functional interpretations of the site and the site use are still ongoing. Initial interpretations indicated that the site represented a single intensive occupation. However, high scraper counts coupled with vertically separated artifacts and features provides evidence that the site was reoccupied. Additionally, the density of artifacts in a newly identified activity locus indicates that the site consists of several discrete areas with intensive Paleoindian activities (Gingerich 2007a). Recent explorations on Hendricks Island in the Middle Delaware Valley have encountered deep sediments with soil development similar to the Paleoindian sediments at Shawnee-Minisink. However, deposits remain undated (Stewart 2005). Other notable Paleoindian sites in the Delaware drainage include Plenge (Kraft 1973) and Zeirdt (Werner 1964).

Within the Upper Delaware Valley, north of the Delaware Water Gap, few Paleo-Indian/Early Archaic sites and isolated surface finds have been excavated in Pennsylvania and New Jersey (Custer 1996; Kraft 1977:267; Kinsey 1972:446-447). Sites within the Upper Delaware Valley show the use of predominantly floodplain settings in the form of small repeatedly reoccupied base camps. Some limited Paleo-Indian use of upland settings, including lakes and bogs, have been identified away from the Delaware River, as indicated by isolated fluted point finds at two upland sites in Pike County (36PI7 and 36PI103) and by multiple fluted point finds at the

Tobyhanna Creek site in Monroe County (Kraft 1977:267; Custer 1996:115). Carr and Adovasio (2002:36) provide data indicating that upland/interior locations in the Delaware drainage comprise only three percent of Paleoindian sites, as 97 percent of all Paleoindian sites are located on the floodplains and higher terraces of the Delaware River or its major tributary streams. This indicates that Paleoindian/Early Archaic groups in the Upper Delaware Valley utilized both floodplain and upland resource zones and may have undertaken seasonal movement between zones (Custer 1996:114-115).

Intact Paleoindian sites and fluted point findspots within the Middle and Lower Delaware Valley of the neighboring Great Valley Physiographic province are similarly sparse. None have been extensively tested or excavated and very few have been fully published. The Wilhiem site (36LE93), located near the confluence of two intermittent Susquehanna drainage streams at the northern margin of the Great Valley, was tested by Witthoft (1952). The site appears to be unstratified, and produced a small number of fluted points and distinctive flake tools. The Poirier site, located in the middle Delaware drainage, produced at least six fluted points and more than 100 flake tools from surface collections. Although the overwhelming majority of fluted points from this site were manufactured on cherts identified as Onondaga and "Coxsakie" cherts, most of the flake tools appear to have been manufactured from what may be local chalcedony (Fogelman and Poirier 1990).

Carr and Adovasio (2002:36) indicate that the settings of Paleoindian sites in the Susquehanna and Delaware River Valley differ from Great Valley sites. Reported fluted point find spots in the Great Valley appear to be associated with sinkhole complexes, springs, and low-order streams, as well as Hardyston Jasper quarries at the southern margin of the Great Valley (Hatch 1993:33, Table 4.1; Custer 1996:126). Great Valley Paleoindian sites are present at higher-elevation settings, are located at greater distances from large stream confluences, and are more often associated with lower-order streams than sites of other time periods. In terms of general aspects of the settlement pattern, Carr and Adovasio suggest that Custer *et al*'s (1983) cyclical settlement pattern model best explains the high frequencies of jasper on Paleoindian sites in the Piedmont, while a serial settlement pattern may apply to those in areas that were more directly influenced by glaciation (2002:41-42) like the Upper Delaware Valley.

3. Early Archaic (10,000 to 8,500 B.P.)

The Early Archaic period (10,000 to 8,500 B.P.) is not well represented in the Delaware Drainage overall (Carr 1998a, Carr and Adovasio 2002), and this summary necessarily draws on data from excavated sites in the greater Middle Atlantic region. This cultural period generally coincides with the early Holocene environmental period (10,000-8,000 B.P.). As the Laurentide ice sheet further decreased in size during the Early Holocene, zonal flow from the warm, dry Pacific Airmass dominated Pennsylvania's climate, and restricted intrusions of the Maritime Tropical Airmass. The result was the gradual replacement of boreal elements in lowland settings by oak-hemlock forests, although mixed conifer-hardwood forests and spruce-fir forests would have still been present at progressively higher elevations. This transition was probably complete by the beginning of the Middle Holocene (8,000-5,000 B.P.) (Delcourt and Delcourt 1994: 13). The Early Archaic period was initially designated by researchers based on exploratory excavations at such sites as St. Albans (Broyles 1971), Doershuk (Coe 1964) and Icehouse

Bottom (Chapman 1977). Projectile point types such as Charleston, Amos, Kessel, Palmer, and Kirk (stemmed and notched) are diagnostic of the period. The work of William Gardner and his students on the Thunderbird Complex sites indicated that a chronological sequence similar to that seen at southeastern and mid-continental sites characterized the Early Archaic in Virginia's Shenandoah Valley. Plant food collection and processing is thought to have taken up a larger percentage of the subsistence activities of these groups and contributed a substantially larger part of the diet than during the Paleoindian period (Meltzer and Smith 1986). Botanical data from Early Archaic contexts at the Shawnee-Minisink site suggest that a wider variety of floral species was utilized (Dent and Kauffman 1985). Pennsylvania's Early and Middle Holocene fauna is known only from three sites (Hosterman's Pit, Meadowcroft Rockshelter, New Paris #3), and although the assemblages are not large or diverse, they do not contain species that were not present in the Historic period, with the exception of red fox and opossum (Toomey and Fay 1994: 35). Fauna from these periods suggest that deciduous woodland conditions prevailed in Pennsylvania; open-habitat and boreal species are rare or absent in these few assemblages (Toomey and Fay 1994: 36). The addition of chipped stone adzes, drills, and significant numbers of cobble tools to Early Archaic toolkits serve as proxy data for a greater diversity of subsistence and maintenance activities during the period.

Sites with stratified Early Archaic components in the upper and middle Delaware drainage include Shawnee-Minisink (McNett 1985), Harry's Farm (Kraft 1975), and Sandts Eddy (Bergman *et al*. 1994). At Shawnee-Minisink, two early Archaic components were recognized. The older of the two, termed the "Early Early Archaic" component is undated, and no intact features were encountered (McNett 1985:101). Flake tools were generally larger and appeared to display more expedient approaches to their manufacture than those recovered from the Paleoindian component. This component yielded a single complete, broad-bladed, corner notched projectile, termed the Kline point. No features were associated with the upper Early Archaic component at the site, however, cross-dating of recovered projectile types with those for which radiocarbon dates were available led McNett to suggest a range of 9,000 to 8,000 B.P. for this series of occupations (McNett 1985:105-107). Lithic raw material frequencies for both components indicate a continuation from the preceding Paleoindian component of the predominant use of locally available black flint, however, the proportion of tools manufactured on jasper, exotic flints, and argillite increases (Evans 1985, McMillan 1985). Drills, perforators, and cobble-based tools make their first appearance in the Early Early Archaic component (McNett 1985).

Radiometric dating of early sites in the upper and middle Delaware has yielded somewhat problematic results. The Early Archaic component at Harry's Farm (Zone 8) is dated to 7,320±120 B.P. and displays higher artifact diversity than those recovered from Shawnee-Minisink (Kraft 1975:9). Zone 8 produced a Kirk-like projectile in association with large quartzite flake tools and cores, battered and pitted cobbles, and netsinkers (Kraft 1975). The association of a Kirk-like projectile with a Middle Archaic date has led some researchers to consider the date to be too late (Custer 1996:114, Stewart and Cavallo 1991:24). Alternatively, Kirk-like points could have a longer history of use in the upper Delaware. The Early Archaic component at Sandts Eddy produced one date of 9,420 ± 90 B.P. on wood charcoal from a hearth in Stratum XI, which is stratigraphically consistent with other dates from the site (Bergman *et al*. 1994:165-166). The hearth was in apparent association with a Lecroy projectile and chert biface thinning flakes, thus raising the possibility that bifurcate-base points span the Early and Middle

Archaic periods as currently defined by Carr (1998a, b), Gardner (1989), and Stewart and Cavallo (1991). The association could also be the result of soil deflation/erosion of an Early Archaic site that was re-occupied by bifurcate-using groups. The Upper Shawnee Island Site (36MR45), also identified by Kline, is located approximately 2 km upriver from the Shawnee-Minisink Site. Early Archaic deposits, including a hearth, jasper debitage, and a hammerstone or nutting stone were encountered. The excavated hearth yielded a radiocarbon date of 7,380B.C.+/-545 (9,330+/-545 B.P.). However, due to the lack of recovered temporally diagnostic points from this feature, the date cannot by corroborated by lithic technology. Due to limited excavations at the site, little information can be provided regarding Early Archaic activities beyond the exploitation of non-local jasper and use of floodplain environments (Custer 1996:113-114).

Carr's analysis of lithic types represented by diagnostic Early Archaic projectile points indicates that jasper point frequencies decline from Paleoindian levels, while rhyolite makes its first appearance as a raw material for point production in the Delaware drainage (Carr 1998a:56). The retention of high-quality lithic materials at slightly lower levels than in Paleoindian assemblages led Carr to suggest that Early Archaic settlement systems in the Delaware drainage may have become more serial in focus. Alternatively, undiscovered base camps may have been focused near quarries (Carr 1998a:56-57). Carr’s Early Archaic projectile sample is limited to eleven specimens; and inferences regarding the entire settlement system made from this small data base are premature. Carr also uses PASS file data to investigate differences in site locations between Early Archaic sites and those of other periods. He sees a drop in the use of riverine settings and a lack of patterned use of different topographic settings by Early Archaic peoples in comparison to earlier Paleoindian groups and later bifurcate-using groups, attributing the difference to rapid environmental change during the Early Holocene (Carr 1998a: 58-59). In general, Carr feels that there are sufficient similarities in settlement patterning and lithic preferences to include Early Archaic groups in an "adaptive pattern" similar to that of Paleoindian groups, the primary difference between the two being the less riverine-oriented site preferences exhibited during the Early Archaic. Carr is in agreement with several authors (Custer 1996, Gardner 1989, Geier 1990, Stewart and Cavallo 1991) that greater organizational differences existed between Early Archaic groups and those of the Middle Archaic period than with the preceding Paleoindian period.

4. Middle Archaic (8,500 to 5,000 B.P.)

Reported Middle Archaic sites in Pennsylvania are more numerous than either Early Archaic or Paleoindian sites. This cultural period tracks the mid-Holocene transition to predominantly deciduous forests, which is attributed to a change from warm and dry conditions during the Pre-Boreal and Boreal climatic periods to warmer and wetter conditions during the Atlantic climatic period (Davis 1983, Delcourt and Delcourt 1994, Vento and Rollins 1990). The most widely accepted explanation for the shift in climate, proposed by Knox (1983), has to do with the final ablation of the Laurentide ice sheet. By 6,000 B.P, the glacier was restricted to a small portion of Quebec Province (see maps in Jacobsen *et al*. 1987). Zonal flow from the Pacific Airmass was weakened, allowing the penetration of polar and tropical systems into the Midwest and Middle Atlantic. Regardless of the causes of vegetation change at the Early to Middle Holocene transition, the development of predominantly deciduous forests by 8,000 B.P. would have had obvious consequences for Pennsylvania's natives. Delcourt and Delcourt (1994) indicate that chestnut, hickory, and beech were present in the Commonwealth's forests by ca. 6,000 BP. The increases in mast-producing species would have resulted in larger terrestrial game populations, provided greater subsistence security, and opened avenues for increased sedentism.

The majority of the Middle Archaic sites recorded in the PASS files were dated on the basis of the recovery of bifurcate-based points (Carr 1998b). Dates associated with bifurcate types in the Middle Atlantic region generally range from ca. 8,500 to 8,000 B.P. Bergman *et al*. (1994) suggest that sites from later in the Middle Archaic period are under-represented. Custer (1996) has argued that this may be due to archaeologists' inability to differentiate Late and Middle Archaic sites on the basis of projectiles collected from surface sites. With the spread of mast-bearing trees into interior areas, it appears that Middle Archaic groups relied more heavily on upland areas for subsistence, as indicated by the occurrence during the period of small procurement camps and base camps in interior settings (Carr 1998b, Custer 1996). Stewart and Cavallo (1991) report that site locations indicate that there was a significant focus on varied interior and riverine wetland environments.

Custer (1996) lists the following additional trends for the Middle Archaic in southeastern Pennsylvania and the Delmarva Peninsula: (1) a greater diversity of tools-particularly heavy woodworking tools, suggesting a wider range of tasks and (possibly) localized forest clearance, and the appearance of ground stone tools, indicating the increased use of plant food resources and the greater availability of edible plant species; (2) flake core as opposed to biface core technology, possibly indicating more expedient approaches to tool production and use; and (3) wider range of raw materials utilized, suggesting the localization of lithic catchments and perhaps smaller territories. Custer's reconstruction of settlement patterns includes base camps occupied seasonally by small family bands and ephemeral procurement camps characterized by few artifacts and a limited number of tool types (1996: 153-155, 159-162). The repeated use of a specific landform is a common pattern in the southern portion of the Middle Atlantic, but the occupations do not often overlap, which is substantially different from the Late Archaic pattern of dense, overlapping occupations over a broad portion of a landform (Stewart and Cavallo 1991, Wall *et al*. 1996).

The trends highlighted by Custer (1996) are represented in the Delaware River Valley in Stratum IX at the Sandts Eddy site. Two radiocarbon dates of 7,330 ± 60 B.P. and 7,080 ± 70 B.P. were returned on carbonized hazelnut shells and an unspecified charcoal sample from Stratum IX (Bergman *et al*. 1994:164). These dates are associated with a lithic assemblage that includes few bifacial tools, although the debitage suggests that these were present. Cortical surfaces on chert debitage suggest that some of this material was collected in cobble form from the river while jasper was transported to the site from primary or near-primary sources. The majority of the lithic assemblage, however, is composed cores and debitage of non-cryptocrystalline materials such as quartz, quartzite, conglomerate, sandstone, sub-graywacke, and granite, along with cobble-based tools on these same materials (Bergman *et al*. 1994). All of these latter materials could be collected from the bed and banks of the Delaware River. The behaviors represented in the Stratum IX occupation appear to have been focused on nut processing, the creation of heavy cutting and chopping tools, and the manufacture and maintenance of bifacial tools. Spatial patterning and artifact densities suggest short-term use of the site by small foraging groups (Bergman *et al.* 1994:167-168).

Middle Archaic components have also been reported at Shawnee-Minisink (McNett 1985; McMillan 1985), Faucett (Kinsey 1975), and Upper Shawnee Island (Stewart et al. 1991) within the Delaware River Valley (Custer 1996). Though excavations at Upper Shawnee Island were very limited, a hearth containing fire-cracked rock was encountered, which appears to date stratigraphically to the Middle Archaic (Stewart et al. 1991). Excavations at the Faucett Site encountered multiple Middle Archaic deposits, both of which contained pre-contact features and lithic material. The later and more extensive component yielded three Vosburg points, three "ovate knives," two "choppers or teshoas," one pitted hammerstone, and 198 pieces of debitage (Kinsey 1975: Table 29). The Middle Archaic occupation was determined to represent a briefly exploited small base camp. Two Middle Archaic components were excavated at the Shawnee-Minisink Site (McMillan 1985). The first occupation (Locus 4) yielded an argillite Kanahwa point. Based on the recovery of additional chipped cobble tools, hammerstones, flake knives, scrapers, and singular examples of a wedge, perforator, and spokeshave, McMillan has formed the opinion that bipolar lithic reduction was utilized during this occupation along with hide processing and woodworking (McMillan 1985). The larger Middle Archaic component (Locus 5) also provides evidence for the use of bipolar reduction technology, with anvils and hammerstones found within lithic reduction areas. However, McMillan (1985:313) notes that it is unclear whether the tool manufacturing areas and other work/activity areas represent separate occupations, or if they represent activities areas within a single occupation. Due to the wide variety of tool types present at the site, it is likely that both Middle Archaic occupations are base camps (Custer 1996).

Middle Archaic components postdating ca. 7,000 B.P. are rare in the Delaware River Valley and the Middle Atlantic, however evidence from stratified sites in the central Susquehanna River Valley suggest that stemmed projectiles (Neville and Stanly types) had replaced bifurcate forms by this date and were followed by side- and corner-notched types (i.e. Otter Creek, Brewerton Series, Vosburg), some of which were used well into the Late Archaic (Custer *et al*. 1994, 1996, East *et al*. 2002, Hart 1995, Wyatt *et al*. 2005). These types have also been recognized on surface sites in the eastern Great Valley and Delaware River Valley. Triangular projectile/knife forms may also be part of late Middle Archaic though Late Archaic toolkits in both areas. Excavations at 28Me1-D recovered triangular projectiles/knives in strata dated between ca. 4000 and 5500 B.P. and in underlying strata that may date as early as 6,500 BP (Stewart and Cavallo 1991:25, Wall *et al*. 1996). This early temporal estimate is supported by the recovery of three triangular bifaces from the upper Bt horizon at Oberly Island in stratigraphic association with non-feature charcoal dating to 6,340 ± 70 B.P. (Siegel *et al*. 1999:40).

5. Late Archaic (5,000 to 3,000 B.P.)

Most of the recorded Archaic sites in the state of Pennsylvania are attributed to the Late Archaic period (5,000 to 3,000 B.P.). This period bridges the late Middle Holocene and Late Holocene environmental periods. Perhaps the most significant vegetational change of the Middle Holocene was the catastrophic reduction in hemlock ca. 4,500 B.P. Although Vento and Rollins (1990) indicate that warm-dry conditions associated with the Sub-Boreal climatic period may have been responsible for hemlock decline in the adjacent Susquehanna Drainage, Davis (1981, 1983) attributes the sharp and nearly simultaneous drop in hemlock pollen throughout its range to a possible pathogen or insect attack. More recent paleoenvironmental work in Ontario links the hemlock decline to insect-driven defoliation (Bhiry and Filion 1996). Prior to its recovery nearly 2,000 years later, increased oak, hickory, and beech apparently filled the gap created by hemlock's decline (Delcourt and Delcourt 1994, Fuller 1998). The existence of a return to warm and dry climate ca. 5,000 to 3,000 B.P. (variously called the Xerothermic or Hypsithermal period) is suggested by several Middle Atlantic researchers (Custer 1988, Curry and Custer 1982, Stewart 1990, Vento and Rollins 1990). Custer (1988), in particular, sees the desiccation of upland water sources and forests as causal factors in Late Archaic cultural developments. Curry and Custer (1982) present evidence for increased aeolian deposition at Piedmont and Coastal Plain sites. However, there is at present no compelling evidence to suggest desiccation of upland environments within the Ridge and Valley Province or the adjacent Glaciated Appalachian Plateau. Pollen profiles presented by Watts (1979) for Tannersville Bog and Longswamp show no significant increases in non-arboreal pollen during the interval in question.

Many of the cultural trends seen on Late Archaic sites were apparently based on patterns that were developed during the Middle Archaic period (Custer 1996). Late Archaic sites, generally, display increased use of local lithic resources, greater numbers of cobble-based and ground stone tools, more expedient approaches to lithic technology, and greater use of upland locales. Differences between the two periods are more a matter of scale. Through the Late Archaic period, site size and complexity increase in floodplain and terrace settings along major rivers and tributary streams, the number of features per site generally increases, and the frequency of extensive fire-cracked rock scatters and concentrations (often called platform hearths) in these settings increases, particularly during the interval between ca. 3,800 B.P. and 2,750 B.P. (aka Terminal Archaic after Snow 1980). The pattern of small, spatially restricted activity areas seen during the Middle Archaic gives way to intensively and repeatedly reused locations that are presumed to have functioned as base camps (Custer 1996). These river-proximal locations are complimented by numerous small sites with limited tool inventories in uplands. Although this settlement pattern is similar to that of the Middle Archaic, storage features encountered at a small number of Late Archaic sites (Kraft 1970, McLearen 1991a and b, Wyatt *et al*. 2005) suggests that settlement/subsistence systems were trending towards a more logistical organization (*sensu* Binford 1980) than was the case for Middle Archaic systems. The implications of these trends suggest that Late Archaic territories were smaller, and that population growth continued through the period.

The exchange of non-local lithic materials in the form of partially finished to finished artifacts began in the early portion of the period, but gained momentum and greater intensity from ca. 3,600 to 3,000 B.P. Steatite bowls from southeastern Pennsylvania and eastern Maryland sources were traded into the Middle and Upper Delaware Valley during this interval, as was rhyolite from South Mountain sources in southcentral Pennsylvania and northcentral Maryland. Various authors have proposed that increased regional exchange during the waning years of the Late Archaic was a response to the reduction in the size of resource procurement territories as population density increased. More frequent gift exchange would have served to promote alliances/debt relations between distant social groups that could be used to offset local resource shortfalls (Custer 1988, Stewart 1989). Other positive aspects of more formalized group alliances would have included the transmission of technological, social and environmental information and the ability to adjust group size/composition over a larger spatial scale.

The early Late Archaic cultural sequence throughout the Delaware drainage is signaled by artifacts associated with what Kinsey (1972) termed the "Delaware Valley Archaic Complex". This concept was framed by research conducted on stratified sites in the Upper Delaware in association with the Tock's Island project, primarily the Faucett and Brodhead-Heller sites. It is defined by the Lackawaxen and Macpherson stemmed projectile types, but includes examples of the Brewerton Series. Other portions of the toolkit include adzes, chipped celts, "bannerstones", and large cobble-based flake knives. Features are almost exclusively restricted to small, rock-lined hearths (Kinsey 1972:336). The early end of the time range suggested for the complex was based on a date of 5,180 ± 200 B.P. returned on scattered wood charcoal in association with a Brewerton Eared-Notched point from Faucett. The later end was established on a date of 3,830 ± 120 B.P. on wood charcoal from a hearth at the Brodhead-Heller site. This hearth was in apparent association with Lackawaxen projectiles and was stratigraphically sealed from an overlying Perkiomen component (Kinsey 1972:339). Additional Archaic components have also been encountered at the Padula site (Bergman et al. 1992 and 1994; Weed et al. 1990), Egypt Mills site and Shawnee-Minisink. Although Kinsey suggests that Brewerton Series and Lamoka projectiles were a minor part of the complex, the suite of other Laurentian tradition artifacts are rare in early Late Archaic components, carrying the implication that the Upper Delaware Valley residents were part of a different Late Archaic cultural tradition (Kinsey 1972:337).

Dates of 4,020 ± 180 B.P. and 3,870 ± 70 B.P. were returned on an extensive fire-cracked rock pavement and small pit, respectively at stratified Lower Blacks Eddy site in the middle Delaware drainage (Schuldenrein *et al*. 1991: Table 2 and pp. 64). The rock pavement feature included several projectiles of the Lackawaxen type; however, other rock pavements contained appreciable number of Broadspear forms and featured dates of 3,610 ± 150 B.P. and 3,520 ± 100 B.P. (Schuldenrein *et al*. 1991: Table 2, pp. 64). Establishing the temporal relationship between these projectile types at the site was hindered by low sedimentation rates between ca. 4,000 B.P. and 3,400 B.P. which resulted in a Late Archaic land surface that was open to occupation throughout this interval (Schuldenrein *et al*. 1991:65-66). Nevertheless, the horizontal distribution of these types was largely horizontally non-contiguous, which suggested that they may have been deposited during different occupations at the site (Schuldenrein *et al*. 1991:65-66). Broadspear components were encountered above Lackawaxen components at both Brodhead-Heller and Faucett, indicating that some degree of temporal separation existed between these two projectile traditions (Kinsey 1972). The data from Lower Black's Eddy suggests that the construction of large thermal features associated with intensive food processing may have begun prior to the Terminal Archaic.

It is more certain that the large thermal features (aka "platform hearths") became common during the final centuries of the Late Archaic and the early portion of the Early Woodland period (ca. 3,800 B.P. to 1,750 B.P.) based on data from Brodhead-Heller, Faucett, Peters-Albrecht (Kinsey 1972), Zimmerman (36PI14) (Werner 1972), and the Miller Field site (Kraft 1972, 1975) in the upper Delaware River Valley, and the Lower Blacks Eddy (Schuldenrein *et al*. 1991) and Bachman sites (Anthony and Roberts 1987) in the middle Delaware River Valley. The creation of larger food processing features and a marked increase in net weight counts during the

Terminal Archaic may signal larger group sizes and/or general population growth. With the exception of the Lower Blacks Eddy site, jasper from the Hardyston Formation dominates the chipped stone assemblages of sites during the time frame noted above, and steatite bowls become common after ca. 3,600 B.P. A sequence of broad-bladed projectiles (Snook Kill, Lehigh, Perkiomen, and Susquehanna Broad) are diagnostic of the period to ca. 3,200 B.P.; after this, Orient Fishtail projectiles become the primary diagnostic until ca. 2,700 B.P. Kinsey notes that grit-tempered, cordmarked pottery, as well as Vinette I-like pottery may have been associated with the Orient components at Faucett and Brodhead-Heller (1972:190, 222).

6. Early Woodland (3,000 to 2,000 B.P.)

In comparison to the preceding period, Early Woodland components on excavated sites in the Delaware drainage are rather rare, but enough have been examined to suggest significant differences between the sites and those dating to the Terminal Archaic elsewhere in the Middle Atlantic (Stewart 2003). Regionally, the period is marked by evidence for increased sedentism, burial ceremonialism, and greater use of ceramics. The cyclical re-use of sites appears to continue from the Terminal Archaic; however, evidence for horticulture is sparse (Stewart 2003). Early Woodland diagnostic artifacts include Meadowood, Hellgramite, Adena, Rossville, and other projectile point types, Vinette I, Marcey Creek, and Brodhead Net-Marked pottery, although ceramics from the Early and Middle Woodland periods show great variety in temper and surface treatments. Sites with excavated Early Woodland components in the upper Delaware drainage include Faucett, Brodhead-Heller, Zimmerman (36PI14), and Rosenkrans. Middle Delaware drainage sites include Williamson and Lower Blacks Eddy, while the best known Early Woodland site in the lower Delaware drainage is the Indian Point site on the Schuylkill River.

At Faucett, Meadowood projectiles were recovered above the Orient component, however, many appeared to be associated with the large Orient Phase platform hearth described above. Gorgets, pendants, and caches of unused tools with probable ceremonial value were also recovered. A date of 2,700 ± 100 B.P. was returned on scattered wood charcoal in apparent association with Meadowood “living floor” at the site (Kinsey 1972:191). This date’s overlap with the one secured for the large Orient hearth at the site suggests that these projectile types were at least partially coeval. As noted above, exterior cordmarked-interior smoothed pottery may have been associated with either component. No date was secured on a possible Meadowood component which was stratigraphically superior to the Orient component at the Brodhead-Heller site. Meadowood projectiles in the upper Delaware and Susquehanna drainages are primarily manufactured on Onondaga chert, which led Stewart (2003:12) suggest that blanks and finished Meadowood points of this material were widely traded during the period.

Kinsey places the Bushkill Complex, defined by the presence of net-marked pottery and Rossville projectiles, in the Middle Woodland period based on a date of 2,430 ± 80 B.P. at the Miller Field site (1972:367). A discussion of this phase/complex is included here based on our more arbitrary date for the onset of the Middle Woodland period. Kinsey’s periodization of the Middle Woodland was made in light of the earliest dates for mound construction in the Ohio Valley, while ours is more heuristic, seeking to evenly divide the time span between ca. 3,000 B.P. and 1,150 B.P. The Faucett site yielded no hearth or pit features that could be conclusively linked to the Bushkill component at the site. Nevertheless Kinsey notes that artifacts diagnostic of the component were extensive across the site, and that an oval postmold pattern ca. 2.3 by 2.8 meters (25 by 30 feet) is likely associated with this component (Kinsey 1972:366-368).

The Rosenkrans site is an Early Woodland cemetery located on a bluff above the Delaware River on the New Jersey side of the Wallpack Bend. Twelve graves were excavated during the 1940's in a restricted area of the site; flexed, extended, and cremated interments were represented. Together, these graves contained spectacular mortuary offerings that included copper beads, copper pan pipe fragments, block-ended tube pipes, boatstones, and bifaces that most closely resemble Adena types. Ritchie (1994:204) secured a date of 2,560 ± 120 B.P. on wood charcoal from a cremation burial at the site, and Kraft (1976:23) reports a date of 2,400 ± 60 B.P. for an additional cremation burial.

The Williamson site is located on a high terrace of the Delaware River near Frenchtown, New Jersey in the Piedmont. The Early Woodland component here, with dates ranging from 3,210 B.P. to 2,740 B.P., is marked by good stratigraphic separation from an overlying Middle Woodland component (Hummer 1991:143-146). The primary projectile point type is the Hellgrammite, although several other generalized side-notched forms co-occur. Ceramics include Vinette I and Marcey Creek. Spatial analysis indicates four discrete, non-overlapping activity areas, each with an essentially redundant set of feature types which included shallow hearths and pits, and four to five large fire-cracked rock features (Hummer 1991:148). Hummer interprets the site as a series of seasonally occupied base camps. The high density of features within the site, and the abundance of pottery vessels indicate a continuation of increasingly intensive utilization of floodplain locations that appears to have begun in the closing centuries of the Late Archaic (Hummer 1991:148).

Unlike the underlying Late Archaic component, the Early/Middle Woodland component at the Lower Blacks Eddy site does not appear as intensive or functionally diverse (Schuldenrein *et al.* 1991). Nevertheless, four cylindrical pits encountered at the site are similar in form to Late Woodland storage pits, possibly indicating an increased investment in delayed subsistence return. The authors propose that these features may constitute food caches that were used by people whose base settlements were located elsewhere, with the caches being used during forays in the vicinity of the Lower Blacks Eddy site. Early and Middle Woodland occupations were not stratigraphically separated at the site, and radiocarbon determinations range between 2,540 B.P. and 1,620 B.P. (Schuldenrein *et al.* 1991:43).

Perhaps the best evidence for increased sedentism in the lower Delaware drainage comes from the Indian Point site, located on a bluff formed by a bend in the Schuylkill River near Phoenixville (Kingsley *et al.* 1990). Three feature clusters were identified at the site after mechanical plowzone removal. Two of the feature clusters each contained large oval depressions that were interpreted as prepared living floors, possibly representing the substructure of houses. All feature clusters contained hearths and basin-shaped features of unknown function. Although radiocarbon assays were not entirely consistent within each of the feature clusters, a range from 2,430 B.P. to 1,930 B.P. was returned on two feature dates from Feature Group 1, while an earlier range from 2,550 B.P. to 2,180 B.P. was returned on two feature dates from Feature Group 2. Pottery associated with each feature group was dominated by Vinette I-like, interior/exterior cordmarked, quartz tempered sherds (Kingsley *et al.* 1990:102-105). Botanical remains indicate summer through early fall occupations (Kingsley *et al*. 1990:108-109). Although the authors feel that the clusters represent brief occupations by small social units, the presence of prepared living floors which may have been house substructures are the first substantial indication of semi-permanent encampments within the lower Delaware drainage.

7. Middle Woodland (2,000 to 1,000 B.P.)

Few excavated examples of Middle Woodland sites are known for the upper Delaware drainage, inhibiting the construction of even rudimentary model of settlement/ subsistence systems (Stewart 2003). The initial part of the period (2,000 to 1,500 B.P.) in the Ridge and Valley is primarily represented by Fox Creek projectile point types and Point Peninsula series ceramics, while diagnostic artifacts for the entire period in the Coastal Plain include Fox Creek projectiles and cordmarked, shell-tempered Mockley pottery. Interior adaptations are poorly understood, however much better data exists for the Fox Creek phase in coastal areas. Stewart indicates that groups in the middle and lower Delaware drainage were clearly linked to the Coastal Plain pattern of large, multi-seasonal aggregation in areas of high resource diversity most commonly associated with both tidal marshes and non-tidal wetlands at stream confluences with the Delaware River (2003:20). When Fox Creek components are encountered in surface contexts in the Coastal Plain, they are marked primarily by the heavy use of argillite for projectile points, which suggests exchange with groups in the middle portion of the drainage or possibly annual movements which included the middle Delaware drainage. Because the full range of Fox Creek phase site types have not been encountered in the middle and upper portions of the Delaware and Susquehanna drainages, Stewart feels that the few small interior sites recovered in plowed contexts probably represent the interior portion of the settlement system of groups based largely in the Coastal Plain (2003:20-21).

In the upper Delaware, the dominant late Middle Woodland cultural expression is referred to as the Kipp Island phase after the type site in central New York (Ritchie 1994), where it is dated between 1,450 and 1,150 B.P. (Funk 1993:206). In the Great Lakes drainages of central New York, sites of this phase include “large, recurrent, semi-permanently occupied camps; small, recurrent seasonal camps, and cemeteries” (Ritchie and Funk 1973:352). Subsistence practices reflect hunting and gathering, although fishing-related sites are the most common habitation sites (Ritchie and Funk 1973:354). Diagnostic artifacts in both central New York and the northern Middle Atlantic include Jack’s Reef Corner Notched, Pentagonal, and triangular points, along with diverse cordmarked, dentated, and rocker-stamped ceramics of the Point Peninsula series (Ritchie and Funk 1973:119,164). Kipp Island phase cemeteries in central New York display great variability in both burial modes and grave goods. The presence of fossil sharks teeth in central New York Kipp Island interments and the concomitant occurrence of Kipp Island-style grave goods in Middle Atlantic coastal plain sites like Island Field suggests that focused (*sensu* Stewart 1989) exchange networks united these areas, especially considering that the scale of mortuary ceremonialism which marks them is not seen in the upper and middle Delaware drainage. No separable late Middle Woodland components were identified by Kinsey during the Tocks’ Island Reservoir Project, although isolated finds of Kipp Island phase artifacts were encountered in plowed contexts at Faucett, Brodhead-Heller, Peters-Albrecht sites (1972:371-373). Middle Woodland components have also been identified at Shawnee-Minisink, Minisink, Upper Shawnee Island, Sandts Eddy, Padula, and Wordsworth sites, as well as quarry site 36MR0123.

8. Late Woodland (1,000 to 400 B.P.)

The Late Woodland is marked by an almost region-wide transition to horticultural practices and a shift to larger, more permanent settlements throughout the Middle Atlantic. In the upper Delaware drainage, settlement in floodplain hamlets began by ca. 1,050 B.P. together with short-term exploitation of upland areas continuing as in previous times. Though there is little information on house types in the region, possible circular houses and longhouse patterns have been found in association with pottery types that are characteristic of the Late Woodland period at the Lee's Terrace site (36PI35), Shawnee-Minisink, and sites in New Jersey. Palisaded villages are unknown for the drainage as a whole (Kinsey 1972:389, Stewart 1993:169). Excavations at the Padula site (36NM15) indicate the predominance of locally exploited chert from eastern Pennsylvania and northwestern New Jersey during the Late Woodland period.
Though a wide variety of lithic raw materials were present at the site, chert was the most heavily exploited (60%). And, though more exotic chert types, such as Normanskill and Onondaga from New York, are present, the chert procurement strategies appear to be based primarily on localized catchments (87%) (Bergman et al. 1992 and 1994). The Pahaquarra/ Owasco phase within the upper Delaware drainage is distinguished by the co-occurrence of Owasco and Clemsons Island ceramics with minor expressions of Bowmans Brook and Overpeck incised types. Occupations at the Smithfield Beach site that contain some mixture of these types yielded dates of 1,020 ± 80 B.P., 890 ± 60 B.P., 760 ± 100 B.P., and 750 ± 60 B.P. (Fischler and French 1991: Table 6-II). Two small, partial house patterns attributable to this phase were also encountered at the Smithfield Beach site (Fischler and French 1991:159-160). Maize is most consistently in evidence after 750 B.P., and squash is present ca. 950 A.D. (Fischler and French 1991:160-161). Ceramic decoration implies extensive interaction with adjacent Owasco, Clemsons Island, and middle Delaware Valley groups (Kraft 1986a). The Intermediate phase is marked by the occurrence of Kelso Corded, Oak Hill Corded, and Bainbridge Linear type pottery, indicating that design preferences first recognized in central and eastern New York State (Ritchie 1994) were common in the upper Delaware as well. Diagnostic pottery of the subsequent Minisink phase also include New York State Iroquoian types such as Chance, Deowongo, Garoga, and Durfee Incised as well the type Munsee Incised, which is considered to represent the initial material expression of groups that would become known as the Munsee (or Minsi) tribe during early European exploration and settlement (Kraft 1986a, Witthoft 1959).

In the middle and lower portions of the Delaware Valley, sites of the early Late Woodland period most commonly contain pottery ascribable to the Overpeck, Bowmans Brook, and Minguannan series, all of which display slightly different arrangements of complex incised or cordmarked decoration. The stylistic differences between these Delaware drainage pottery types and Shenks Ferry types of the Susquehanna drainage have led several researchers to view the former types as cultural markers for proto-Lenape groups (Custer 1987, Stewart 1998). In contrast to early Late Woodland Pahaquarra phase sites in the upper Delaware, Minguannan complex sites of the lower Delaware have not been shown to contain house patterns, storage features, or dense middens. Evidence for Mesoamerican cultigens is limited to finds of squash rind and possible maize kernels at the Pearsall site in Chester County (Hart and Cremeens 1991, cited in Custer

1996:288-289), which is surprising given the horticultural focus established for the Shenks Ferry complex (Kinsey and Graybill 1971, Nass and Graybill 1991). Custer notes that most Minguannan complex base camps are located on multicomponent Late Archaic through Middle Woodland sites, which suggests that these groups were not shifting the focus of their primary settlements towards landforms and soils with high agricultural potential. The implication of these traits is that Minguannan groups continued a hunting and gathering settlement system from earlier times (Custer 1996:287-289). In general, Minguannan complex sites have not been as extensively excavated or radiometrically dated as neighboring Shenks Ferry complex sites. Although Shenks Ferry complex sites are most numerous in the lower Susquehanna drainage, a few of their sites are located farther east in the Piedmont in the Brandywine watershed of Chester County (Custer 1996:286-287).

B. Historic Context

1. Contact Period

During the contact period, Native Americans of the Upper Delaware Valley are referred to as the Munsee. The name refers to both the Minisink descendants as well as emigrants from areas to the south and east displaced by European advance. The Native American groups of the Lower Delaware Valley are referred to as the Lenape or Delaware (Kraft 1986a and 1986b).

Only a few historic Indian towns were present in the Upper Delaware, including Pechoquealin and Minisink. These settlements seem to have been abandoned or had their occupants driven out of the region shortly after European contact. Native American trails extended north and south along the banks of the Delaware River connecting the settlements. Pechoquealin (also Pechoquealing and Shawnee on Delaware), located on the western bank of the Delaware River near the Delaware Water Gap (Kent et al. 1981), was a Shawnee refuge occupied from ca. 1694-1728 (Kent et al. 1981:10). The Pechoquealin Path extends west through Stroudsburg toward Wyoming, now Wilkes-Barre and meets the Minsi Path to the east. The Minsi Path, which leads to Minisink and settlements farther north, was the principal means of communication between groups occupying the Upper and Lower Delaware River Valley and the Hudson River Valley (Wallace 1998).

The participation of these groups in the fur trade appears to have been minimal. The first European settlers in the region were the Dutch. Although some historical documents note trade relations between the Lenape and the Swedes and Dutch, the extent of trade within these groups was marginal when compared to the involvement of the Susquehannocks (Custer 1996:315). Throughout the entire Delaware Valley trade goods produced between 1550 and 1675 are virtually nonexistent (Kraft 1986b:213-214; Custer 1984, 1989). However, amateur archaeologist Don Kline has reportedly recovered a variety of Euro-trade goods from native sites situated closer to the river (R. Michael Stewart, personal communication November 7, 2013).

Nicholas DuPui (also spelled DePue, DePuy, Depew) settled in the vicinity of Shawnee and established a homestead around 1727. During the first half of the eighteenth century Dutch, English and French-Huguenot settlers arrived in the Upper Delaware Valley. Many immigrants arrived in Philadelphia and proceeded along the Delaware and Lehigh Rivers. In 1737 the colonial government of Pennsylvania orchestrated the infamous "Walking Purchase" which resulted in a significant acquisition of land in the Upper Delaware Valley, but also incensed the native population which saw the action as dishonest and furthered disharmony.

During the French and Indian War, the Pennsylvania provincial government established a series of military defenses to protect the frontier. The defensive line was supervised under the direction of Benjamin Franklin. The line of forts extended from present-day Monroe County to present-day Huntingdon County. In Northampton County (which included Monroe County at that time), five forts were established. These included Fort Hamilton, Fort Norris, Fort Hyndshaw,Fort Allen, and DuPui's Fort (Hunter 1960: 214). These constituted the provincial fortifications which were manned by provincial troops. Several private defensive bastions were established in Northampton County, including the private residence of Daniel Brodhead.

During the American Revolution, an additional fortification, Fort Penn, was constructed at the private residence of Captain Jacob Stroud. The purpose of the fort was three-fold: "to operate as part of a line of defense from Indian attack; to function as a depot for military supplies and munitions that were sent from Easton, and to provide a training area for new recruits for the Continental Army" (Leiser 2013).

2. Monroe County

Monroe County was formed on April 1, 1836 from portions of Northampton and Pike Counties. The county was named in honor of President James Monroe. Monroe County currently consists of Barrett Township, Chestnuthill Township, Coolbaugh Township, Eldred Township, Hamilton Township, Jackson Township, Middle Smithfield Township, Paradise Township, Pocono Township, Polk Township, Price Township, Ross Township, Smithfield Township, Stroud Township, Tobyhanna Township, and Tunkhannock Township. The county also contains four municipal boroughs, Stroudsburg Borough, Delaware Water Gap Borough, East Stroudsburg Borough, and Mount Pocono Borough.

The earliest immigrants to the region were German and English. The settlers engaged in agriculture which was supported by the broad valleys, abundant woodland and numerous bodies of water that were capable of providing power to mills. Agriculture and forest products were the main economic forces that encouraged development of the area. Lumber, wood products and tree bark for tanning leather were desirable resources. Textiles emerged as an important industry during the early twentieth century. Tourism and recreation industries developed during the nineteenth century, particularly in the area of Delaware Water Gap. In 1840, the county had a population of 9,879. In 1843, Monroe County was reduced in area by the establishment of Carbon County. By 1860 the population had increased to 16,758 ***(Figure 4)***.

During the late nineteenth and early twentieth centuries, transportation systems in and through Monroe County improved access and eventually attracted tourists to the scenic beauty of the region. The region is home to numerous recreational destinations, including Delaware Water Gap National Recreational Area, Pocono International Speedway, and several state forests and ski resorts. Pocono Mountains developed a tourism industry, beginning with development at Delaware Water Gap. The county is home to East Stroudsburg University and the Monroe

County Campus of the Northampton Community College. The main highway corridors within the county are Interstate 80 (I-80), Interstate 380 (I-380), and State Route 611. The principal population centers are Stroudsburg, East Stroudsburg, Tannersville, Mount Pocono and Delaware Water Gap. By 1970 the population of Monroe County had reached 45,422. The county experienced continued population growth throughout the late twentieth century, reaching 95,709 in 1990. In 2010 Monroe County had a population of 169,842.

3. Borough of Stroudsburg

In 1730, Peter LaBar and his brothers arrived in America from France. The family moved into the interior county and settled in present-day Mount Bethel Township, Northampton County, Pennsylvania. The brothers eventually married and established homesteads for their own families. Peter LaBar relocated to the vicinity of present-day Stroudsburg (Mathews 1886: 1082-1083). Other pioneering families settled in the region. Later, Jacob Stroud purchased a tract of land for development which abutted LaBar's property.

The Borough of Stroudsburg was settled during the late eighteenth century by the Stroud family. Jacob Stroud was born in Amwell Township, Hunterdon County, New Jersey, on January 13, 1735. The Stroud Family settled in Smithfield Township, Northampton County (now Monroe County), Pennsylvania, c. 1745. Jacob was sent to live with Nicholas DuPui, a prominent early settler and land-holder in Shawnee-on-Delaware. Jacob Stroud learned farming as a trade. Around 1756 Stroud enlisted in the English Colonial Army and was mustered out of the army on April 6, 1761. He settled in Smithfield Township and married Elizabeth McDowell, the granddaughter of Nicholas DuPui.

Fort Hamilton, a French and Indian War fort, was established in present-day Stroudsburg and was named in honor of James Hamilton, a prominent Pennsylvania politician and former lieutenant governor (Hunter 1960: 220). The fort was roughly square in shape with the outer walls measuring approximately 80 feet in length. The fort consisted of a log palisade surrounding a blockhouse. Four half bastions, designed to support artillery, were built as part of the fort. The fort was completed in January 1756 and was intended to support approximately 40 men. In June 1756, the fort was occupied by an officer and fifteen soldiers. Several accounts indicated that the fort was not built solidly and was frequently in poor condition. Fort Hamilton was occupied by provincial troops until mid-to-late 1757 and was fully abandoned in 1758. The blockhouse was utilized by members of the community after the evacuation of the provincial troops. By March 1758, the fort had been abandoned and the structure had significantly deteriorated.

In 1769, Jacob Stroud settled in present-day Monroe County. Stroud had previously been engaged in agriculture and transportation. He acquired land and established a homestead and gristmill operation. In 1776, Jacob Stroud, then a Captain in charge of the Lower Smithfield Military Company, was ordered by the executive council of the Commonwealth of Pennsylvania to build a stockade around his stone home. This fortified structure, which became part of Jacob Stroud's command, was called Fort Penn, named for the governor of Pennsylvania, John Penn. Fort Penn did not encounter much activity during the American Revolution. Its most important role was receiving the survivors of the Wyoming Massacre that occurred on July 3, 1778 (Leiser

2013). Though historians do not know the precise location of the fort, nor is there a detailed description of the structure itself, the general place in which Fort Penn stood is identified by a historical marker on the 500-block of Main Street in Stroudsburg. According to the Monroe County Historical Association, the last remains of Fort Penn were washed away in the Flood of 1886 (Leiser 2013).

The Stroud family laid out plans for the town of Stroudsburg in 1810. The site was selected for its location along McMichaels Creek, which provided water-power for industrial use. In 1815, Stroudsburg was incorporated as a borough and in 1836 was established as the county seat of the newly formed Monroe County (Appel 1975: 9). During the 1810s and 1820s several industrial operations were established in Stroudsburg, including a saw mill, tannery, distillery and two gristmills.

During the early to mid-nineteenth century industrial operations expanded within the Borough of Stroudsburg. The borough served as a commercial and governmental center for Monroe County. In 1857, the Stroudsburg Bank was chartered. Other financial institutions followed. The Stroudsburg Woolen Mill was organized in 1865 and employed over 120 workers. During the early twentieth century several silk mills were built, including the Monroe Silk Mills and Pocono Silk Mills (Sanborn Map Company 1930: 6). In 1927, textile firms, including the Thomas Kitson & Son, Monroe Silk Mills, and others, employed over 400 workers in Stroudsburg.

Between 1856 and the 1890s three railroads, including the Delaware, Lackawanna & Western Railroad (DL&W), New York, Susquehanna & Western (NYS&W), and Wilkes-Barre & Eastern Railroad (WB&E), were constructed and provided access to Stroudsburg. These railroad lines improved commerce and encouraged development of the borough. In 1927, the Erie Railroad, with its control of the NYS&W and WB&E, employed over 200 workers at its Stroudsburg operations (Keller 1927: 275-276). In addition, the NYS&W established a major car repair and logistical center in Stroudsburg which employed hundreds of workers. During the early twentieth century an electric street railway was built to link Stroudsburg with the Delaware Water Gap area and its tourism trade.

During the mid-to-late nineteenth century a variety of services were instituted in the Borough of Stroudsburg intended improve the quality of life of its residents. The Stroudsburg Water Company was chartered in 1876. On May 26, 1865 a citizen of Stroudsburg donated 7 acres for a public cemetery (Mathews 1886: 1182). The cemetery was located outside the borough at the time, but has since been incorporated into Stroudsburg. The Stroudsburg Cemetery is situated along the south side of State Route 2004 and abuts I-80. In 1890 the Romanesque-style Monroe County Courthouse, designed by architect T.I. Lacy, was constructed.

By 1868 the community had expanded to a population of approximately 1,600. Stroudsburg continued to experience growth throughout the late nineteenth and early twentieth centuries, due in part to its location along several important transportation corridors, industrial development and its position as the governmental center of the county. On several occasions the borough annexed adjacent lands from Stroud Township ***(Figures 5, 6, 7, 8, 9, and 10)***. During the late nineteenth and early twentieth centuries, the Pocono region developed as a popular vacation destination, and further encouraged growth in Stroudsburg ***(Figures 11, 12, 13, and 14)***.

Tourism has emerged during the twentieth century as a major economic factor for the borough. In 2000, the Borough of Stroudsburg had a population of 5,756.

The APE within Stroudsburg is located in the southeast and southern sections of the borough. The APE is composed of areas historically associated with residential, commercial and industrial development. The vicinity of Palmer Street was historically associated with tannery operations and textile factories, including the Monroe Silk Mills and Pocono Silk Mills. The properties along Ann Street, west of McMichael Creek included several industrial operations, including the NRHP listed Kitson Woolen Mill along Main Street. The Frisbie Lumber Company also maintained a large industrial operation along the south side of Main Street in the vicinity of 4th Street (Sanborn 1930) ***(Figures 1, 6, and 8)***.

The APE contains educational, funerary, and several industrial sites near the intersection of Interstate 80 and State Route 2004. The Stroudsburg Cemetery abuts the I-80 corridor. The B.F. Morey Elementary and Stroudsburg High School (located on the former site of the Monroe County fairgrounds) are located west of downtown Stroudsburg. The former H.B. Marsh & Sons, Inc. complex is situated at the northeast corner of the intersection of I-80 and State Route 2004. The former NYS&W car repair shop and facilities site is immediately south of I-80 along Katz Drive ***(Figure 1)***.

The APE includes residential neighborhoods located south of Interstate 80 and along State Route 191. These residential neighborhoods were established during the late nineteenth century, but were largely developed during the early to mid-twentieth century. Ann Street also displays residential structures built between the mid nineteenth and early twentieth centuries ***(Figure 1)***.

4. Borough of East Stroudsburg

In 1737, Daniel Brodhead III received a patent for 600 acres of land in Bucks County, which would later be developed as East Stroudsburg, Monroe County. Brodhead was a native of New York and among the earliest settlers of the region. Brodhead was politically active and was noted as a prominent supporter of the Moravian church. He died in 1755 and his land passed to his children, Daniel, Garret, Luke and John. The area remained largely agricultural throughout the early to mid-nineteenth century.

East Stroudsburg experienced significant industrial and commercial development during the early-to-mid 1860s, primarily as a result of the construction of the Delaware, Lackawanna and Western Railroad (DL&W) ***(Figure 5)***. The railroad was built in 1856. Industrial operations, shops, and residences were developed along the railroad line following its completion. On May 23, 1870 East Stroudsburg was incorporated as a borough. In 1875, Stephen Kistler operated a large tannery operation in the borough along the DL&W. During the early 1880s a cigar factory, foundry, and silk mill were established in the borough. By 1886 the borough included six general stores, two furniture stores, three hotels, two drug stores, a jewelry store and numerous other commercial operations (Mathews 1886: 1188-1189).

In 1893, the East Stroudsburg Normal School, a private educational institution, was established in East Stroudsburg (East Stroudsburg State College 1968). The first class included 320 students. In 1920, ownership was transferred to the Commonwealth of Pennsylvania and was renamed the East Stroudsburg State Normal School. In 1927, the school was reorganized as the State Teachers College at East Stroudsburg. In 1960, the school became the East Stroudsburg University of Pennsylvania. The institution was officially designated as East Stroudsburg University on July 1, 1983 and is an accredited university offering both undergraduate and graduate degrees (East Stroudsburg University 2014). In 2011, East Stroudsburg University had an enrollment of 7,353.

By 1900 the population of East Stroudsburg stood at 2,648. The population then increased from 3,330 in 1910 to 6,099 in 1930 (United State Department of Commerce 1931: 951). The increase was due in large part to the expansion of the railroad operations and East Stroudsburg University ***(Figures 10, 11, and 12)***. By 1940 the population had grown to 6,404. The borough continued to experience population growth throughout the late twentieth and early twenty-first centuries ***(Figures 13 and 14)***. In 2010, East Stroudsburg had a population of 9,840.

The APE within East Stroudsburg is located in the southwestern portion of the borough. This area experienced limited development during the nineteenth and twentieth centuries. During the mid-nineteenth century the DL&W Railroad was constructed within the APE ***(Figure 1)***.

5. Stroud Township

Present-day Stroud Township was originally settled during the 1750s. This area included the future sites of Stroudsburg and East Stroudsburg. Early settlers included members of the Sly, Keller, Drake, Felker, Frederick, Decker, and Van Vliet families (Mathews 1886: 1123). The region suffered as a result of the French and Indian War, but settlers returned following the conclusion of the hostilities. Fort Hamilton was a prominent military post during this time, situated within the boundary of present-day Stroudsburg. Fort Penn, a Revolutionary War fort, was also located within the boundary of present-day Stroudsburg. By 1762 the first recorded tavern operator, John McMichael, had established operations within Stroud Township. In 1778, John Logan established a second tavern within the township (Mathews 1886: 1134-1135). Early settlers engaged in agriculture; the Cherry Valley, in the southern portions of Stroud Township, proved to be well suited for agriculture.

Stroud Township was formed on January 22, 1817 as part of Northampton County. By 1820 the population had increased to 1,143. The population continued to grow and by 1830 consisted of 1,631 residents, including those residing in Stroudsburg. The township was part of Northampton County until 1836. In 1840, the Stroud Township population was 1,206 (Mathews 1886: 1121). The decrease was due to the organization of the Borough of Stroudsburg. The township is bounded by Pocono and Hamilton Townships to the west, Price Township to the north, Smithfield Township, Stroudsburg, and East Stroudsburg to the east, and Northampton County to the south. Kittatinny Mountain also bounds the township to the south ***(Figure 1)***.

In 1870, Stroud Township had a population of 2,160. The population included 2,032 native born Americans, 128 foreign-born residents, and 38 African-Americans (Beers 1875: 4). In 1875, Stroud Township remained a rural, agricultural community adjacent to the population centers of Stroudsburg and East Stroudsburg. The township benefitted from the construction of the

Delaware Lackawanna & Western Railroad (DL&W) through the township. The village of Spragueville, situated in northern Stroud Township, included a tannery and station along the DL&W (Beers 1875) ***(Figure 7)***. During the mid-to-late nineteenth century the township included several gristmills, sawmills, blacksmith shops, and tanneries (Beers 1875) ***(Figure 9)***.

The Tanite Company of Stroudsburg, Pennsylvania (located in Stroud Township) was one of the most successful companies located in Stroud Township during the mid-to-late nineteenth century. The company was founded in 1867 and produced emery wheels used in the manufacture of stoves, plows, hardware, and cutlery (Appel 1976: 87-88). The company produced a variety of machinery, including polishing machines, grinding machines, metal worker's tools, and emery wheel products (Technical Literature 1907: 391). The facilities consisted of at least four buildings, including a power station and manufacturing plant.

The township experienced continued commercial and residential growth throughout the mid to late twentieth century ***(Figures 13 and 14)***. According to the 2000 census, there were 13,978 people, 5,174 households, and 3,880 families residing in the township (United States Census Bureau 2013).

The APE within Stroud Township is comprised of areas immediately adjacent to transportation corridors along I-80, State Route 611 and US 209. The area was developed during the nineteenth century and includes a mixture of residential, commercial, and industrial properties. An early twentieth century residential neighborhood is situated south of State Route 2012 (Bus US 209) along Sweet Fern Road. A mix of early-to-late twentieth century residential development is located west of US 209 along the State Route 2012 corridor. The State Route 611 corridor includes a mix of early-to-late twentieth century commercial and residential development ***(Figure 1)***.

6. Transportation

The first transportation corridors within present-day Monroe County were established by the native population. Present-day Stroudsburg was situated along the course of the Minsi Path. The path connected the Hudson River and Delaware River, at Philadelphia. The path can be traced through the modern communities of Philadelphia, Bethlehem, and Stroudsburg (Wallace 1998: 102-103). The Pechoquealin Path extended between Shawnee-on-Delaware and Wilkes-Barre (Wallace 1998: 124). During the 1720s the first European settlers began to migrate to present-day Monroe County. The settlers established paths, often expanding existing trails. The earliest roads were crude and little more than bridle paths. In 1725, the first road was petitioned and built by local authorities. In 1737, another road linking the homestead of Nicholas DuPui to William Cole's property was constructed (Keller 1927: 491-492). Additional roads were petitioned and built during the mid-to-late eighteenth century to connect communities like Bushkill, Stroudsburg, and Shawnee.

According to historian Joseph Durrenberger, the era of turnpike construction in the United States occurred during the period between 1800 and 1830. The turnpike road developed in response to the needs for improved internal transportation and communication. By 1821, 146 turnpike companies had been organized in Pennsylvania. This pattern continued into the 1830s, even though railroad and canal building was beginning to take a larger role. The turnpike system, at its peak, has been estimated to consist of approximately 2,400 miles of roadways (Durrenberger 1968). In Monroe County, turnpikes were established between the main population center of Stroudsburg and neighboring communities, such as Scranton, Wilkes-Barre, Honesdale, and others. The routes improved communications and commerce but were eventually supplanted by rail and canal transportation. During the early twentieth century many of the turnpike routes were incorporated into the state highway systems.

The Delaware Lackawanna & Western (DL&W) Railroad was organized in 1853 as the result of the merger of previously existing railroad companies. The DL&W established a 411 mile line between Hoboken, NJ and Buffalo, NY. The railroad passed through the communities of Hoboken, NJ; Delaware Water Gap, PA; Stroudsburg, PA; Scranton, PA; Binghamton, NY; and Buffalo, NY. The line passed through the anthracite coal region of Pennsylvania and became a major transporter of coal ***(Figure 4 and 5)***. The DL&W also benefitted from its location through the Pocono region. The Pocono region became an important tourist destination during the nineteenth century and developed tourist resorts in Delaware Water Gap and other locales. By the 1940s, the DL&W began a period of decline due in large part to increased use of automobiles and a decrease in anthracite coal production. On October 17, 1960, the DL&W merged with the Erie Railroad to form the Erie Lackawanna Railroad in an attempt to stem its lines decline and consolidate resources. The Erie Lackawanna continued to decline and was absorbed by Conrail in 1976.

The New York, Susquehanna and Western Railway (NYS&W), also known as the Susie-Q, operated over 500 miles of track in New York, Pennsylvania, and New Jersey. The NYS&W was formed in 1881 from the merger of several smaller railroads ***(Figure 9)***. In 1898, the NYS&W was leased by the Erie Railroad which valued the company's connections within the anthracite coal mining region of Pennsylvania ***(Figure 10)***. Passenger service between Stroudsburg and New York City began in the fall of 1882 and continued until 1941. The company provided commuter service from Northern New Jersey to New York City until 1966. The railroad was purchased by the Delaware Otsego Corporation in 1980, which conducts operations as an intermodal freight transport business.

The NYS&W Stroudsburg Shops were located south of the Stroudsburg Cemetery and east of State Route 2004 ***(Figure 10)***. The shops included an engineer repair shop, boiler shop, blacksmith shop, casting supply shed, carpenter shop, paint shop and a variety of other support structures (Sanborn Map Company 1930). A car repair shop was adjacent to the rail yard and was a major feature of the facilities. The complex also included a main office, supply buildings, and locker rooms. The facilities included a number of support structures, such as lumber sheds, oil tanks, sand houses, bins, towers, and water tanks. Following the closure of the shops, most of the buildings and track were removed. The I-80 alignment followed the NYS&W right-of-way along the south side of Stroudsburg and within Stroud Township. The shop location is currently occupied as a salvage yard ***(Figures 1 and 10)***.

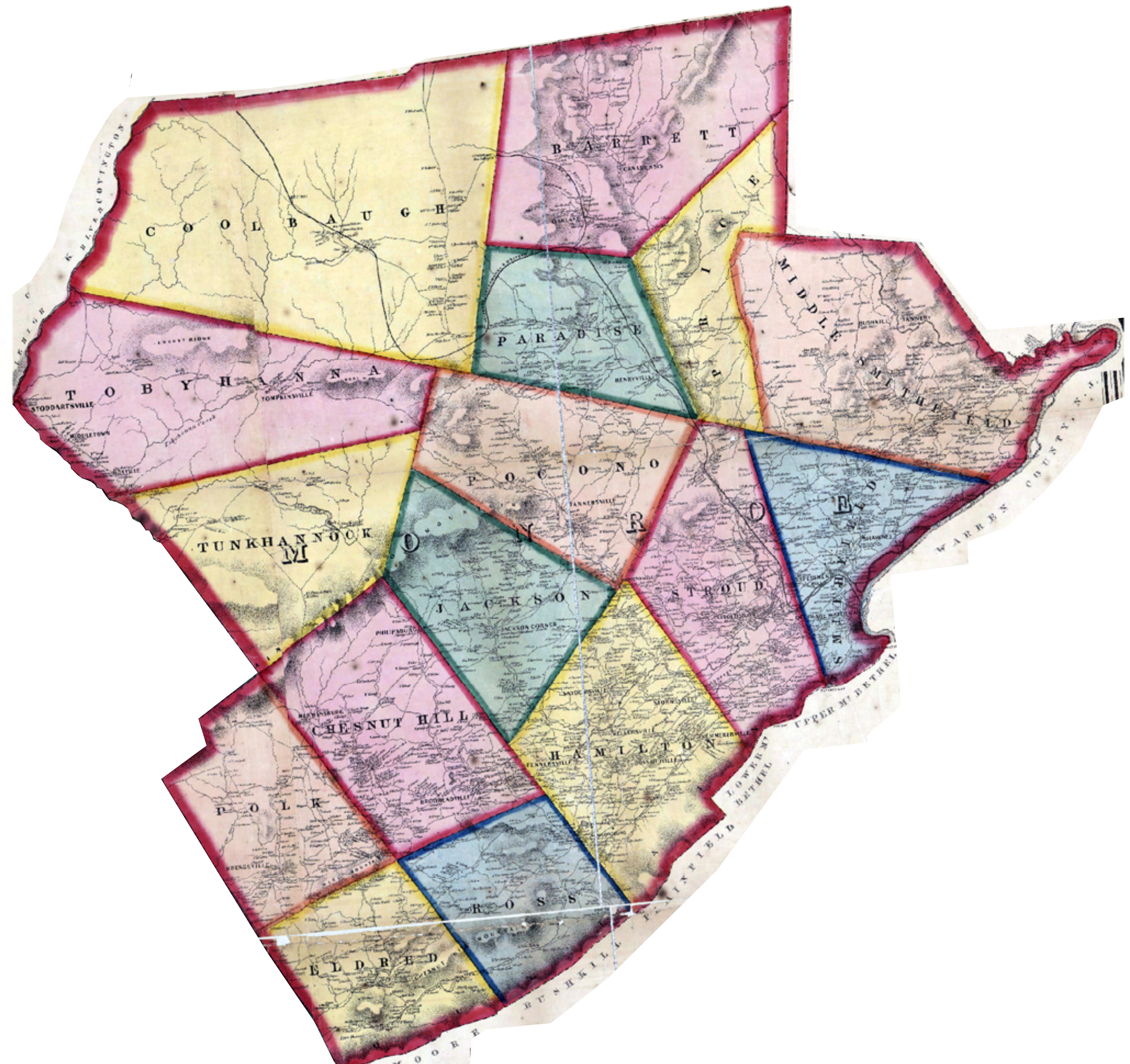
In 1892, the Wilkes Barre & Eastern Railroad (WB&E) was chartered to establish a line to the Scranton area coal fields. The WB&E was a wholly-owned subsidiary of the NYS&W. The NYS&W had previously been dependent upon the Erie Railroad and Pennsylvania Railroad to complete its connection with major distribution centers. The WB&E was intended to be a NYS&W owned connection between the Scranton area coal fields and major distribution points along the east coast. In 1898, the Erie Railroad gained control of the NYS&W and its subsidiaries. Under the Erie Railroad management, the WB&E declined in use as it already maintained connections between the anthracite region and its distribution sites ***(Figure 11)***. The WB&E continued in service until its bankruptcy in 1937. The line was abandoned in 1939. The right-of-way was later incorporated into I-80 during the mid-twentieth century.

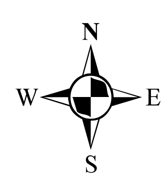
In 1907, a 4-mile street railway line was established in the Borough of Stroudsburg. In 1911, the electric railway was merged with another line to form the Stroudsburg, Water Gap & Portland Railway to create a 10-mile line which provided access to the Delaware Water Gap recreational area from Stroudsburg. In 1917, the company was reorganized as the Stroudsburg Traction Company. In 1925, the company incorporated buses as part of its operations. Increased automobile use challenged the feasibility of continued electric street railway. In 1928, the street railway was abandoned (Hilton and Doe 1960: 301)

During the late nineteenth century a national movement sought to improve the quality of America's roads. Originally supported by bicycle enthusiasts, it was later adopted by automobile manufacturers, tire makers, and the public. The Good Roads Movement supporters advocated for improved roads and lobbied government officials. In 1916, the Federal Aid Road Act was signed into law by President Woodrow Wilson, which ushered in the modern highway system. In 1920, the residents of Monroe County supported a major bond issue to help finance road construction in the county. By 1927, Monroe County had 58 miles of concrete road, 47 miles of bituminous road, and approximately 4,800 feet of brick road (in Stroudsburg) (Keller 1927: 500). Monroe County also had jurisdiction over 35 miles of abandoned former turnpike roads.

Several state routes converged on the Borough of Stroudsburg during the early twentieth century. The borough served as the county seat of government and a regional population center. State Route 164, State Route 165, State Route 168, and Route 169 provided connections with the surrounding communities with Stroudsburg (Benedict 1915) ***(Figure 10)***. Most early highways incorporated and upgraded existing roads and turnpike. Route 168 was later renamed as State Route 611. Route 164 became U.S. Route 209. Both these routes are located within the I-80 Project APE ***(Figure 1)***.

On June 29, 1956, when the Interstate Act was passed, all planning was moved to the Department of Highways. The construction of I-80 began on March 19, 1959 near Corsica. The first section to see construction was from Exit 308 (East Stroudsburg) to Exit 310 (Delaware Water Gap) in 1959; the section opened in 1960 at the same time work began on the section from Exit 70 to Exit 78 ***(Figures 13 and 14)***. However, the first segment of I-80 originally opened in 1953 when the 2,465-foot-long Delaware Water Gap Toll Bridge opened to traffic. I-80 follows the alignment of WB&E Railroad immediately south of Stroudsburg and within the project's APE ***(Figure 1)***.





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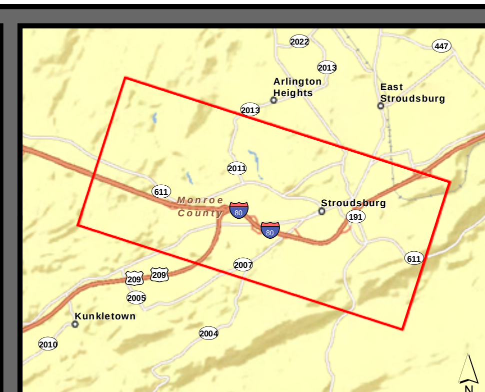


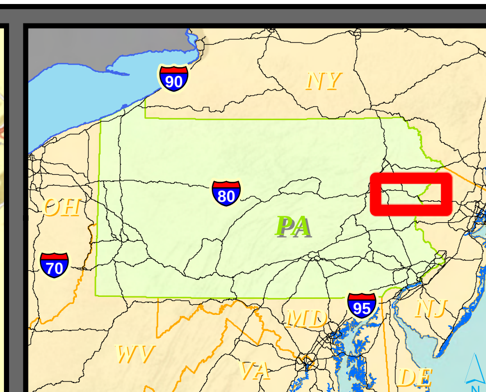
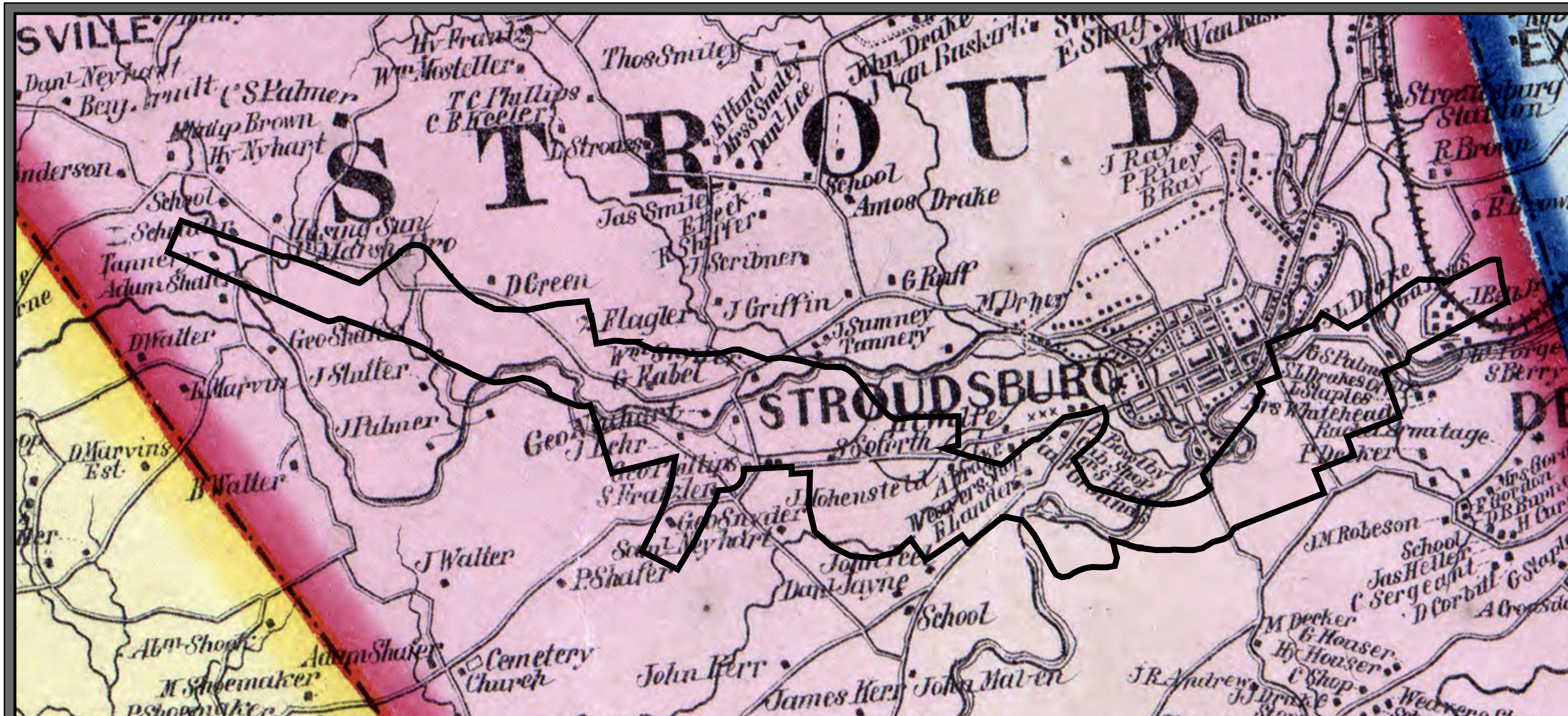


Figure 4: Monroe County, 1860

Pennsylvania Department of Transportation, District 5-0 I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Loomis Way and Palmer, Map of the Counties of Monroe and Carbon, PA, 1860



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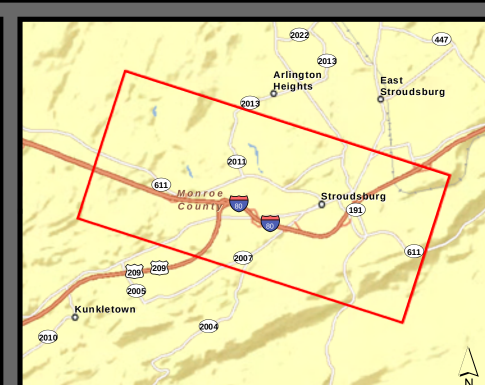

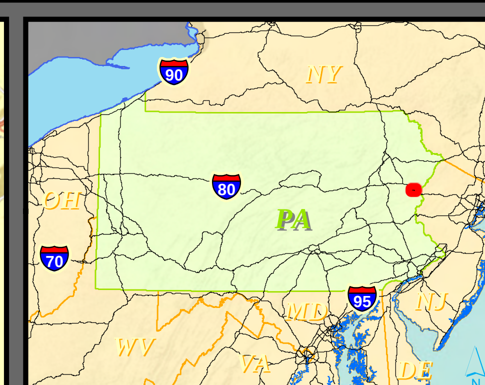

Figure 5: Archaeological Area of Potential Effects in 1860

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Loomis Way and Palmer, Map of the Counties of Monroe and Carbon, PA, 1860

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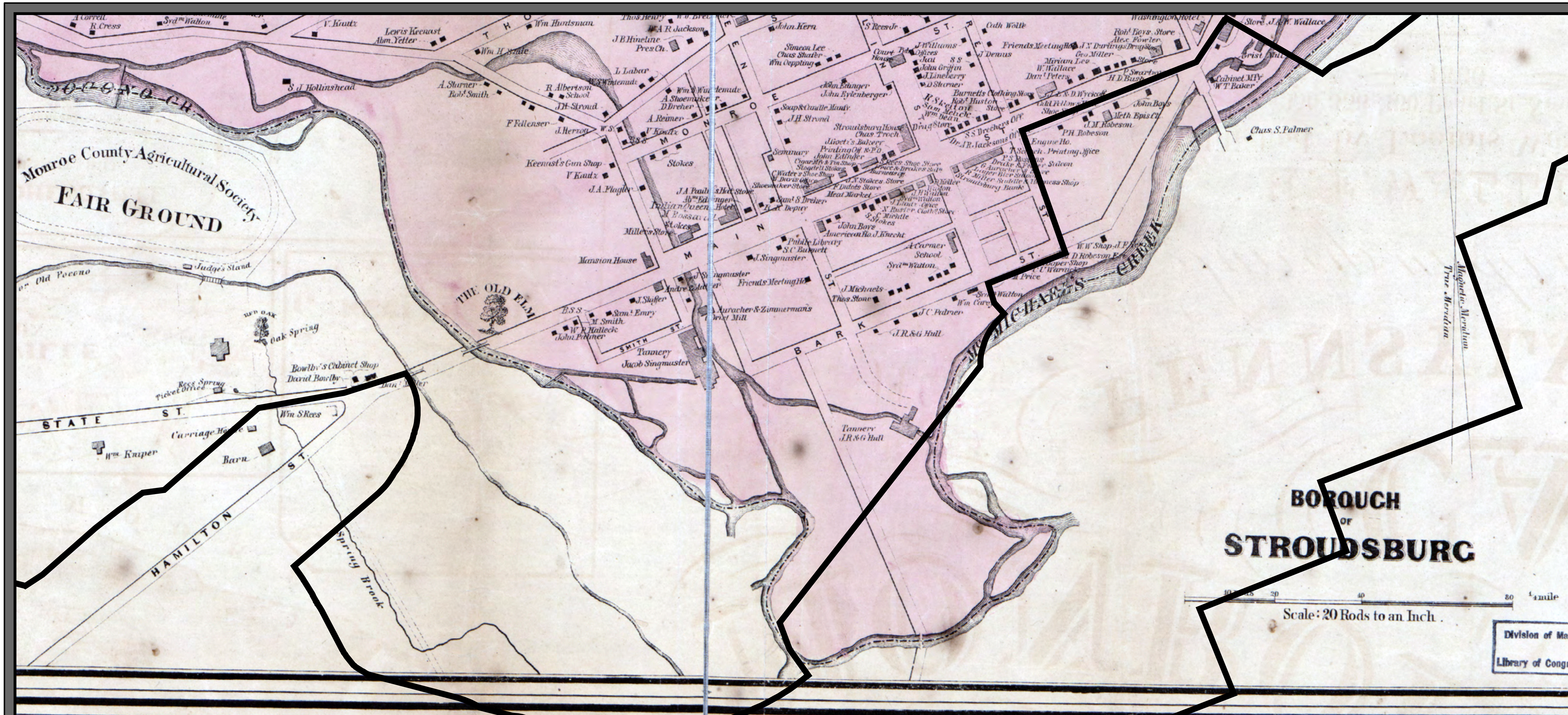

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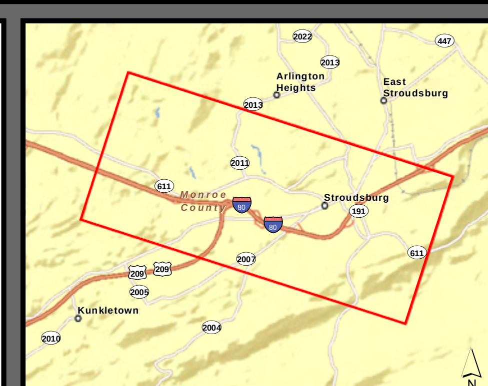


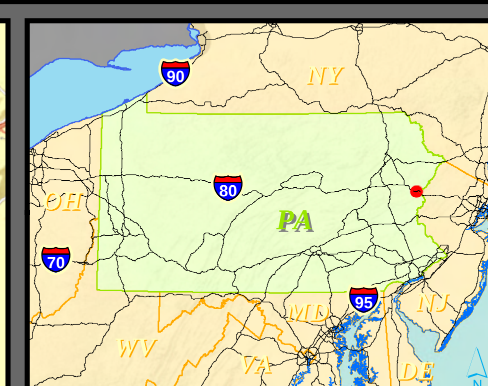
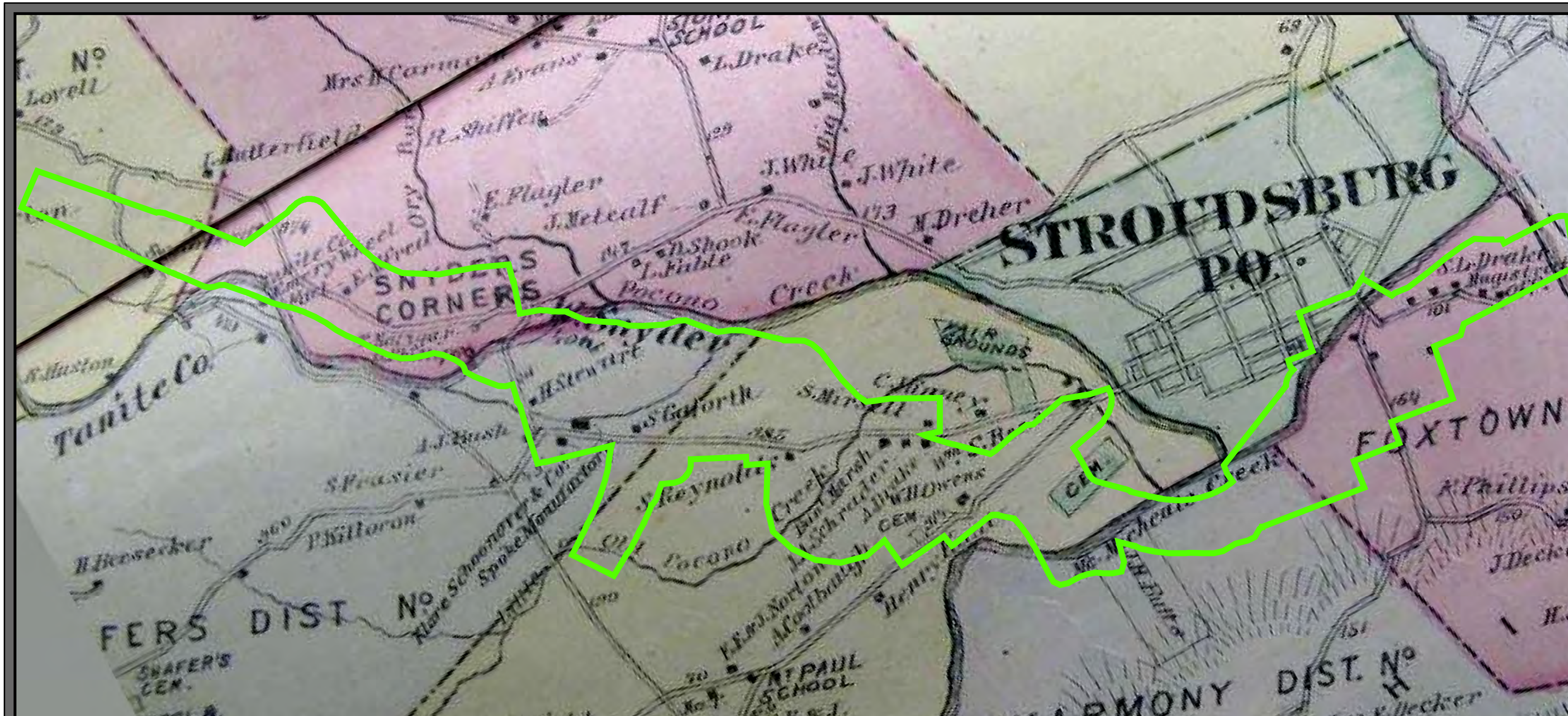


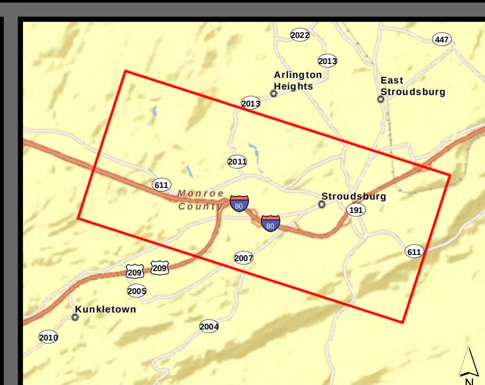
Figure 6: Archaeological Area of Potential Effects in 1860, Downtown Stroudsburg

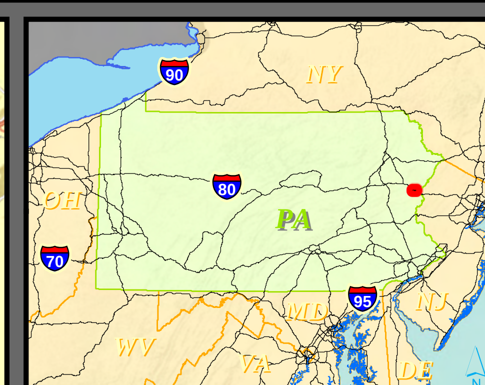
Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Loomis Way and Palmer, Map of the Counties of Monroe and Carbon, PA, 1860







Archaeological Area of Potential Effects

0 625 1,250 2,500 Feet

0 150 300 450 600 750 Meters

N W E S

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Figure 7: Archaeological Area of Potential Effects in 1875

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: 1875 County Atlas of Monroe, PA, Beers and Company, 1875

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Archaeological Area of Potential Effects

0 250 500 1,000 Feet

0 60 120 180 240 300 Meters

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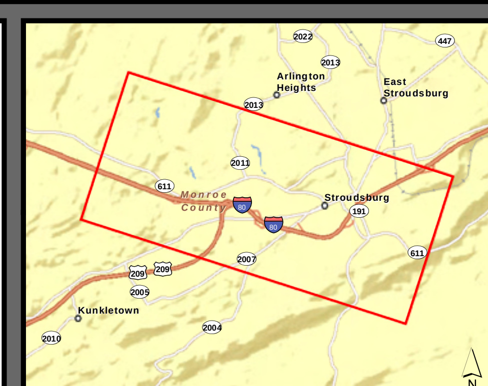

Figure 8: Archaeological Area of Potential Effects in 1875, Downtown Stroudsburg

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: 1875 County Atlas of Monroe, PA, Beers and Company, 1875

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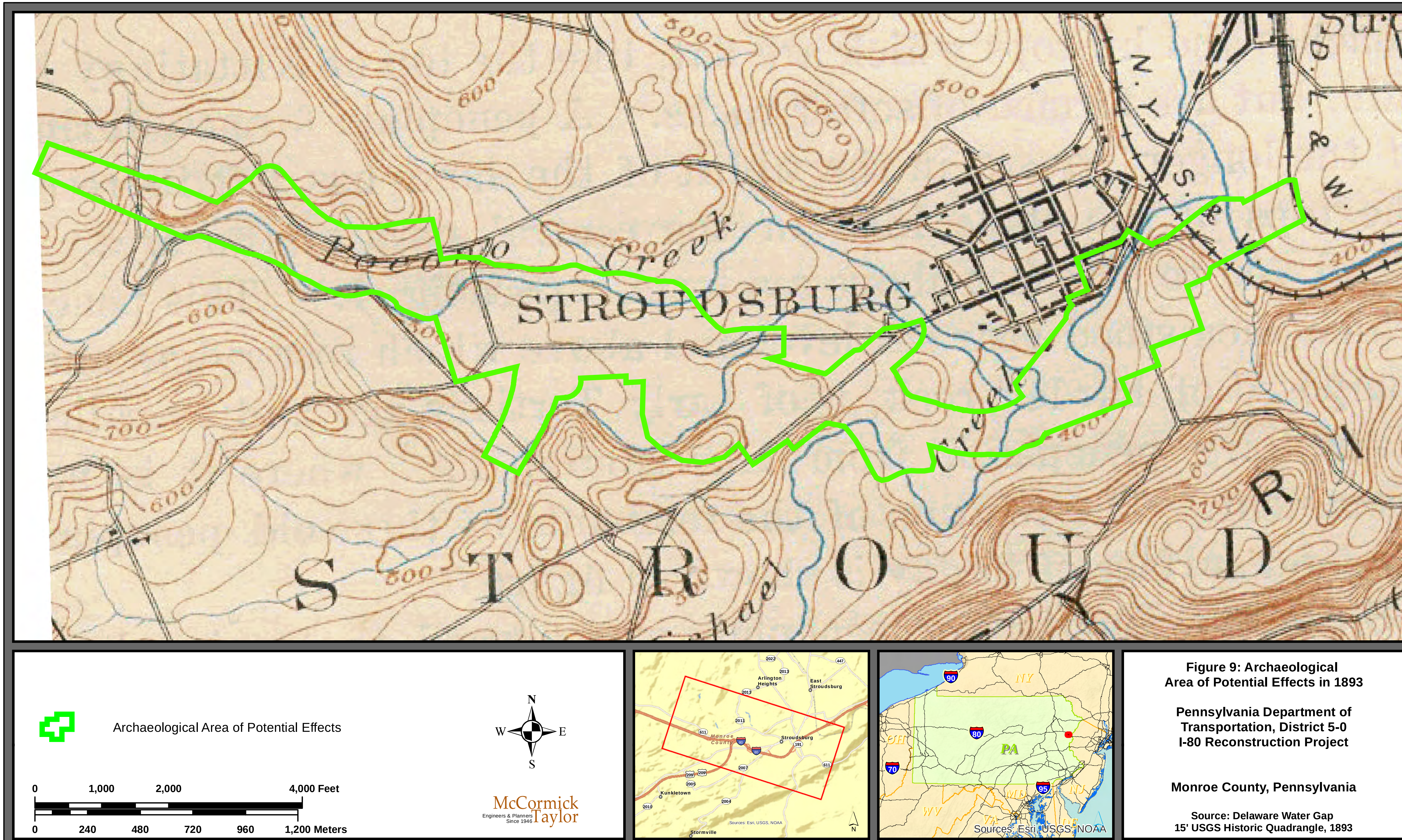


Figure 9: Archaeological Area of Potential Effects in 1893

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Delaware Water Gap 15' USGS Historic Quadrangle, 1893

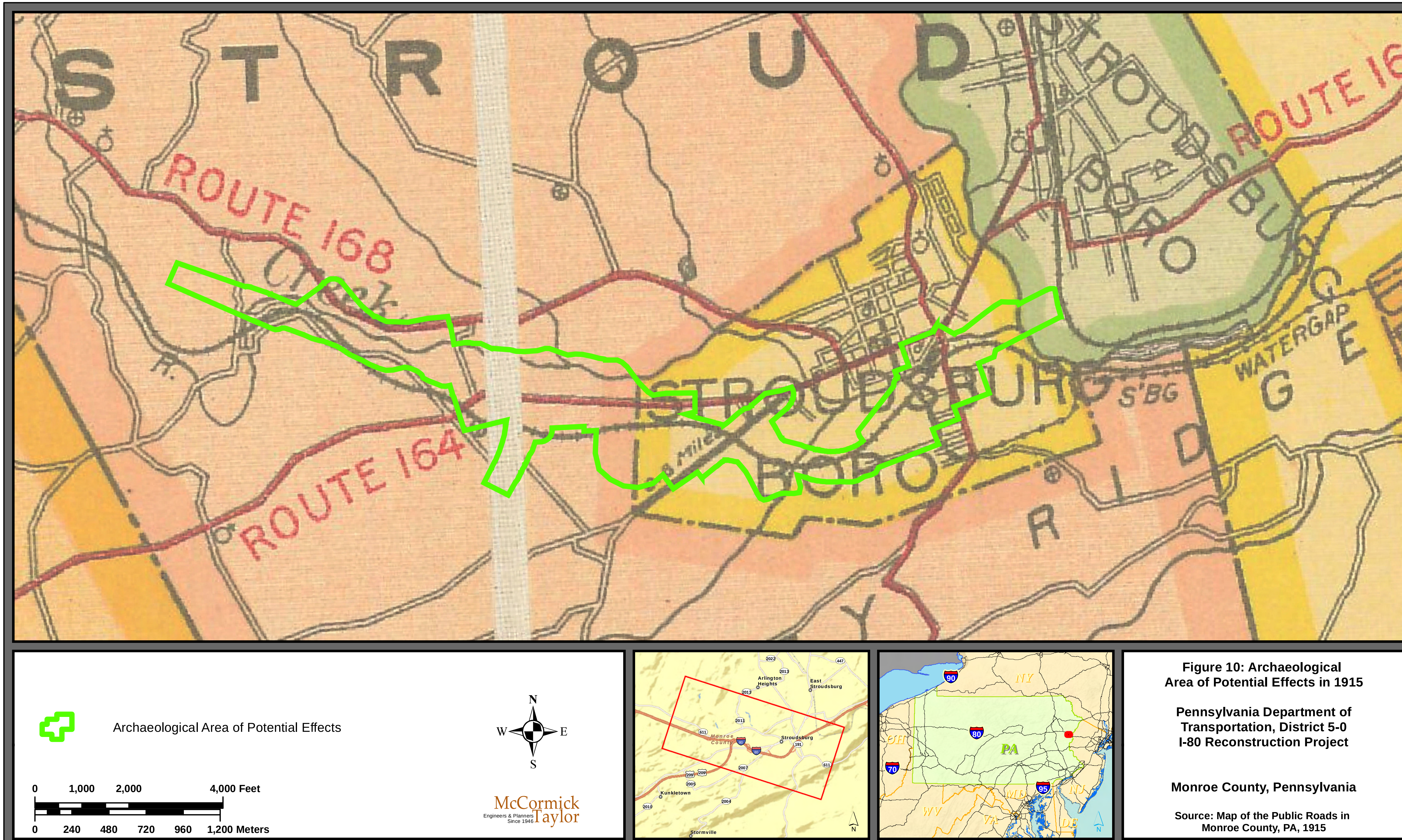
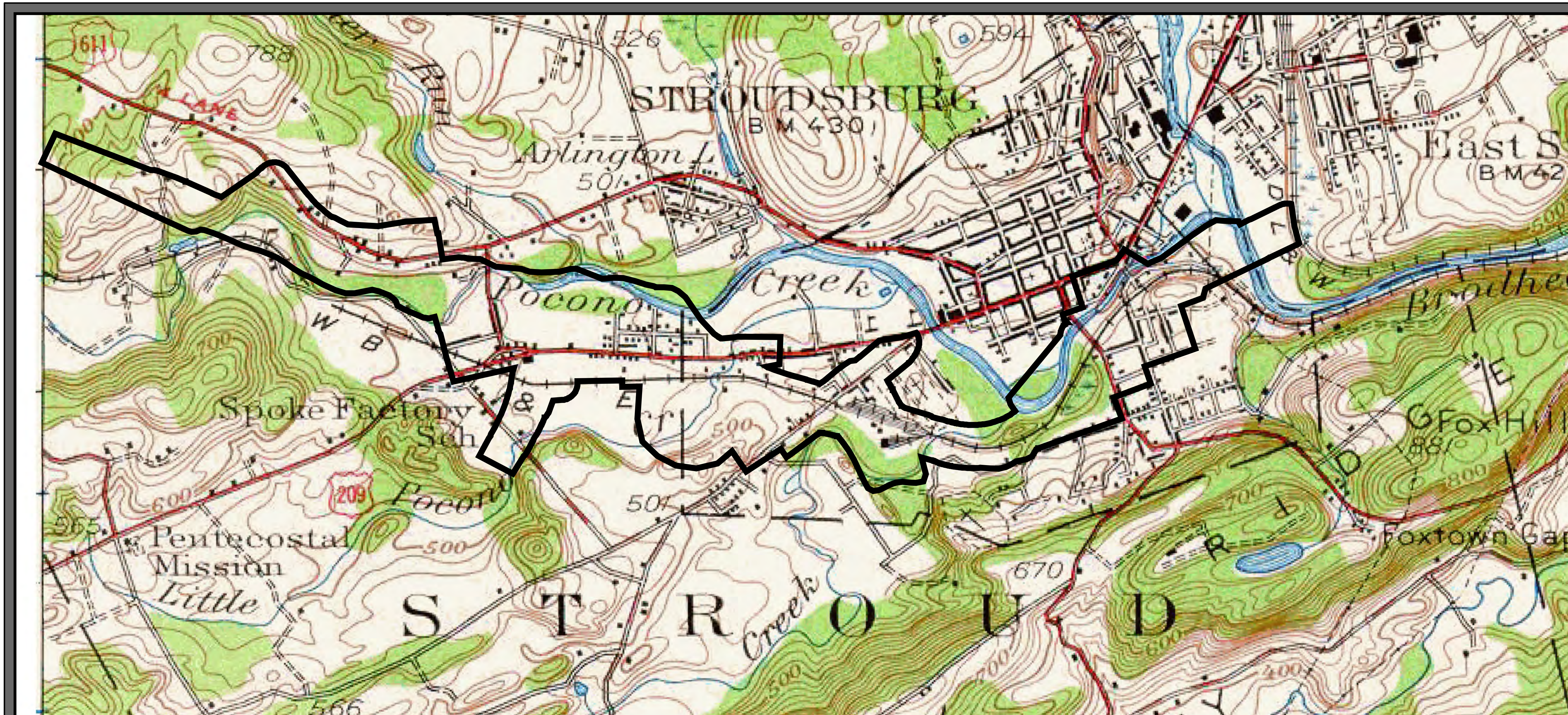


Figure 10: Archaeological Area of Potential Effects in 1915

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Map of the Public Roads in Monroe County, PA, 1915



Archaeological Area of Potential Effects

0 1,000 2,000 4,000 Feet

0 240 480 720 960 1,200 Meters

N
W E
S

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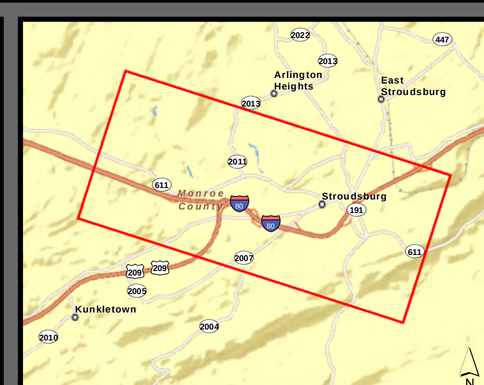


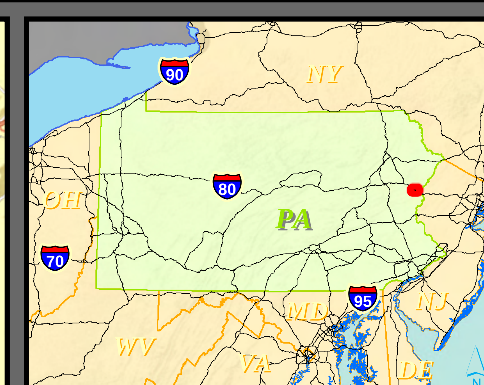
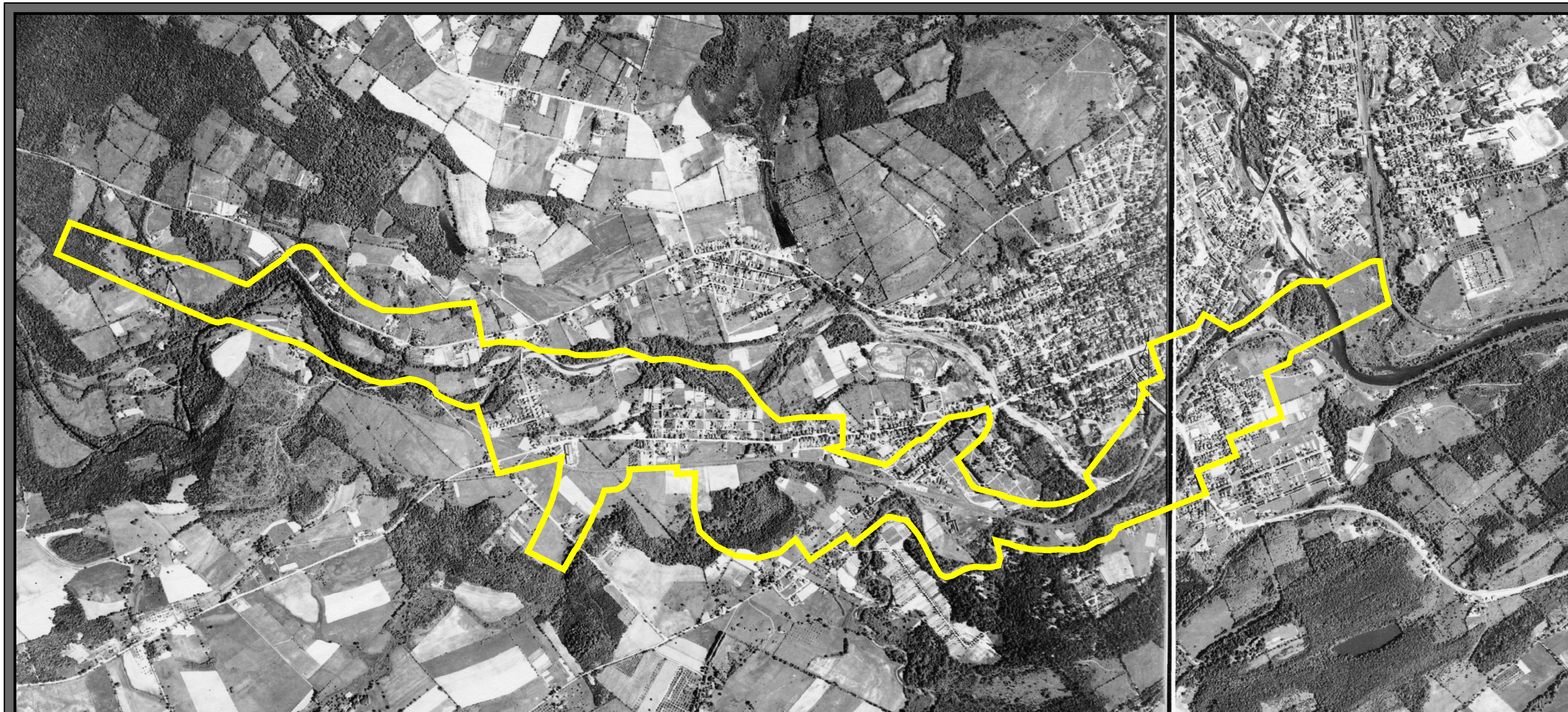


Figure 11: Archaeological Area of Potential Effects in 1936

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Delaware Water Gap, PA
15' USGS Historic Quadrangle, 1936



Archaeological Area of Potential Effects

0 1,000 2,000 4,000 Feet

0 240 480 720 960 1,200 Meters

N
W E
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McCormick Taylor
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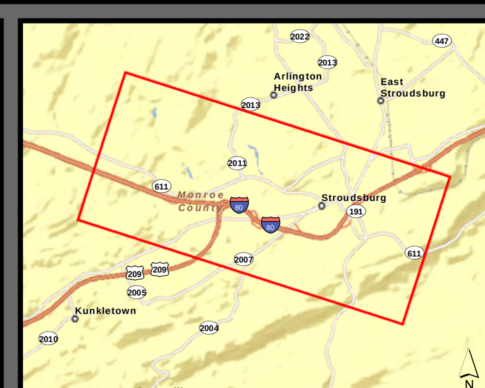


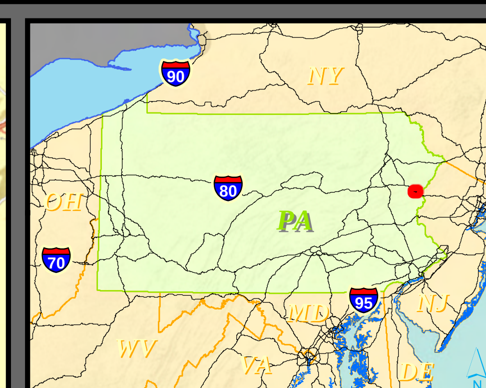
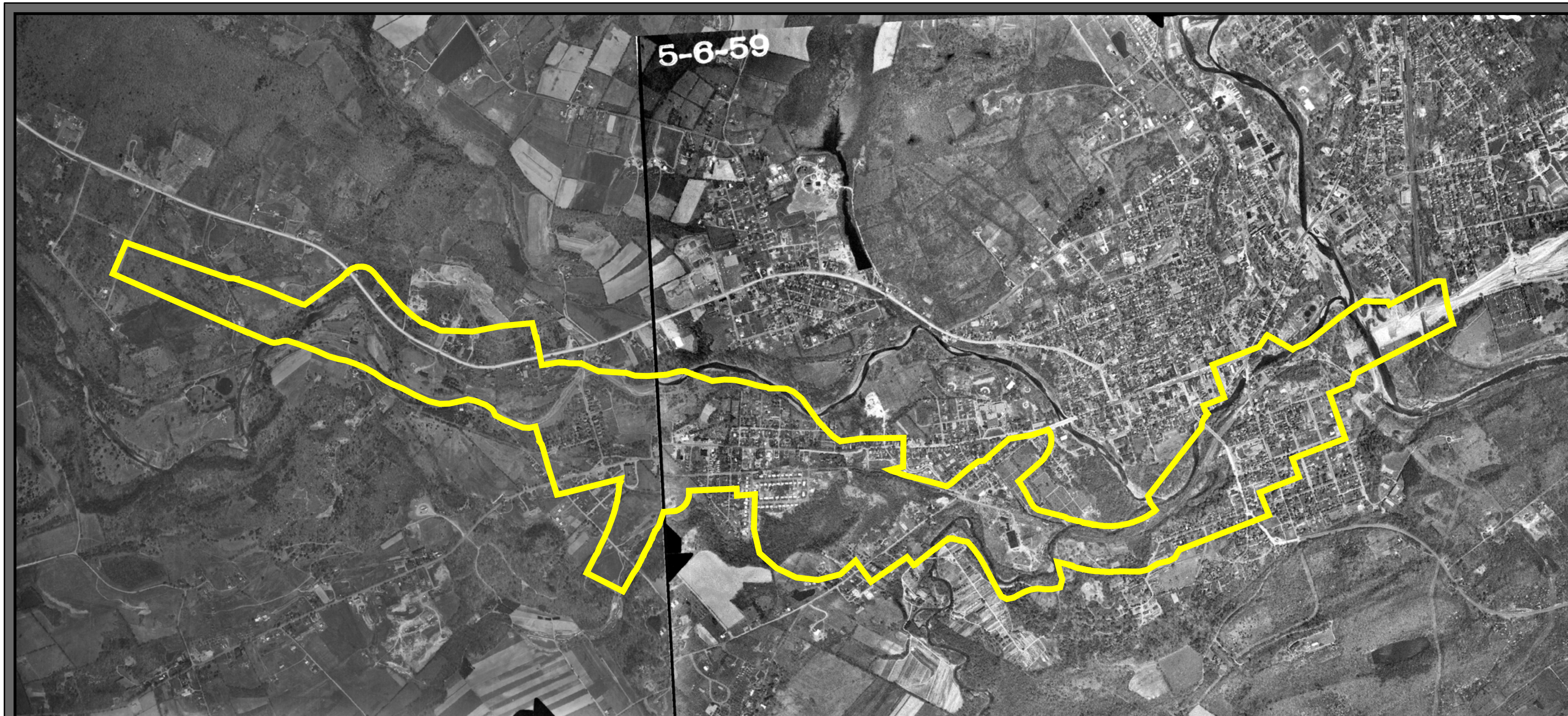


Figure 12: Archaeological Area of Potential Effects in 1939

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: PennPilot, 1939



Archaeological Area of Potential Effects

0 750 1,500 3,000 Feet

0 180 360 540 720 900 Meters

N
W
E
S

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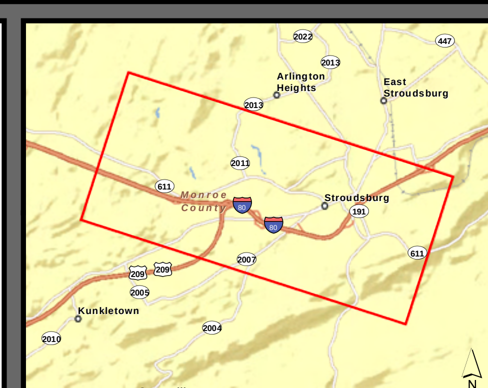


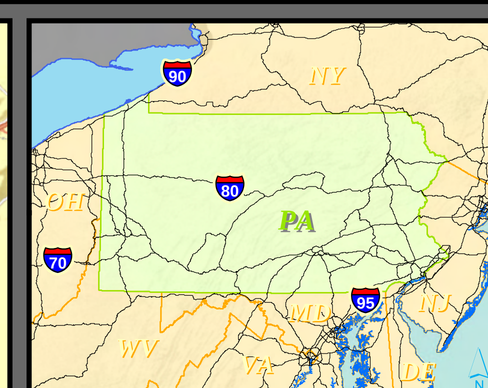
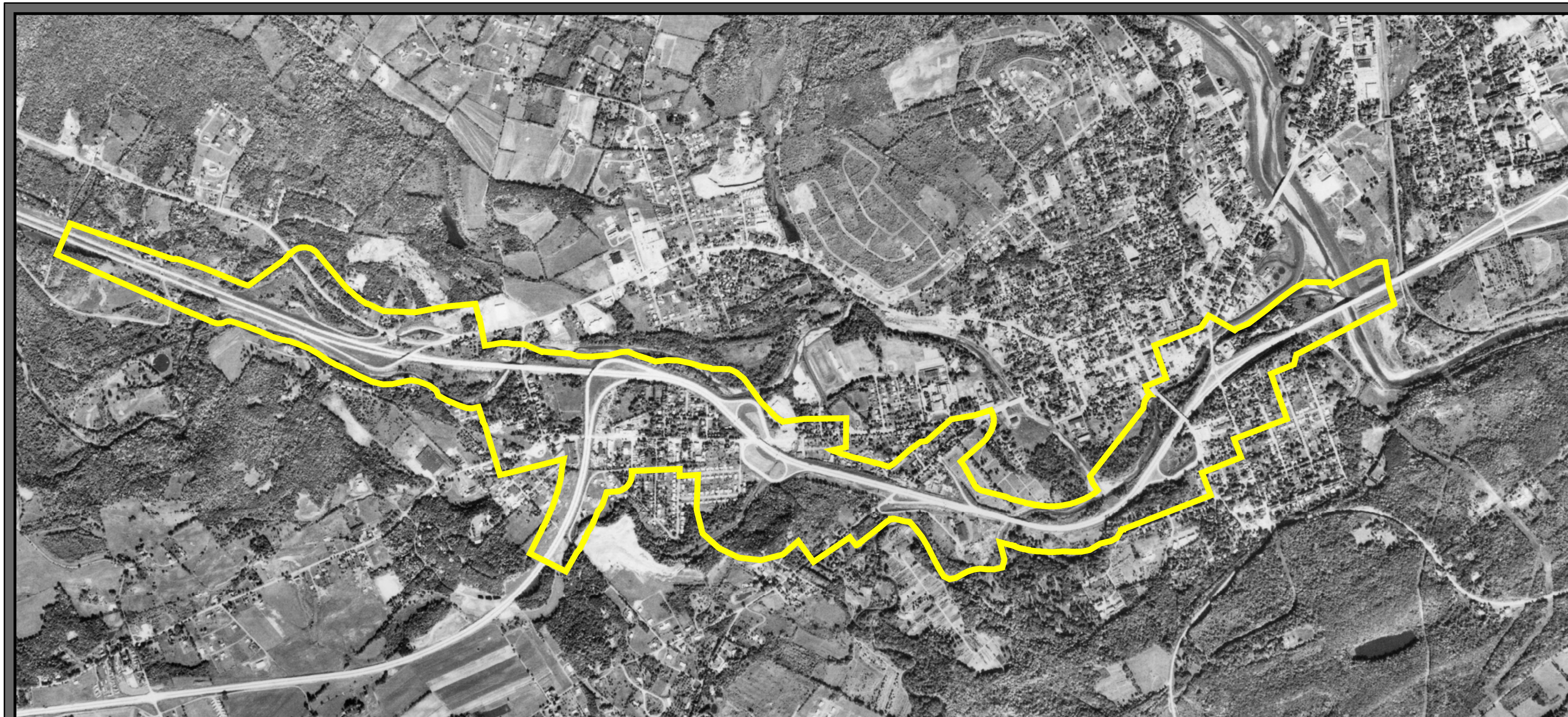


Figure 13: Archaeological Area of Potential Effects in 1959

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: PennPilot, 1959



Archaeological Area of Potential Effects

0 1,000 2,000 4,000 Feet

0 240 480 720 960 1,200 Meters

N
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McCormick Taylor
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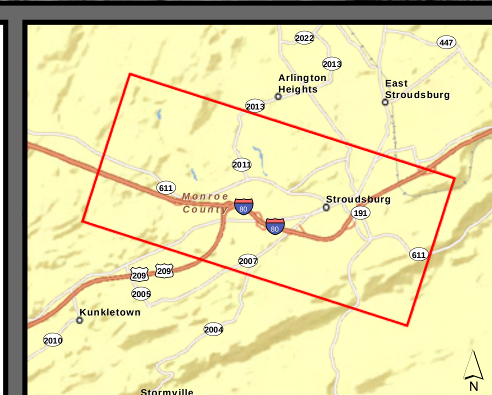
Since 1946



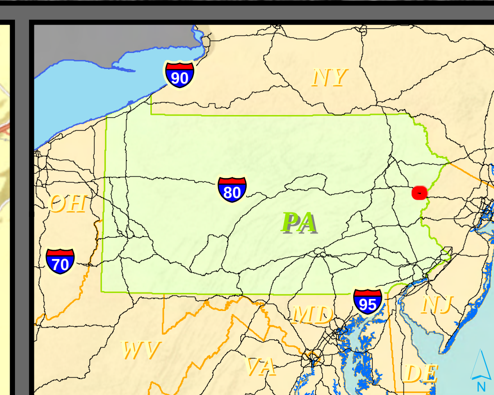


Figure 14: Archaeological Area of Potential Effects in 1969

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: PennPilot, 1969

C. Previously Identified Resources

Multiple Phase I Archaeological Identification Surveys have been conducted in the immediate project vicinity and/or overlap with the current APE. No archaeological sites have been previously identified within the archaeological APE. Surveys completed within the archaeological APE include studies for proposed pipeline projects, housing development projects, and roadway improvement projects. These surveys tested both upland and alluvial settings, including sections of Pocono Creek and the confluence of Pocono Creek and McMichael Creek. These surveys indicate that the majority of the APE has been severely impacted by urbanization and development and that the alluvial settings along Pocono Creek and McMichael Creek have little potential to contain intact pre-contact deposits due to the rapid accumulation of recent alluvium from high flow velocities ***(Figure 3)***.

In 2002, fieldwork completed by Kittatinny Archaeological Research, Inc. (KAR) was conducted along the northern bank of Pocono Creek as part of a proposed pipeline project. The study area was located southwest of the intersection of Bridge Street and S.R. 611, south of the current alignment of I-80 (Presler 2002). Architectural debris, including brick, clear flat glass, ashy concretions, coal, wood, and reinforced concrete were encountered. Two historic period structures, located just outside the study area toward Bridge Street, had been identified on historic mapping. KAR determined that this deposition was likely associated with the destruction of one or both of the structures prior to the construction of I-80. The encountered materials were not collected as they were not temporally diagnostic and appeared to be relatively modern. Neither diagnostic historic remains nor prehistoric materials were recovered from the study area. Culture bearing deposits in the study area were shallow, less than 0.5 m deep, due to the presence of medium to high velocity overbank flood plain deposition and/or glacial outwash. It was considered unlikely that potentially significant archaeological resources were located in this area and no further archaeological work was recommended (Presler 2002). During the current survey, two concrete block foundations and one limestone cistern were encountered north of the current alignment of I-80, north of the study area investigated by KAR. These foundations and potential historic deposits may be associated with those encountered by KAR during their 2002 survey ***(Figure 3)***. The significance of these deposits is indeterminate.

Two surveys have been conducted as part of housing development projects within or immediately adjacent to the APE ***(Figure 3)***. In 2008, a Phase I archaeological survey was conducted for the Susquehanna Valley Development Group, Inc. and the proposed Berkshire Garden Housing Complex. Based on background research, areas within their APE were designated as having high, medium, and low potential to contain pre-contact and historic resources/deposits. Phase I testing of areas predicted to contain pre-contact deposits did not yield cultural material. Phase I testing also occurred in the vicinity of one historic property. However, only cultural materials that were indicative of casual discard and no site was recorded (Coppock 2008). In 2011, an Archaeological and Geomorphological survey was completed for the proposed Glenbrook East Apartment complex development by RETTEW Associates, Inc. The APE for the project is located immediately east of the Stroudsburg Cemetery at the confluence of Pocono Creek and McMichael Creek. Auger probes placed within the entire APE indicated the presence of stratified Historic to recent alluvium with no pedologic development. An observed terrace-like landform identified within the APE was determined to have been the product of filling activities. Based on the results of the geomorphological survey, no potential exists for the presence of intact pre-contact alluvium within the study area due to the presence of high flow velocities present within the narrow valley floor (Stasiulatis 2011). During the current survey, geomorphological evaluations of the soils immediately east of the confluence of Pocono Creek and McMichael Creek identified the presence of similar packages of Historic and recent alluvium ***(Appendix B)***. Though no potential exists for intact pre-contact deposits within this portion of the APE, historic documentation, via the 1860 Atlas of Monroe County and its inset map of the Borough of Stroudsburg, indicates the presence of a tannery owned by J.R. & G. Hull in this location ***(Figures 5 and 6)***. Races are also depicted adjacent to the Tannery, extending from an additional tannery, owned by Jacob Singmaster, and Auracher and Zimmerman's Grist Mill which are located further in town. A non-extant road is also present immediately adjacent to the Hull Tannery, which is shown to cross McMichael/McMicheal's Creek via a non-extant bridge. The non-extant roadway is depicted as extending to meet S.R. 191 south of the project area ***(Figures 5 and 6).*** The J.R. and G. Hull Tannery and the adjacent roadway are not depicted on subsequent mapping of the area in1875 and 1893 ***(Figures 7, 8, and 9)***. However, a slaughter house owned by S.W. Palmer and Brother is present in this area by 1875 ***(Figure 8)***.

Disturbance within the current APE was previously documented by the archaeological testing of two locations north of I-80 in East Stroudsburg Borough (Blades 2006) ***(Figure 3)***. These areas were surveyed in anticipation of proposed roadway improvements associated with entrance and exit ramps for I-80 (Exit 308). Soils indicated the presence of gravelly fill deposits and debris associated with the 1950's removal of a 1930's residence in one location, as well as rock and asphalt deposition at a second location. The debris encountered at the second location is likely associated with the construction of I-80 and the area's use as a twentieth century refuse dump. No further work was recommended (Blades 2006).

1. Pre-contact Archaeological Resources

Topographic characteristics are considered to be important factors when considering the probability that archaeological resources will exist on a particular landform. Slopes of less than 15%, well drained soils, aspect, type of surface water, proximity of surface water to habitable landforms, and stream confluences are important characteristics when evaluating the desirability of certain settings for pre-contact occupation. Locations of previously identified archaeological sites in the vicinity of the project APE and previous research were utilized to help evaluate the probability that pre-contact sites would exist within the APE for this project. No previously identified archaeological sites were located within the APE and no pre-contact Native American archaeological sites have been previously recorded within 1,000 feet of the APE.

Due to the lack of identified sites within the archaeological APE and its immediate vicinity, the evaluation of sites and site characteristics was expanded to include an analysis of sites located within the Upper Delaware River sub-basin (1), Watershed E. The CRGIS database/PASS files indicate the presence of 128 sites within Watershed 1E. All chronological time periods are represented. However, the breakdown of the number of sites with particular components is skewed due to the reported presence of multiple components at individual sites ***(Table 2)***. Although 93% (n=119) occur within 200 meters (656 feet) of water, 80% of the sites (n=102) are within 100 meters (328 feet) of a water source ***(Table 3)***. Of the 65 sites for which topographic settings are listed, most are on terrace and floodplain settings (n=20 and n=14, respectively; ***Table 4***). The majority of the sites (72%) have been described as lithic reduction sites (n=63; 49%) or open habitation sites (n=30; 23%; ***Table 5***). In addition, eight (8) sites are described as quarries, three (3) as rockshelters or caves, one (1) as a specialized aboriginal site, and four (4) are listed as having an undetermined function ***(Table 5)***.

Eight aboriginal quarry sites within the Upper Delaware River Valley, including 36MR44, 36MR111, 36MR112, 36MR122, 36MR123, 36MR134, 36MR174, and 36MR215, lie approximately 1.5 miles to 5 miles east/northeast of the project area along Brodhead Creek and Marshall's Creek. Though site 36MR0215 is recorded as an historic quarry, background research and reconnaissance conducted by Louis Berger Group, Inc. suggests that areas in the immediate vicinity of the site have a high potential to contain evidence for both historic and pre-contact quarrying activity (Brown 2007). During the 2005 reconnaissance and 2006 survey conducted by Louis Berger, pre-contact quarrying tools, including anvils, hammerstones, chert scrapers, and chert reduction debris, were found to the south of the APE on a high terrace. These investigations indicate that the boundaries of the site 36MR0215 (Atlas Limestone Quarry) likely extend outside of reported APE for that project. No evaluation has been made regarding the eligibility of the site (Brown 2007). The remaining six quarry sites (36MR111, 36MR112, 36MR122, 36MR123, 36MR134, and 36MR174) are located in the Marshall's Creek drainage in Smithfield Township approximately five (5) miles northeast of the APE. Sites 36MR111, 36MR0122, 36MR0123 have been subjected to more intensive investigation, including controlled excavations, soil reconstruction, functional and technological lithic analysis, and raw material sourcing due to the identification of quarry pit features and recovered Middle and Late Woodland projectile points; all three sites have been recommended eligible for listing on the National Register of Historic Places (NRHP). To the south, additional lithic sources include the Hardyston Formation (chert and jasper), Allentown Formation (chert), and the Brunswick and Lockatong formations (argillite). The closest known aboriginally-quarried sources of Hardyston Formation jasper and chert are the Vera Cruz (36LH12) and Macungie (36LH11) quarries, located approximately 72 kilometers (45 miles) south of the project area, respectively.

One (1) Contact Period Native American trail, the Pechoquealin Path, lies in proximity to the APE. The Pechoquealin path "extended west from the village of Pechoquealin near the Delaware Water Gap along the northern bank of Brodhead Creek through East Stroudsburg and from there through Stroudsburg along Pocono Creek and west over the Pocono Mountains to Wyoming (now Wilkes-Barre)" (Wallace 1998:124-125). Therefore, the trail may have passed through if not within one half mile of the APE due to its description and depiction north of the confluence of Brodhead Creek and McMichael Creek and along the northern bank of Pocono Creek (portions of which are now designated as McMichael Creek) ***(Figure 3)***.

Table 2: Native American Sites within Watershed 1E by Component

Time Period		Number of Sites
Paleoindian		1
Archaic		
	Undefined	11
	Early	2
	Middle	9
	Late	19
Transitional		4
Woodland		
	Undefined	15
	Early	2
	Middle	4
	Late	15
Protohistoric		0
Unspecified Pre-Contact		87

Table 3: Native American Sites within Watershed 1E by Distance to Water

Distance to Water (m)	Number of Sites
0-25	82
26-50	8
51-100	12
101-150	11
151-200	6
201-250	3
251-300	2
301-350	0
351-400	1
400+	3

Table 4: Native American Sites within Watershed 1E by Topographic Setting

Topographic Setting	Number of Sites
Floodplain	13
Hill Slope	3
Island	1
Lower Slopes	8
Ridge Top	4
Saddle	4
Stream Bench	4
Terrace	20
Upland Flat	4
Rise in Floodplain	1
Upper Slopes	3
None Entered	63

Table 5: Native American Sites within Watershed 1E by Site Type

Native American Site Type	Number of Sites
Historic and Prehistoric	10
Lithic Reduction	63
Open Habitation	30
Open - Unknown Function	4
Quarry	8
Rockshelter/Cave	3
Unknown Function - Open Site >20m	2
Unknown Function - Surface Scatter <20m	2
Other Specialized Aboriginal Site	1

Due to the environmental factors/characteristics associated with the recorded sites within Watershed 1E overall, as well as the proximity of the Pechoquealin Path, Native American sites of all periods are likely to occur in the vicinity of the archaeological APE on level to gently sloped, well-drained settings within ca. 150 meters (492 feet) of water sources. While more extensively exploited base camps are more likely to be encountered on stream terraces and floodplains, smaller resource procurement camps are also likely to be encountered in upland settings.

2. Historic Archaeological/Architectural Resources

No historic archaeological sites have been identified within 1,000 feet of the project area. Few historic archaeological sites are located within five miles of the APE. Minimal information is provided for these sites, which include two (2) sites of unknown/other/multiple function dating from the early nineteenth to mid-twentieth century, twelve (12) sites designated as historic and prehistoric sites, four (4) domestic sites, and two industrial sites.

Numerous historic/architectural resources, however, have been identified within and immediately adjacent to the APE. It is likely that many of these historic/architectural resources contain associated archaeological deposits ***(Figure 3)***. According to the CRGIS, thirty-two (32) historic resources have been identified within the archaeological APE and one hundred historic resources have been identified within 1,000 feet of the project area. These historic resources include buildings and structures, an historic district, multiple linear resources, and nine (9) unmapped (within the CRGIS) historic resources, which may represent potential historic sites ***(Table 6)***. Though many of the identified historic resources lie outside of the APE, the potential exists for associated archaeological deposits to extend within the APE. A review of the historic resources identified within proximity to the APE provides contextual information regarding the types of resources that may be present but previously unidentified within the APE. Linear resources present within and/or immediately adjacent to the APE include sections of the Delaware, Lackawanna and Western Railroad: Line (Scranton to Slateford Junction) [#097540 (NRHP Eligible) and #156166 (Aggregate file)] and New York, Susquehanna and Western Railroad [#156533 (Aggregate file)]. One (1) Historic District, Stroudsburg Historic Preservation District (#155775), is present within the APE. Unmapped historic resources within and immediately adjacent to the APE, those identified as being present within a particular municipality by the CRGIS but for which no exact locational information has been provided, include seven (7) structures built between 1932 and 1956 (#038760, #038761, #136502, #136588, #136589, #136590, #136593, #136594, and #136595) and two (2) indeterminate resources. All of the twentieth century structures have been determined to be not eligible for listing on the NRHP. The two (2) indeterminate resources include the Trach House (#038760) built c. 1890, and the Storm/Judge Property (#038761). Neither resource has been evaluated due to insufficient information. Though no information is provided regarding the age of the Storm/Judge Property, its identified association with Storm St. may indicate that the property has significant age due to the presence of Storm St. on 1860 historic mapping and the presence of a property and structure owned by J.B. Storm on 1875 mapping ***(Figures 6 and 8)***.

Table 6: Recorded Historic Resources within the Area of Potential Effects

Key #	Historic Name	National Register Status	Date Built
64337	Kitson Woolen Mill	Listed	1893;1904
38768	Wallace Hardware Building	Eligible	c1857;c1902
64420	Stroudsburg U.S. Post Office	Eligible	1934;1966
141880	Stroudsburg Commercial Historic District	Eligible	1795;1949
32621	Stroudsburg Freight Station	Not Eligible	1882
38775	First Presbyterian Church	Not Eligible	c1868
136598	Unnamed Structure	Not Eligible	1955
136599	Unnamed Structure	Not Eligible	1934
155619	Stroudsburg High School	Not Eligible	1927; 1959
155987	Bell Telephone of Pennsylvania	Not Eligible	1929;1930
155775	Stroudsburg Historic Preservation District - HDA	Local Historic District	
156533	New York, Susquehanna & Western Railroad (aggregate file)	No Determination Made	1881
38597	Tri-County Detox Center	Insufficient Information to Evaluate	1836
38598	Miller Farm; Dolby-Palmer Farm	Insufficient Information to Evaluate	
38599	Rice Home	Insufficient Information to Evaluate	1920
38606	Unnamed Resource	Insufficient Information to Evaluate	c1800
38729	Wagner House	Insufficient Information to Evaluate	c1865
38760	Trach House	Insufficient Information to Evaluate	c1890;c1905
38761	Storm, Judge, Property	Insufficient Information to Evaluate	
38769	Culver Mill Site	Insufficient Information to Evaluate	c1753; c1941
38770	Megargel's Appliance	Insufficient Information to Evaluate	c1890
38772	Stroudsburg Methodist Church	Insufficient Information to Evaluate	c1914
38773	Pocono Mountain Chamber of Commerce	Insufficient Information to Evaluate	c1870
38774	Malta Temple	Insufficient Information to Evaluate	c1906
38776	Dreher, Darius, Store & Residence	Insufficient Information to Evaluate	c1875
38780	Masonic Lodge	Insufficient Information to Evaluate	c1890
38809	Stroudsburg Cemetery	Insufficient Information to Evaluate	c1864
38810	Trolley Barn	Insufficient Information to Evaluate	c1905
150038	B.F. Morey Elementary School	Insufficient Information to Evaluate	1925; 1950; 1980
155988	Murray, Robert & Josephine, Property	Insufficient Information to Evaluate	c1895
155989	Unnamed Building	Insufficient Information to Evaluate	c1895
155990	Unnamed Building	Insufficient Information to Evaluate	c1895

Within the Archaeological APE, only one (1) resource, the Kitson Woolen Mill (#64337), is listed on the NRHP. Three (3) properties, the Wallace Hardware Building (#38768), the Stroudsburg U.S. Post Office (#64420), and the Stroudsburg Commercial Historic District (#141880), which are a part of the larger Stroudsburg Historic Preservation District (#155775), have been determined eligible for listing on the NRHP. Twenty (20) structures, buildings, and properties with ranging construction dates from c 1800-1925 have not been evaluated due to insufficient information.

In addition to the Stroudsburg Cemetery (#38809), one (1) small historic cemetery was also identified within the APE. The Hollinshead Graveyard, which also lies along present day Dreher Avenue, was identified on 1875 historic mapping and was subsequently relocated within the APE ***(Figure 8)***. It is possible that additional small family plots, cemeteries, and marked and unmarked graves could be present within the APE. Though unlikely, potential exists that unmarked graves may lie outside of the demarcated limits of Stroudsburg Cemetery and the Hollinshead Graveyard.

One hundred (100) historic resources have been identified within 1,000 feet of the APE. These historic resources include buildings and structures, an historic district, multiple linear resources, and numerous unmapped historic resources, which may represent potential historic sites. Historic resources listed on the NRHP include the Stroud Mansion (#586), Monroe County Courthouse (#591), and the Academy Hill Historic District (#95188). NRHP eligible resources include the George Tillotson House (#86644). Non-eligible resources and unevaluated structures, buildings, and properties include multiple churches, homes, schools, and industrial buildings, including the Hollinshead-Kautz-Patterson House (#038764), Stroudsburg Freight Station, Trolley Barn, Orthodox and Hicksite Quaker Cemeteries, Fort Hamilton, Fort Penn, Monroe County Jail, Culver Mill, and the Dansbury Mission. Eighteenth century properties within the vicinity of the APE include the Dansbury Mission (#38765), Culver Mill (#38769), The Old Stone House (#39112), the Stroud Community House (#38796), Fort Hamilton (#38797), and Fort Penn (#38771). A reference, *The French and Indian War in Pennsylvania, 1753-1763: Fortification and Struggle During the War for Empire*, published by the Pennsylvania Historical and Museum Commission (PHMC), provides a brief description for the location, use, and duration of the occupation at Fort Hamilton (#38797) (Waddell and Bomberger 1996). However, no mention is made of any archaeological work that may have been completed in this location, and no site number has been allocated to, or PASS form completed for, the Fort itself.). Though Fort Penn (#38771) is generally located north of the 500-block of Main Street in Stroudsburg, its precise location is unknown. No detailed description of the structure exists (Leiser 2013). As with Fort Hamilton, no reference could be found regarding archaeological work that may have been completed in the location of Fort Penn, and no site number has been allocated to, or PASS form completed for, the Fort itself.

Historic mapping indicates the presence of numerous additional structures and complexes, previously unrecorded and unmapped within the CRGIS, within or immediately adjacent to the APE. These structures and complexes include tanneries, mills, and farmsteads that contain a high probability for the presence of associated archaeological deposits. Multiple historic structures are present on the 1860atlas of Monroe and Carbon Counties ***(Figures 5 and 6)***. The 1860 Atlas indicates that the main roadways throughout Stroudsburg Borough and surrounding areas were established by 1860, including the majority of present day downtown Stroudsburg, S.R. 191, Storm St., Main St. (and by extension State St.), Hamilton St. (present day Dreher Ave.), Bridge St., S.R. 611 north and west of Stroudsburg, Tanite Rd., and Beech St./ White Stone Corner Rd. ***(Figures 5 and 6)***.

The inset map for the Borough of Stroudsburg ***(Figure 6)*** identifies multiple structures within downtown Stroudsburg along Main St. and south of Bark St. (now Ann St.) that lie within the current APE, including the Methodist Episcopal Church, a WW shop owned by J.F. H…., a business or residence owned by M.D. Robeson Est., a cooper shop, structures owned by C. U. Warnick, C.M. Price, and S. Walton, and a tannery owned by J.R. & G. Hull. Races are also depicted in association with the tannery. It is likely that these races were also utilized by a tannery owned by Jacob Singmaster and the Auracher and Zimmerman's Grist Mill which are located further in town. A non-extant road is also depicted immediately adjacent to the Hull Tannery. This roadway is shown to cross McMichael/McMicheal's Creek via a now non-extant bridge. The non-extant roadway is depicted as extending to meet S.R. 191 south of the project area ***(Figure 6).*** At the eastern end of the APE, east of current S.R. 191 on the northern bank of McMichael/McMichael's Creek, historic structures associated with businesses that are within or are immediately adjacent to the APE include a Cabinet Manufactory owned by W.T. Baker and a grist mill. South of McMichael Creek, a residence owned by Chas S. Palmer is also observed, but has since been destroyed by modern development. Structures present west of town, including Bowlby's Cabinet Shop and his residence, as well as other residences, a barn, and a carriage house, which have also been destroyed by the construction of housing and the Stroudsburg High School and BF Morey Elementary School ***(Figure 6)***.

Historic mapping from 1875 and 1893 do not indicate the presence of newly constructed roadways. However, the continued development of downtown Stroudsburg is marked ***(Figures 7, 8, and 9)***. The tannery owned by J.R. & G. Hull is non-extant by 1875. The unnamed roadway that previously led past the tannery terminates in the location of a slaughter house owned by S.W. Palmer and Brother by 1875. The unnamed roadway, likely Palmer St., no longer connects with S.R. 191 south of the project area and the associated bridge crossing in this location is also noticeably absent ***(Figures 7, 8, and 9)***. South of McMichael Creek, many structures, including houses owned by J. B. Storm, S. Berry, and Thomas A. Bell and the Magistrates Office, are depicted along an unnamed roadway parallel to the creek; this is present day Storm Street. Present day S.R. 191 is labeled as Storm Lane. Development within the western portion of the APE is less pronounced. By this time, the Stroudsburg Cemetery had been established, as well as the Hollinshead Graveyard ***(Figure 8)***. This graveyard is potentially associated with the Hollinshead-Kautz-Patterson House (#038764) that lies adjacent to the APE. According to the CRGIS, the Hollinshead-Kautz-Patterson House (#038764) is a Georgian style house constructed c. 1800; its NRHP eligibility has not been evaluated due to a lack of sufficient information.

Historic mapping from 1915 indicates that more substantial development has occurred within the Borough of Stroudsburg south of McMichael Creek ***(Figure 10)***. The 1915 mapping depicts the extension of Franklin St. (present day 7th St.) over McMichael Creek, and eventually intersecting with S.R. 191 south of the APE. This extension is the current alignment of S.R. 611. Side streets connecting S.R. 191 and S.R. 611 are also observed, including present day Bryant St., Robeson St., Barry St., and Lenox St. The construction of Colbert St. east of S.R. 191 is also noted. Despite the presence of these new roadways on the 1915 mapping, the extent of the development and population of these streets is in doubt. Though the roadways are present, no structures are illustrated along their lengths ***(Figure 10)***. Of special note is the depiction of the Eastern R.R., which extends east to west along the banks Pocono Creek and McMichael Creek within the APE. Previously established railroads, including the New York, Susquehanna, and Western R.R. and Delaware, Lackawanna, and Western R.R. had formerly only followed the banks of Brodhead Creek ***(Figure 10)***.

Historic maps and aerials from the 1930's highlight continued development south of McMichael Creek along S.R. 191 and S.R.611 and their associated side streets, specifically present day Bryant Street ***(Figures 11 and 12)***. Continued development west of downtown Stroudsburg, specifically along S.R. 611 and State St. (present day Main St.) is also marked. The appearance of multiple housing developments is observed within the APE, as well as the formalization of the Stroudsburg Cemetery. Historic aerials from the 1950's and 1960's continue to show the increasing urbanization and development of the Borough of Stroudsburg and the surrounding area ***(Figures 13 and 14)***.

V. The Predictive Model

A. Pre-contact Archaeology Predictive Model

Previous surveys and predictive models have been completed across Pennsylvania for a wide variety of projects and clients, including pipeline and utility projects, housing development projects, roadway improvements projects, and educational research projects. According to the PASS files, only two surveys, reported as containing predictive models, have been conducted within Monroe County. A Cultural Resource Sensitivity Model was created by Kittatinny Archaeological Research, Inc. for the development of the Country Club of the Poconos in Middle Smithfield Township, Monroe County, PA (Kittatinny Archaeological Research, Inc. 1993), and Louis Berger submitted a brief model as part of their 2010 Phase I/II Archaeological Investigations for the Susquehanna to Roseland 500kV Transmission Project, Pike and Monroe Counties (Fortugno and Beadenkopf 2010). However, additional information regarding criteria employed for the creation of predictive models within Monroe County, in Coppock 2008, and for the Pocono Uplands in general, in Perazio 1994 and 2008, has also been identified.

Additional previous studies and predictive models across Pennsylvania (Berge et al. 1991; Botwick and Wall 1992 and 1994; Bush 1992; Coppock and Heberling2001; Corrie 1984; Curtain 1981; Duncan 2002; Duncan et al. 1995 and 1999; Duncan and Schilling 1999a and 1999b; Glenn 2010; Hay 1993; Hay and Hatch 1980; Katzet al. 2002; Knepper and Petraglia 1994; Kuznar 1984; Lawrence et al. 2003; McIntyre 2009; Miller 2001; Miller and Kodlick 2006; Neusius and Neusius 1989; Neusius and Watson 1991; Stevenson 1982; Stewart and Kratzer 1989; Wadleigh 1981; Wall 1981; and Wood 1993) were also reviewed in an effort to identify appropriate criteria and parameters to use in the design of the predictive model.

An effort was made to define a relatively small set of commonly accepted criteria that would prove effective in delineating areas of relative pre-contact archaeological potential within the APE. These variables and their parameters were selected because they were generally recognized in the literature as correlating strongly with pre-contact site location. Based on the referenced sources above, variables suggested to contain little or no predictive value for determining site locations include elevation, aspect, and solar insulation (Coppock and Heberling 2001; Glenn 2010; Perazio 2008). Therefore, these variables were not selected for use in the current model. Variables considered to be of more critical importance or have to more accuracy regarding site location prediction were distance to water sources, slope, soil drainage, and distance to identified historic trails (Duncan and Schilling 1999; Duncan et al. 1999; Duncan 2002). The cultural and topographic characteristics of the majority of the previously recorded archaeological resources within Watershed 1E conform to these criteria ***(Tables 2, 3, 4, and 5)***.

The following table ***(Table 7)*** summarizes the model developed for the project.

Table 7: Criteria for the I-80 Reconstruction Pre-contact Predictive Model

Variable	High Probability	Moderate Probability	Low Probability
Ground Slope	0-8%	8-15%	>15%
Distance to high-order streams (3rd or higher)	<100 meters	100-200 meters	>200 meters
Distance to confluences	<100 meters	100-200 meters	>200 meters
Distance to low-order streams (1st and 2nd and intermittent)	<75 meters	75-150 meters	>150 meters
Soil drainage characteristics	Well-drained soils	Moderately well drained to somewhat poorly drained soils	Poorly drained soils Hydric soils
Previously disturbed areas (made land, previous road disturbance, etc.)			All low probability
Distance to wetlands	<75 meters	75-150 meters	>150 meters

Of the variables utilized in this model, four were given greater weight and were determined to be limiting variables. Areas assigned low probability scores with respect to these variables were assigned low overall scores. These four are as follows:

1. **Slope**: Areas with surface slope >15% were given a low probability overall.
2. **Previously disturbed areas:** Areas determined to have been impacted by previous disturbance, including transportation and utility related corridors, roadways, railroads, pipelines, and previous survey were given a low probability overall.
3. **Soil drainage characteristics:** Areas comprised of poorly drained soils, hydric soils, or located within a mapped wetland were given a low probability overall.
4. **Distance to water of any order:** Areas with a distance to water (of any order) >200 meters were given a low probability overall.

In general, ground slope less that 8% (Berge et al. 1991; Duncan et al. 1995; Hay 1993; and Stewart and Kratzer 1989; McIntyre 2009; Coppock and Heberling 2001 among others) was delineated as the boundary for high probability, 8-15% moderate probability, and greater than 15% low probability. Most authors discussed the limitation of the use of the slope criterion in assessing the potential for finding rock shelters and pre-contact quarries, both site types likely to be associated with high ground slopes.

The APE was examined for the presence of artificial ponds, canals, dam pond, and manmade/excavated wetlands. These features were not included in the above table when calculating probabilities based on distances from wetlands. However, areas designated as containing hydric soils were merged with recorded wetland polygons. The locations of the stream channels within the APE were also compared through time via aerial photographs and historic mapping in order to determine the degree to which the stream channels have been affected by development and deforestation. The digital overlays did not indicate that extensive erosion and redeposition have occurred within the APE and no significant changes to the stream channels have occurred since the nineteenth century.

Multiple variables, employed by previous predictive models, could not be utilized in the creation of the current model, including distance to pre-contact quarries and distance to Native American trails. Distance to reported pre-contact quarries was not utilized as a variable due to the lack of such resources within the vicinity of the APE. Eight aboriginal quarries (36MR0044, 36MR111, 36MR112, 36MR122, 36MR123, 36MR134, 36MR174, and 36MR0215) containing chert suitable for stone tool manufacture have been identified within Watershed 1E. However, all eight sites are located approximately 1.5 to 5 miles east/northeast of the archaeological APE. Sites 36MR0215 (Atlas Limestone Quarry) and 36MR0044 (Zimmerman Flint Quarry) are the closest reported quarry sites to the archaeological APE. 36MR0044 (Zimmerman Flint Quarry) is located at the confluence of Marshall's and Brodhead Creek; 36MR0215 (Atlas Limestone Quarry) is located 0.5 miles west of 36MR0044.

One (1) Contact Period Native American trail, the Pechoquealin Path, lies in proximity to the APE. The Pechoquealin path "extended west from the village of Pechoquealin near the Delaware Water Gap along the northern bank of Brodhead Creek through East Stroudsburg and from there through Stroudsburg along Pocono Creek and west over the Pocono Mountains to Wyoming (now Wilkes-Barre)" (Wallace 1998:124-125). Therefore, the trail may have passed through if not within one half mile of the APE due to its description and depiction north of the confluence of Brodhead Creek and McMichael Creek and along the northern bank of Pocono Creek (portions of which are now designated as McMichael Creek) ***(Figure 3)***. Due to the obscurity of the exact location of the Pechoquealin Path, the historic trail could not be used as a reliable/measurable variable within the model. However, due to the reported proximity of the historic Native American path to the major tributaries within the project area, areas that would have been designated as containing high potential due to their proximity to the path would likely still be designated as having high potential due to their proximity to the low and high order streams and stream confluences within the APE. The potential data set of "distance to Native American trail" is likely reflected by the data set "proximity to streams and confluences."

A GIS based program (ArcGIS:Esri) was used to apply the model to the project area ***(Appendix C)***. Predictive models reviewed as part of the background research for the design indicated that the use of raster data was more generally used than vector data (data expressed using polygons). GIS raster data (cell/pixel data) has been used because data can be collected for a standardized area or pixel cell (Duncan et al. 1999). Cell sizes utilized in previous models include 50 x 50 foot cells, 100 x 100 foot cells, and 200m x 200m cells (Duncan et al. 1999; Glenn 2010; Katz et al. 2002; Miller and Kodlick 2006). In some cases, vector data was collected for the project area as a whole and was later converted to raster data for analysis (Lawrence et al. 2003). A report submitted by Coppock and Heberling (2001) indicated that a GIS model was not utilized to apply the predictive model due to the presence of extensive disturbance within their APE.

The variables employed within the current model were expressed utilizing vector data (polygons). Polygons were created for each variable. The polygons created for the individual variables were then overlain. Determinations of high, medium, and low potential were determined based on the weighted system of limiting variables mentioned above. Where multiple polygons overlapped, high, medium, and low potential was assigned by the limiting variable in that area. In the absence of these limiting variables in areas of the APE, totals for the combined polygons were scored and high, medium, or low potential was assigned based on the scores (High =>14; Medium=10-14, Low =<10). The model uses vector data because it gives a better geographic representation of the features used in the model than would large square raster cells. In other words, a vector will represent where the edge of something is, instead of averaging together a large square, and possibly either eliminating a feature or making it cover an area much larger than it really is. Using vector data allows for more detailed analysis and results that follow the model guidelines more closely.

The acknowledged limitations of the model include its inability to account for the numerous low-density lithic scatters that are likely to be present in the APE and do not correlate with environmental variables (Miller and Kodlick 2006). Additional site types that are difficult to relate to settlement patterning include Isolated Finds, rockshelters, petroglyphs, and burials (Katz et al. 2002; Perazio 2008). Though the site data utilized to create this predictive model is the most up-to-date, as reported by CRGIS, it should also be recognized that the reported site data and location of identified sites is skewed because of the completion of projects which have occurred based on biased (non-random) sampling. More lowland areas and floodplains have been evaluated due to these biases than upland areas, which may affect the environmental characteristics employed in current site location prediction (Duncan et al 1999; Perazio 2008).

In order to further refine the predictive model, a pedestrian reconnaissance and a geomorphological evaluation of the APE were conducted subsequent to its development. The goal of the pedestrian reconnaissance was to delineate disturbed landforms with low archaeological potential. The pedestrian reconnaissance encountered several areas exhibiting obvious modern disturbance or depleted T0 and T00 terraces ***(Photographs 1 and 2)***. These areas were discounted from the predictive model mapping and were determined to have low pre-contact archaeological potential. Not all areas with >15% slope were traversed during the pedestrian reconnaissance. Due to the presence of identified rockshelters fronting upstream portions of Brodhead Creek (R. Michael Stewart, personal communication November 7, 2013), these areas should be reevaluated in order to verify the presence or absence of rockshelters, rock overhangs, and caves within the archaeological APE after the selection of potential Alternatives.

The geomorphological investigations were focused on defining the alluvial landforms present within the APE and their respective archaeological potential. Though floodplains are associated with McMichael Creek, Pocono Creek, Little Pocono Creek, and Brodhead Creek within the APE, the results of the geomorphological survey indicate that these landforms are comprised of shallow soils of relatively recent age. Therefore, the floodplains within the archaeological APE were determined to have low potential for containing pre-contact deposits. Archaeological testing is not recommended on any of the identified floodplains. However, multiple T1 terraces and outwash terraces are present along McMichael Creek. These landforms were determined to have moderate potential for containing pre-contact deposits ***(Appendix B).***

Photograph 1: General view of disturbance immediately adjacent to McMichael Creek east of S.R. 611, facing southwest. Note the presence of grading from non-extant railroad and disturbance from bridge construction and utility emplacement.

Photograph 2: General view of low lying T0 terrace along McMichael Creek north of I-80, facing south. Saturated soils, heavy gravel content, and multiple back channels within this area indicate the rapid accumulation of alluvium in this area and a low potential to contain intact deposits.

B. Historic Archaeology Predictive Model

Historical settlements are generally more difficult to predict based on environmental data alone. Historic archaeological potential was defined as being confined to within 100 feet of known historic resources, including standing structures greater than fifty years of age and structures that appear on historic maps but are no longer standing. Historic roadways were also included as historic resources due to the frequency of historic development that is known to exist along historic transportation routes ***(Figures 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14)***.

Predictive models across the state report varying recommendations for buffering historic roadways, previously identified historic resources, and resources identified on historic mapping, including 75 feet, 200 feet, and 300 feet (Coppock and Heberling 2001; Glenn 2010; Miller and Kodlick 2006), and in some cases 100 m from the center of the map location or roadway centerline (Glenn 2010; Miller and Kodlick 2006). A 200 foot buffer is commonly applied to historic resources located within rural contexts based upon the site layout, outbuildings, and artifact distributions generally encountered at such sites. Due to the fact that the majority of the APE lies within a heavily urbanized and highly developed area, and that potentially encountered historic resources were likely to be confined within delineated house lots, buffering for historic resources was reduced to 100 feet. Historic roadways were also buffered by 100 feet. The locations of mills, tanneries, and other industrial sites identified on historic mapping are likely to contain archaeological deposits that are distributed over an area larger than that identified by the designated buffering (Coppock and Heberling 2001). However, the purpose of the current research and predictive model serves to merely identify these sensitive locations. Future testing of these locations should serve to establish potential site boundaries and determine the full extent of the buried deposits.

The development of the historic predictive model was directed toward identifying areas which are likely to contain historic sites predating 1920, as those were estimated to be most likely to contain significant archaeological information. Based on the preliminary background research and historic context of the area, the designations of high, moderate, and low potential were assigned to the buffered structures and roadways to reflect the probable occurrence of additional resources in these areas and the research potential of any identified and anticipated resources. Therefore, buffered historic roadways that appeared repeatedly on historic mapping during the mid-nineteenth century were designated to have greater potential for containing significant historic deposits than a roadway constructed in the mid-twentieth century (Katz et al. 2002:11). Structures and roadways identified on 1860, 1875, 1893, and 1915 mapping, as well as non-extant roadways, were determined to be areas with high potential to contain historic archaeological resources ***(Figures 5, 6, 7, 8, 9, and 10)***. Structures and new roadways appearing on 1936 mapping and 1939 aerials were determined to be areas with moderate potential to contain historic archaeological resources ***(Figures 11 and 12)*** (Katz et al 2002; Glenn 2010; Miller and Kodlick 2006). Low potential areas were reserved for areas where previous disturbance has been documented or observed. A GIS based program (ArcGIS:Esri) was used to apply the model to the project area.

Church properties were not mapped as potential sites as they have limited potential for archaeological features and deposits or significant information (Coppock and Heberling 2001).

While cemeteries are recorded and mapped by the PHMC, they are typically not treated as archaeological sites and are not considered eligible for the National Register unless they meet special requirements (Little et al. 2000). Additionally, cemeteries were not buffered due to their clearly delineated boundaries. Despite these considerations, extant and non-extant cemeteries were identified within the APE and their locations have been noted on project mapping ***(Figures 3 and 8)***. Any potential impacts to these culturally sensitive properties will need to be coordinated with the PHMC. Bridges also were not buffered due to the limited range of activities that occurred there and a lack of potential for archaeological deposits (Glenn 2010).

The pedestrian reconnaissance encountered several areas exhibiting obvious modern disturbance or the presence of late twentieth century buildings. These areas were discounted from the predictive model mapping and were determined to have low historic archaeological potential. The pedestrian reconnaissance resulted in the removal of potential sites, identified on historic mapping that had suffered an obvious loss of integrity. The pedestrian reconnaissance also identified the presence of additional historic resources not previously identified on historic mapping ***(Photographs 3, 4, 5, and 6)*** within the archaeological APE.

Photograph 3: General view of house and associated outbuildings at the terminus of Myrtle St. south of I-80, facing west.

Photograph 4: General view of outbuildings and well associated with the house at the terminus of Myrtle St. south of I-80, facing southwest.

Photograph 5: General view of house and associated outbuildings along White Stone Corner Road north of I-80, facing east.

Photograph 6: General view of outbuilding associated with the house along White Stone Corner Road north of I-80, facing southeast.

VI. Results

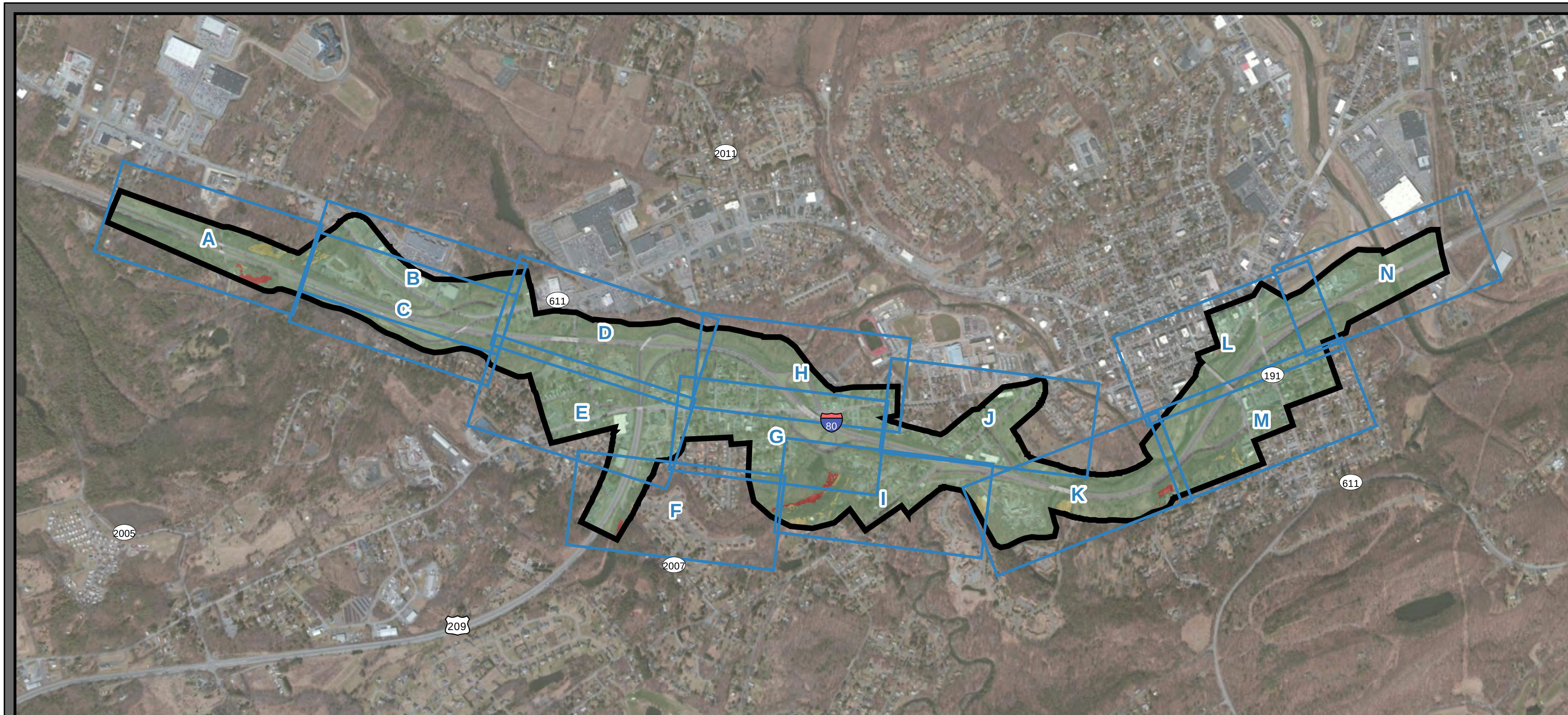
Due to the environmental factors/characteristics associated with the recorded sites within Watershed 1E overall, as well as the proximity of the Pechoquealin Path, Native American sites of all periods are likely to occur in the vicinity of the archaeological APE on level to gently sloped, well-drained settings within ca. 150 meters (492 feet) of water sources. While more extensively exploited base camps are more likely to be encountered on stream terraces and floodplains, smaller resource procurement camps are also likely to be encountered in upland settings. However, the majority of these landforms and potential site locations have been severely impacted by urbanization and development within and immediately adjacent to the APE ***(Figure 3)***.

Based upon the pre-contact predictive model, McCormick Taylor has identified 506.83 acres (98.2%) as having low probability for containing intact pre-contact resources, 5.88 acres (1.1%) as having medium probability for containing intact pre-contact resources, and 3.58 acres (0.7%) as having high probability for containing intact pre-contact resources within the archaeological APE ***(Figures 15, 15A, 15B, 15C, 15D, 15E, 15F, 15G, 15H, 15I, 15J, 15K, 15L, 15M, and 15N)***.

Numerous historic/architectural resources have been identified within and immediately adjacent to the APE. Thirty-two historic resources have been identified within the archaeological APE and one hundred historic resources have been identified within 1,000 feet of the project area. These historic resources include buildings and structures, an historic district, multiple linear resources, and nine unmapped historic resources, which may represent potential historic sites. Historic mapping also indicates the presence of numerous unrecorded and unmapped structures, including tanneries, mills, and farmsteads, that may indicate the presence of additional historic sites within and immediately adjacent to the APE. In addition, two culturally sensitive properties, the Stroudsburg Cemetery (#38809) and the Hollinshead Graveyard have been identified within the APE ***(Figures 3 and 8)***. Structures and roadways identified on 1860, 1875, 1893, and 1915 mapping, as well as non-extant roadways, were determined to be areas with high potential to contain historic archaeological resources. Structures and new roadways appearing on 1937 mapping were determined to be areas with moderate potential to contain historic archaeological resources ***(Figure 3)***.

Based upon the historic predictive model, McCormick Taylor has identified 388.04 acres (75.4%) as having low probability for containing intact historic resources, 58.65 acres (11.4%) as having medium probability for containing intact historic resources, and 68.07 acres (13.2%) as having high probability for containing intact historic resources within the archaeological APE ***(Figure 16, 16A, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 16I, 16J, 16K, 16L, 16M, and 16N)***.

To aid in project planning, the predictive models were combined in order to identify all areas within the APE as having low, medium, or high probability to contain archaeological resources regardless of whether they are pre-contact or historic. This additional mapping was created to reflect the overall results of both predictive models ***(Figure 17, 17A, 17B, 17C, 17D, 17E, 17F, 17G, 17H, 17I, 17J, 17K, 17L, 17M, and 17N)***. All areas of the APE depict the highest level of probability for containing archaeological resources. In essence, if the pre-contact potential of a property is low, but the historic potential is moderate, the property is depicted as moderate in potential. Based upon the combined pre-contact and historic predictive models, McCormick Taylor has identified 388.08 acres (75.2%) as having low probability, 60.14 acres (11.6%) as having medium probability, and 68.07 acres (13.2%) as having high probability for containing either intact pre-contact or historic resources within the archaeological APE ***(Figure 17, 17A, 17B, 17C, 17D, 17E, 17F, 17G, 17H, 17I, 17J, 17K, 17L, 17M, and 17N)***.



Archaeological Area of Potential Effects

Cut Sheets

0 750 1,500 3,000 Feet

0 180 360 540 720 900 Meters

N W E S

McCormick Taylor Engineers & Planners Since 1946

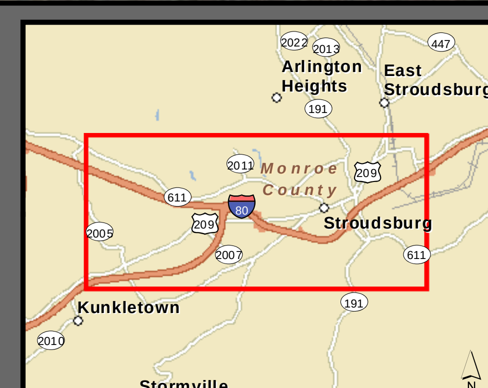


Figure 15
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

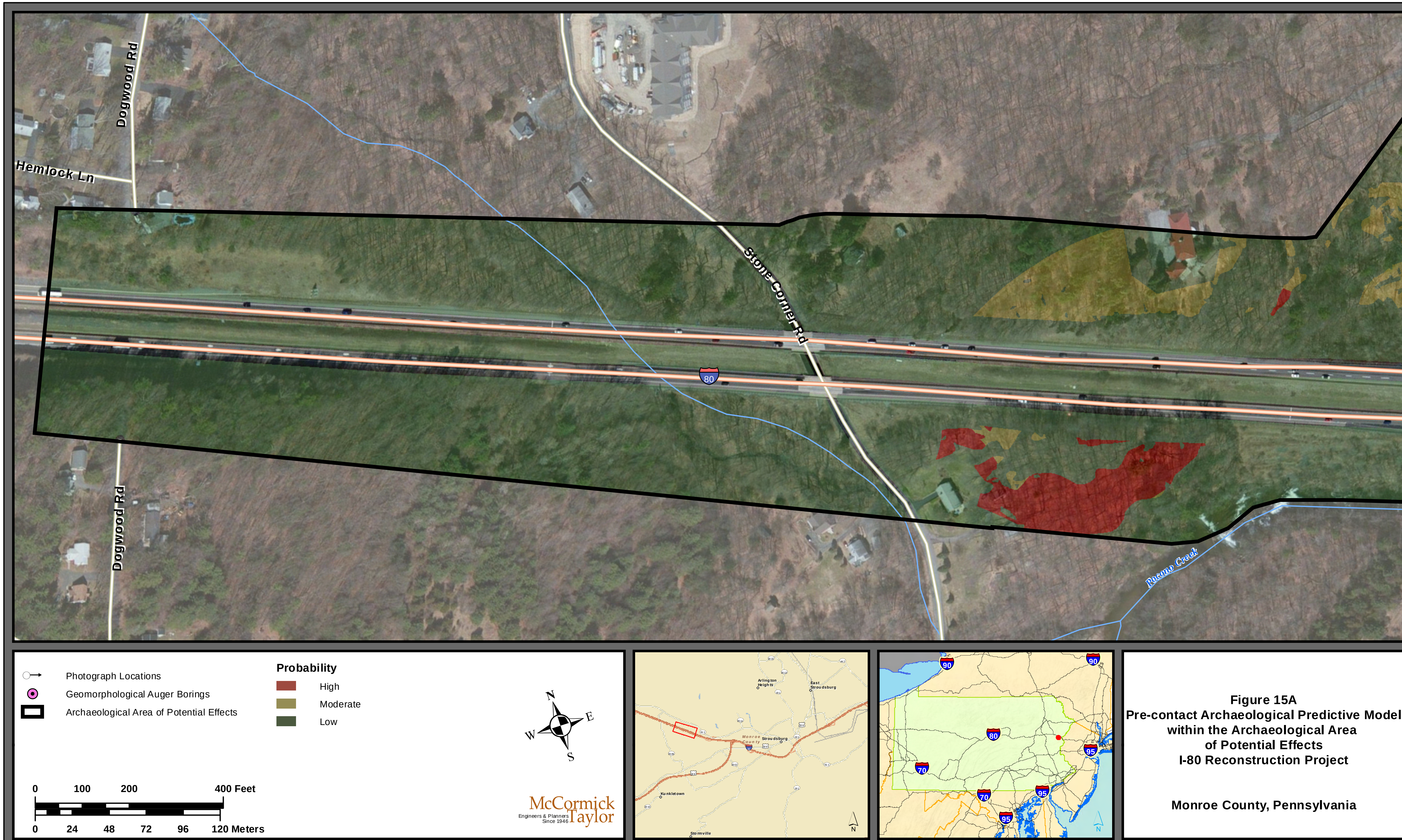


Figure 15A
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

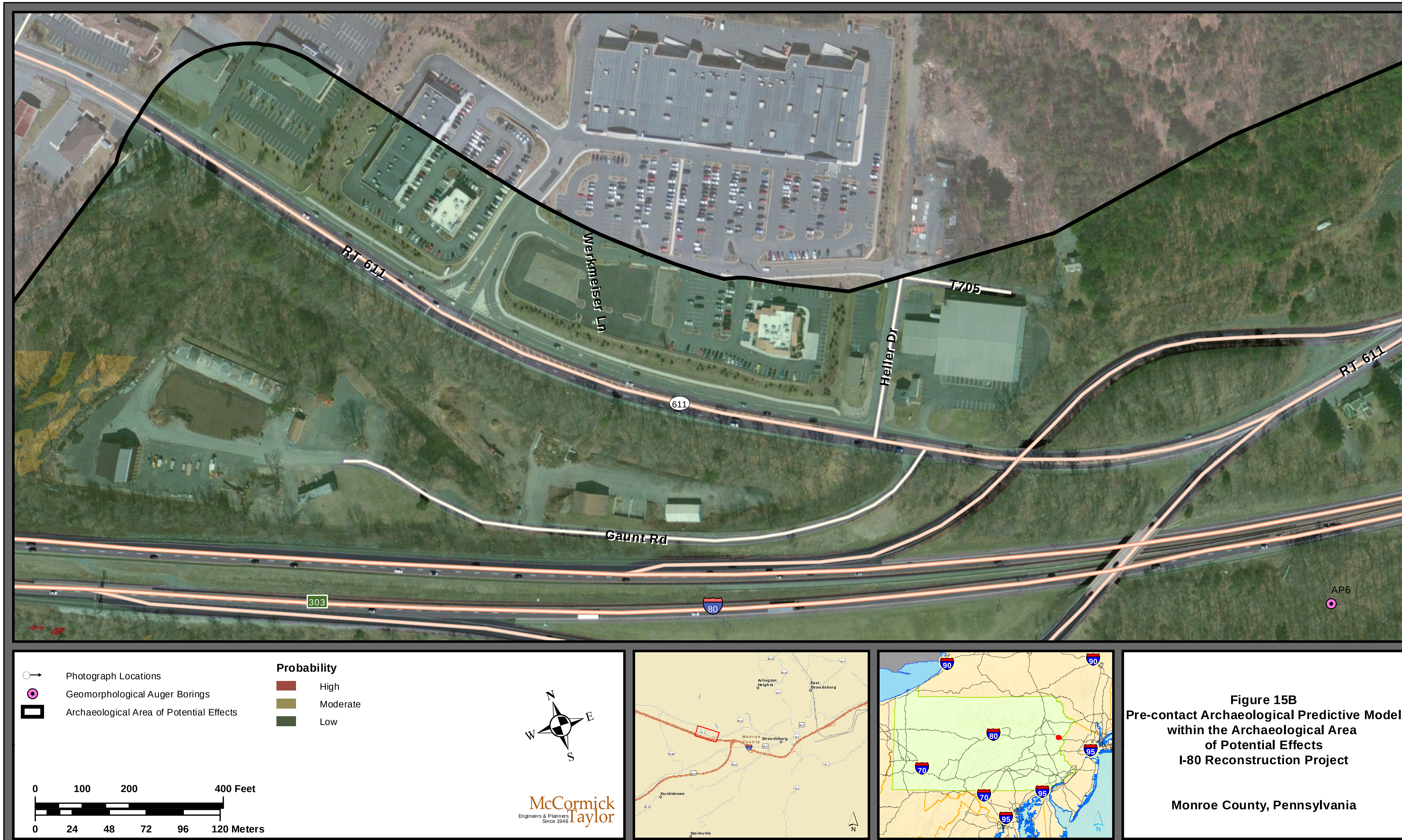


Figure 15B
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Photograph Locations
Geomorphological Auger Borings
Archaeological Area of Potential Effects

Probability
High
Moderate
Low

0 100 200 400 Feet
0 24 48 72 96 120 Meters

McCormick Taylor
Engineers & Planners Since 1946

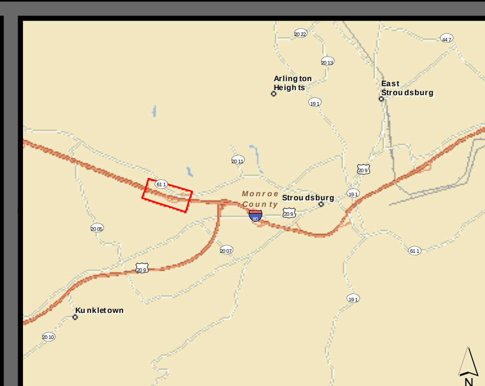
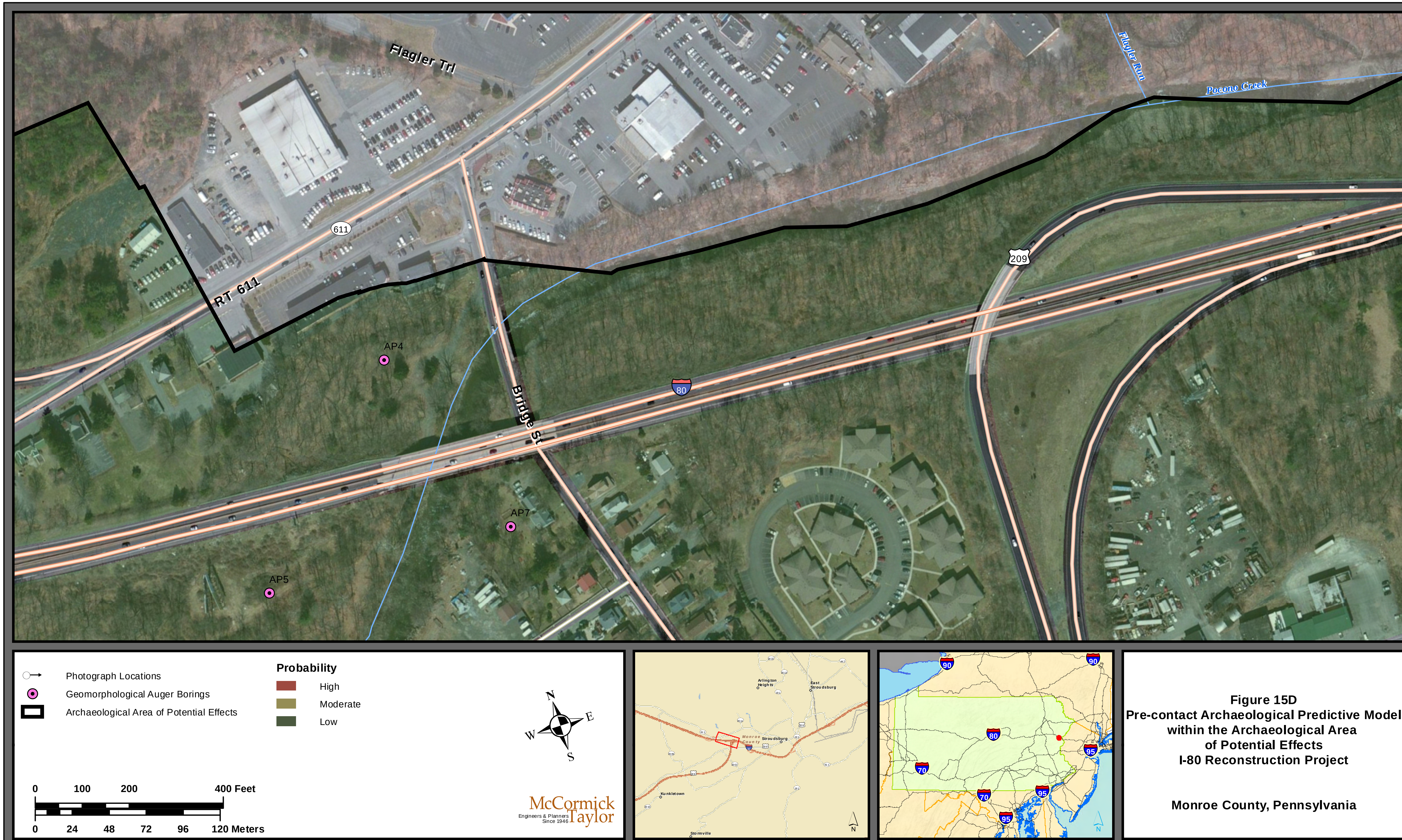


Figure 15C
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania


Flagler Trl
Flagler Run
Pocono Creek
RT 611
611
209
80
Bridge St
AP4
AP7
AP5
04904 MT HB 1/17/2014 12:48:39 AM
Photograph Locations
Geomorphological Auger Borings
Archaeological Area of Potential Effects
Probability
High
Moderate
Low
0 100 200 400 Feet
0 24 48 72 96 120 Meters
N
E
S
W
McCormick Taylor
Engineers & Planners Since 1946
Figure 15D
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project
Monroe County, Pennsylvania

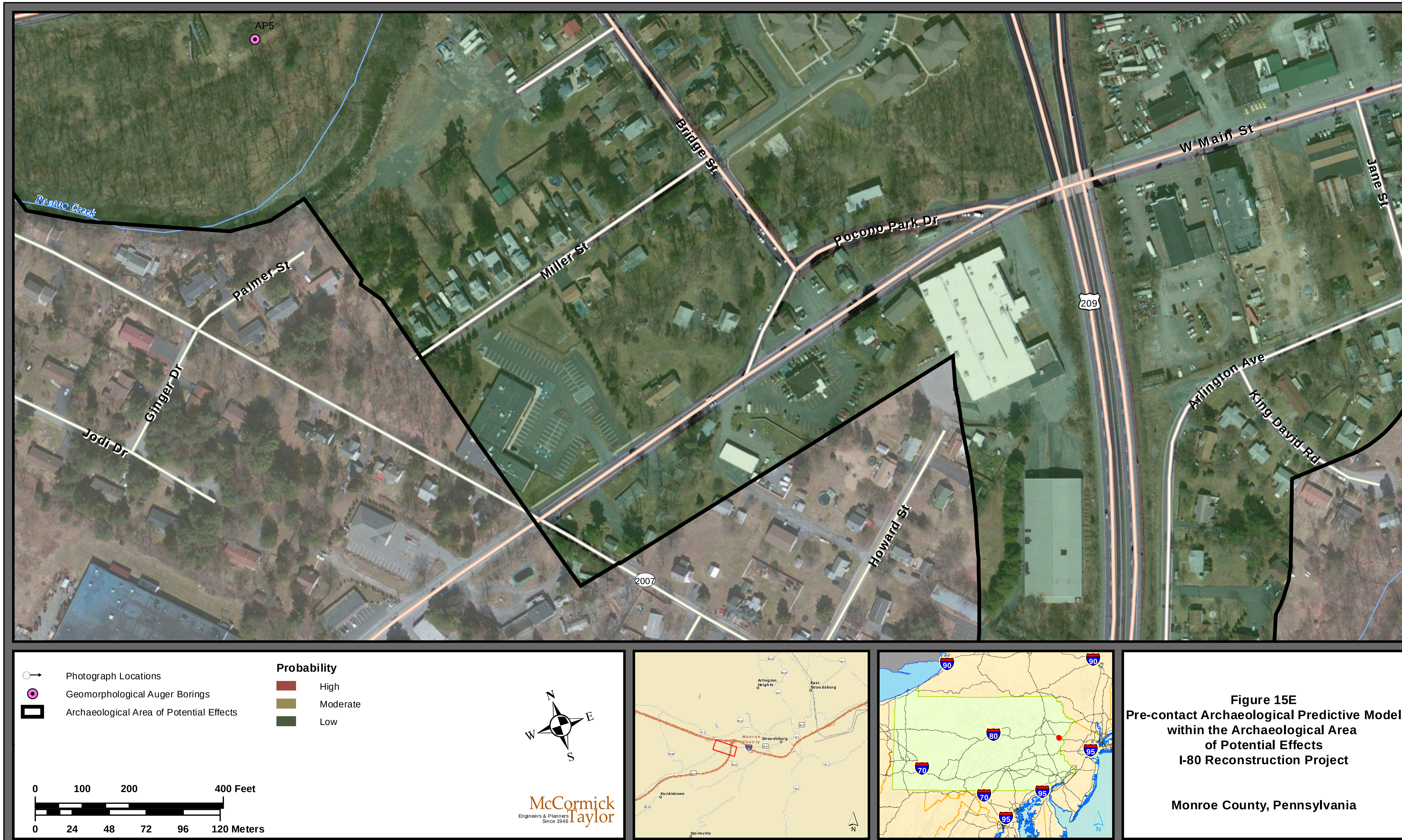


Figure 15E
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

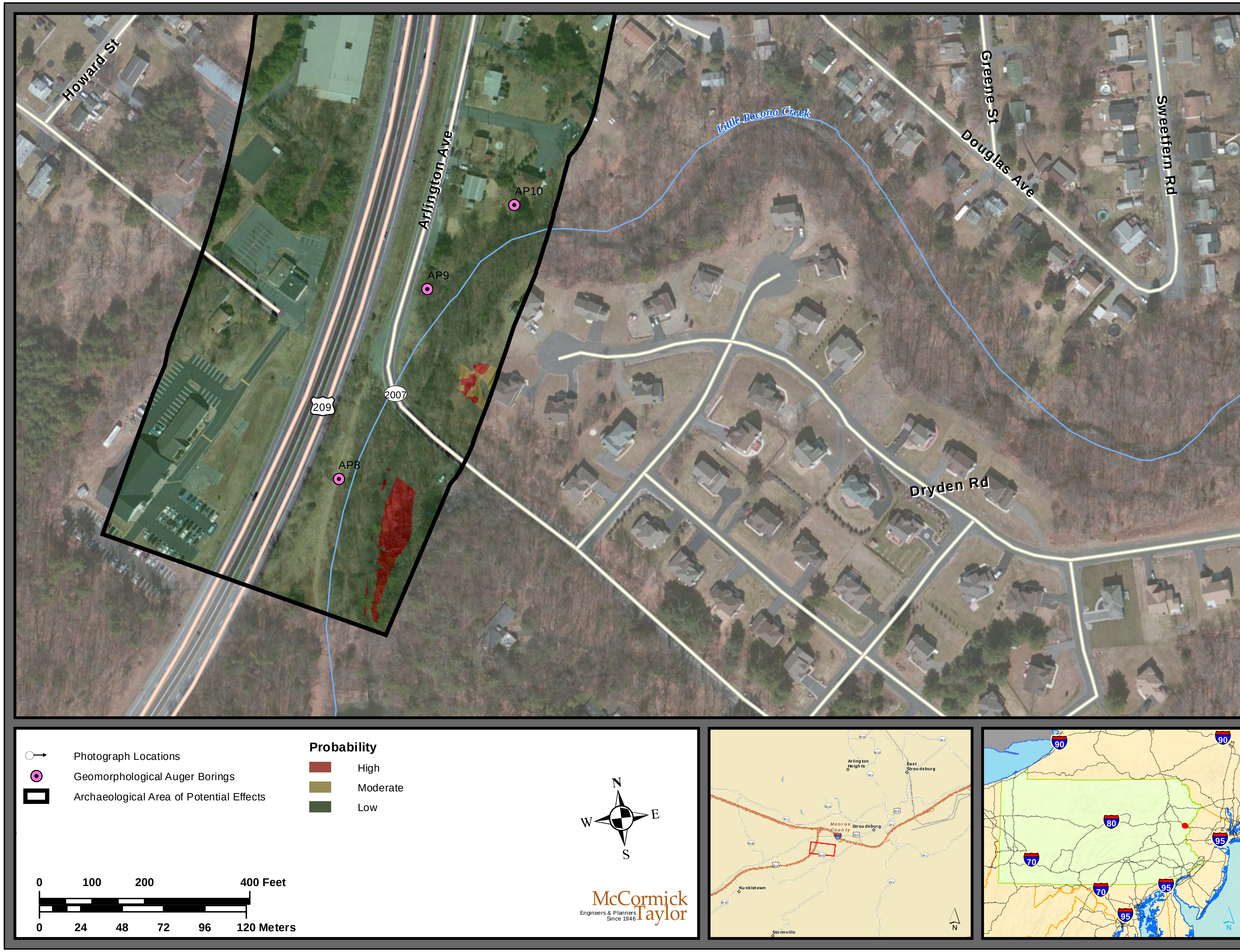


Figure 15F
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

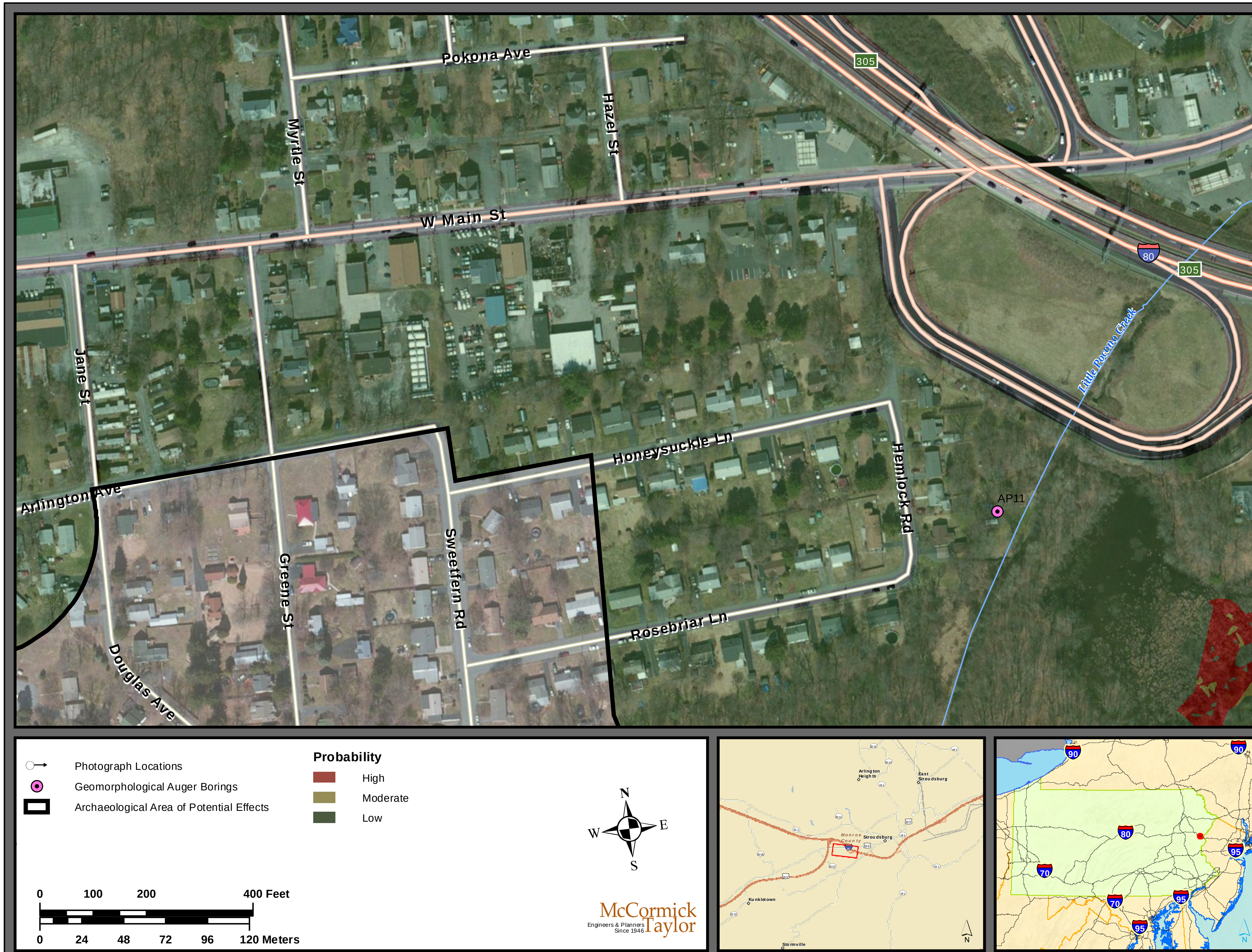


Figure 15G
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

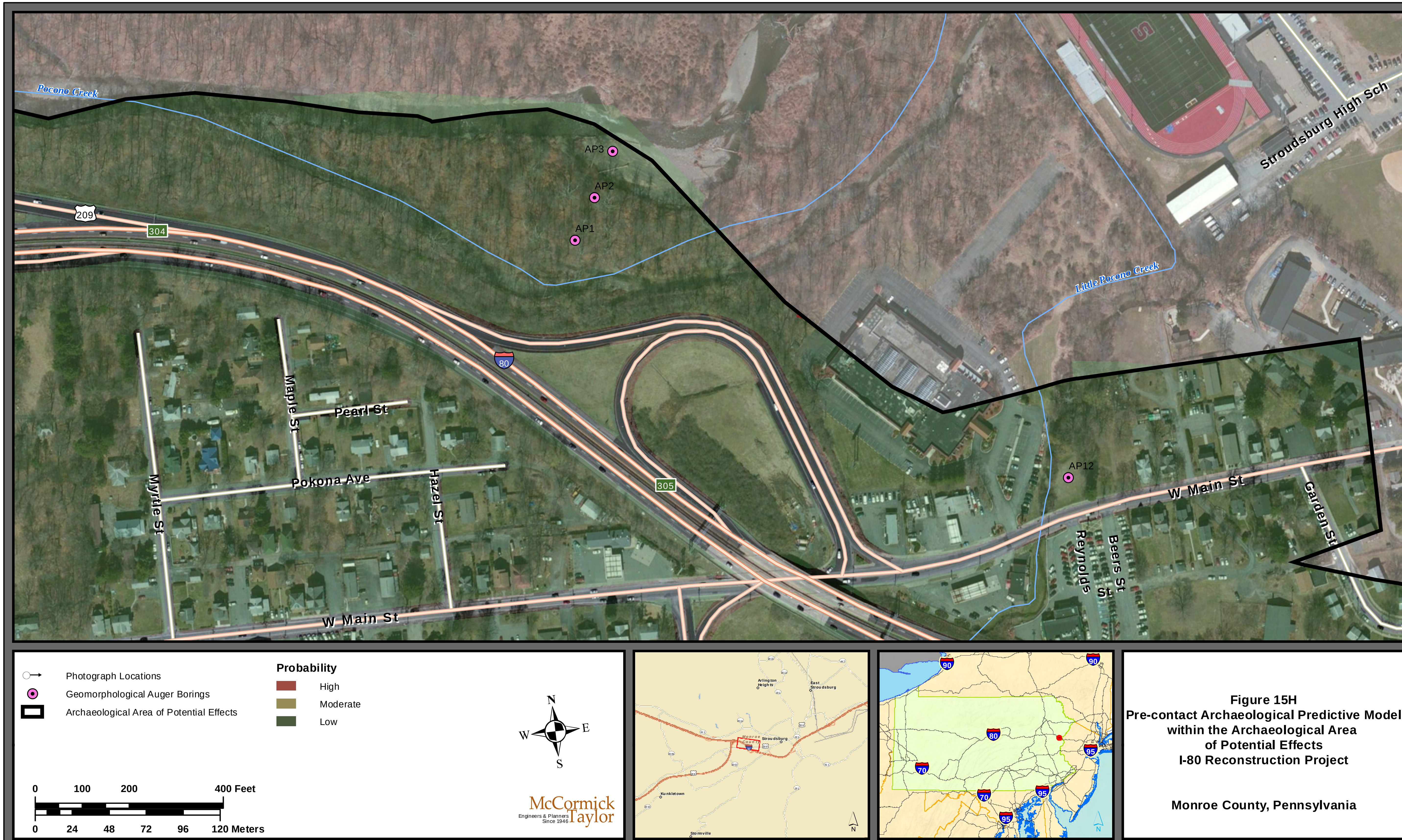


Figure 15H
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Photograph Locations
Geomorphological Auger Borings
Archaeological Area of Potential Effects

Probability

High
Moderate
Low

0 100 200 400 Feet
0 24 48 72 96 120 Meters

N W E S

McCormick Taylor
Engineers & Planners Since 1946

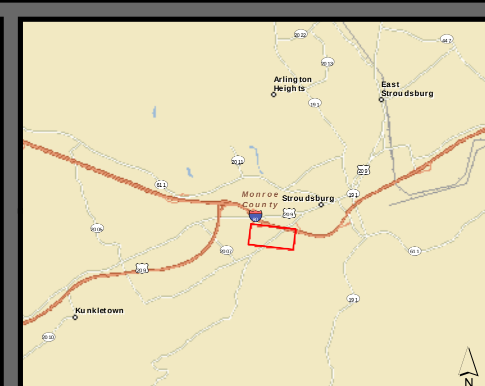


Figure 15I
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

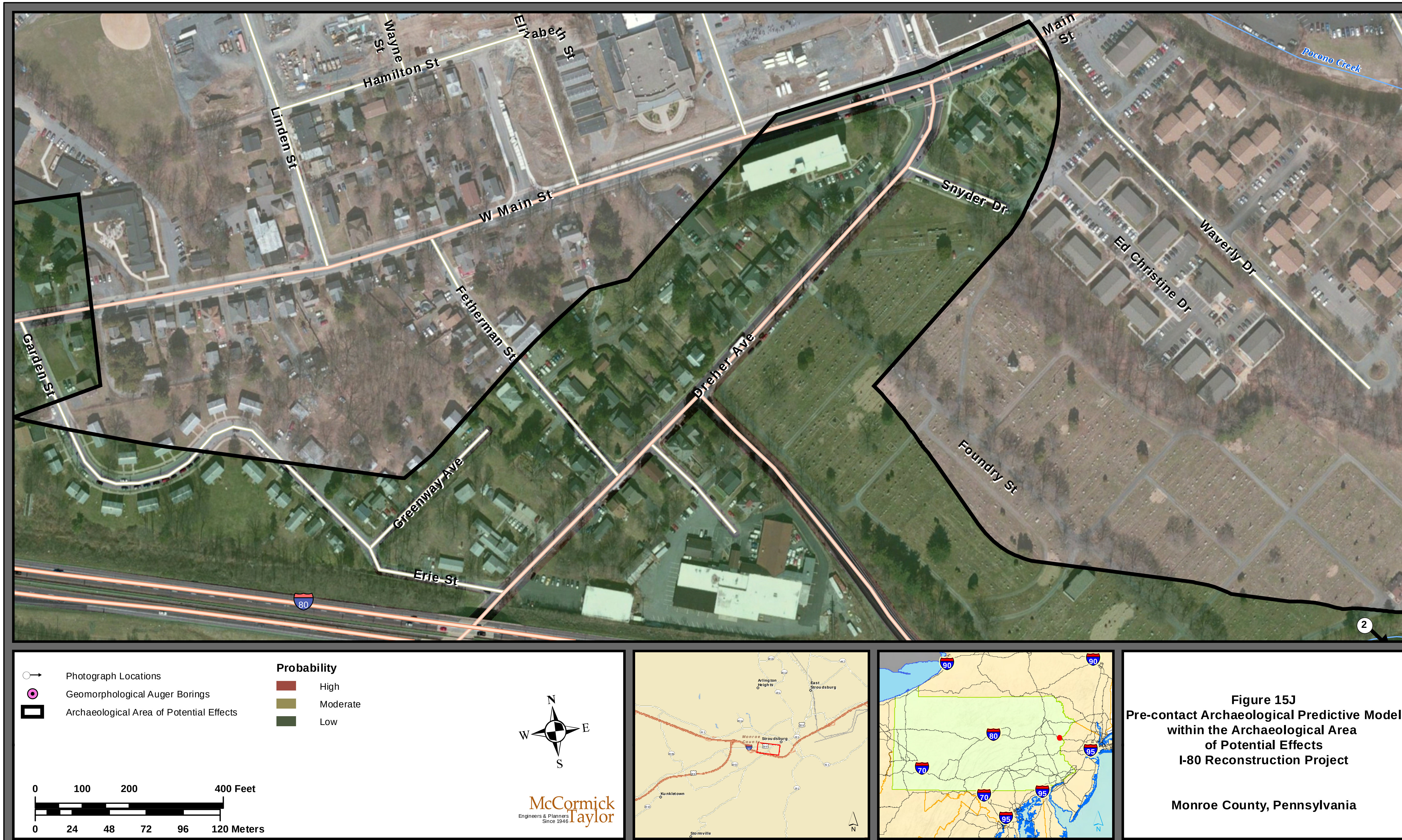


Figure 15J
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

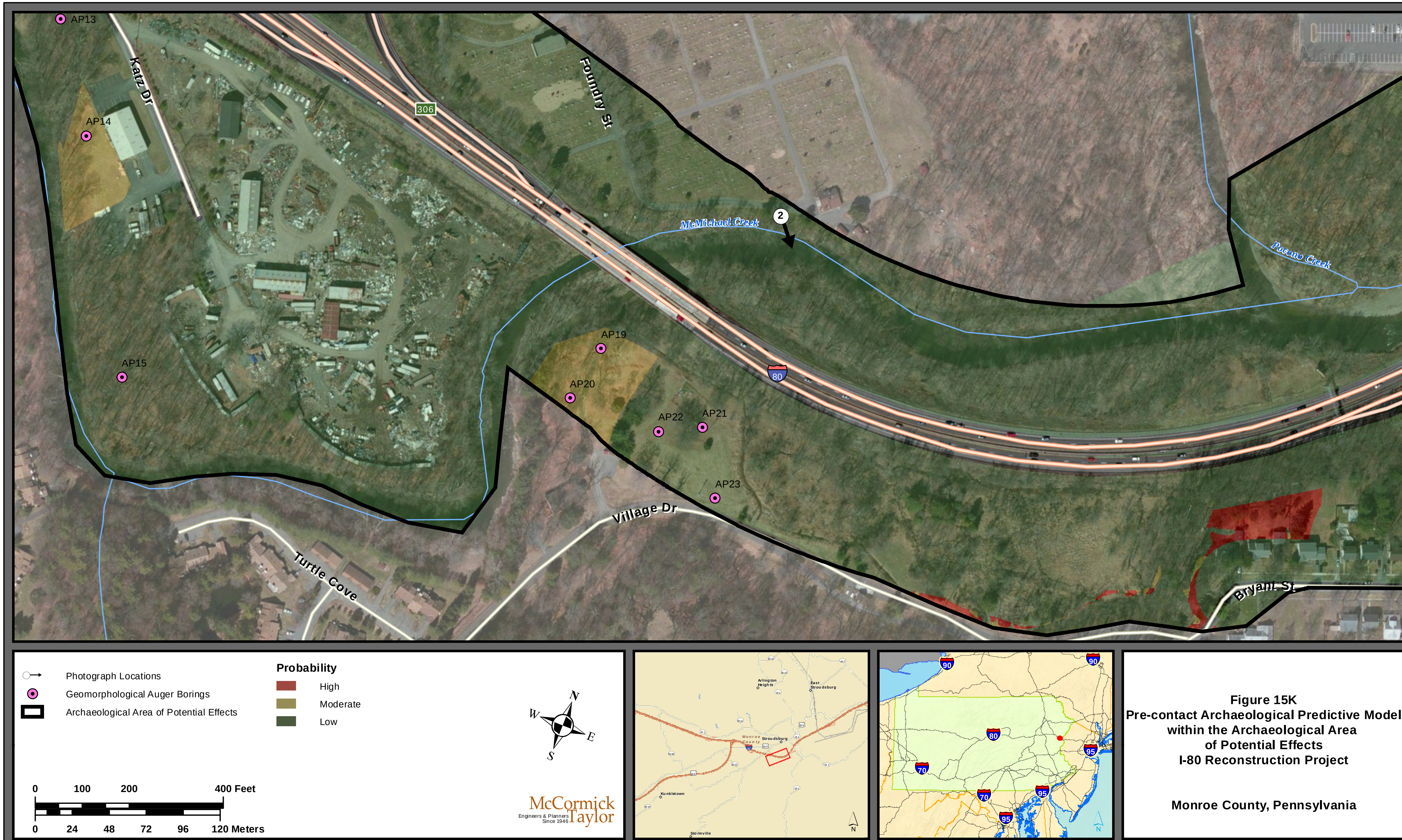


Figure 15K
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

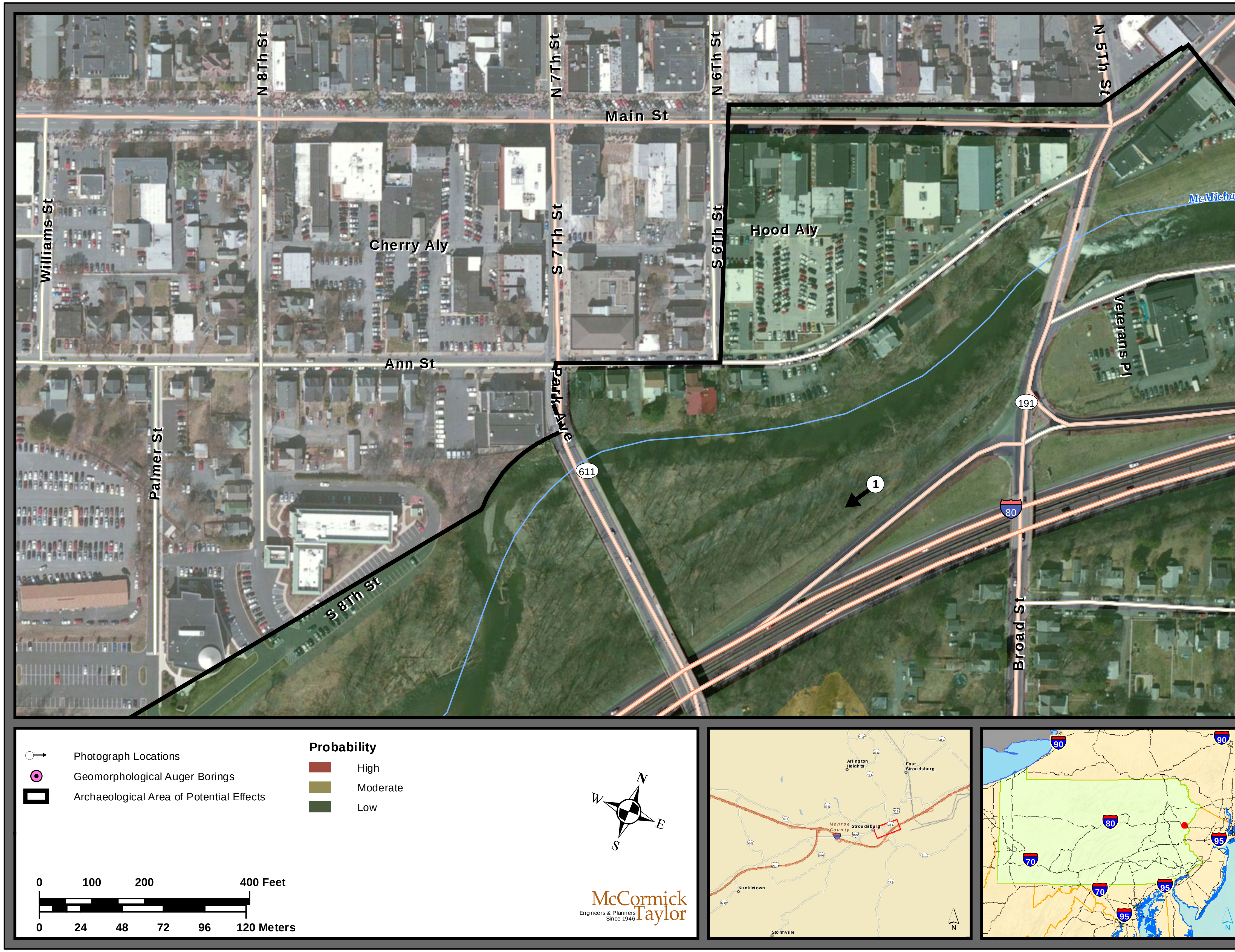


Figure 15L
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

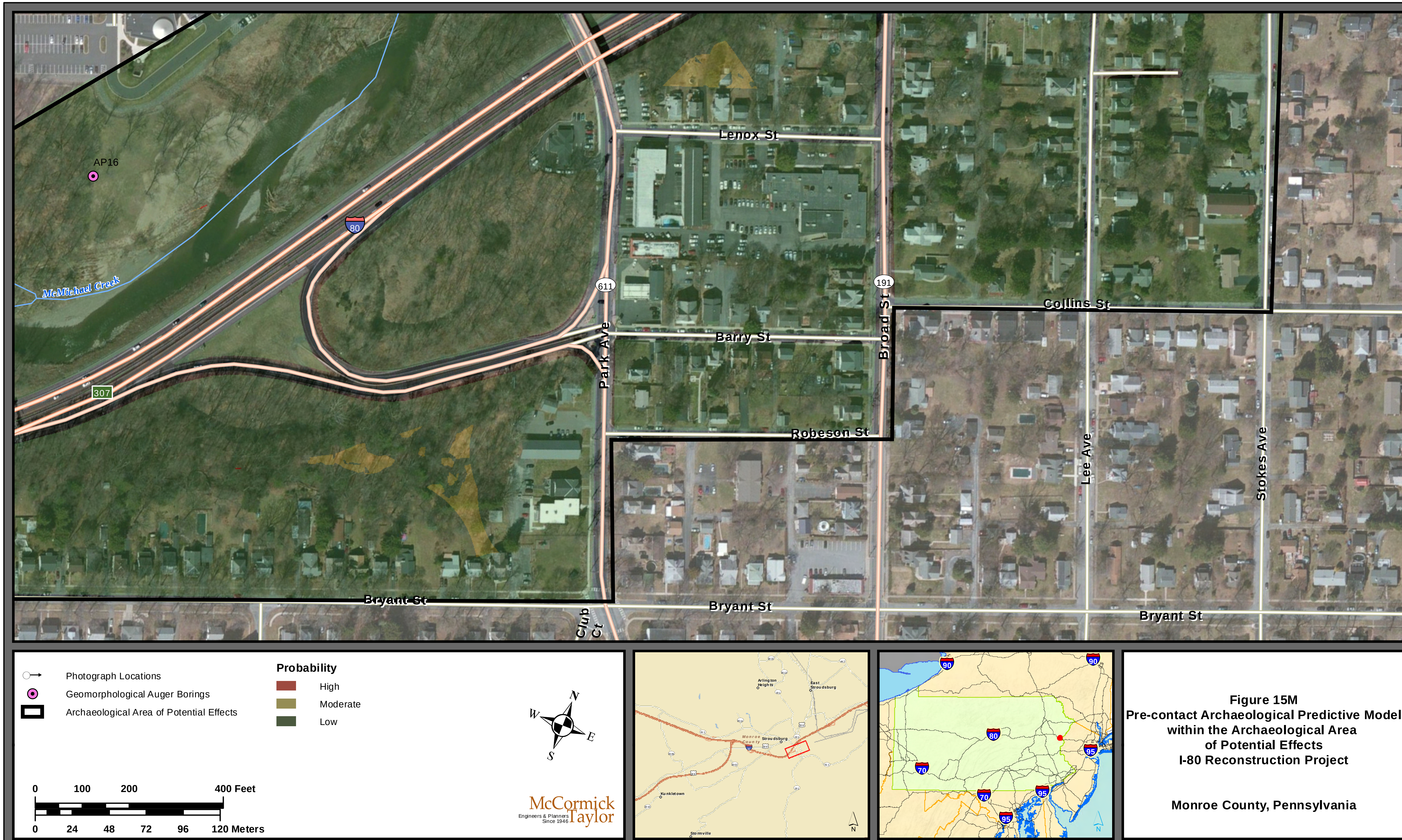


Figure 15M
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

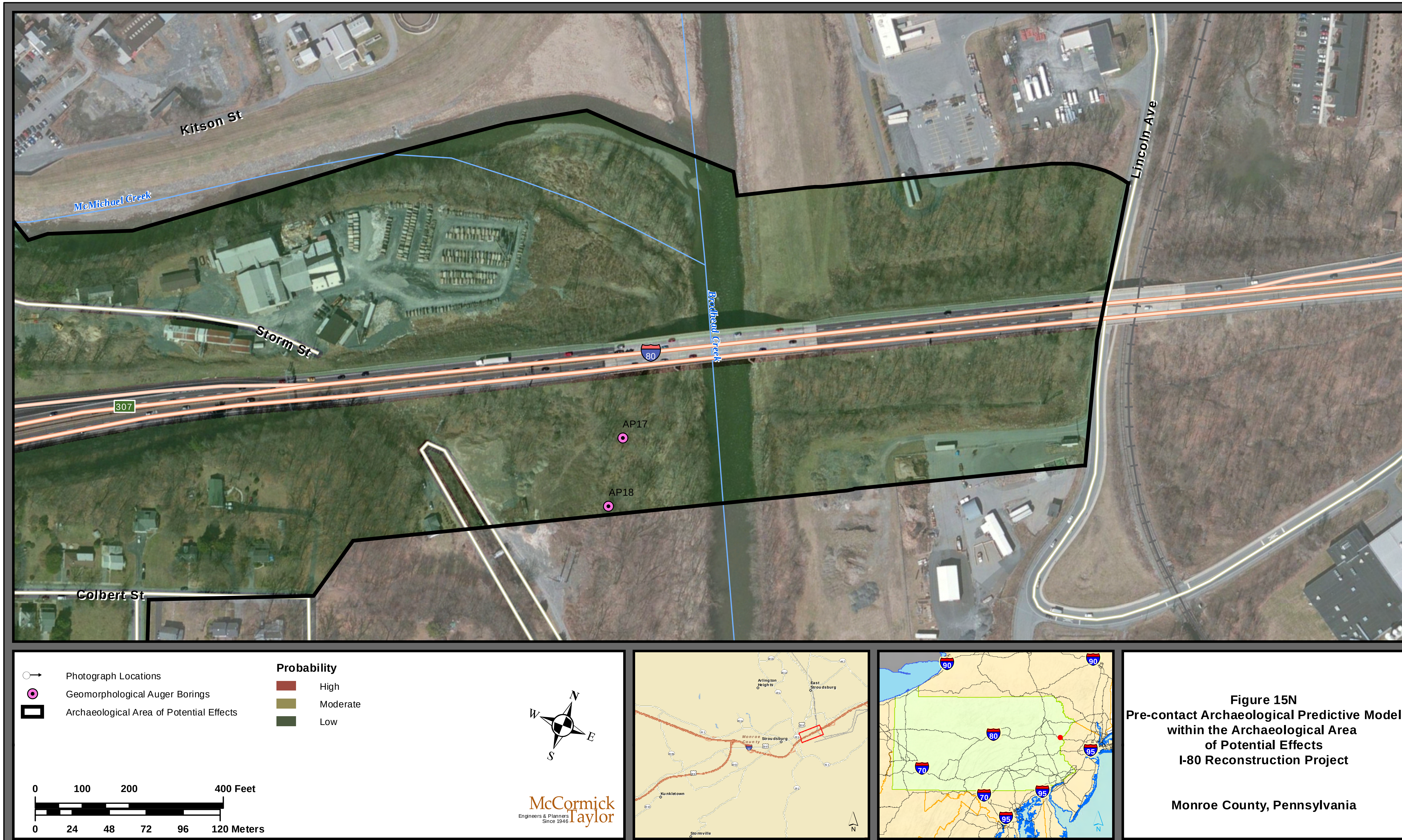


Figure 15N
Pre-contact Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

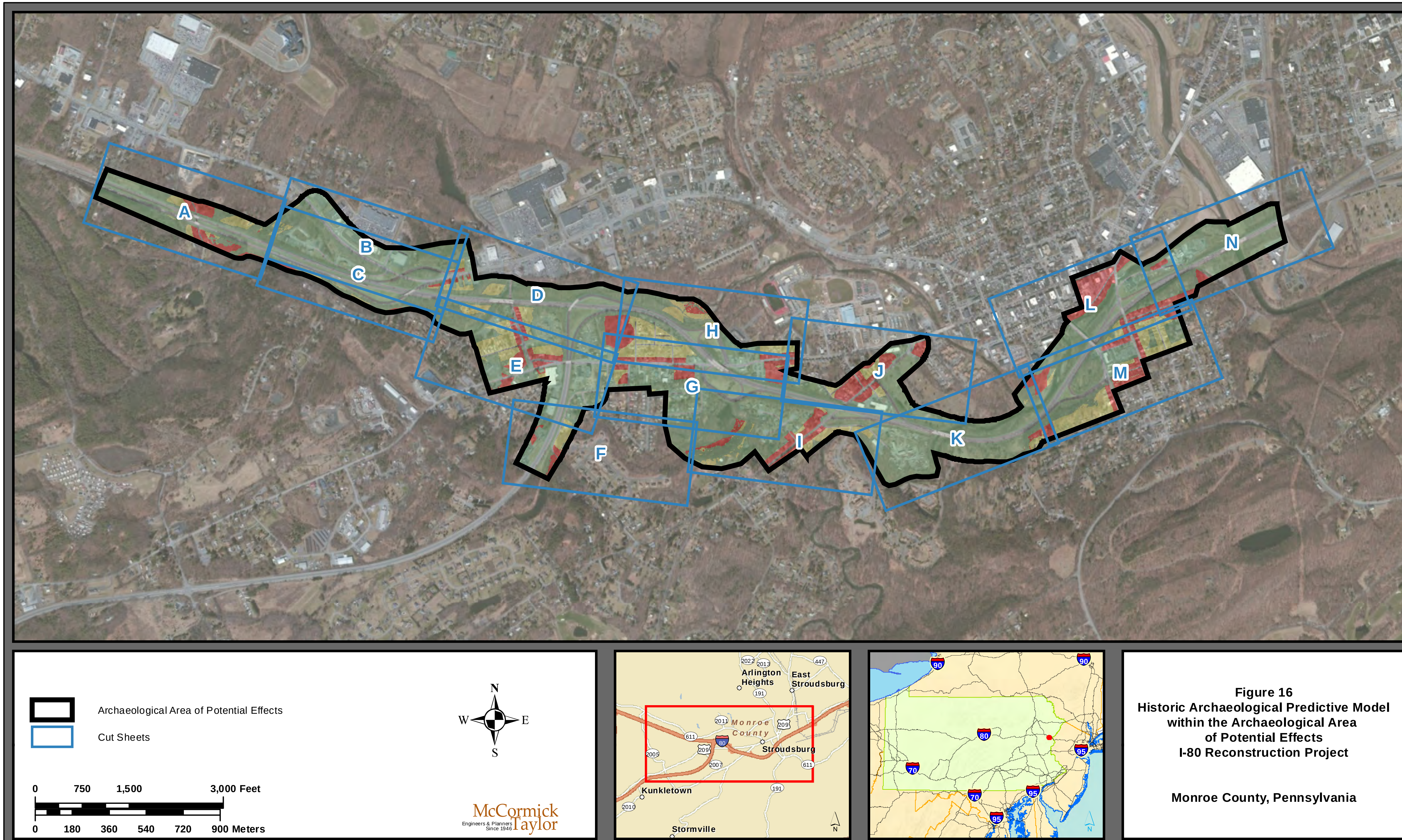


Figure 16
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects I-80 Reconstruction Project

Monroe County, Pennsylvania

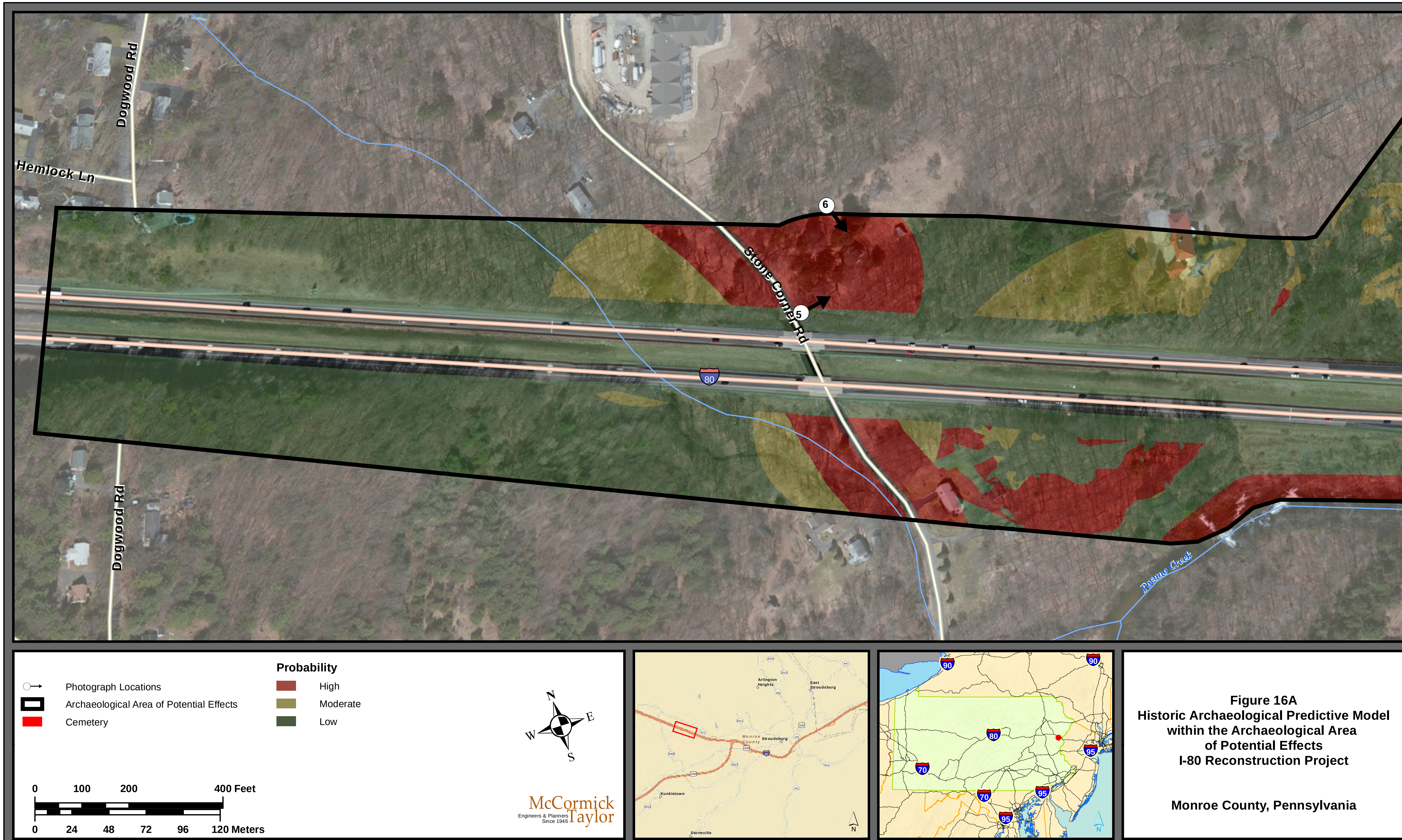


Figure 16A
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

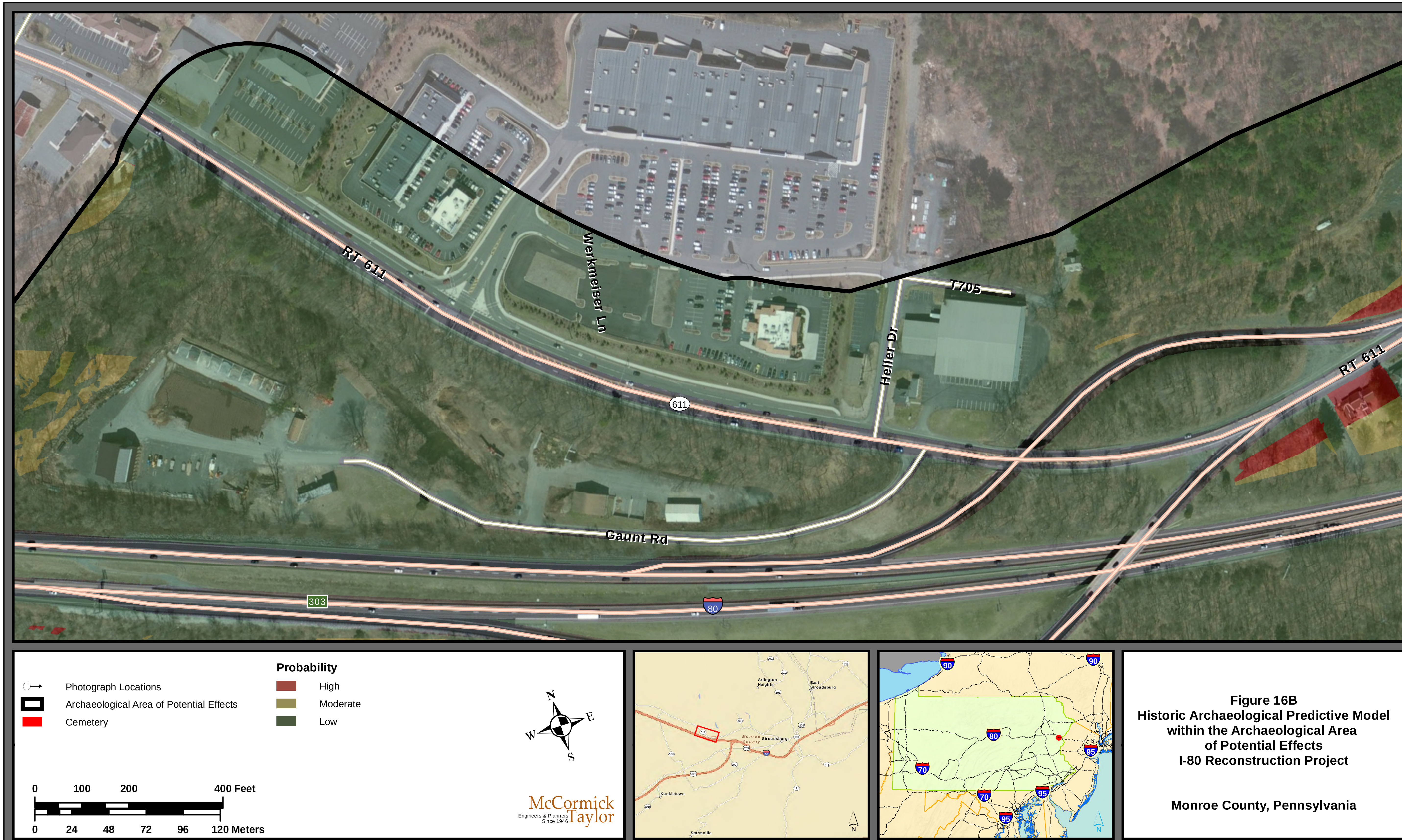


Figure 16B
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

04982_hb_I-80_Reconstruction_his_model_cut_sheets_ANB 5/29/2014 10:35:20 AM

Photograph Locations
Archaeological Area of Potential Effects
Cemetery

Probability

High
Moderate
Low

0 100 200 400 Feet

0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners Since 1946

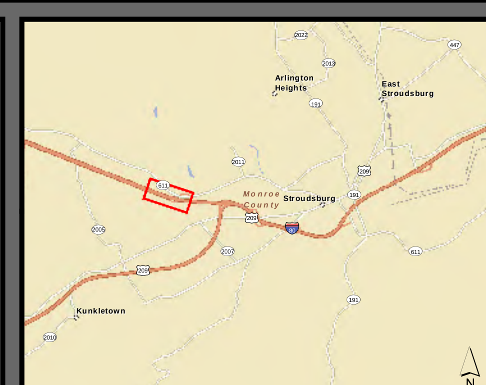


Figure 16C
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Photograph Locations
Archaeological Area of Potential Effects
Cemetery

Probability
- High
- Moderate
- Low

0 100 200 400 Feet
0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners Since 1946

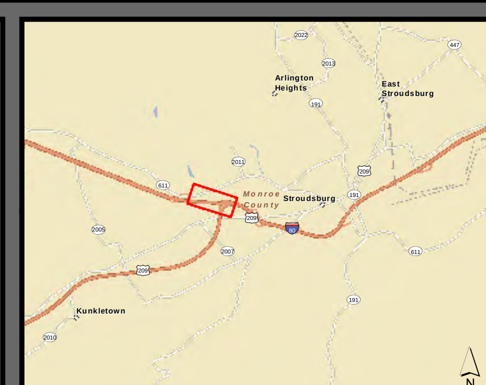
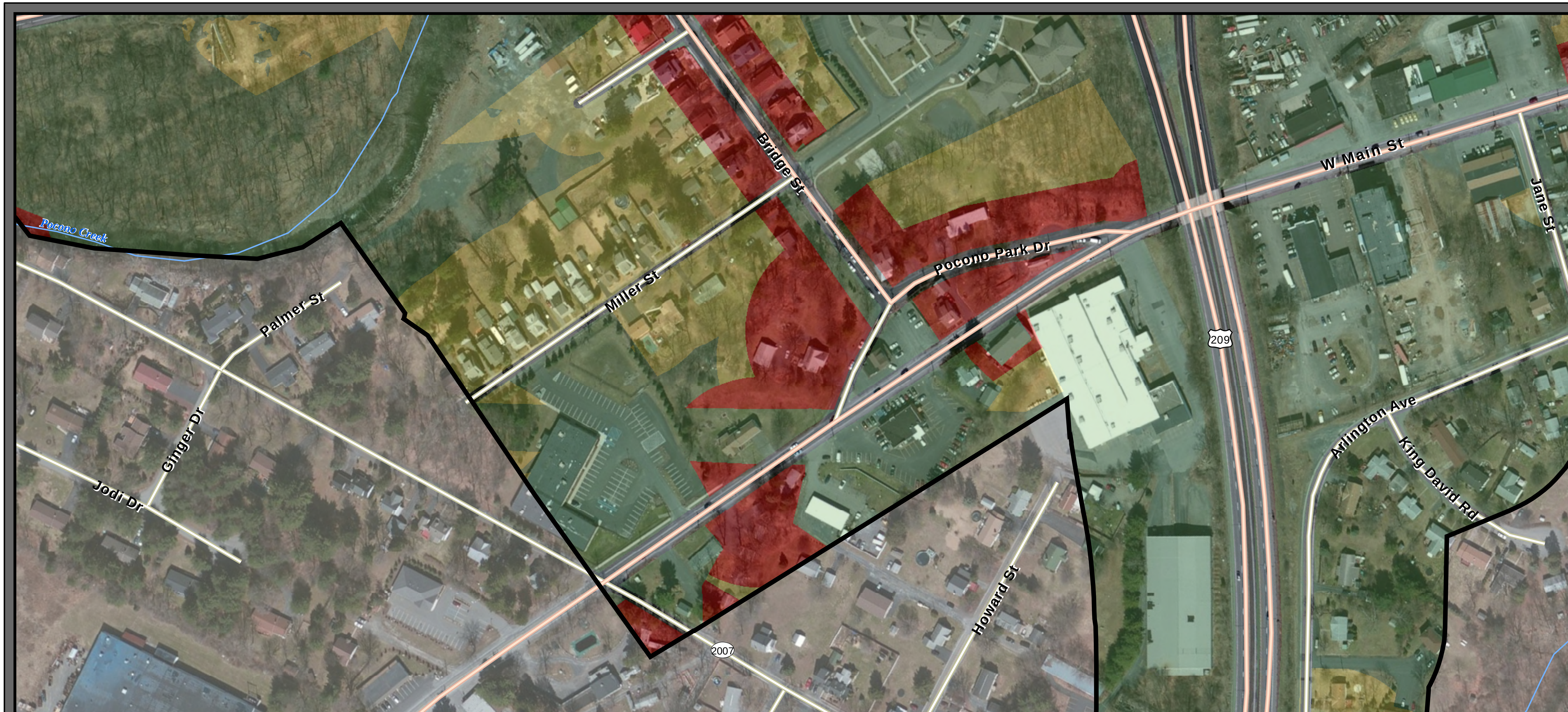


Figure 16D
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



Photograph Locations
Archaeological Area of Potential Effects
Cemetery

Probability

High
Moderate
Low

0 100 200 400 Feet

0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners Since 1946

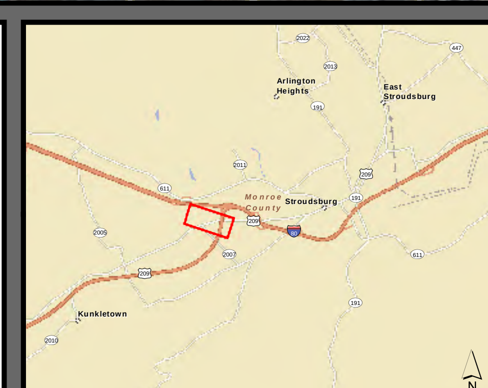


Figure 16E
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Photograph Locations
Archaeological Area of Potential Effects
Cemetery

Probability
High
Moderate
Low

0 100 200 400 Feet
0 24 48 72 96 120 Meters

N W E S

McCormick Taylor
Engineers & Planners Since 1946

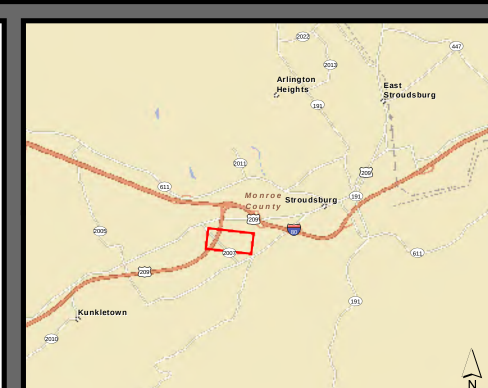


Figure 16F
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

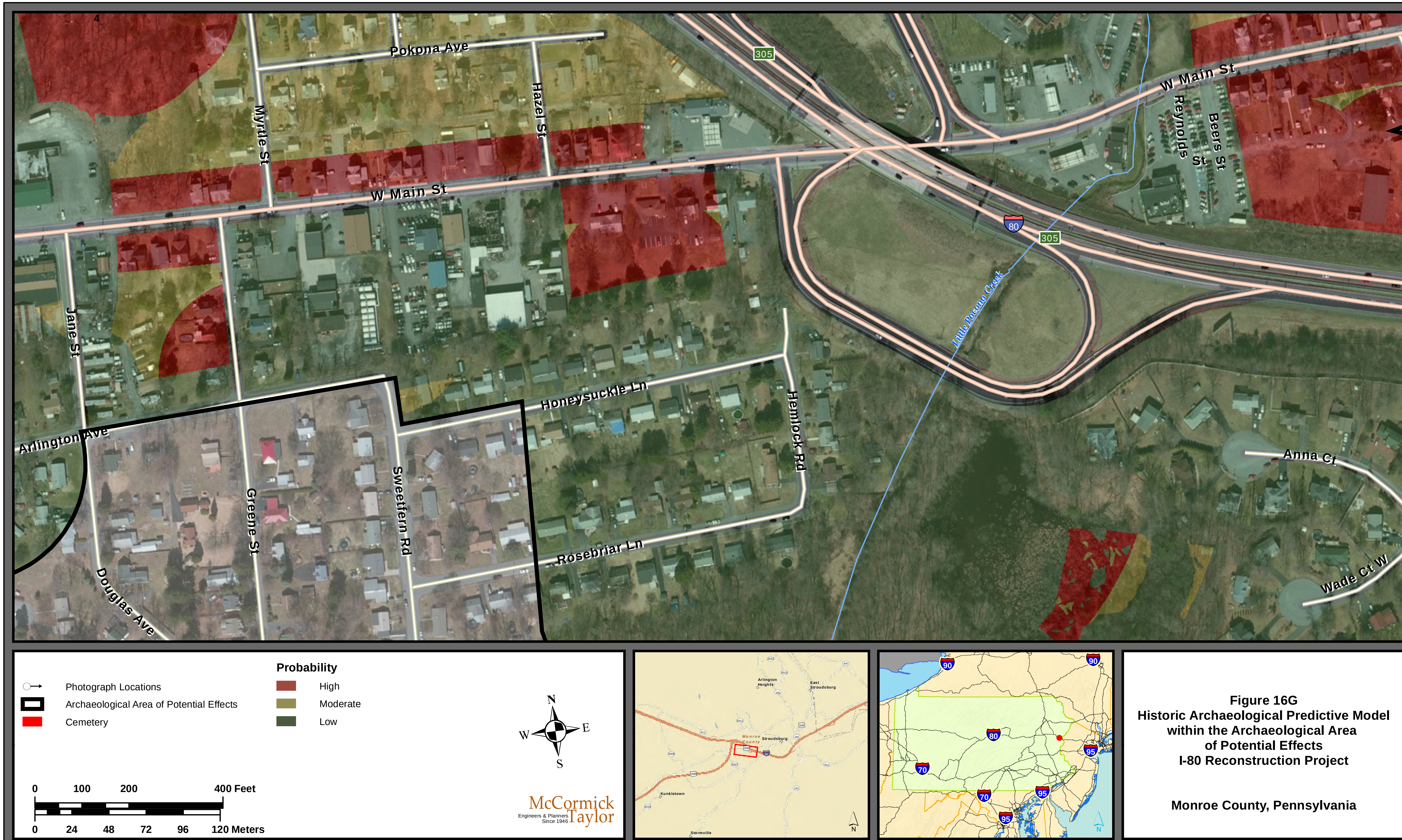


Figure 16G
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

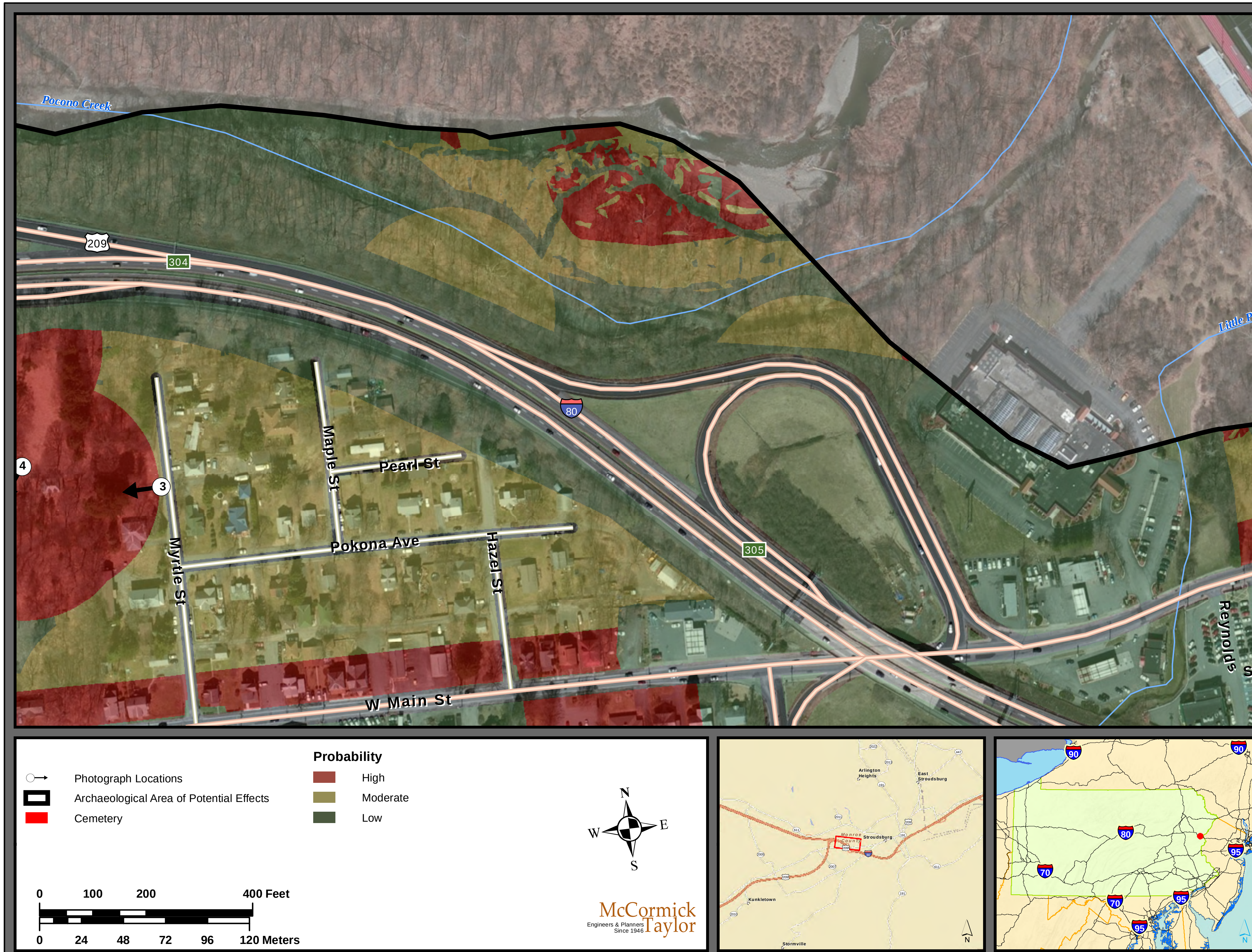


Figure 16H
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

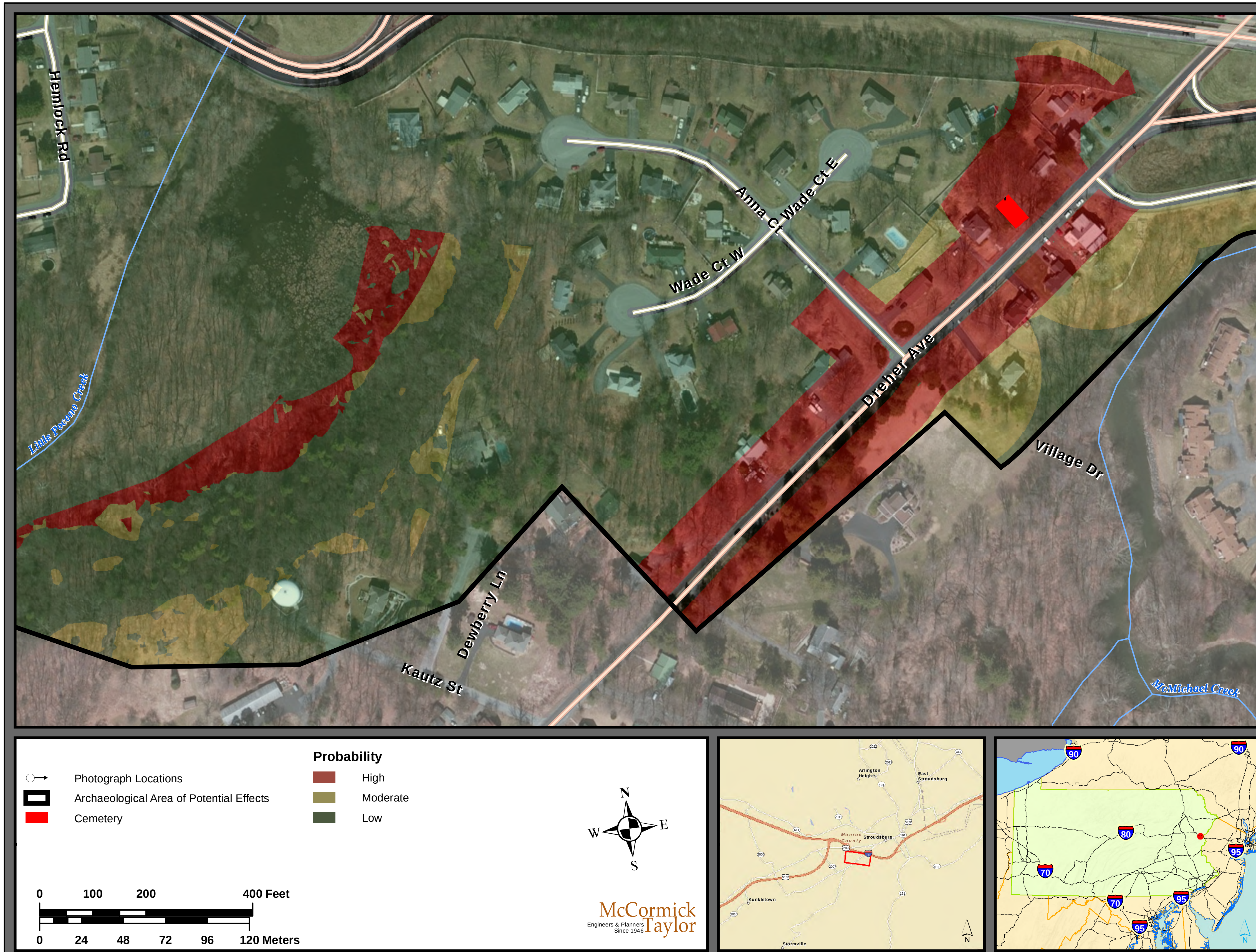


Figure 16I
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Photograph Locations
Archaeological Area of Potential Effects
Cemetery

Probability
High
Moderate
Low

0 100 200 400 Feet
0 24 48 72 96 120 Meters

N S E W

McCormick Taylor
Engineers & Planners Since 1946

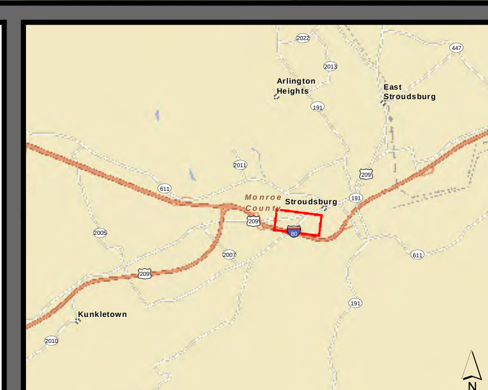


Figure 16J
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

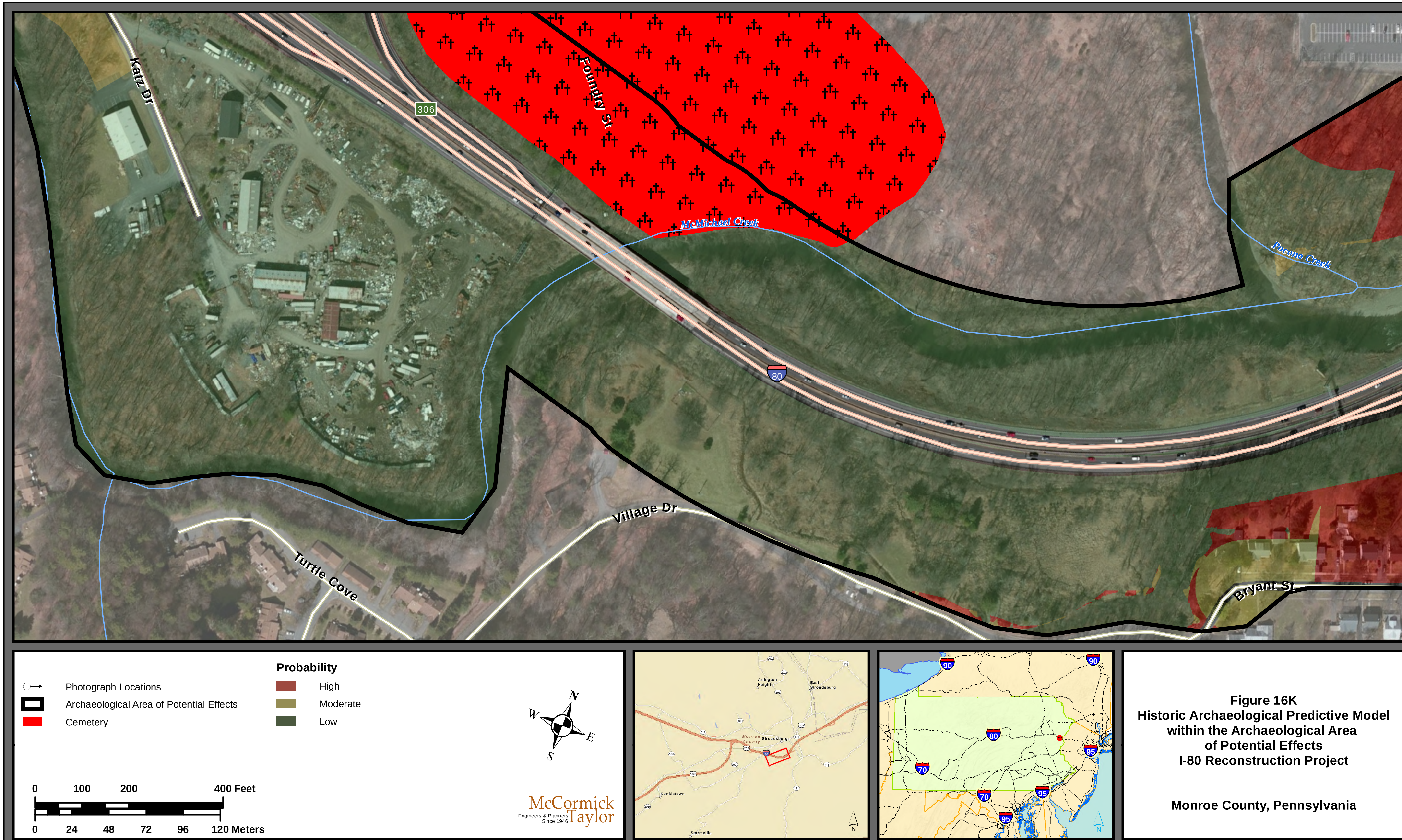


Figure 16K
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

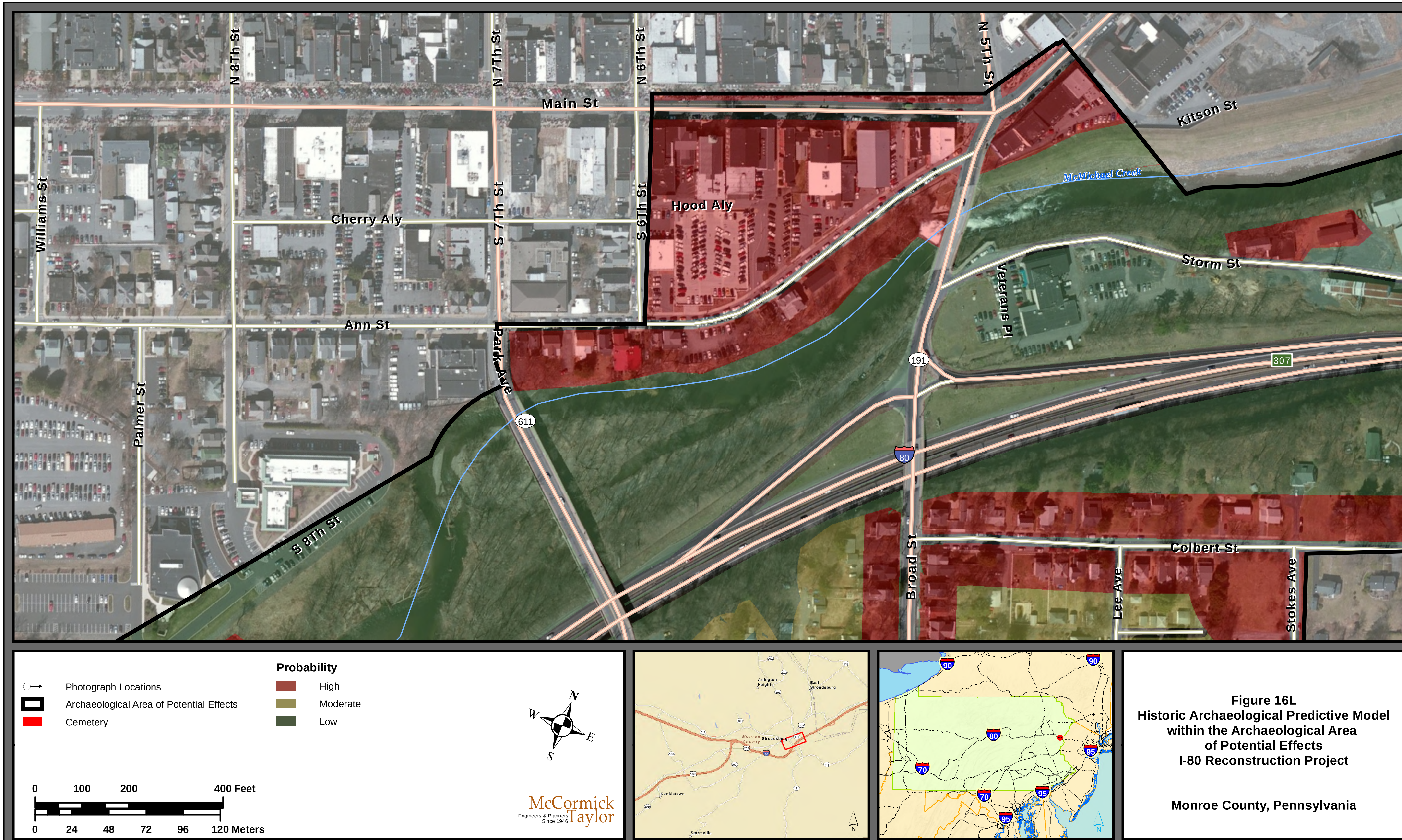
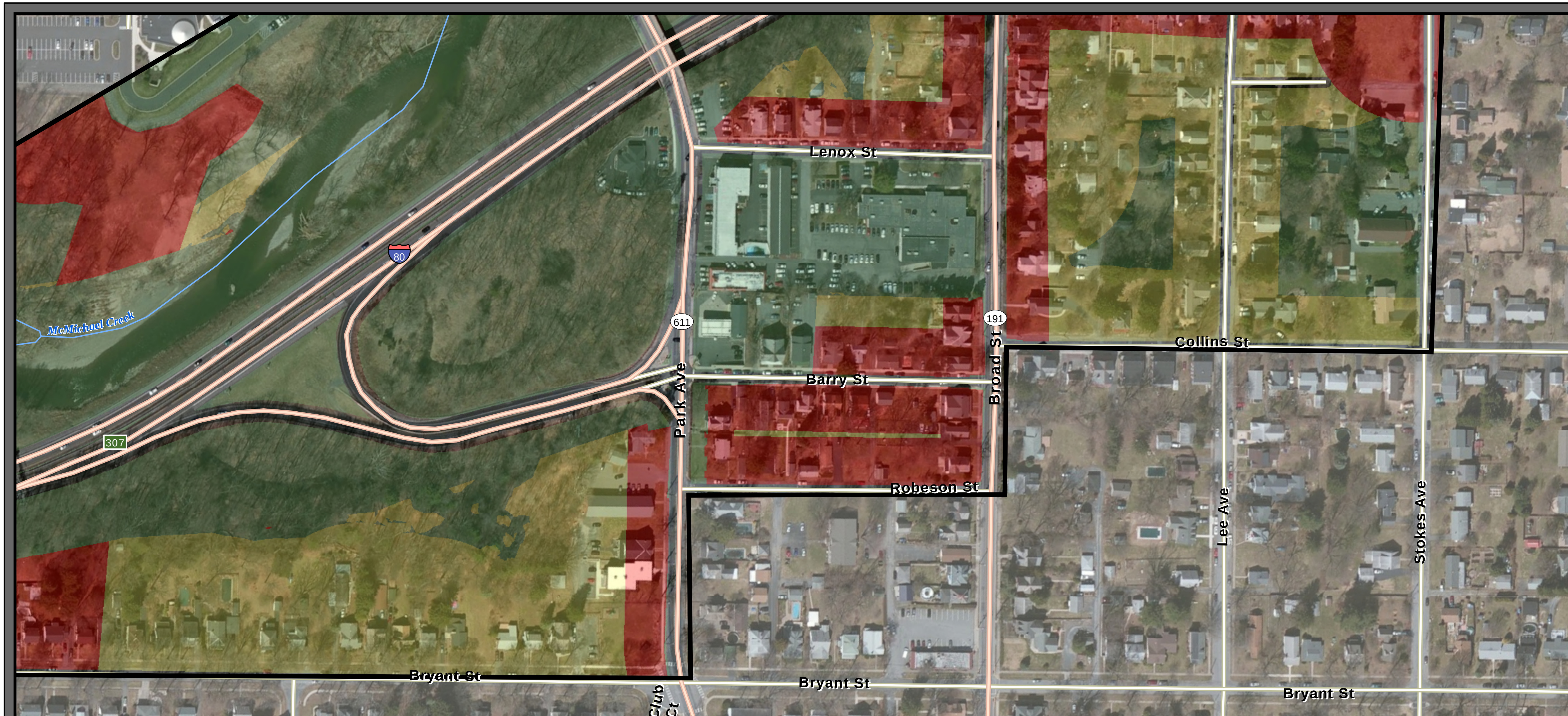


Figure 16L
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



Photograph Locations
Archaeological Area of Potential Effects
Cemetery

Probability

High
Moderate
Low

0 100 200 400 Feet

0 24 48 72 96 120 Meters

McCormick Taylor
Engineers & Planners
Since 1946

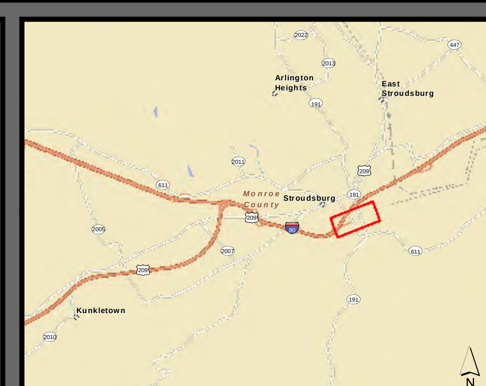


Figure 16M
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

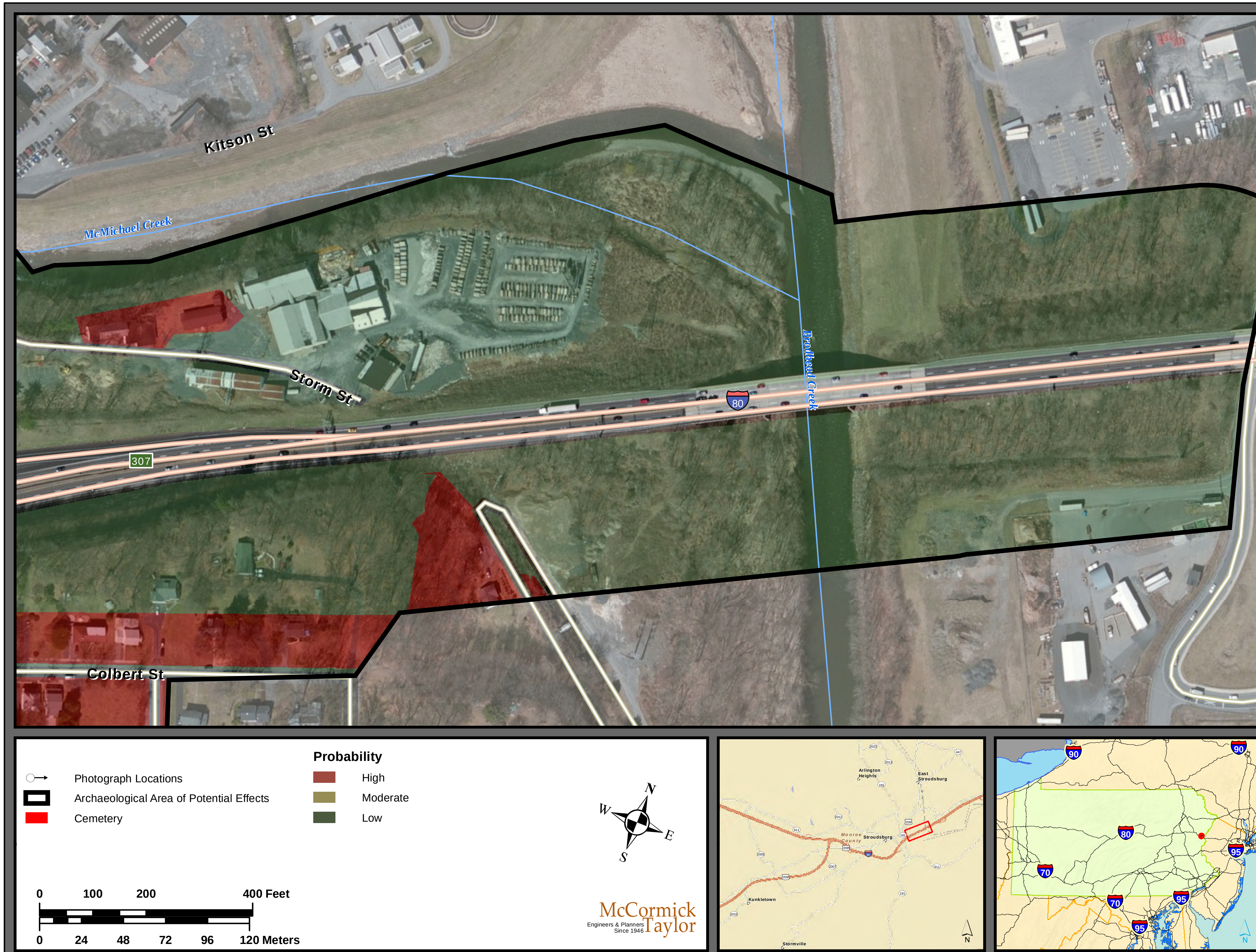


Figure 16N
Historic Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

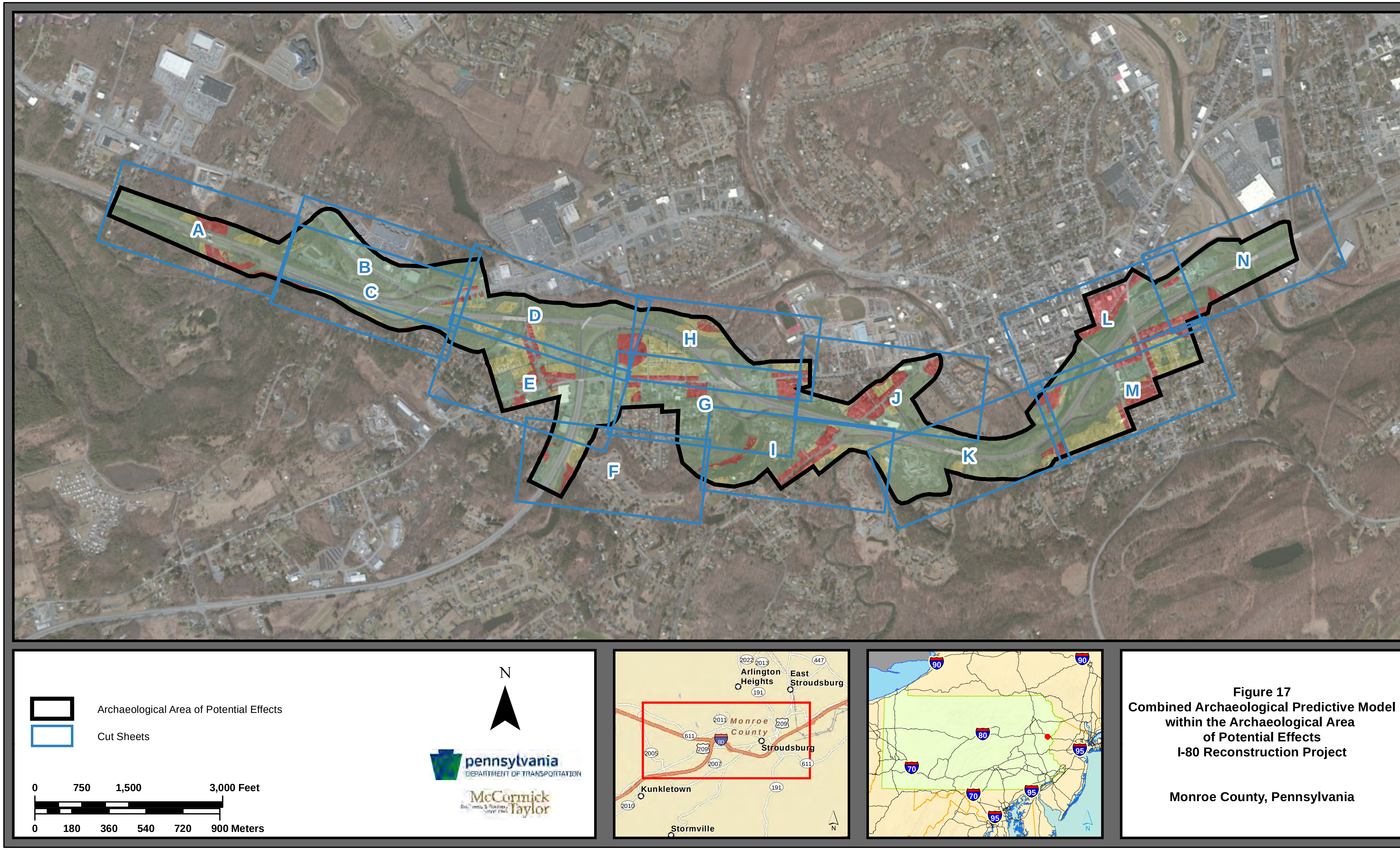


Figure 17
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Archaeological Area of Potential Effects

Probability

- High
- Moderate
- Low

0 100 200 400 Feet

0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners Since 1946

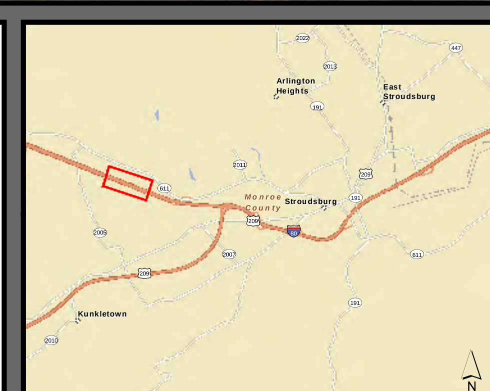
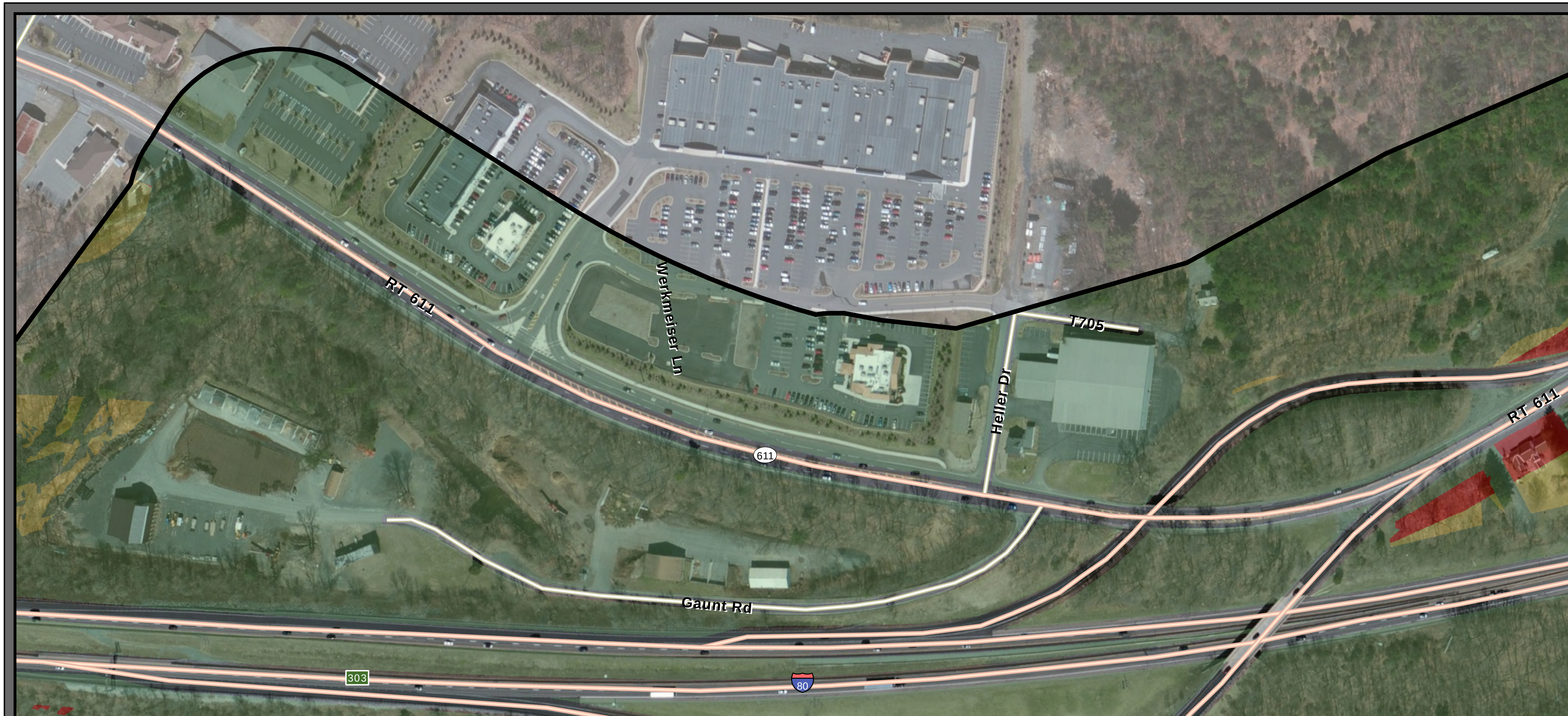


Figure 17A
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



Archaeological Area of Potential Effects

Probability

- High
- Moderate
- Low

0 100 200 400 Feet

0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners Since 1946

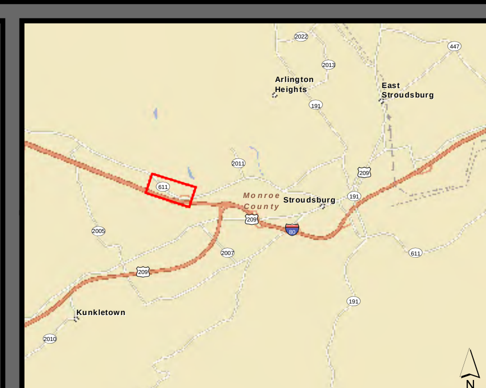


Figure 17B
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

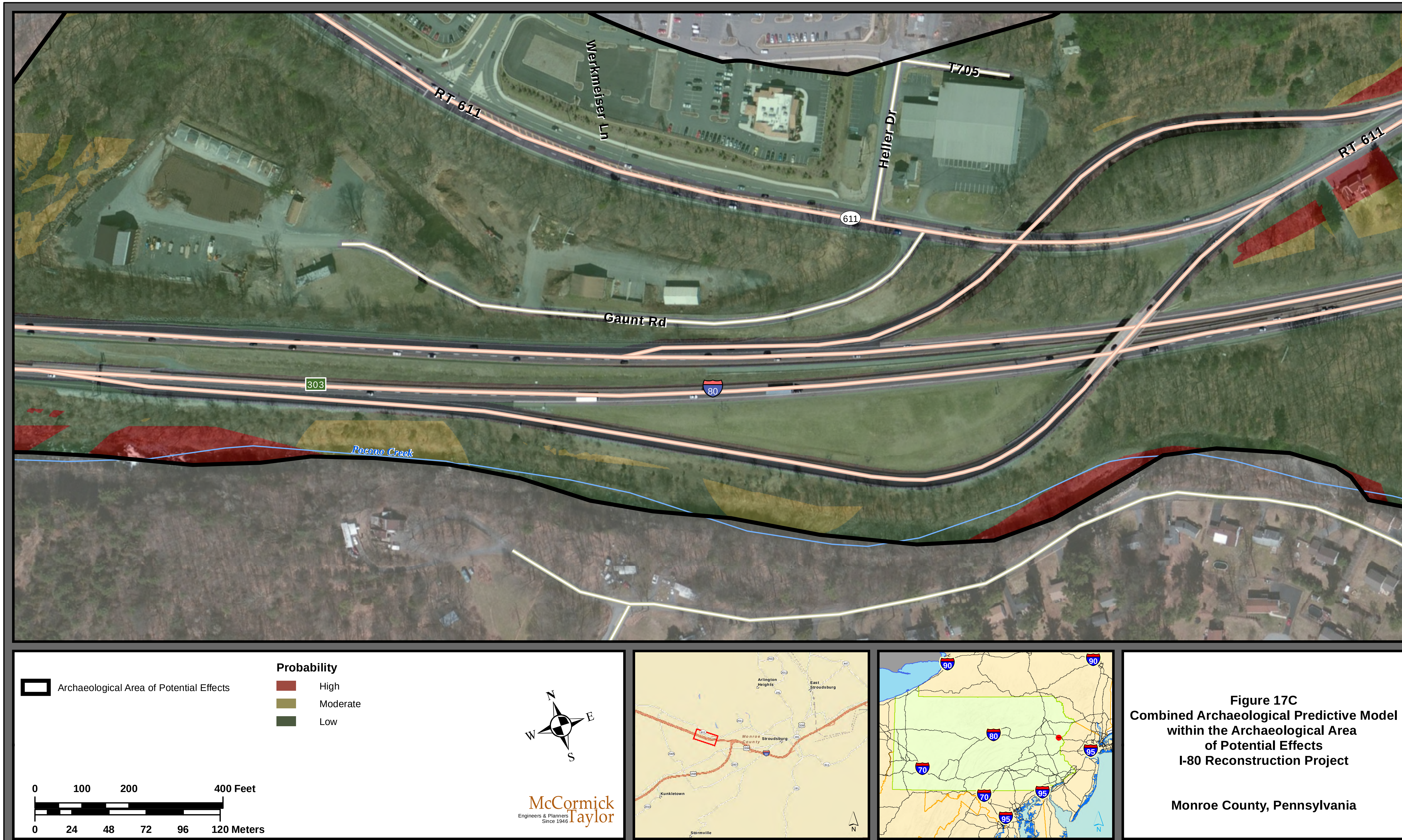


Figure 17C
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

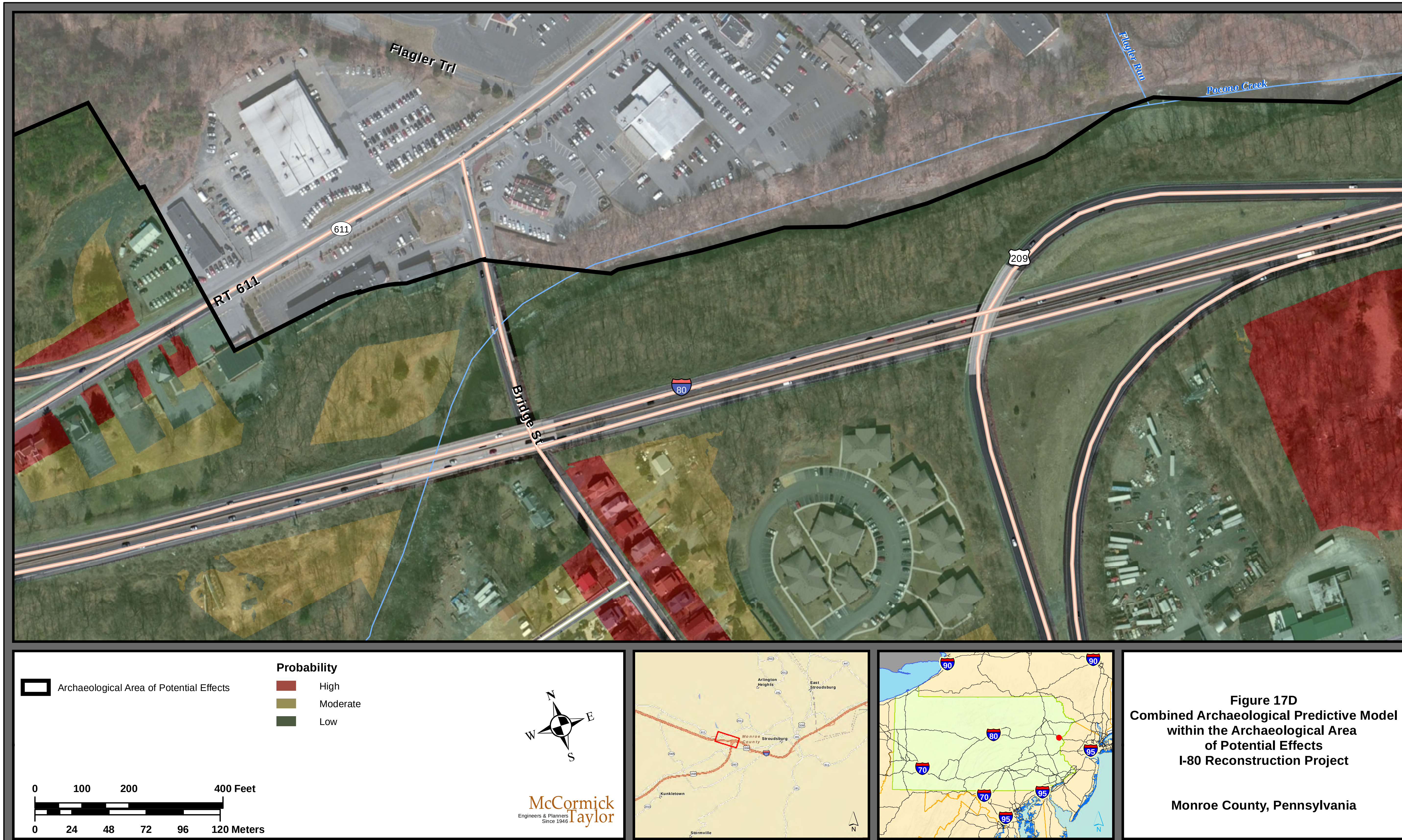
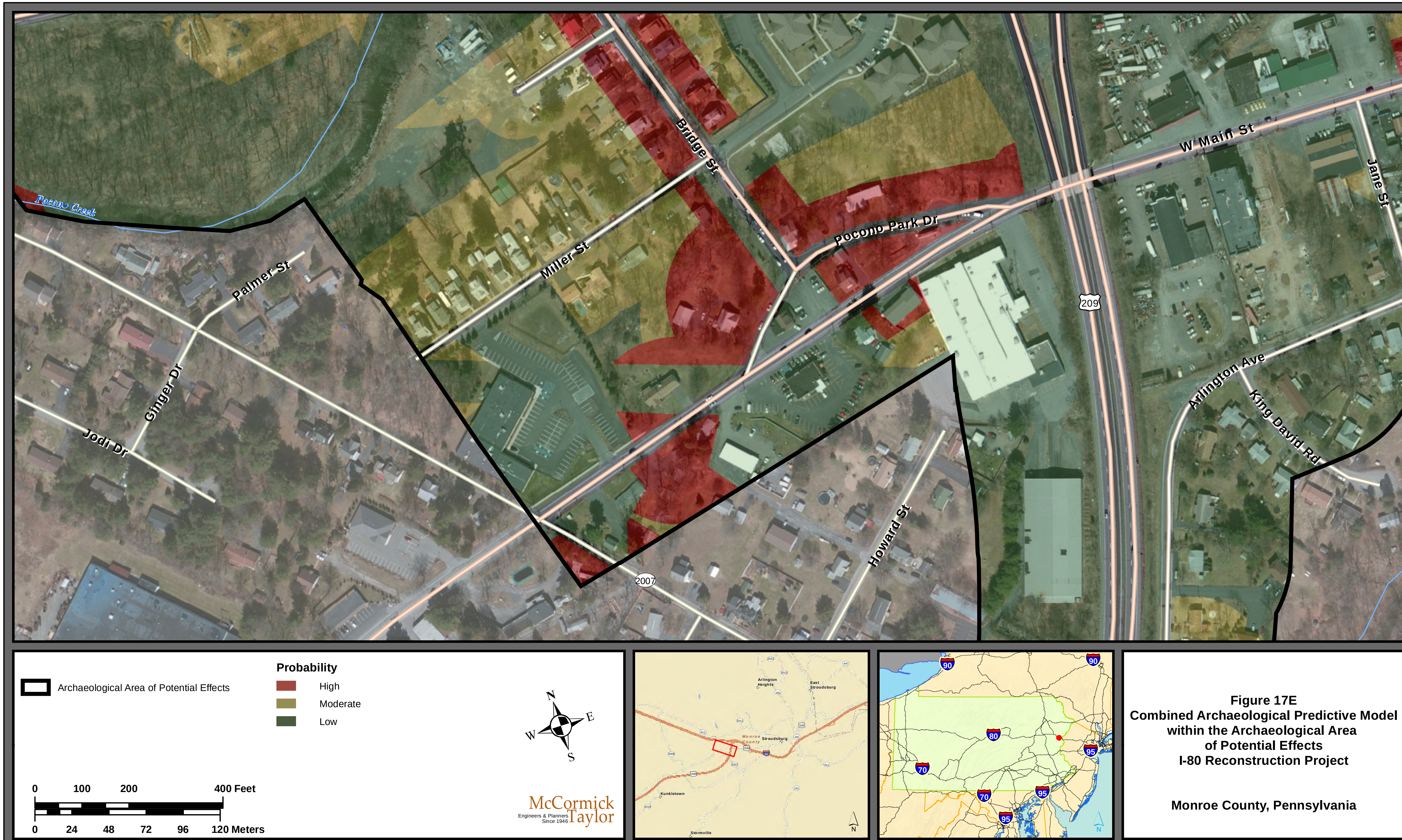


Figure 17D
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



Pocono Creek
Bridge St
Miller St
Palmer St
Ginger Dr
Jodi Dr
Pocono Park Dr
W Main St
Jane St
209
Arlington Ave
King David Rd
Howard St
2007
Archaeological Area of Potential Effects
Probability
High
Moderate
Low
0 100 200 400 Feet
0 24 48 72 96 120 Meters
N
E
W
S
McCormick Taylor
Engineers & Planners Since 1946
Arlington Heights
East Stroudsburg
Stroudsburg
Monroe County
Kunkletown
Stormville
90
80
70
95
Figure 17E
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project
Monroe County, Pennsylvania
05159_hb_I-80_Reconstruction_combined_model_cut_sheets_ANB 5/29/2014 11:50:18 AM

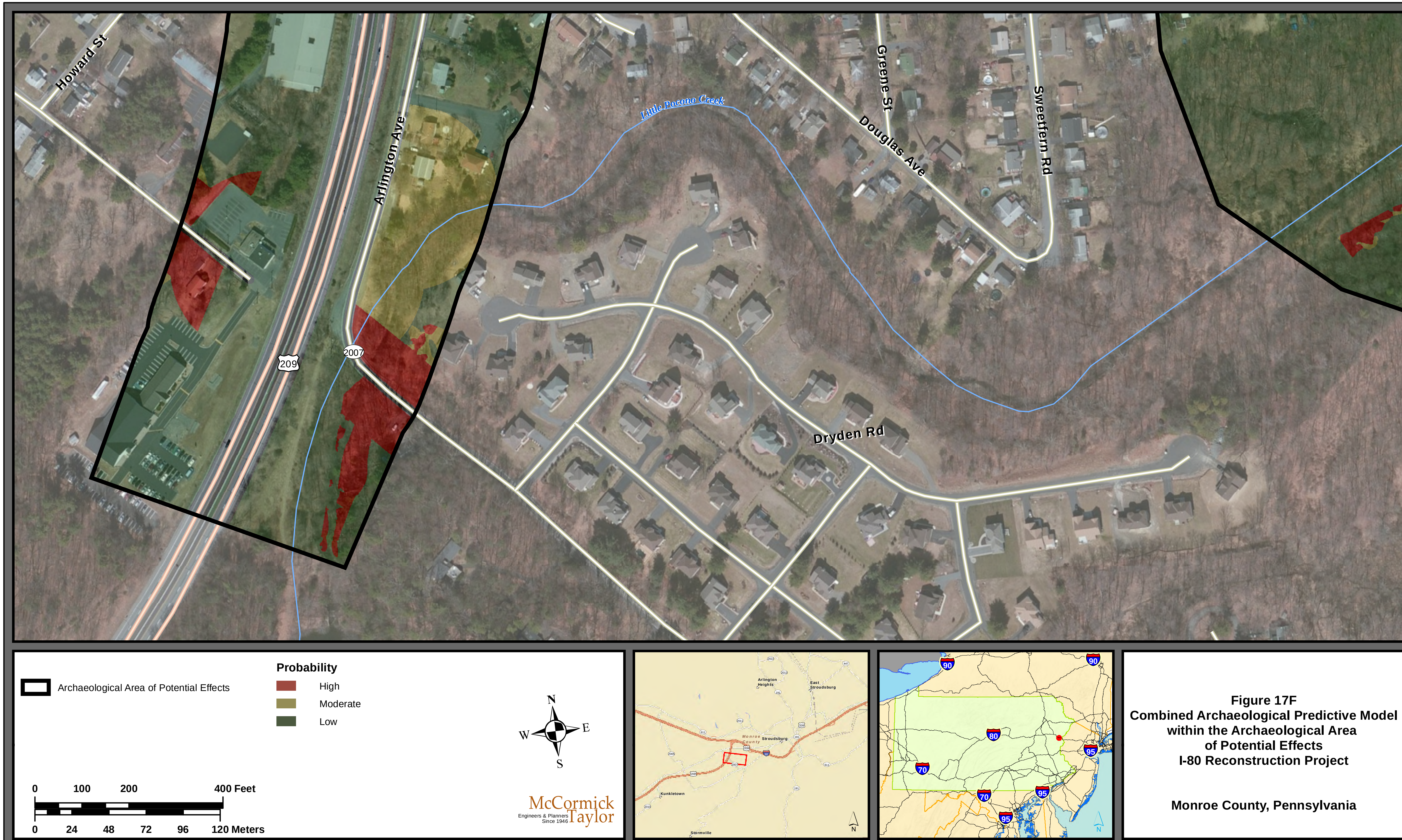
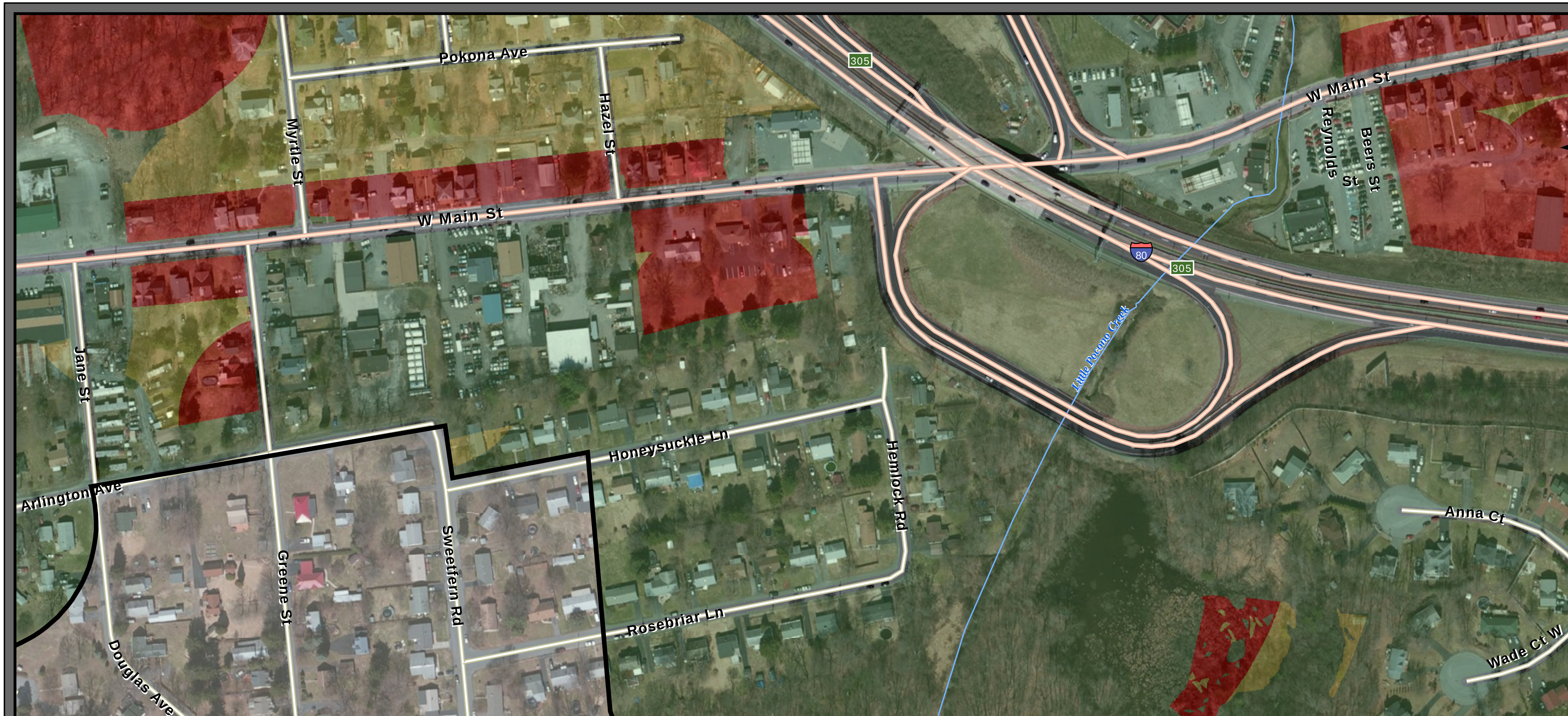


Figure 17F
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



Archaeological Area of Potential Effects

Probability

- High
- Moderate
- Low

0 100 200 400 Feet

0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners Since 1946

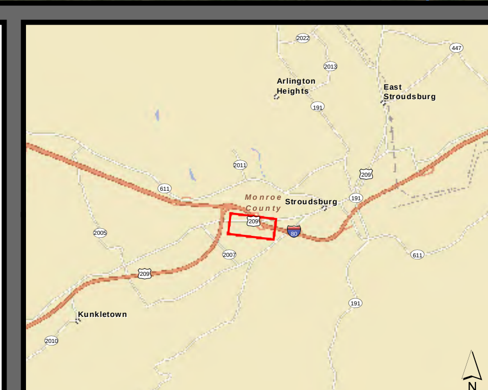


Figure 17G
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

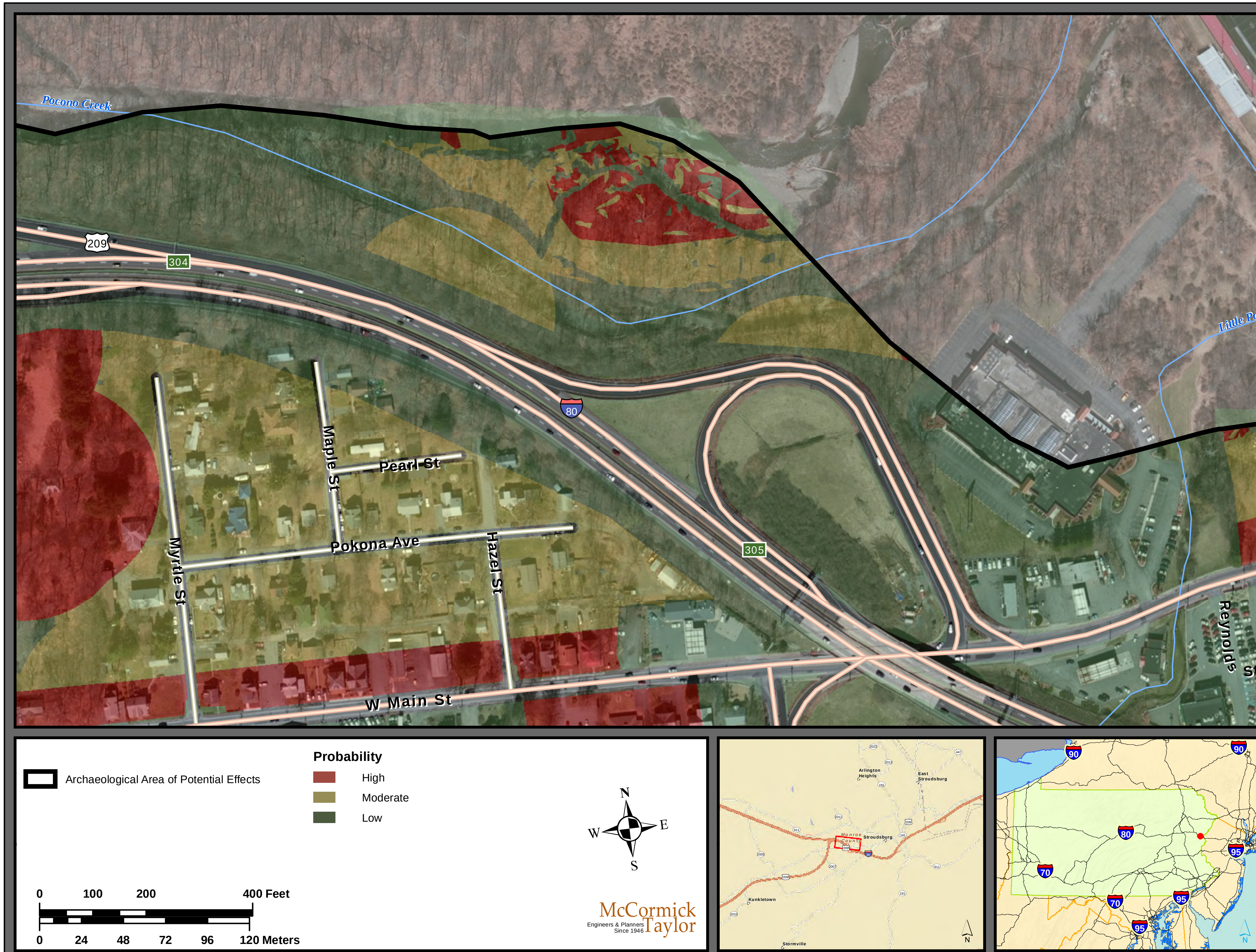


Figure 17H
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

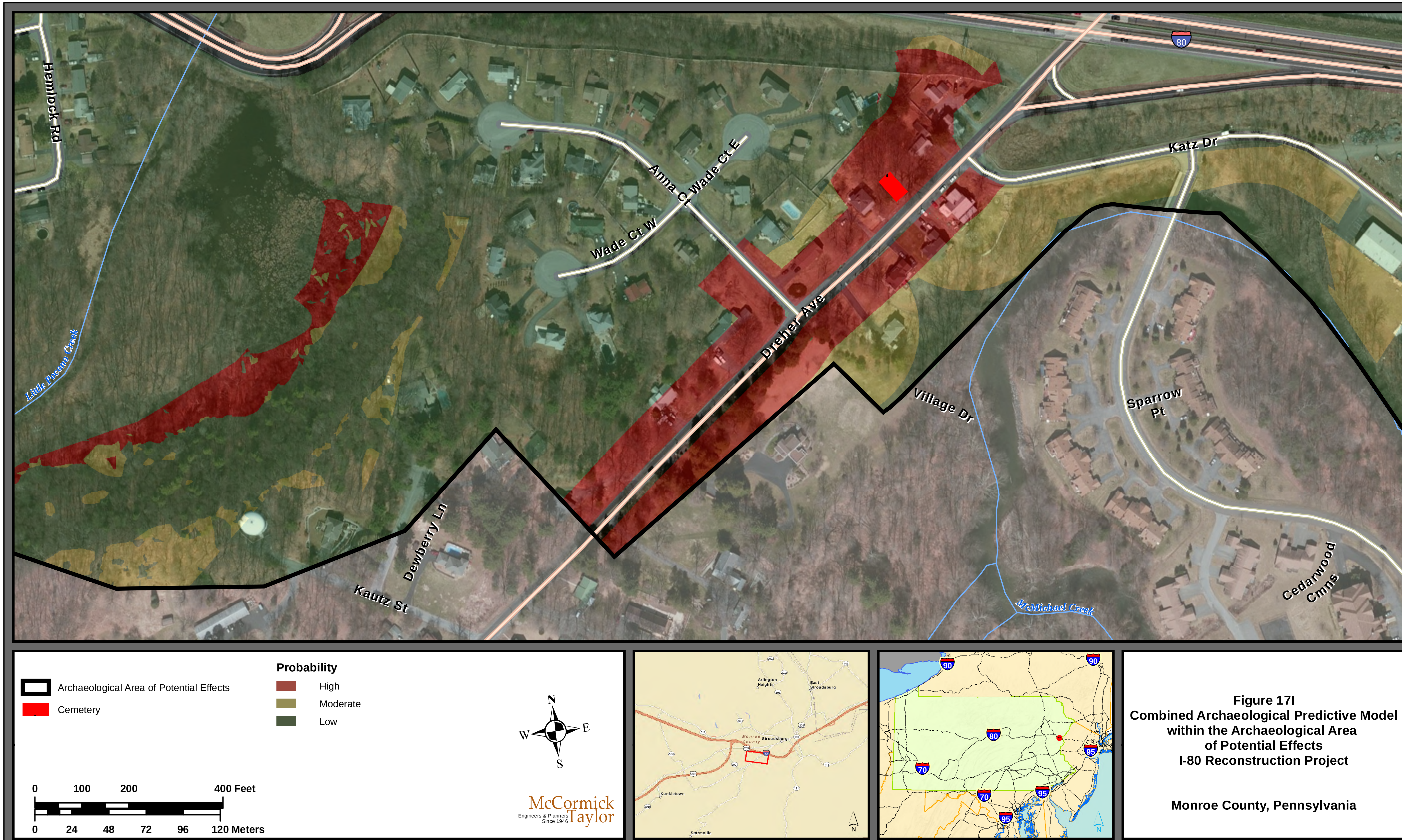


Figure 17I
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

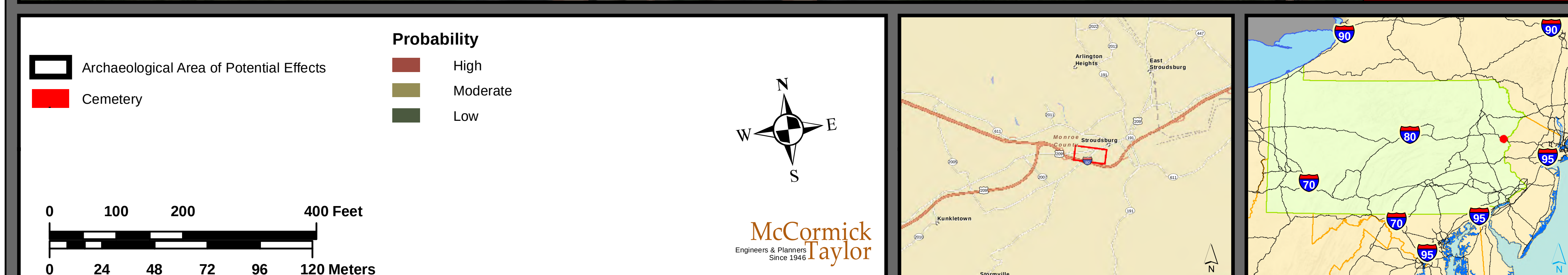


Figure 17J
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

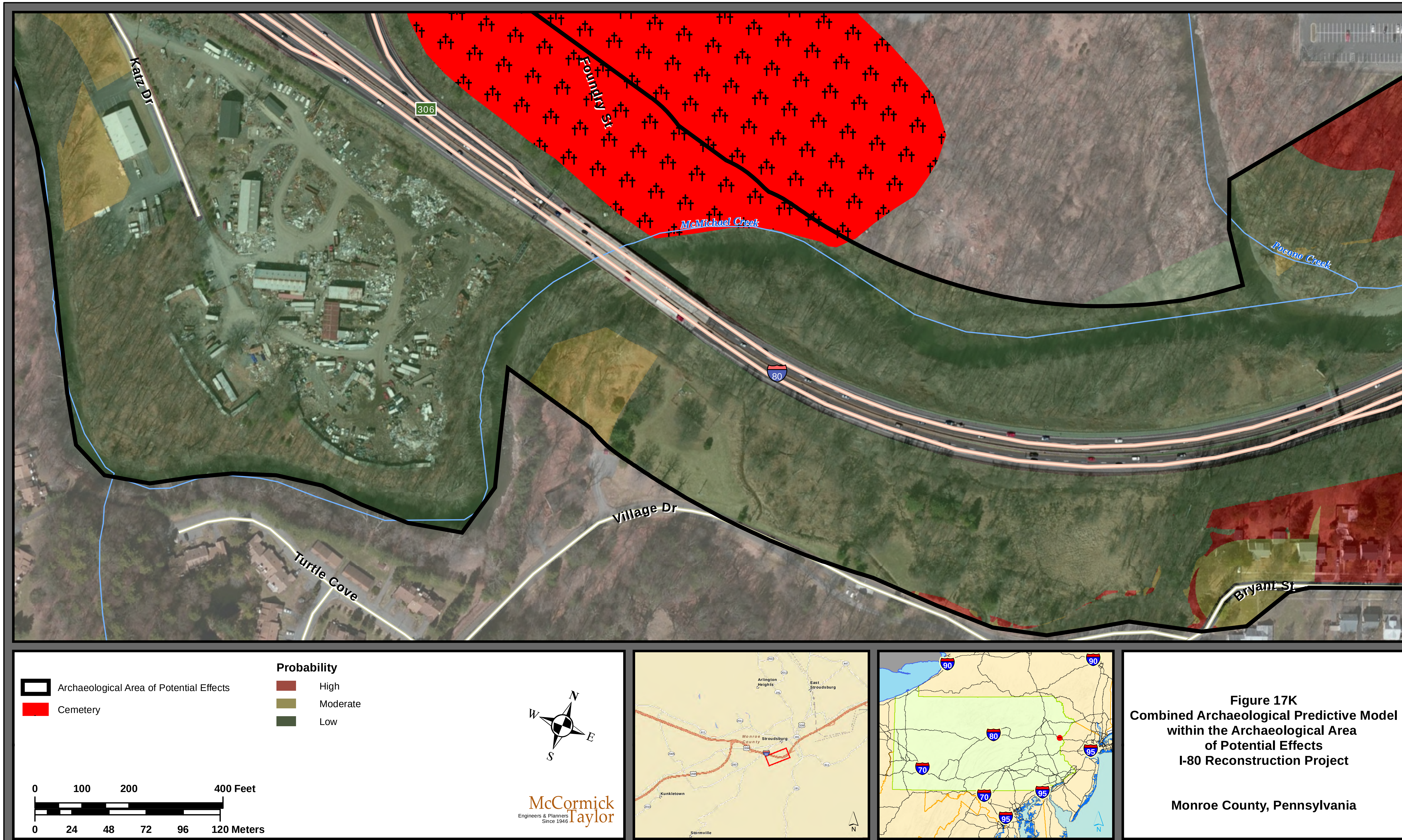


Figure 17K
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

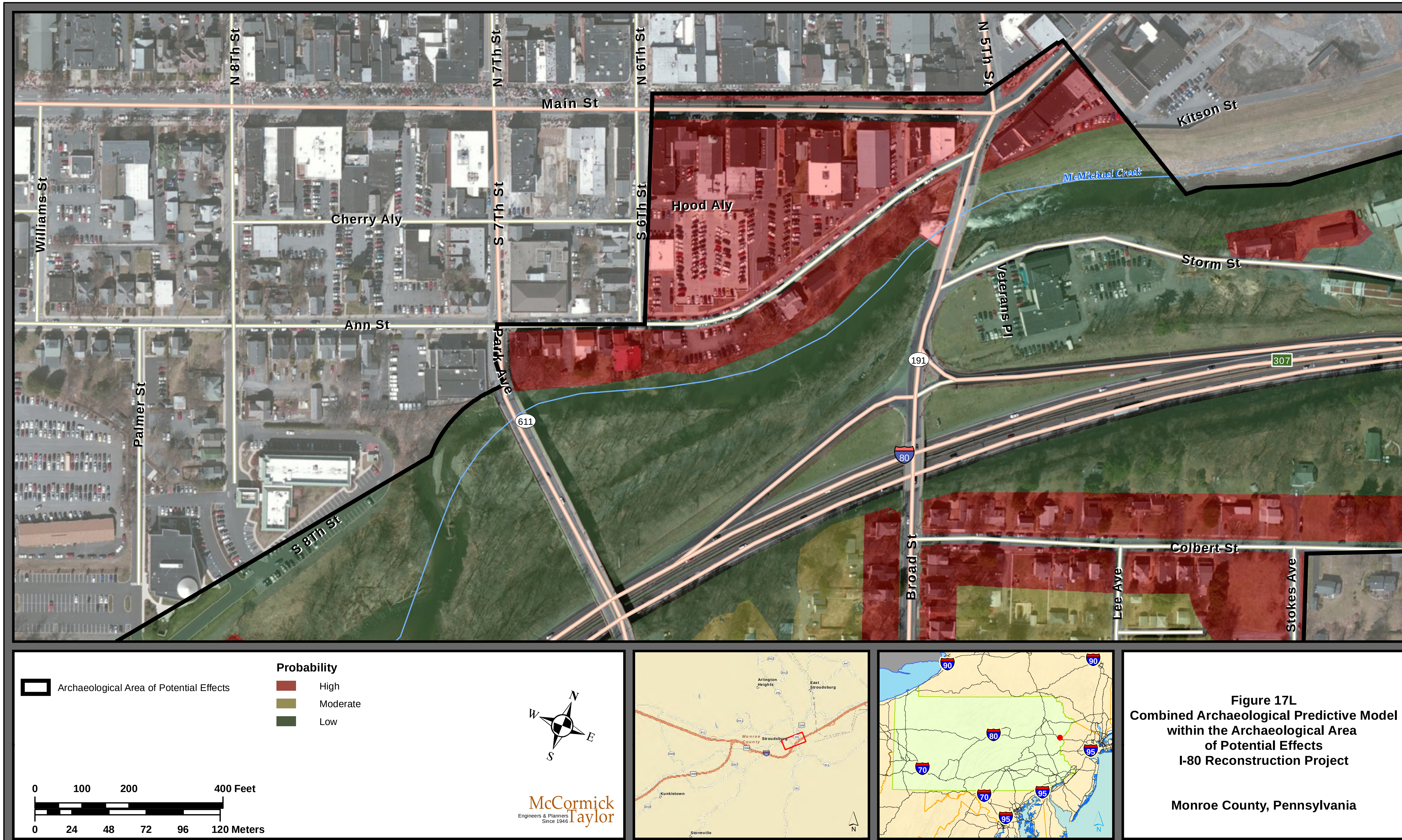


Figure 17L
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

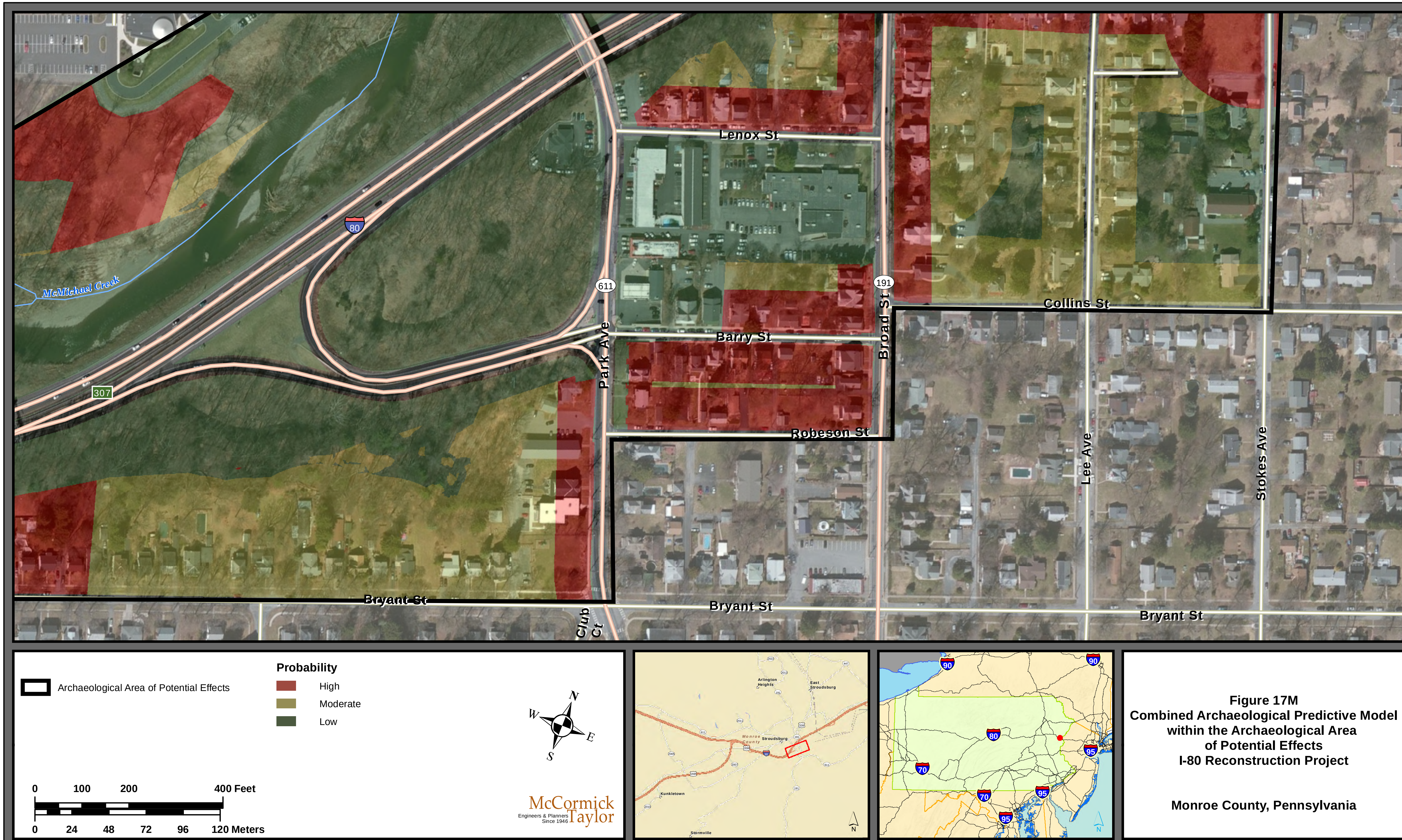


Figure 17M
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

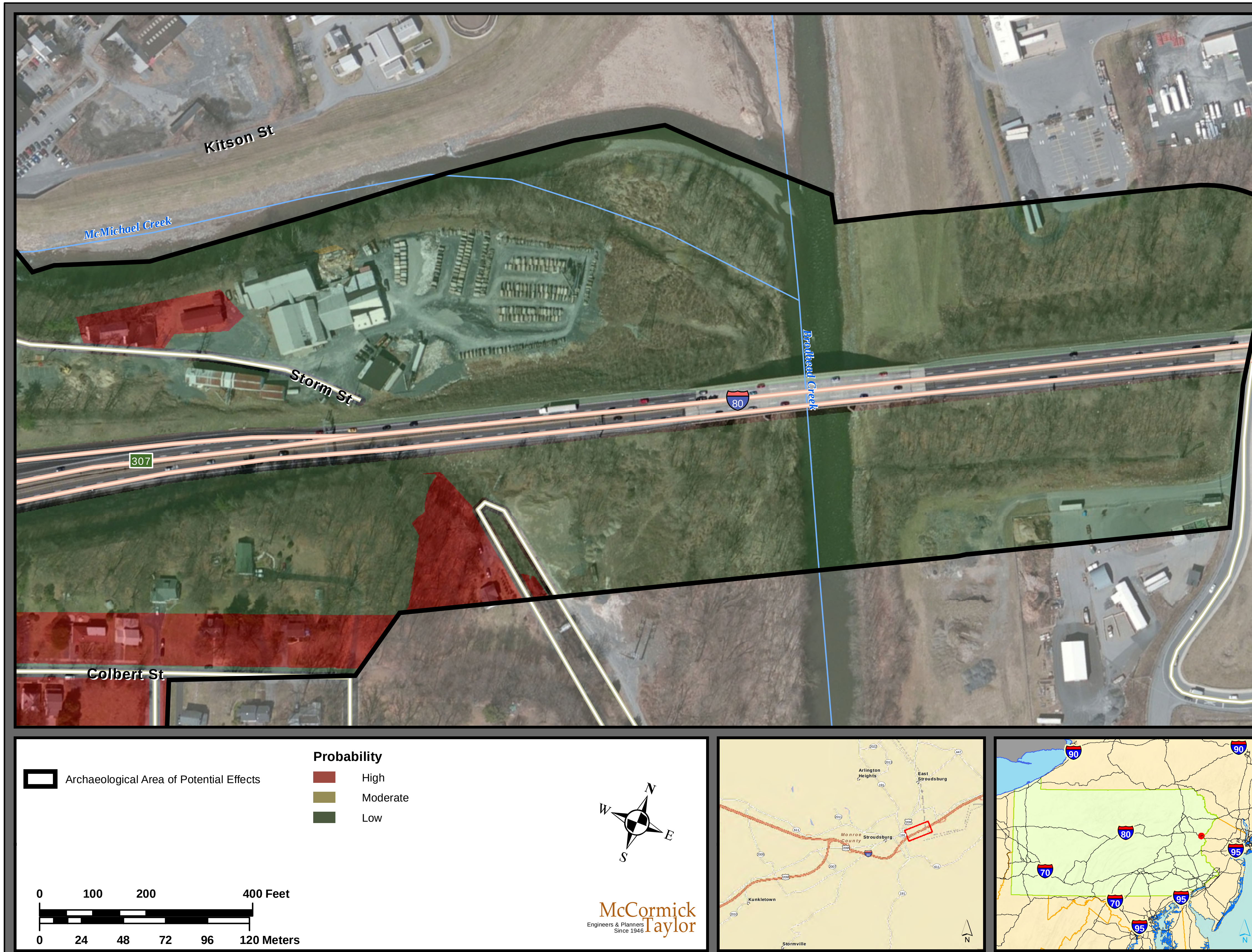


Figure 17N
Combined Archaeological Predictive Model within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

VII. Summary and Recommendations

The results generated by the predictive model created by McCormick Taylor were used to develop a testing strategy for proposed alternative alignments which may have potential impacts to pre-contact and historic archaeological resources. The predictive model will be applied to the project APE in order to identify areas of high, medium, and low probability for containing pre-contact and historic archaeological resources. In conjunction with other environmental and design concerns, the predictive model will assist in the selection of a preferred alternative by determining the amount of potential archaeological impacts to each alternative. Once the preferred alternative is chosen, McCormick Taylor recommends that areas contained within it be subjected to archaeological survey according to the designated probabilities. McCormick Taylor also recommends that the preferred alternative be subjected to a pedestrian reconnaissance to delineate any pre-contact contexts (such as rockshelters, overhangs, tool-grade lithic outcrops, benches, and springheads) that may fall within low probability areas but warrant high-probability testing. These are contexts that may not be discernible given the limitations of the GIS data. Based on the results of the geomorphological investigations, no need for any deep testing is anticipated. No additional geomorphological investigations are recommended.

For pre-contact archaeological resources, testing should be undertaken using the methodology specified in the Bureau for Historic Preservation's (BHP's) *Cultural Resource Management in Pennsylvania: Guidelines for Archaeological Investigation* (November 2008). It is recommended that all high and medium probability areas be subjected to subsurface survey. It is recommended that areas designated as having a high probability for containing pre-contact archaeological resources be tested at 15 meter (50 foot) intervals and areas designated as having a medium probability for containing pre-contact archaeological resources be tested at 25 meter (82 foot) intervals. Due to the steep slopes and severe disturbance present within the current APE from residential, commercial, and transportation-related development, as well as the results of the geomorphological survey, no subsurface testing is recommended within the majority of the designated low probability areas. However, McCormick Taylor recommends that a percentage of the low probability areas that do not display evidence of prior disturbance be tested at the high probability interval in order to assess the effectiveness of the model.

For historic archaeological resources, McCormick Taylor recommends that property-specific deed and property research be undertaken prior to the Phase I survey in order to assess the historic value and integrity of areas designated as having high probability for containing historic archaeological resources. These high probability areas include areas identified on the basis of background research and areas identified as containing subsurface historic deposits (artifacts and structural remains) during the course of the pedestrian reconnaissance. Following this additional research, it is recommended that areas identified as having a high probability for historic archaeological resources be tested at either 7.5 meter (25 foot) or 15 meter (50 foot) intervals depending on the size of the lot, as well as the location (urban vs. rural) and type of resource (farmstead vs. commercial or residential lot) identified via the background research.

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Appendix A:

Qualifications of Investigators

Allison N. Brewer, *Archaeologist, Principal Investigator*

M.A., Anthropology (Archaeology track), University of Denver, 2010

B.S., Anthropology (Archaeology track), Geology minor, Mercyhurst College, 2005

Meets the Secretary of the Interior's Professional Qualifications Standards for Archaeology (36CFR§61)

Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Worker Training Certification (29CFR§1910.120)

Ms. Brewer has seven years of experience in the excavation of archaeological sites, as well as the conservation and curation of historic and prehistoric artifacts. Ms. Brewer has expertise in the survey and excavation of Phase I, II, and III sites in Pennsylvania, Ohio, Colorado, and Texas. Due to her experience and training at the R. L. Andrews Center for Perishable Analysis at the Mercyhurst Archaeological Institute, she has focused her endeavors on the analysis, research, and conservation of prehistoric perishable materials. She has used this knowledge to conduct experimental archaeology trials in order to develop new conservation methods and protocols.

Steven E. Barry, R.P.A., *Archaeology Group Leader*

M.A, Anthropology, University of Alabama, 2004

B.A., Anthropology, Pennsylvania State University, 1999

Meets the Secretary of the Interior's Professional Qualifications Standards for Archaeology (36CFR§61)

Member of the Register of Professional Archaeologists

Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Worker Training Certification (29CFR§1910.120)

Mr. Barry has over thirteen years of professional experience in prehistoric archaeological research in the Mid-Atlantic region, Southeastern U.S., Southwestern U.S. and Central America. In addition, Mr. Barry has had extensive experience in the supervision, management and coordination of transportation projects involving archaeology and cultural resources as a PennDOT Culture Resource Professional.

Charles A. Richmond*, Architectural Historian*

M.A., American Studies, Pennsylvania State University, 2000

B.A., History and Political Science, Thiel College, Pennsylvania, 1992

Meets the Secretary of the Interior's Professional Qualifications Standards for Architectural History (36CFR§61)

Mr. Richmond has ten years of experience in historic preservation research, inventory, and evaluation of above ground historic resources for the National Register of Historic Places. Mr. Richmond has received additional training regarding Section 106, NEPA, Section 4 (f), and project development. He has gained experience in field survey work, historic context development, report writing, and preparing evaluations of properties for the National Register of Historic Places. In addition, Mr. Richmond provided assistance with the review of survey forms for the Pennsylvania Comprehensive Bridge Survey. Through his experience as an Intern with the PA Game Commission Land Management Bureau, he has a strong degree of knowledge regarding environmental resources and planning. Mr. Richmond has experience in documenting historic resources and conducting research in Pennsylvania, Delaware, Maryland, New Jersey, Ohio and Virginia.

Frank J. Vento, Ph.D.*, Geomorphologist*

Ph.D., Geology, University of Pittsburgh, 1985

Dr. Vento has over twenty years of professional experience interpreting soil depositional and weathering sequences on archaeological and historical sites. He is currently a professor of Geology at the University of Clarion. Dr. Vent has also established his own firm, Quaternary Geological and Environmental Consultants, LLC.

John Stiteler, *Geomorphologist*

M.S., Soil Science, Pennsylvania State University, 1997

B.A., Anthropology, Pennsylvania State University, 1985

Mr. Stiteler currently works for Quaternary Geological and Environmental Consultants, LLC. Mr. Stiteler has several decades of professional experience as both a soil scientist and an archaeologist. In his role as a soil scientist/geomorphologist, he determines land surface and landform stability, depositional and erosional environments, the extent of disturbance and ages of soils at archaeological sites, and he assists in the interpretation of paleoenvironmental conditions at archaeological sites and contributes to project reports. As an archaeologist, he has been responsible for conducting Phase I/II/III investigations, background research, artifact analysis, site interpretation, and report preparation.

Appendix B:

Geomorphological Evaluation

Phase IA Geomorphologic Investigations for the I-80 Reconstruction Project, Monroe County, Pennsylvania

Prepared by

Dr. Frank J. Vento, PG 001831-G, RPA

Quaternary Geological and Environmental Consultants, LLC.

4640 Walten Woods Drive

Erie, Pennsylvania 16511

Submitted to

Ms. Allison Brewer, Principal Investigator

McCormick-Taylor, Inc.

December 24, 2013

TABLE OF CONTENTS

FIGURES

PHOTOGRAPHS

TABLES

INTRODUCTION

General

The following geomorphological report was completed as part of the overall Phase I investigations recently completed by Dr. Frank J. Vento, President, Quaternary Geological and Environmental Consultants, LLC., under the Memorandum of Agreement with McCormick-Taylor Inc. for the proposed I-80 reconstruction project ***(Figure 1)***. The report below follows conditions outlined in the Scope of Work as issued by McCormick-Taylor, Inc. and follows guidelines for Phase IA investigations forth by the Pennsylvania Bureau for Historic Preservation.

Geomorphological testing within the archaeological APE was undertaken by Dr. Frank Vento (PG-001831-G, RPA) and Mr. John Stiteler, M.S. (Soil Scientist) in order to evaluate the structure of the soils on representative alluvial settings for which previous disturbance could not be documented. Dr. Vento and Mr. Stiteler examined hand auger probes in order to characterize the depositional history of the alluvium and other soils within the APE, identify areas in which previous disturbance had occurred, and identify the depth to which pre-contact archaeological deposits are likely to extend ***(Figures 1 and 2)***.

Purpose of the Investigation

This study and its objectives were developed in consultation with Mr. Steven Barry, Archaeology Group Leader and Ms. Allison Brewer, Principal Investigator for McCormick-Taylor, Inc. A summary of the objectives of each stage of investigation are discussed below:

1) Determine the ages of the landforms (flood plain/terraces) and associated soils which occur along the surface drainage lines which will be impacted by the proposed I-80 road renovation project area;

2) Determine the depths to which testing should extend to ensure recovery of any and all potentially significant cultural resources and;

3) Discuss the site specific depositional processes responsible for emplacement of the soil/sediment package at the site.

Field Methods and Scope of Investigation

The geomorphology study included a review of both general and specific references on the bedrock geology, quaternary history, and previous archaeological work conducted within the general project area. In addition, topographic maps, geologic and soil survey maps and reports, and hydrologic information were reviewed.

Field and archival investigations were initiated on November 18, 2013 and subsequently completed on December 9, 2013. Field work included a pedestrian surface reconnaissance and mapping of the various landforms present within the study area as well as the excavation of multiple auger probes along the identified fluvial and glaciofluvial landforms identified along Brodhead, Pocono and McMichael Creeks. All soils were described following standard soil nomenclature (Soil Taxonomy 1999) while select landforms along the corridor were photographed in a digital color format ***(Figure 2)***.

Location and Description of Study Area

The project includes the evaluation of a section of I-80 within Monroe County that extends from Exit 303 to Exit 307 of I-80 and along adjacent sections of U.S. 611 (S.R. 0611) and PA 209 (S.R. 0209) ***(Figures 1 and 2)***. Proposed improvements to the current alignment include widening in association with improvements to on- and off-ramps, side streets, intersections, highway alignment, and shoulder improvements. Proposed alternatives within the corridor have not yet been selected, but it is assumed that there will be approximately 60 acres of proposed ground disturbance.

In order to reduce the expenditure of time and resources that field testing of all the proposed alternatives would require, an archaeoloigcal predictive model has been developed. The model is intended to assist in the alternative creation and selection process. Through the application of this model, the project team will be able to gauge the relative impacts each alternative is likely to have on archaeological resources within the study area. At the beginning of the endeavor, it was assumed that approximately 80% of the archaeological area of potential effects (APE) would have been previously disturbed or would have slopes of greater than 15%. The archaeological APE, which consists of approximately 463 acres, is comprised of both alluvial settings and upland settings. Geologically, the study area lies near the terminus of the late Wisconsin ice sheet. Glacial landforms composed of glacial till (moraines), glaciofluvial drift (outwash terraces, kames, kame terraces) and glacio-lacustrine deposits are abundant in this part of Monroe County, Pennsylvania. One of the most striking local features is an extremely broad, relict outwash channel which trends southwest to northeast and within which Brodhead Creek has established its present channel ***(Figures 3, 4, 5, 6, 7, 8, and 9)***.

Previous studies and Significance of Soil Studies along Brodhead Creek

Other recent geomorphologic investigations along Brodhead Creek were undertaken in 2007 by Dr. Vento for PPL, Inc. to examine a proposed small (1/2 acre) substation along Brodhead Creek and in 2010 with McCormick Taylor Inc. at the proposed Stokes Bridge replacement, Monroe County, Pennsylvania. The landforms at the substation site and Stokes Bridge were the same and included: 1) a low lying T0 flood plain zone situated less than 2 m above the active stream channel and 2) a higher T1 outwash terrace situated between 3.5 m and 4 m (11 ft to 13.5 ft) above the active stream channel. The T0 flood plain zone was extensively flood scoured and was comprised of coarse sands and gravels of recent age. The higher T1 terrace is of late Wisconsin age and lacks any Holocene age overbank deposition. Interestingly, these same high outwash terraces are also extensive and persistent landforms along the I-80 Reconstruction project corridor.

A review of previously recorded sites in the region has provided a context for identifying and interpreting archaeological resources within the current project area and their association with specific landforms. An examination of the PASS files found no previously recorded archaeological sites within the project APE. The project APE is located within the Upper Delaware River drainage (Sub-Basin 1) where 885 archaeological sites have been recorded. It is further distinguished as being located within Upper Delaware River Watershed E where 128 archaeological sites have been recorded. Twenty-four previously recorded archaeological sites were identified within the study area. These included 16 prehistoric sites, two historic sites, and six sites with both precontact and historic period components. The precontact components included Unknown Precontact, Paleo-Indian, Early Archaic, Middle Archaic, Late Archaic, Archaic, Transitional, Early Woodland, Middle Woodland, and Late Woodland. The historic components included Unknown Historic, 1875-1900, 1900-1925, and 1925+ periods. Two prehistoric sites located within the study area were recorded on similar soils to those of the current project survey area. The previously recorded sites located within the study area provided an indication of the sensitivity of the current project area for prehistoric and historic archaeological resources. Based on the previously recorded archaeological sites, there is medium to high potential for precontact archaeological resources and low to medium potential for historic period archaeological resources within the current project APE. In examining the project area, however, a high degree of historic development has likely impacted many of these resources ***(Table 1)***.

Sixteen archaeological surveys have been undertaken within the study area (and reported/recorded in the PHMC Cultural Resources GIS), which include: water treatment/sewer facility surveys in 1981, 1986 and 1991; a 1991 gas line survey; a 1994 park and ride survey; commercial and residential development surveys in 1995, 2004, 2007, and 2011; a 1996 Fort Hamilton survey; a 1997 trail survey; a 2005 survey for a high school; a 2006 power line survey; and roadway surveys in 2006 and 2007. While seven archaeological sites were identified during these surveys, none were located within the current project APE ***(Table 2)***.

Pertinent Environmental Background Information

Physiography

The I-80 Reconstruction project area is situated at the boundary between the Glaciated Poconos Plateaus Section of the Appalachian Plateaus physiographic province and the Blue Mountain Section of the Ridge and Valley physiographic province. The Blue Mountain Section is comprised of a linear ridge to the south, where it is a southern limb of a broad fold, and a valley to the north. The valley widens eastward and includes low linear ridges and shallow valleys. Local relief is moderate to high. The Section's highest elevation is 1,680 feet and its lowest is 300 feet. The Blue Mountain Section is formed on sandstone, siltstone, and shale, and some limestone and conglomerate. Very resistant sandstones occur at the crests of the Blue Mountain. Shales and siltstones occur on the slopes and valleys (www.dcnr.state.pa.us).

The Glaciated Pocono Plateau Section is a broad upland surrounded on all but its western side by a steep to moderately steep slope that marks the boundary with an adjacent Section. The upland is underlain mainly by tough, erosion resistant sandstones that are relatively flat lying. Relief on the upland is generally less than 200 feet, but can be as much as 600 feet where small hills rise above the general level of the upland. Elevations on the upland range from 1,200 to 2,320 feet. Weather in this area can be severe. The upland is drained by several small streams that flow from the upland interior to and away from the margins. The low relief and relative smoothness of the upland surface results from both the flatness of the underlying rock and the scouring of the surface by glacial ice. The area was glaciated at least three different times in the past million years. In addition to erosion, the most recent glacier also left behind a variety of glacial deposits that occur on the surface of the upland. Particularly notable is the abundance of sandstone boulders that litter the surface in many places. Swamps and peat bogs have developed in small undrained depressions created by glacial scour and deposition (www.dcnr.state.pa.us).

Elevations within the region range from 50 feet to more than 800 ft. The area has been significantly impacted by glaciation, and glacial landform features are a dominant aspect of the topography. The Allegheny Front is the division between the more gently folded lithologies of the Appalachian Plateaus and the more complexly folded Ridge and Valley physiographic province. Subsections east of the Appalachian Plateaus in the Delaware Valley region include the Echo Lake Lowland (Upper Delaware Valley), Wallpack Ridge, "Lower" Delaware Valley and Kittatinny Mountains.

Bedrock Geology

The Devonian formations present within the region are ascribable to the Marcellus, Mahantango and Buttermilk Falls thru Esopus Formations undivided ***(Figures 10, 11, and 12)***. The Marcellus Formation consists primarily of fissile, carbonaceous shale and limestones. The shale units often contain pyrite and siderite nodules. The Marcellus Formation exhibits moderately good surface drainage except in areas where Wisconsin glaciation has mantled the formation causing more complex and multi-basinal drainage patterns.

The Mahantango Formation is comprised of a dark gray, gray, brown, and olive laminated shale, siltstone, and very fine-grained sandstone or claystone containing marine fossils, overlying the Marcellus Shale. The Mahantango Formation can be a resistant ridge forming unit and often is associated with distinct nick points along surface drainage lines.

The Buttermilk Falls Limestone through Esopus Formation, undivided is comprised, of in descending order: 1) the Buttermilk Falls Limestone--gray fossiliferous limestone and black chert; 2) Palmerton Sandstone--massive white siliceous sandstone; 3) Schoharie Formation--gray calcareous, argillaceous siltstone; and 4) Esopus Formation--gray silty shale and sandy siltstone.

The topography developed on these formations consists of terranes of moderate relief with elongate hills and steep slopes. Within the project area, the Marcellus and Mahantango Formations crop out along most of the western and central portions of the corridor, while the Buttermilk Falls/Esopus Formations are present on the eastern end of the study area. Given their resistance to weathering and erosion, these formations often create a series of nick points or waterfalls in the local stream channels. The bedrock units are striking northeast-southwest with a dip of nearly 80 degrees along the northwest flank of a large anticlinal fold. Given the thick package of glacial drift in the region, the bedrock exposures are best along streams like Brodhead, Pocono and McMichael Creeks.

Soils

Based upon the Soil Survey for Monroe County, Pennsylvania, five mapped alluvial soils are present in the project area. These include: Philo, Pope, Holly, Wyoming and Chenango ***(Figures 13, 14, and 15)***.

The Holly series is described as consisting of very deep, very poorly and poorly drained soils formed in loamy alluvium on flood plains. Saturated hydraulic conductivity is moderately high through high in the mineral soil. Slope ranges from 0 through 3 percent. Mean annual precipitation is about 36 inches, and mean annual temperature is about 51 degrees F. Holly soils are classified as fine-loamy, mixed, active, nonacid, mesic Fluvaquentic Endoaquepts. Holly soils are on broad flat areas and in slight depressions on flood plains receiving alluvium from upland areas of low-lime drift and noncalcareous sandstone and shale. In the study area, the soils mapped as Holly either consisted of bare bedrock (northeast quadrant) or were comprised of coarse grained (cobbly pebbly sands) flood deposits of recent to late Holocene age (northwest quadrant).

Wyoming soils are nearly level to very steep soils on outwash terraces, moraines, kames, eskers, and valley trains. Slope gradients range from about 0 to 45 percent. They formed from gravelly, water-sorted material derived from red and gray sandstone, siltstone, and shale. Wyoming soils are classified as loamy-skeletal, mixed, active, mesic Typic Dystrudepts. Wyoming soils are somewhat excessively drained. Runoff is slow to medium. Permeability is rapid. In the study area, both the Chenango and Wyoming soils are typically associated with high outwash terraces bordering the project area streams.

The Chenango series soils are loamy-skeletal, mixed, mesic Typic Dystrochrepts. The Chenango soils are found on glacial outwash terraces. The well-drained soils formed in water-sorted gravelly and sandy material derived from sandstone, shale, siltstone, and to a lesser degree from limestone. Slopes range from 0 to 25 percent. Principally associated with the Chenango series soils are the moderately well drained Braceville soils (outside this study) and those of the somewhat poorly drained Rexford series. The Chenango soil has moderate permeability to moderately rapid permeability in the subsoil and has low available water capacity. Most areas of Chenango soil are used for farming, while a few are used for woodland, recreation, or are left idle.

The Philo Series soils are coarse-loamy, mixed, mesic Fluventic Dystrochrepts. These well drained soils are found on flood plains. They formed in alluvial sediments washed from soils originating from acid sandstone, siltstone, and shale. Slopes range from 0 to 3 percent. The Philo soil has moderate or moderately rapid permeability, high available water capacity, and slow surface runoff. Reaction is extremely acidic to strongly acidic throughout unlimed areas. Most areas containing this soil are used for farming although a few areas are used for woodland, recreation, or are left idle. Philo and Pope soils, as noted above, are generally associated with aggrading terraces which often contain a thick package of Holocene age overbank deposits.

Drainage and Hydrology

Brodhead Creek, the principal drainage line within the project area, lies at a nominal surface elevation of 440 ft above mean sea level. From the study area, Brodhead Creek flows south and then east for a distance of 4.8 km (3 mi) to its confluence with the Delaware River. In the study area, Pocono Creek, Flagler Creek, Little Pocono Creek, and McMichael Creek are major tributaries of Brodhead Creek ***(Figure 3)***.

Runoff and subsequent flooding along Brodhead, Pocono and McMichael Creeks is highly dependent upon variations in precipitation and snowmelt. Based upon soil water budgets and gaging station data, it can be concluded that the highest discharges typically occur during the late winter and early spring in association with lowered rates of evapotranspiration and greater effective precipitation. Late summer and early fall flood events, though rare, have occurred in response to intense cyclonic storms (e.g., Hurricane Agnes 1972).

Gaging station data for Brodhead Creek indicates that a record flood occurred in 1955 with more than 69,000 cubic feet per second discharge. This flood event is well recorded locally due to the amount of destruction and loss of life. Since 1955, other large flood events have occurred in 1969, 1996 and 2005. While all of these events completely scoured the low lying T0 flood plain zone, the 1955 event would have also impacted the higher T2 outwash terrace. For example, the 1969 event caused a rise of more than 4 m (13.5 ft) above the thalweg of Brodhead Creek. Though not recorded, the 1955 event may have raised more than twice this height above the stream channel.

Glacial History of the Study Area

The entire upper Susquehanna and upper Delaware River watersheds were glaciated during Wisconsin time and all glacial deposits are attributed to this stage. It should be noted that although the Illinoian stage ice sheets overrode this area, no definite evidence of these earlier advances have been identified in the study area by earlier investigators (Alden and Fuller 1903, Willard 1932, Denny and Lyford 1963, Coates 1966, Elayers 1972 and Coates 1974) or to the north of the limit of the Wisconsin glacial deposits in Pennsylvania, specifically.

All of the glacial deposits in the project area are ascribable to the Olean Substage of the Wisconsin Stage. The movement of the Olean Substage ice sheets during Wisconsin time was about southwest and covered both north and south divides of the east flowing rivers within the region with as much as 300 meters (1,000 feet) of ice (Coates 1966). Debate concerning the exact age of the Olean drift is presently underway. Muller (1977a and 1977b) states that the Almond moraine in central New York is the morphological continuation of the Kent moraine, and it has been considered the outer limit of late Wisconsin glaciation. The Olean drift, south of the Kent moraine, therefore, has been considered to be of early Wisconsin age (Mickelson, Clayton, Fullerton and Borns 1983). Crowl and Sevon (1980) and Crowl (1980) conclude, on the basis of several radiocarbon assays from bogs and ponds in eastern Pennsylvania, that all the Olean drift in Pennsylvania and New York is late Wisconsin in age. Coates (1974), however, notes that the Olean drift may consist of two or more till units deposited during different glaciations. Presently, the lithologic distinction between Kent and Olean tills is not clear-cut. LaFleur (1979) described the interfingering of Kent- and Olean-type tills in the Snake Run section near West Valley, New York, 3 km (1.24 mi) within the Kent border. The "crystalline-rich" Olean till at the border in Potter County, Pennsylvania may well be Kent till of Woodfordian age (Crowl 1980:52).

The Olean drift can be subdivided into two lithofacies or types based on its mineralogical composition from area to area. The first type (which is not present in the study area) is composed of a high percentage of igneous and metamorphic rock fragments as well as a distinctive bluish colored limestone from the Mohawk Valley. These deposits have been transported by ice overland from western New York to the south. The second type (lithofacies) of Olean drift, the one that is present in the region, contains an abundance of sandstone and shale rock fragments with few if any crystalline rock fragments present. This drift is derived from ice which moved southwestward across the Hudson River Valley across the Catskills and into central and eastern Pennsylvania (Peltier 1949).

In summation, it appears that the glacial drift in the study area is of Woodfordian age. The marginal ice began to down melt and retreat ca. 15,000 B.P. to 14,000 B.P. during the Erie Interstade. Bog and lake bottom organic sediment dates along the Woodfordian border in Pennsylvania range from 12,520 to 14,170 B.P. and are minimum dates for deglaciation (Crowl

1980:54). These dates for ice retreat accord with those from Long Island and New England on the east and with those from northwestern Pennsylvania and Ohio (Crowl 1980).

Quaternary History

During the Pleistocene Epoch, the area had been variously affected by glacial, periglacial and warm, humid temperate interglacial conditions. About ten such alternations have affected northern Pennsylvania during the last one million years (Braun 1989, 1994, 2008). According to Braun (2008), there is evidence for at least three different glacial advances across the general region (Braun 1994). The farthest to the southwest and oldest glacial limit is considered to be of pre-Illinoian-G age (850 Ka) or older. The next distinct glacial limit is considered to be of either late Illinoian (150 Ka) or pre-Illinoian-B (450 Ka) age and is only about 10 miles (15 km) beyond the most recent, late Wisconsinan (20 Ka) aged glacial limit. Other glacial advances have approached the area and caused severe periglacial activity (Braun 1989, 1994).

Braun (2008) states that the earlier glacial advances across the region should have accomplished some erosional work. The trend of the glacial limits and glacial striations of the older glaciations is similar to that of the late Wisconsinan glacier (Braun 1994). This indicates that the older glaciers moved across the region in about the same direction as the late Wisconsinan ice and that the older glaciers should have eroded and deposited in a pattern generally like that of the late Wisconsinan. Preglacial valleys oriented parallel to ice flow would tend to be significantly scoured and partly back filled in each glaciation. Valleys oriented perpendicular to ice flow would have the least scour and be the most backfilled, sometimes becoming completely buried (Braun 1997). The late Wisconsinan glacier advanced and retreated across the region in a general S 20°W – N 20°E direction (Braun 1997). Within the region, glacial striations indicate that ice flow was about S 20°-30°W. A series of sub glacial and/or ice marginal melt water channels (sluiceways) were incised across saddles in the ridges (Braun 2008).

The general region is primarily comprised of late Wisconsin-aged deposits and landforms (Braun 2008). Like Braun's exhaustive and well-conceived examination of the Great Bend, Hawley and Galilee Quadrangles, most of the material in the study area was deposited in the region over a short period of time (decades to centuries) during recession of the ice at approximately 17 - 18 Ka. The last glacial advance and retreat in the region was very effective in removing older glacial deposits from the landscape (Braun 2008). The Wisconsin till deposits are dominated by fresh clasts of the local bedrock indicating considerable erosion of the bedrock during the last glaciation.

As the glacier continued its recession north of Pennsylvania, cold periglacial climate conditions prevailed in the area for several thousand years. At that time, exposed sandstone ledges were frost shattered and the blocks transported down slope by various processes collectively known as gelifluction (Braun 1997). Following Braun (2008), the glacial till deposits themselves have been "mobilized" on the slopes by gelifluction. In the latest Pleistocene, after 13,000 BP (Dalton and others, 1997) and throughout the Holocene, vegetation became well established and organic matter started accumulating in wetlands and lakes in the region. All the lakes and wetlands in the region are the result of glaciation.

Paleoenvironments

Paleoflora

The major expansion of the Laurentide ice sheet took place beginning in the Late Wisconsinan stage at about 23,000 years ago and culminated in a maximum ice advance at approximately 18,000 years B.P. The ice sheet was in full retreat once again by ca. 10,000 years ago. Earlier glacial advances existed within the general project area from about 84,000 to 73,000 yrs. B.P. and were followed by a long interglacial/interstadial stage (Sangamon Subage) with accompanying soil horizon development again at ca. 30,000 years B.P. Another climatic deterioration began at ca. 23,000 yrs. B.P. and culminated in the glacial maximum noted above at ca. 18,000 B.P. Interglacial/interstadial climatic conditions were again established but with a lengthy, slow transition characterized by several ice advances or pulses which lasted from ca. 15,000 years B.P. to ca. 10,000 yrs. B.P. (Watts 1980b, Watts 1983:300). The effects of the ice sheet are clearly evidenced today in the form of both glacial and periglacial landforms throughout the Upper Delaware River valley and its major tributaries. These glacial and periglacial landforms consist of valley trains, outwash terraces, proglacial lake deposits, till plains, kames/kame terraces, periglacial lake deposits, moraines (end and recessional), fan development and asymmetric valleys.

A number of late Wisconsinan age floral localities in Pennsylvania (e.g., Rose Lake, Crider's Pond, Longswamp, Tannersville Bog and Corry Bog) have provided important information on the tentative reconstruction of the probable floral community which was present in the general project area during the full-glacial (Woodfordian Stade) as well as during the final retreat of the late Pleistocene ice sheets.

At approximately 13,000 years B.P., the principal floral taxa present at Crider's Pond in south central Pennsylvania included jack pine (Pinus banksiana), fir (Albies sp), birch (Betula sp) and alder (Alnus rugosa). These taxa replaced the species-poor spruce (Picea sp) woodland recorded for the full-glacial (circa. 18,000 yrs B.P.). A similar flora assemblage invaded the spruce (Picea sp) -dwarf birch (Betula glandulosa) association at Longswamp in southwestern Pennsylvania (Watts 1979), where gray birch (Betula populifolia) was also present (Watts 1983:306). Additionally, recent investigations at Corry Bog, in northwestern Pennsylvania by Cotter (1983), Cotter et al. (1984) and Karrow et al. (1984) indicate that the spruce pollen zone in Pennsylvania occurs between 14,250 to 11,250 B.P. Cotter (1983) and Cotter et al. (1983) state that the herb pollen zone lasted from 18,500 to 14,250 B.P. and that the basal age of the spruce pollen zone of sites near the Woodfordian drift border of Pennsylvania is approximately 14,250 B.P. rather than the 12,600 B.P. as suggested by Karrow et al. (1984).

Watts (1983:307) notes that clear differences exist between the floral history of the periglacial region to the south (i.e., Longswamp and Crider's Pond) and that of the region which was ice covered (i.e., Tannersville and Corry Bogs). The grass dominated tundra flora at unglaciated Longswamp is paralleled by sedge-dominated pollen floras at Tannersville Bog. Since Tannersville and Corry Bogs were located near the margin of the ice sheet, we believe they offer the best available reconstruction of the floral assemblage present during the terminal

Pleistocene (circa. 25,000 to 10,000 yrs. B.P.) for northeastern Pennsylvania and for the Stroudsburg study area, specifically.

At the end of the Pleistocene at Tannersville Bog, which lies very near the project area, the demise of sedge, aspen (Populus tremuloides), and green alder (Alnus crispa) and the invasion of trees such as spruce (Picea sp), fir (Albies sp), jack pine (Pinus banksiana), gray birch (Betula populifolia) and pitch pine (Pinus rigida) can be demonstrated to have occurred between 13,000 and 9,000 yr B.P. (Watts 1983:307).

An in-depth review of tree invasion has been discussed extensively in the recent literature (Davis 1976; Watts 1973; 1979; 1980b; 1983), and it has been demonstrated that the population of each tree species behaved independently of other taxa in response to climatic change (Watts 1983:307). Davis (1969) notes that the invasion of the northeast by forest was a relatively slow process. At Rodger's Lake, Connecticut glacial ice had retreated and tundra was present for over 2,000 years before the invasion of spruce (Picea sp) took place, although spruce was already present in unglaciated Pennsylvania as the ice withdrew (Davis 1969). For a more detailed review of paleoclimatic changes in Pennsylvania, as they relate to genetic stratigraphy and atmospheric circulation change, see Vento and Rollins (1989), Vento et al. (1992) and Vento, Rollins and Vega et al. (2008).

In summation, following the retreat of the late Wisconsin glaciers ca. 15,000 years ago, tundra plants colonized the landscape in much of northeastern Pennsylvania. Tundra pollen assemblages from late-glacial deposits in the eastern United States contained high (up to 40%) percentages of sedge pollen. At this time (circa. 15,000 B.P.), forests of spruce and pine in the south were replaced by deciduous trees (Davis 1983:179). At ca. 12,000 B.P., spruce woodland replaced tundra in western Maryland, western and central New York, and southern New England. The appearance of spruce over such a wide area indicates: 1) the rapid migratory speed of spruce and 2) a climatic amelioration at 12,000 yrs B.P. that allowed spruce to grow in regions where it was previously limited by climate (Davis 1983:179).

At about 10,000 yrs B.P., forests of variable composition developed in the northeast. These forests underwent a series of successive changes with the arrival of new northward migrating taxa. By 5,000 yrs B.P. in the northeast, a number of taxa indicative of warmth and dryness declined in abundance. This occurrence suggests the end of the Middle Holocene age Hypsithermal/Altithermal climatic event. According to Davis (1983:179), at about 2,000 yrs. B.P. (although the time varied from 5,000 to 1,000 yr B.P. from region to region), boreal elements of floral and faunal communities began to increase in greater abundance, which appears suggestive of the onset of cooler climatic conditions.

Paleofauna -Late Pleistocene/Holocene Vertebrate Transition

The Pleistocene fauna of the United States was characterized by a combination of 1) extinct megavertebrates and 2) extant temperate megavertebrates and microvertebrates in association with 3) now disjunct large and small northern species (Semken 1983:192). The Holocene fauna of the Delaware River Valley is generally composed of the second category. Semken (1983) states that this reduction in the number of species has led a number of authors (Martin 1967, Martin and Webb 1974, and Semken 1974) to regard the Holocene biotic record as impoverished or depauperate as compared to the high species densities characteristic of the late

Pleistocene (Graham 1976a, 1979). This faunal change is used to define the Pleistocene/Holocene transition. Discontinuities in the vertebrate record appear at roughly 12,500, 10,500, 8,500 and 5,000 yrs B.P.

Within the general project area, the response time of various vertebrate species to deglaciation and subsequent climatic change was highly variable from one species to another. However, in a fashion similar to the pollen record for the northeast, the concept of a vertebrate transition within a few hundred years after deglaciation appears valid (Semken 1983).

Holocene Paleofauna

The general paucity of bone remains found on the lower flood plain levels and terraces of the Delaware River and its major tributaries is clearly due to soil pH conditions (generally less than 6.0), effects of leaching and biogenic activity. It appears that bone preservation at sites within the region may be somewhat better in those areas where the soil has been buffered by the introduction of mussel shell and/or calcareous cherts. The general absence of any identifiable vertebrate or invertebrate remains from mid to early Holocene deposits in the general region severely limits our reconstruction of the paleofauna. However, other sites in Pennsylvania have provided information on the likely faunal inventory for this part of Monroe County, Pennsylvania.

The mammalian vertebrate fauna from Hosterman's Pit, Pennsylvania, dated at 9,290 yr B.P. is modern in every aspect (Guilday 1967a). This is in direct contrast to the 11,300 yrs. B.P. fauna from Unit B of New Paris Sinkhole No.4, which lies ca. 80 km (50 mi) to the north. This unit contains a strong boreal component, represented by the northern bog lemming (Synatomys borealis), collared lemming (Dicrostonyn hudsonius), yellow cheeked vole (Phenacomys intermdius) and the arctic shrew (Sonex arcticus). A similar boreal fauna also occurs at Bootlegger Sink, York County, Pennsylvania (Guilday, Hamilton and McGrady 1966). Based on the above dates of 9,290 B.P. and 11,300 B.P., the change from a boreal fauna to a recent community structure must have occurred within this 2,000 year interval in central Pennsylvania (Guilday 1971). This statement is supported by the fact that the Unit A fauna at New Paris Sinkhole No.4 contains a large number of temperate species and overlies the strong boreal taxa dominated Unit B fauna at the site.

Guilday (1967a:232) notes that all zooarchaeological faunas from the east during the last 6,000 years contain faunas which are essentially modern. This statement is based on a number of sites, and the longevity of the eastern woodlands Holocene record is confirmed by 11 superimposed strata (11,300 yr B.P. to A.D. 1265) at Meadowcroft Rockshelter in southwestern, Pennsylvania (Adovasio et al. 1977) and the Archaic to Recent period (8,920 yr B.P. to 490 yr B.P.) faunal succession at Sheep Rock Shelter, southeastern, Pennsylvania (Guilday and Parmalee 1965).

The only evidence of the "climatic optimum" or "Hypsithermal Climatic Event" between 5,500 and 3,500 yr B.P. in the eastern forests is noted by Guilday (1965) at the Lamoka Lake site, New York. Guilday's evidence for warming at the Lamoka site is based on the presence of fox squirrel (Sciurus niger) and the box turtle (Terrapene carolina), each of which reflects a warming trend and perhaps a reduction of the closed-canopy deciduous forest at that time (Vento and Rollins 1989).

RESULTS OF INVESTIGATION

The investigation was begun in an area designated as Flagler Street on the northern bank of Pocono Creek. Landforms consist of a high floodplain/T-1 and T-2 terrace. Auger Probe 1 (AP1) and AP2 were conducted on the 60 m wide high floodplain, the surface of which lies 2.5 to 3.0 m (8 ft to 10 ft) above the bed of the Pocono Creek channel ***(Figure 2F; Photograph 1)***. The floodplain surface exhibits evidence of instability, including many low undulations marking flood scours. The profile of AP1, 8 m (26 ft) from the bank edge, consisted of an A/AB/C sequence to auger refusal by gravel at 60 cm below surface (bs). The A and AB horizons (0-30 cm bs) were formed in fine sandy loam containing less than 5% gravel. The C horizon (30-60 cm bs) was 10YR4/4 fine sandy loam containing 10-15% rounded and sub rounded gravel. AP2 was located on the distal portion of the high floodplain, 20 m from the base of the 4.0 to 5.0 m (13.5 ft to 16.5 ft) T-1 riser. The profile consisted of an A/C sequence to auger refusal by gravel at 43 m bs. The 15 cm thick A horizon was formed in loamy medium sand. The underlying C horizon was very gravelly loamy medium sand while AP3 was emplaced to test the higher, outwash T2 terrace.

AP3 was excavated on the T-2 surface, 4-5 m (13.5 ft to 16.5 ft) above AP2 ***(Figure 2F; Photograph 2)***. The terrace tread varies in width from 30 m to 45 m. Large rounded cobbles were noticeable at the ground surface of the terrace through the thin grass cover. Auger refusal by cobbles occurred at 16 cm bs and the profile consisted of a sandy A horizon over a cobbly Bw horizon.

AP4 through AP7 were all conducted on the Pocono Creek high floodplain in the northwest, southwest, and southeast quads of Pocono Creek west of the Bridge Street crossing. Profiles were similar to those described for AP2, with refusal at 18 cm (AP4), 26 cm (AP5), and 34 cm (AP7). In AP6, the profile consisted of an A/AB/C sequence to refusal by gravel at 80 cm bs. The C horizon of AP6 (22-80 cm bs) consisted of structureless, unweathered strata of medium sand and gravelly medium sand ***(Figure 2C and 2D; Photographs 3 and 4)***.

AP8 through AP10 were all conducted on the west bank of Little Pocono Creek at the Arlington Street crossing. AP8 was conducted on the floodplain in the southwest quadrant; the floodplain surface lies 1.5 m (5 ft) above the bed of the narrow channel. Auger refusal was at 18 cm bs within the very gravelly sandy loam Ap horizon ***(Figure 2E; Photograph 5)***. AP9 was conducted on the floodplain in the northwest quadrant; the surface there also lies 1.5 m (5 ft) above the channel. In two attempts, AP9 was refused within the gravelly A horizon at 8 and 12 cm bs. AP10 was located 25 m downstream from AP9 within an area of low floodplain. The surface lies about 0.75 m (2.5 ft) above the channel and is separated from the channel by a 1 m (3.3 ft) high levee. The profile consisted of an A/C/Cg sequence to refusal by gravel at 45 cm bs. The A horizon (0-25 cm bs) was formed in sandy loam containing 3-5% gravel. The C horizon (25-40 cm bs) and Cg horizon (40-45 cm bs) were formed in structureless gravelly sand.

AP11 was conducted on the western bank floodplain of Little Pocono Creek near the intersection of Hemlock and Rosebriar Streets ***(Figure 2G; Photograph 6)***. The surface lies 1.25 m (4 ft) above the bed of the channel. The right bank in this area - at a roughly equivalent elevation - is occupied by an extensive wetland ***(Figure 2G; Photograph 7)***. The profile of AP11 consisted of an A1/A2/AC/Bs/Bg/Cg1/Cg2 sequence to auger refusal by gravel at 120 cm bs. The A1 through Bg horizons (to 80 cm bs) were developed in fine and very fine sandy loam; the Cg horizons were loamy medium sand.

AP12 was conducted on the eastern bank floodplain along one of the lower reaches of Little Pocono Creek, in the northeast quadrant of the State Street/Main Street crossing ***(Figure 2F; Photograph 8)***. The surface lies 0.75 to 1.0 m (2.5 ft to 3.3 ft) above the bed of the channel. The profile, to auger refusal by gravel at 40 cm bs, consisted of an A1/A2 sequence. The A1 horizon (0-10 cm bs) was gravelly loamy sand and included much angular limestone gravel. The A2 horizon (10-40 cm bs) was very gravelly loamy sand.

AP13 was conducted on the northeast bank of McMichael Creek at Katz Drive ***(Figure 2H)***. The setting was the high floodplain, 2.5 m (8 ft) above the bed of the channel. Several deep flood scours flanked the augering location. The profile consisted of an A/C1/C2 sequence to auger refusal at 70 cm bs. The A horizon (0-10 cm bs) was 10YR3/3-3/4 sandy loam containing no gravel. The C1 horizon (10-60 cm bs) was structureless, unweathered medium sand; the C2 horizon was structureless, unweathered sand containing 25% rounded gravel.

AP14 was conducted on a northeast bank T-1 terrace just downstream from the AP13 location ***(Figure 2H and 2J; Photograph 9)***. The T-1 surface lies 2.5 m (8 ft) above the high floodplain and 5 m (16.5 ft) above the bed of the channel. The profile consisted of an A/Bw/C sequence to auger refusal by gravel at 55 cm bs. The A horizon (0-8 cm bs) was 10YR3/3 sandy loam. The Bw horizon (8-45 cm bs) was 10YR3/6-4/6 sandy loam containing less than 1% fine rounded gravel. The Bw horizon showed notably more development of soil color and soil structure than seen in any subsurface horizons in probes to that point. The C horizon (45-55 cm bs) was structureless gravelly sandy loam.

AP15 was conducted 150-200 downstream from AP14 on a landform at an elevation intermediate between that of the high floodplain and that of the T-1, approximately 3.5 m (11 ft) above the bed of the channel ***(Figure 2J; Photograph 10)***. The profile consisted of an A/C sequence to auger refusal at 26 cm bs. The A horizon (0-10 cm bs) was sandy loam with granular structure. The C horizon was very gravelly loamy medium sand.

No testing was conducted along the portion of McMichael Creek that lies parallel to Dreher Ave. This area lies approximately 15 m (50 ft) above the channel. Gravels and cobbles were observed at the ground surface ***(Figure 2H; Photograph 11)***.

AP16 was conducted on the floodplain near the confluence of McMichael and Pocono Creeks ***(Figure 2K; Photograph 12 and 13)***, which is a highly dynamic setting marked by numerous deep scours and abandoned channel segments. The profile of AP16 consisted of an A/C1/C2 sequence to auger refusal at 48 cm bs. The A horizon (0-8 cm bs) was formed in sandy loam. The C1 horizon (8-35 cm bs) was structureless loamy medium sand showing no evidence of stability or soil development. The C2 horizon (35-48 cm bs) was very gravelly loamy medium sand.

AP17 and AP18 were excavated on the western bank floodplain of Brodhead Creek ***(Figure 2M; Photograph 14)***. The floodplain surface lies 6 to 7 m (19.5 ft to 23 ft) above the bed of the channel and is vegetated in Japanese knotweed and scattered trees. It is a dynamic setting with many downed trees, flood scours, and low banks of recently deposited sand. AP17 was located approximately 40 m from the channel. The profile consisted of an AC/C sequence to auger refusal by cobbles at 152 cm bs. The AC horizon (0-10 cm bs) consisted of 10YR3/4 loamy sand. The C horizon consisted of thickly stratified silt loam and medium, fine, and very fine sand exhibiting no development of soil color or structure.

AP19 was excavated on the eastern bank of McMichael Creek along Village Drive at La Bar Village. The setting was a narrow T-1 terrace 4 m above the bed of the channel ***(Figure 2J; Photograph 15)***. A narrow floodplain lying 1.5 to 2 m (5 ft to 6.6 ft) above the channel is present adjacent to the channel. The profile of AP19consisted of an A/AB/Bw/C sequence to auger refusal at 120 cm bs. The A horizon (0-16 cm bs) was 10YR3/2 fine sandy loam; the AB horizon (16-28 cm bs) was 10YR3/3 loamy fine sand free of gravel. The Bw horizon (28-60 cm bs) was 10YR4/6 medium sandy loam free of gravel and exhibiting weak coarse parting to weak medium subangular blocky structure. The C horizon (90-120 cm bs) was loamy medium sand free of gravel and exhibiting some evidence of lamellae development near the base.

AP20 was excavated on an expansive T-2 terrace lying approximately 1 m (3.3 ft) above the T-1 and 5 m (16.5 ft) above McMichael Creek ***(Figure 2J; Photograph 15)***. The profile of AP20 consisted of an A/AB/Bw/C sequence to auger refusal by gravel at 68 cm bs. The Bw horizon (25-50 cm bs) was developed in loamy medium sand and exhibited very weakly expressed soil color (10YR4/4-4/6) and soil structure. Several other probes (AP21, AP22, and AP23) on the T-2 surface revealed profiles exhibiting similarly weak expression of soil development. A large mound of soil on the T-2 was sampled and found to be composed of dark, sandy A horizon material ***(Figure 2J)***.

The geomorphology investigations indicated that virtually no deep (> 1 m) terminal Pleistocene through Holocene overbank alluvium was encountered in sampling the study area. Soil profiles in the sampled areas were made up overwhelmingly of thin, gravelly A horizons overlying very gravelly Bw horizons on outwash terraces or thin sandy A horizons developed in Historic to recent high energy alluvium overlying coarse reworked outwash.

A greater degree of soil development was seen at two locations which include two outwash terraces situated 5 m (16.5 ft) and 4 m (13.5 ft) above the active channel of McMichael Creek, respectively ***(Photographs 16 and 17)***. The A/Bw sequence seen to 45 cm bs in AP14 on the 5 m (16.5 ft) terrace has developed in sandy alluvium relatively free of gravel ***(Figure 2H and 2J)***. This is moderately high energy overbank deposition, and given the elevation above the channel is probably of terminal Pleistocene to Early Holocene age. This landform has the theoretical potential to contain cultural material to the depth at which gravel is encountered in the profile (approximately 45 cm bs). The thick deposit of sandy loam and loamy sand on the 4 m (13.5 ft) terrace, sampled by AP19 and AP20, is interpreted to be a product of rapid deposition on the proximal edge of a meander bend point bar, probably in the Early Holocene ***(Figure 2J)***.

This is a relatively unstable setting, but the potential for the presence of cultural material to a depth of 120 cm cannot be definitively ruled out. Lack of soil development in the upper profile of the higher terrace adjacent to the 4 m terrace (13.5 ft), along with the presence of the stockpiled soil and noticeable down cutting of the surface in some areas, is interpreted to be a result of late 20th century grading of a large area of the T-2 surface.

Deeper sandy sediments and a moderate degree of soil development were also seen in AP11. The relatively fine texture of the sediments and lack of gravel coupled with poor drainage at the sampling location and in the adjacent wetland appear to point to deposition in a temporarily ponded setting. While the wet area may have functioned as a resource procurement locus, the poor drainage would render it inhospitable to habitation.

CONCLUSIONS

Based upon all levels of inquiry, two areas (Village Drive and Katz Drive) were given moderate pre-contact probability. They are both located along McMichael Creek ***(Figures 2H and 2J)*** along high outwash terraces which contain a variably thick package of Holocene age vertical accretion deposits. The nominal thickness of the Holocene overbank alluvium at both areas was 60 cm.

At Village Drive, five probes were excavated along the valley bottom zone ***(Figure 2J)***. The two probes closest to the active stream channel contained an in situ Bw horizon of Holocene age, which has the potential to contain in situ prehistoric cultural resources. The Bw horizon extended to a nominal depth of 60 cm at which point relict lateral accretion deposits were encountered. The other auger probes excavated in a more distal section of the flood plain indicated the presence of disturbance throughout the area.

The second area is located along McMichael Creek at Katz Drive ***(Figure 2H and 2J)***. Three auger probes were excavated on the flood plain zone. One auger probe, placed behind an extant building, contained an in situ Bw horizon of Holocene age. The base of the Bw horizon occurred at 55 cm below ground surface. It is recommended that at both of these loci, Phase I testing be undertaken. Testing should extend to the top of relict coarse grained lateral accretion deposits.

It should be noted that while the project area is rather expansive, the degree of disturbance from road construction, utility lines, and home and commercial building construction has severely impacted the once in situ soils. Most importantly, however, have been the effects of extensive flood scouring and active lateral channel migration during historic times. These high flows and active channel avulsion were in response, initially, to historic deforestation but more recently due to urbanization.

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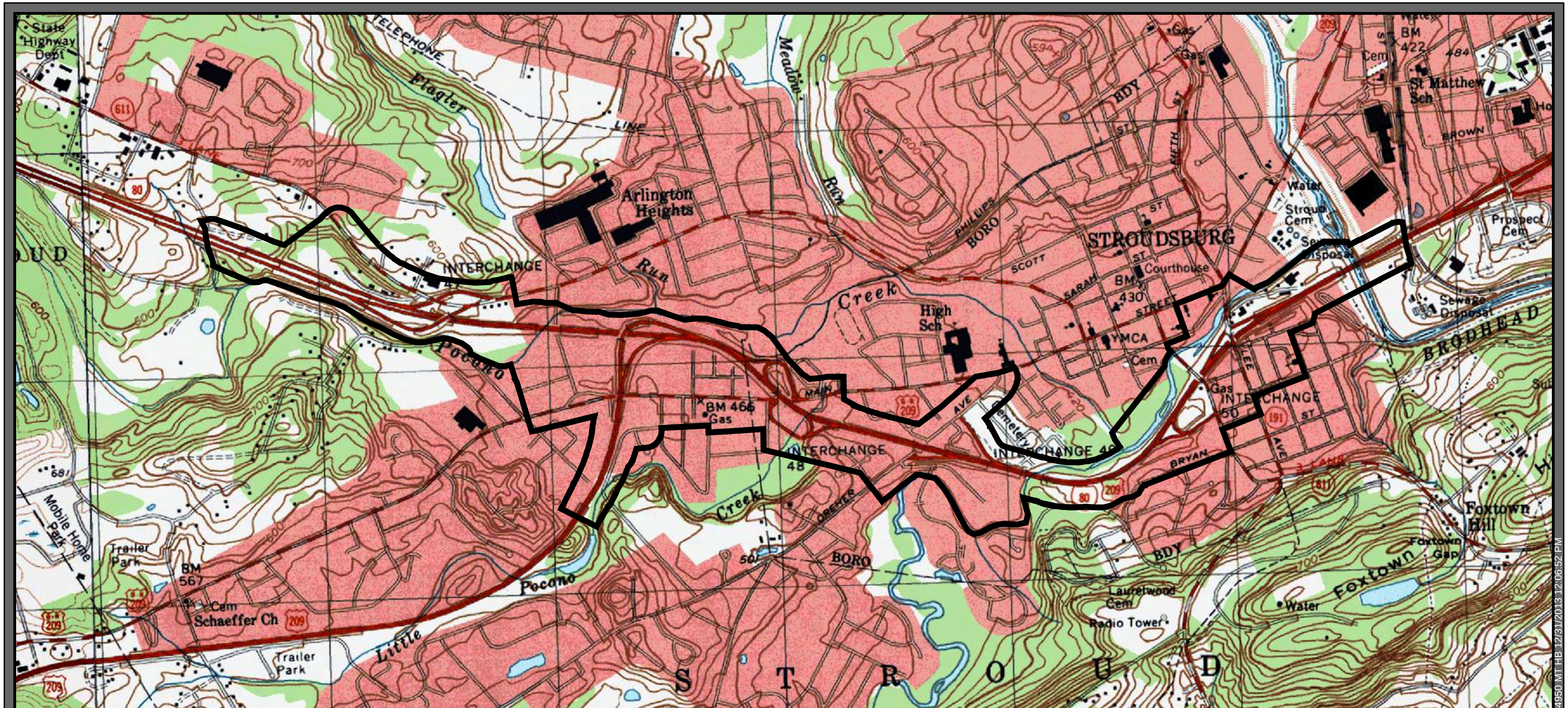

Archaeological Area of Potential Effects

0 1,000 2,000 4,000 Feet

0 240 480 720 960 1,200 Meters

N E S W

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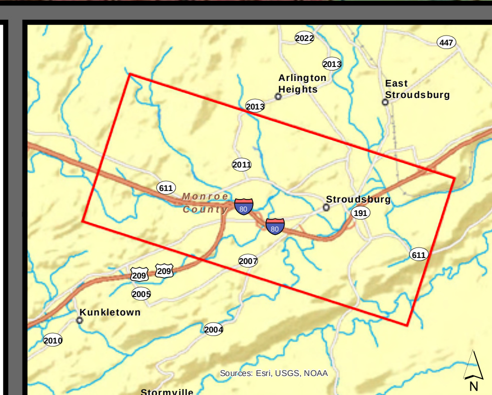


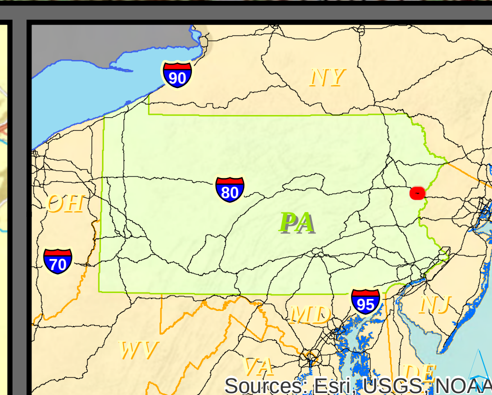


Figure 1: Archaeological Area of Potential Effects

Pennsylvania Department of Transportation, District 5-0
I-80 Reconstruction Project

Monroe County, Pennsylvania

Source: Stroudsburg, PA 7.5' USGS Quadrangle, 1999

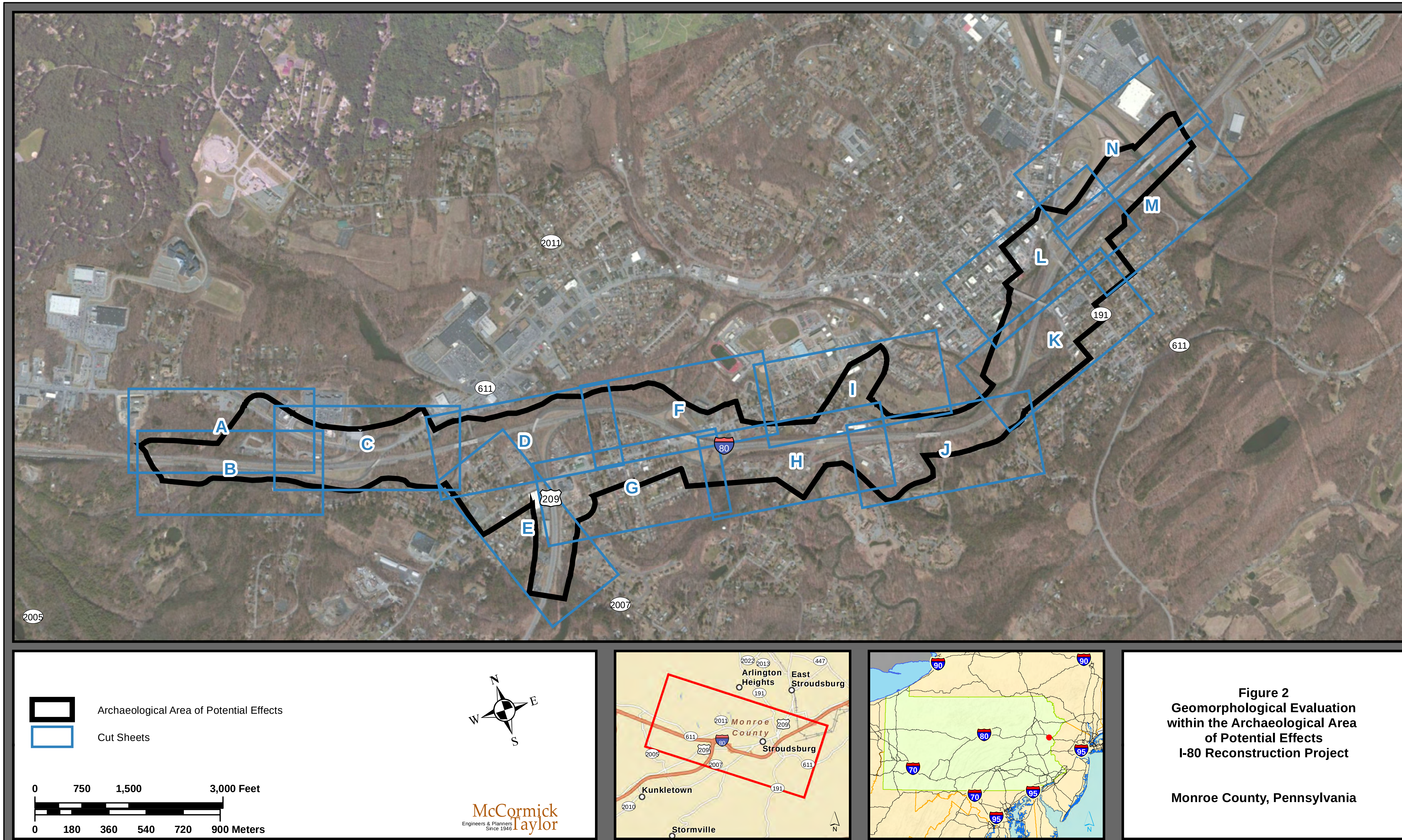


Figure 2
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

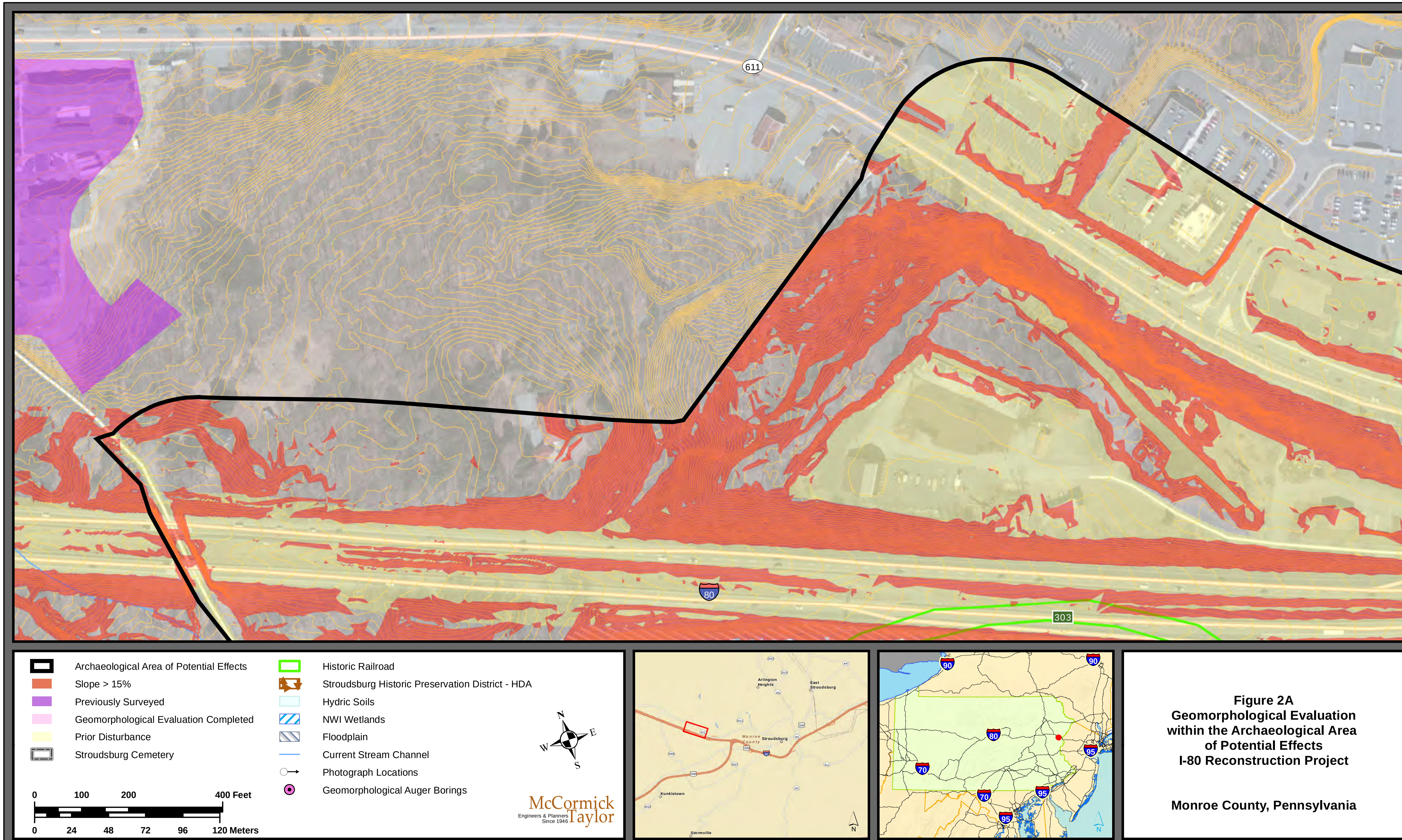
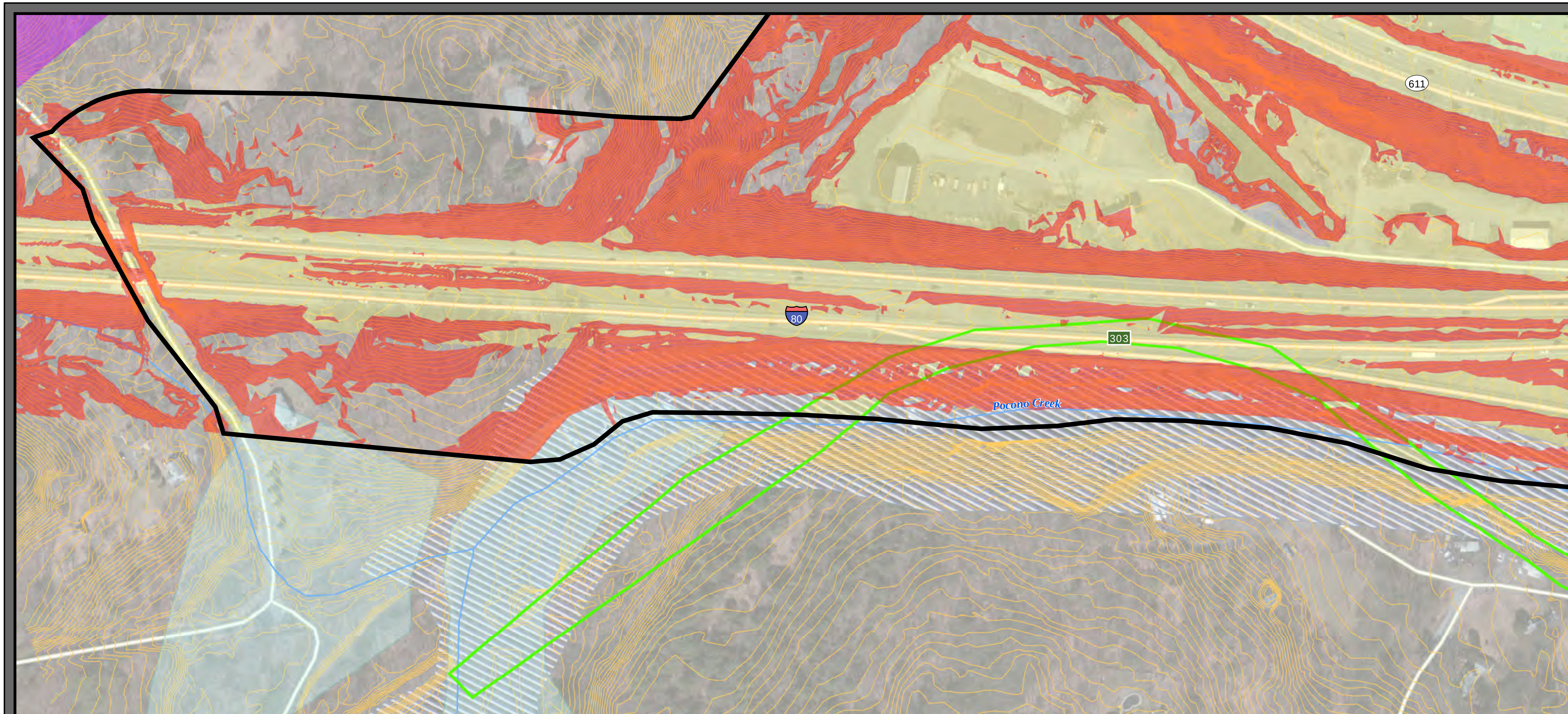


Figure 2A
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



Archaeological Area of Potential Effects
Slope > 15%
Previously Surveyed
Geomorphological Evaluation Completed
Prior Disturbance
Stroudsburg Cemetery
Historic Railroad
Stroudsburg Historic Preservation District - HDA
Hydric Soils
NWI Wetlands
Floodplain
Current Stream Channel
Photograph Locations
Geomorphological Auger Borings

0 100 200 400 Feet
0 24 48 72 96 120 Meters

N E S W

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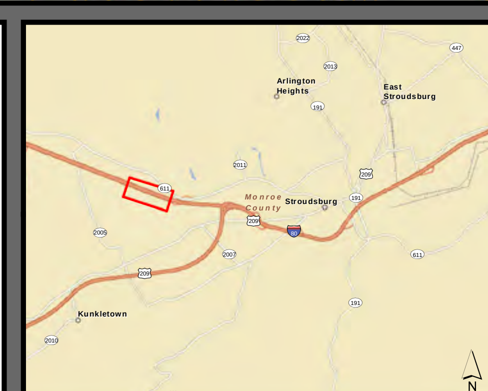
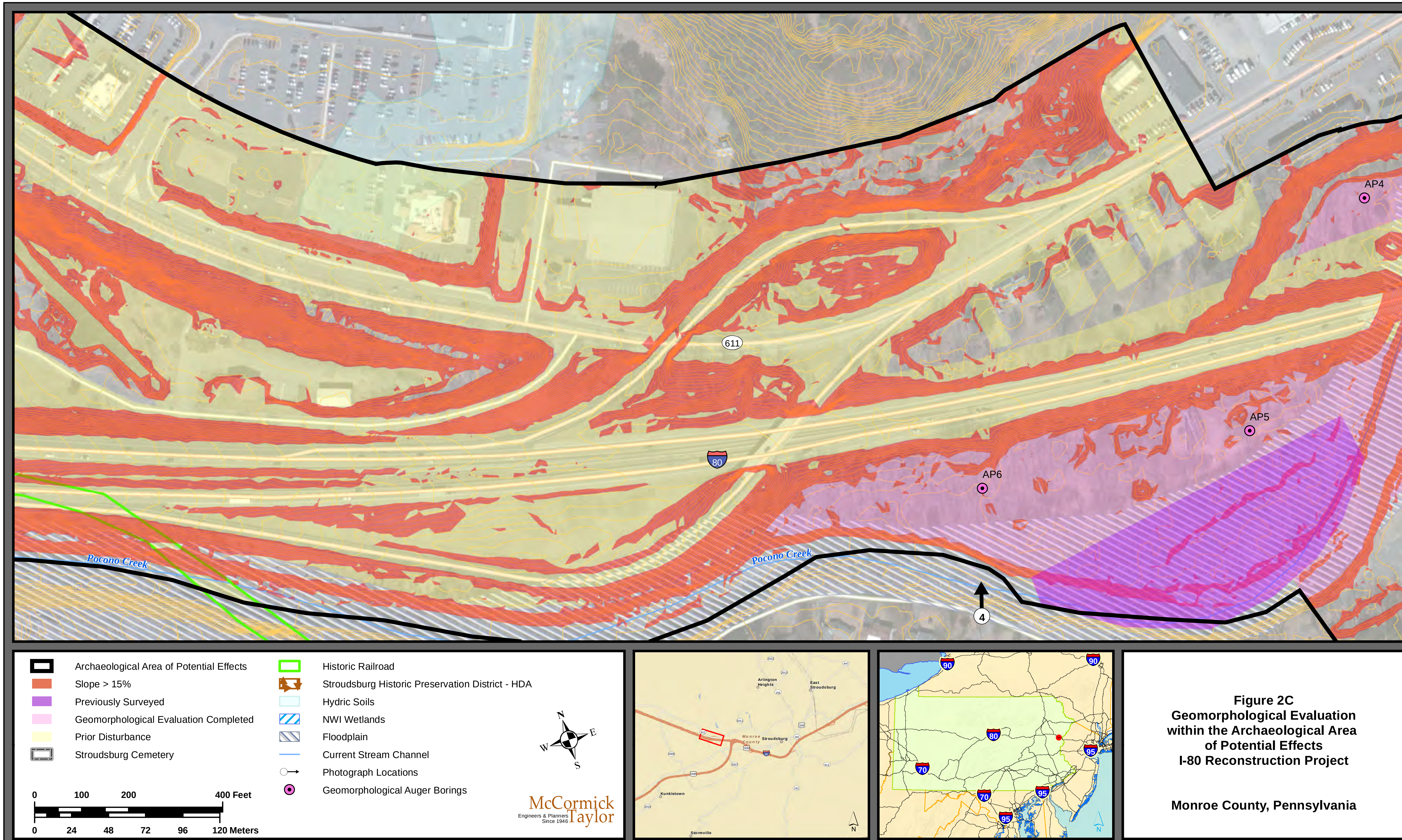


Figure 2B
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



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Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

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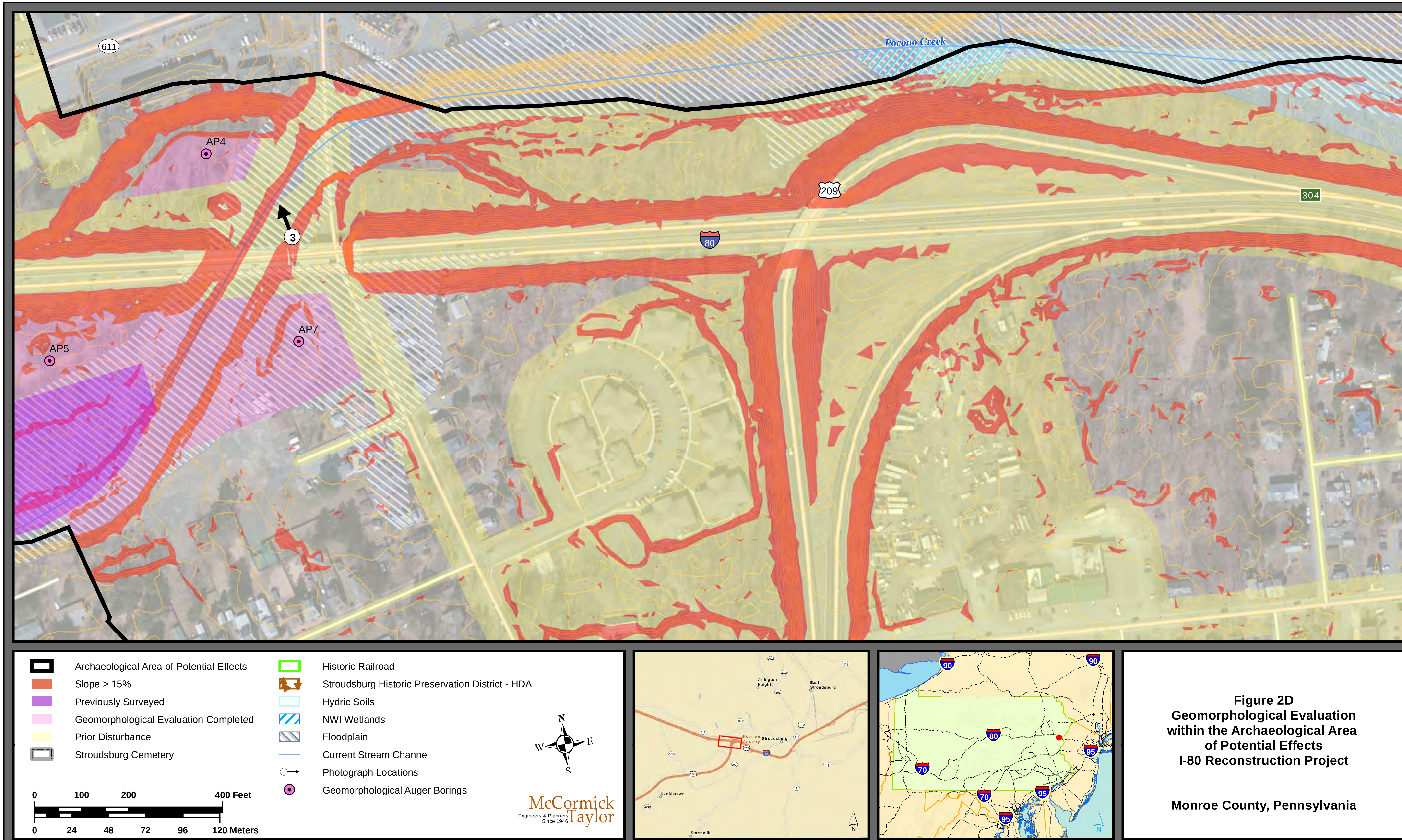

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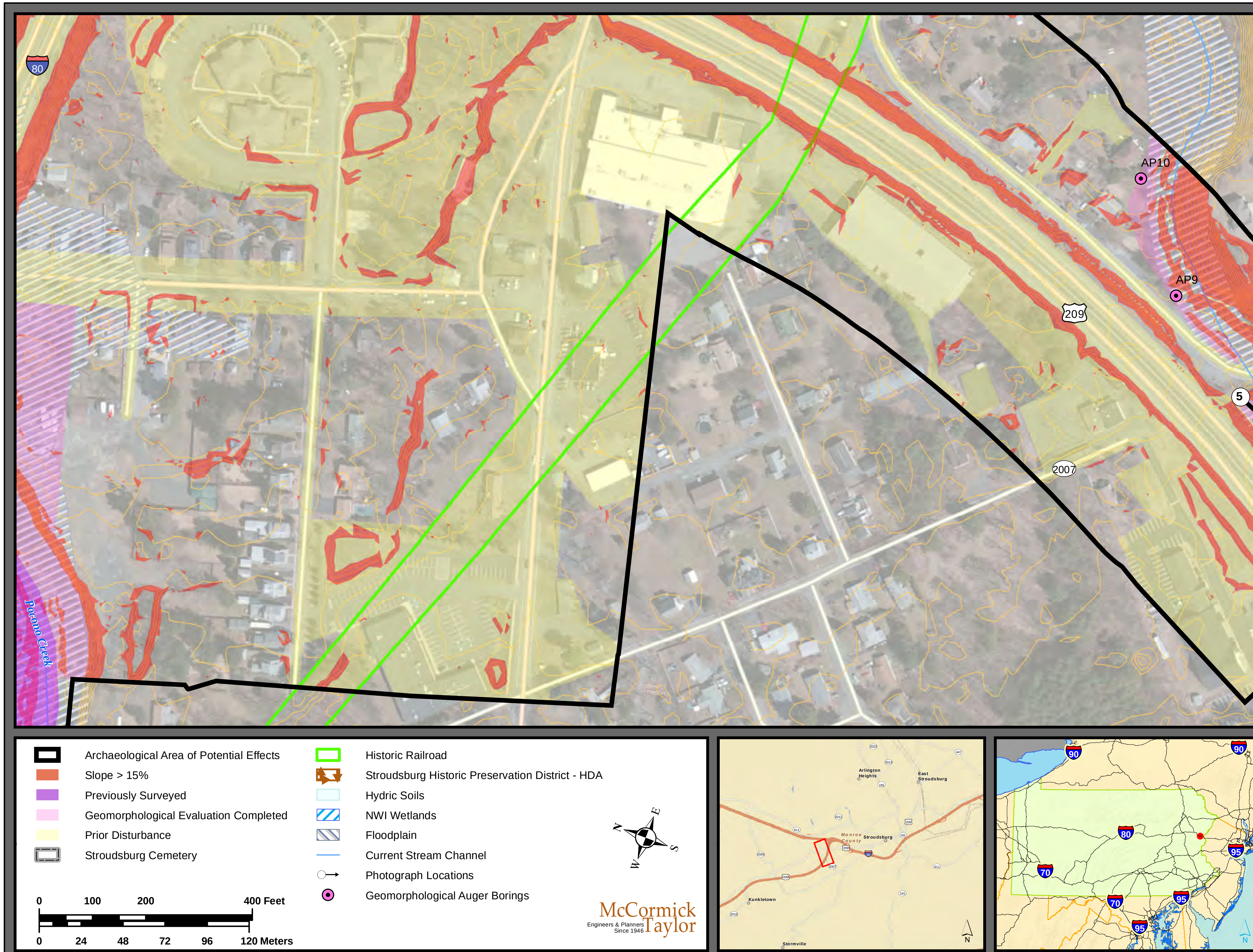

Figure 2E
Geomorphological Evaluation within the Archaeological Area of Potential Effects
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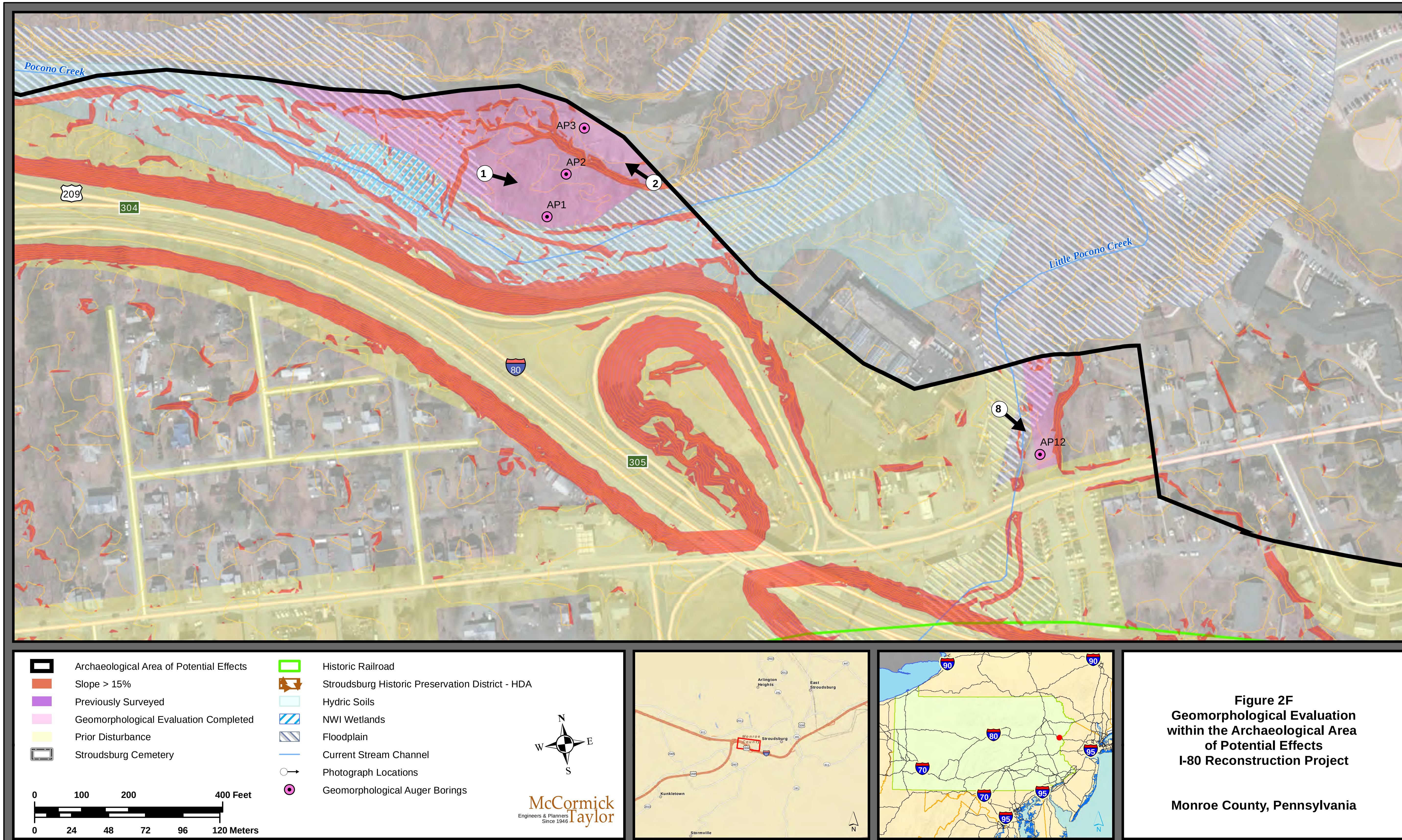

Figure 2F
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

Archaeological Area of Potential Effects
Slope > 15%
Previously Surveyed
Geomorphological Evaluation Completed
Prior Disturbance
Stroudsburg Cemetery
Historic Railroad
Stroudsburg Historic Preservation District - HDA
Hydric Soils
NWI Wetlands
Floodplain
Current Stream Channel
Photograph Locations
Geomorphological Auger Borings

0 100 200 400 Feet
0 24 48 72 96 120 Meters

N E S W

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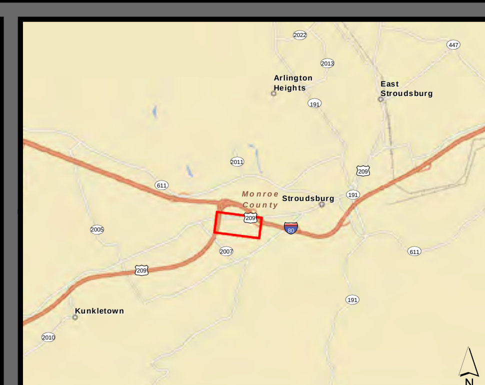

Figure 2G
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

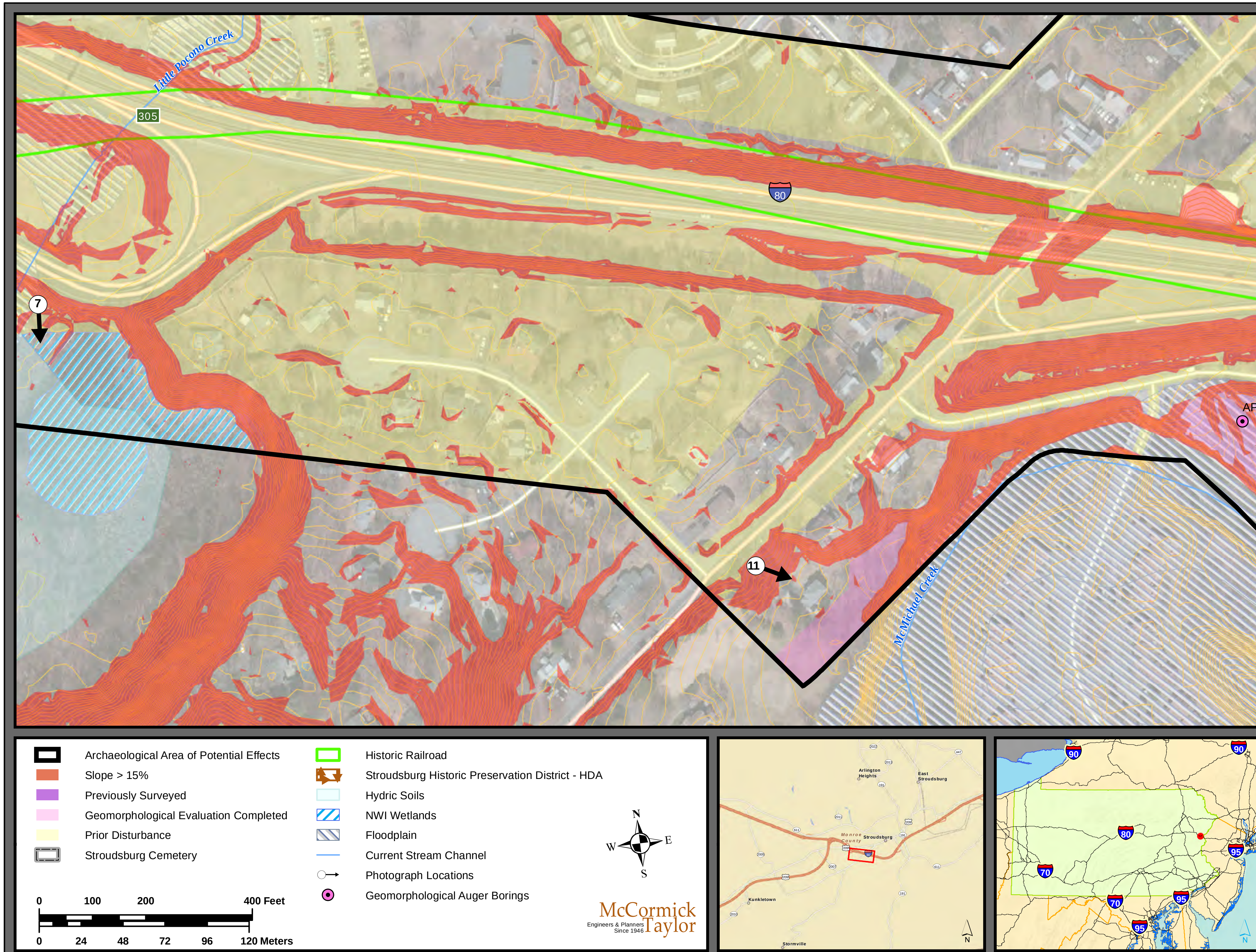

Figure 2H
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

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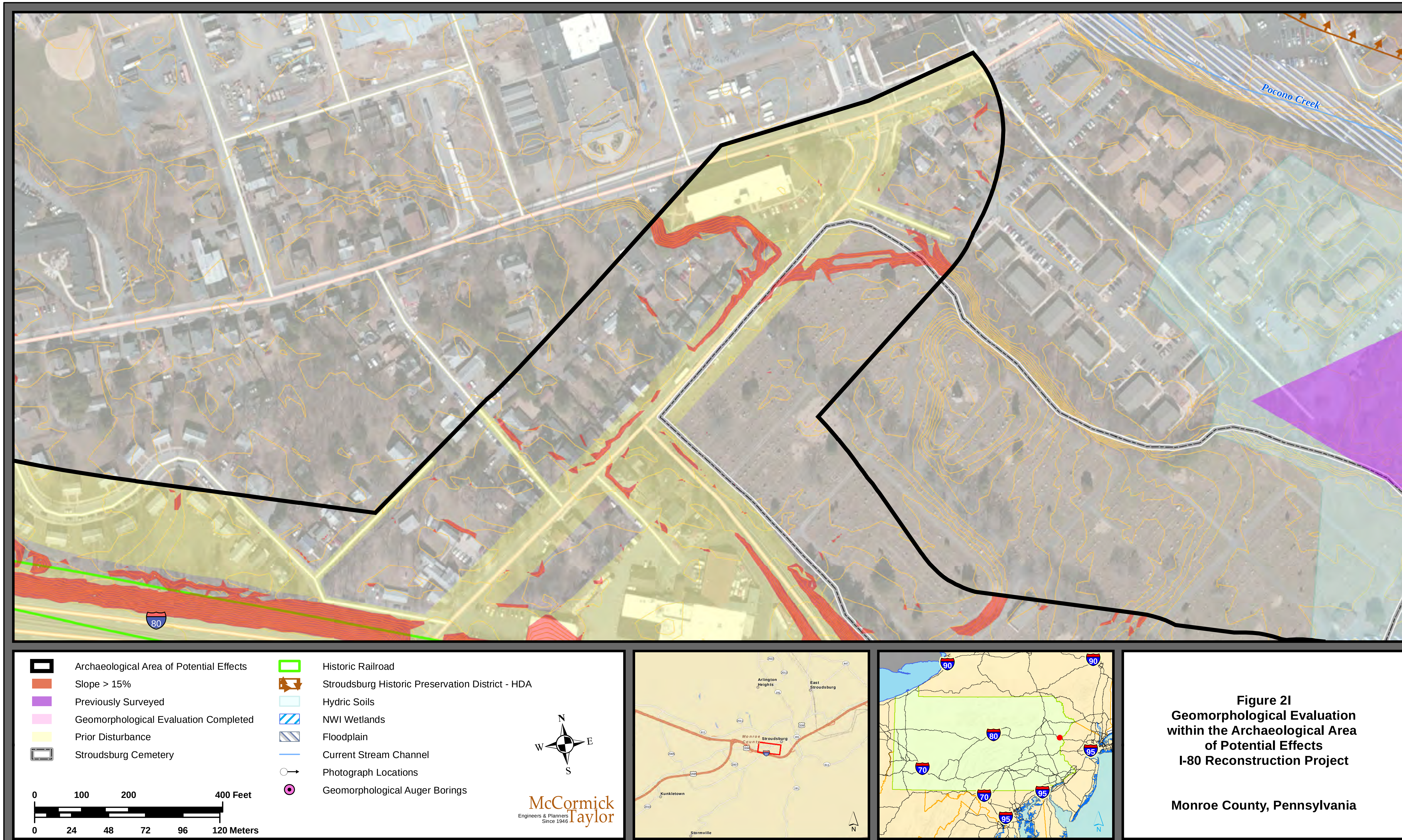

Figure 2I
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

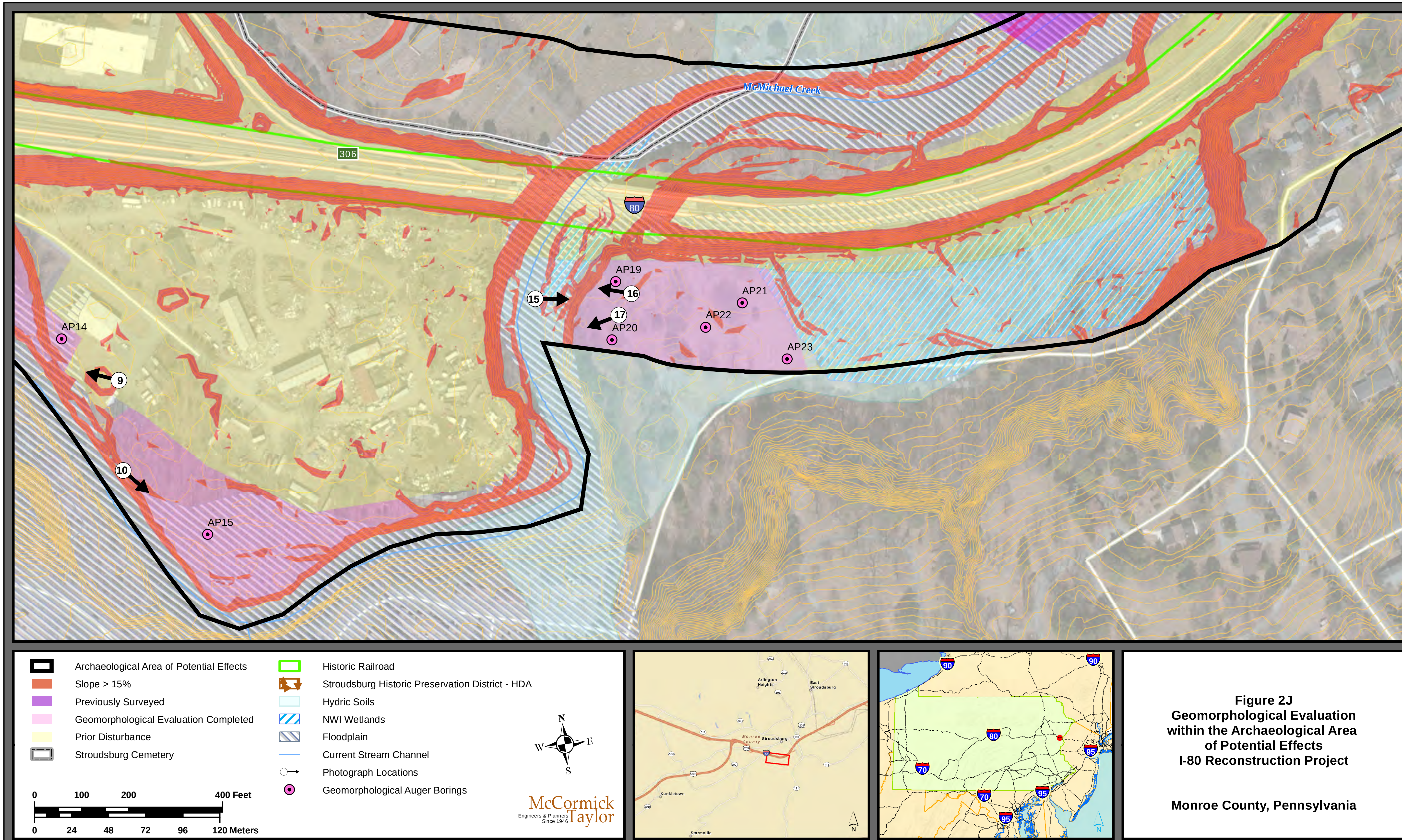

Figure 2J
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I-80 Reconstruction Project

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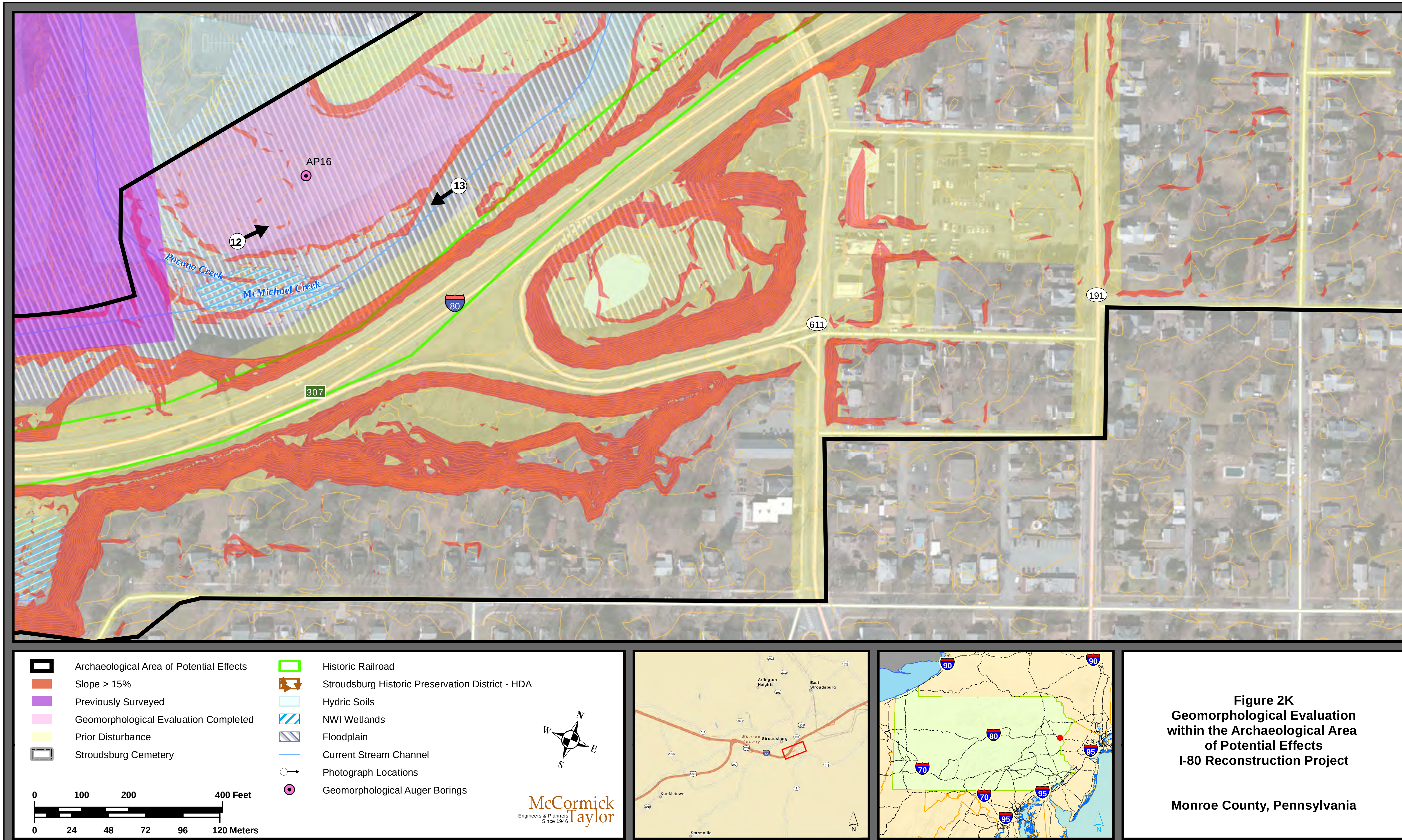


Figure 2K
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

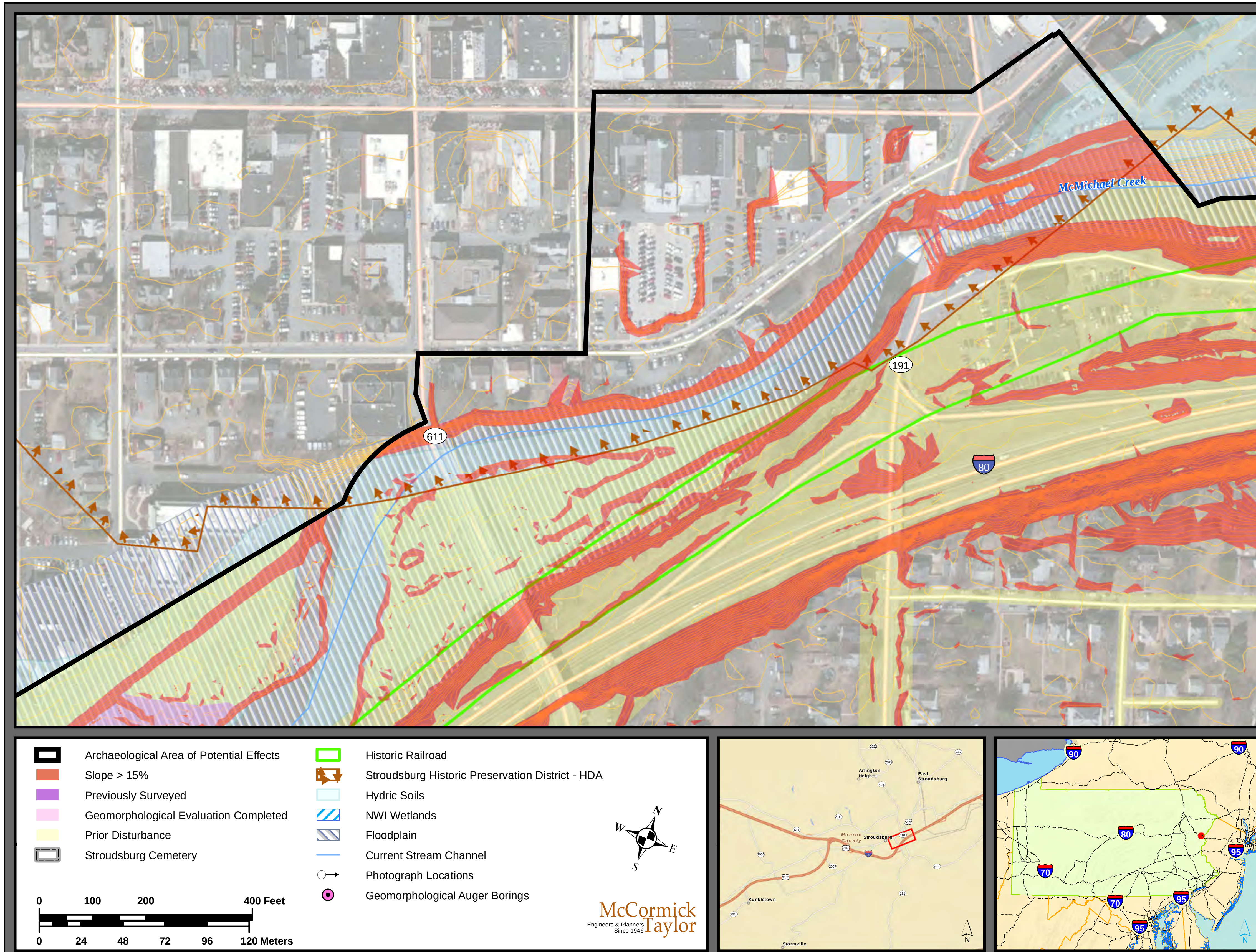


Figure 2L
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

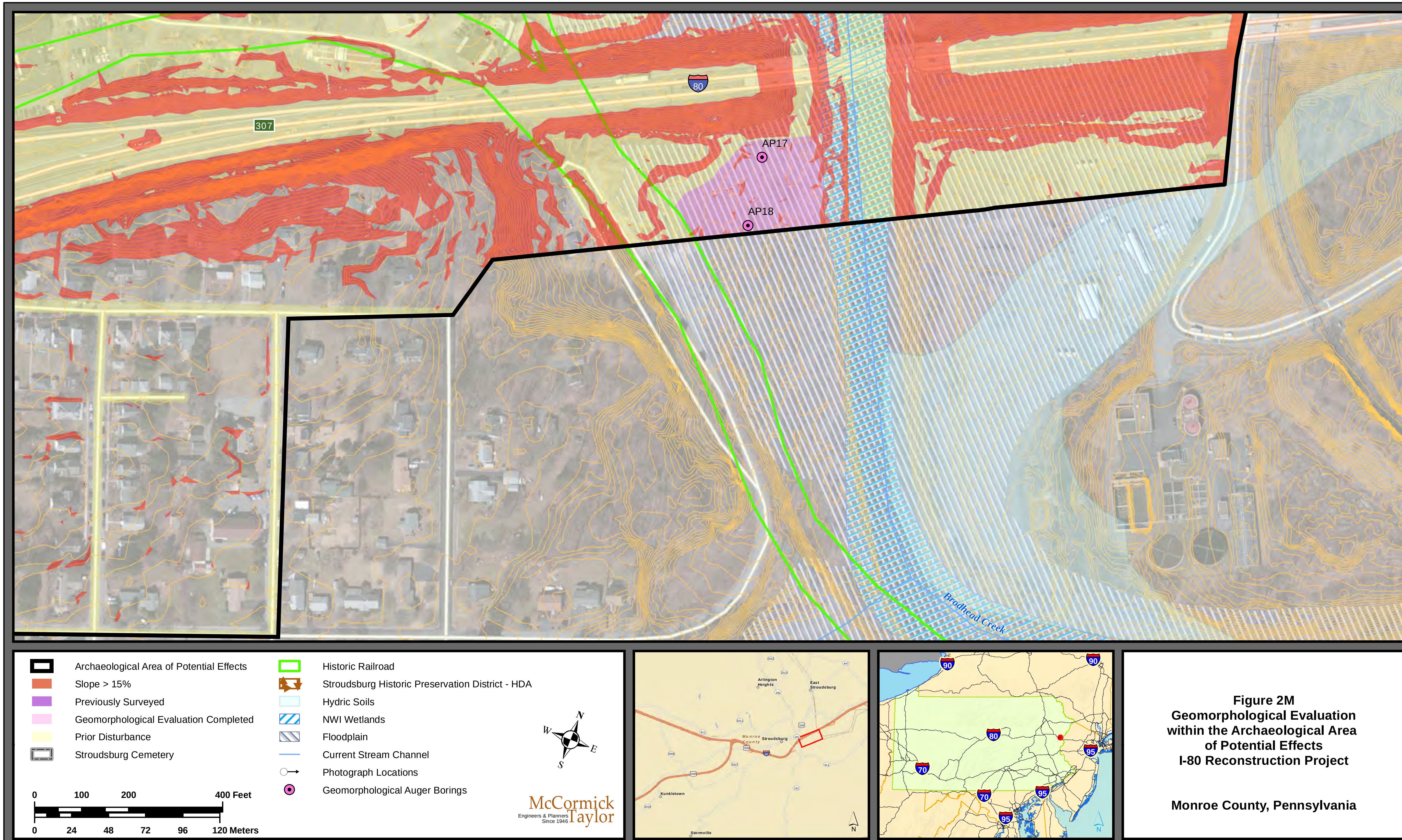
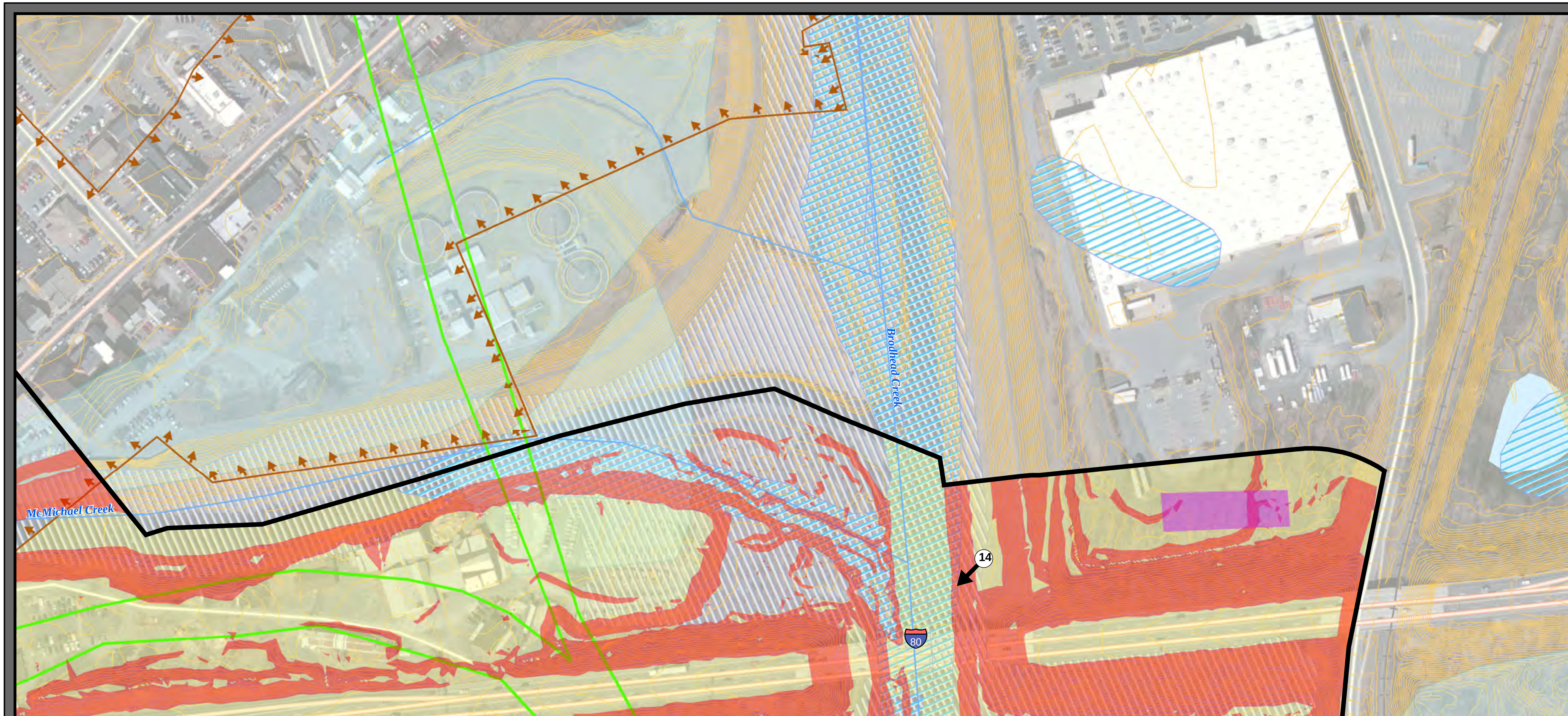


Figure 2M
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



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- Archaeological Area of Potential Effects
- Slope > 15%
- Previously Surveyed
- Geomorphological Evaluation Completed
- Prior Disturbance
- Stroudsburg Cemetery
- Historic Railroad
- Stroudsburg Historic Preservation District - HDA
- Hydric Soils
- NWI Wetlands
- Floodplain
- Current Stream Channel
- Photograph Locations
- Geomorphological Auger Borings

0 100 200 400 Feet

0 24 48 72 96 120 Meters

N E S W

McCormick Taylor
Engineers & Planners
Since 1946

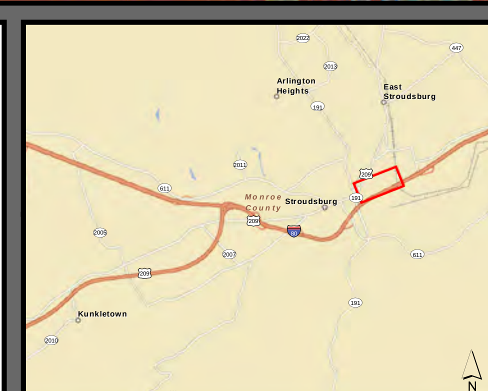
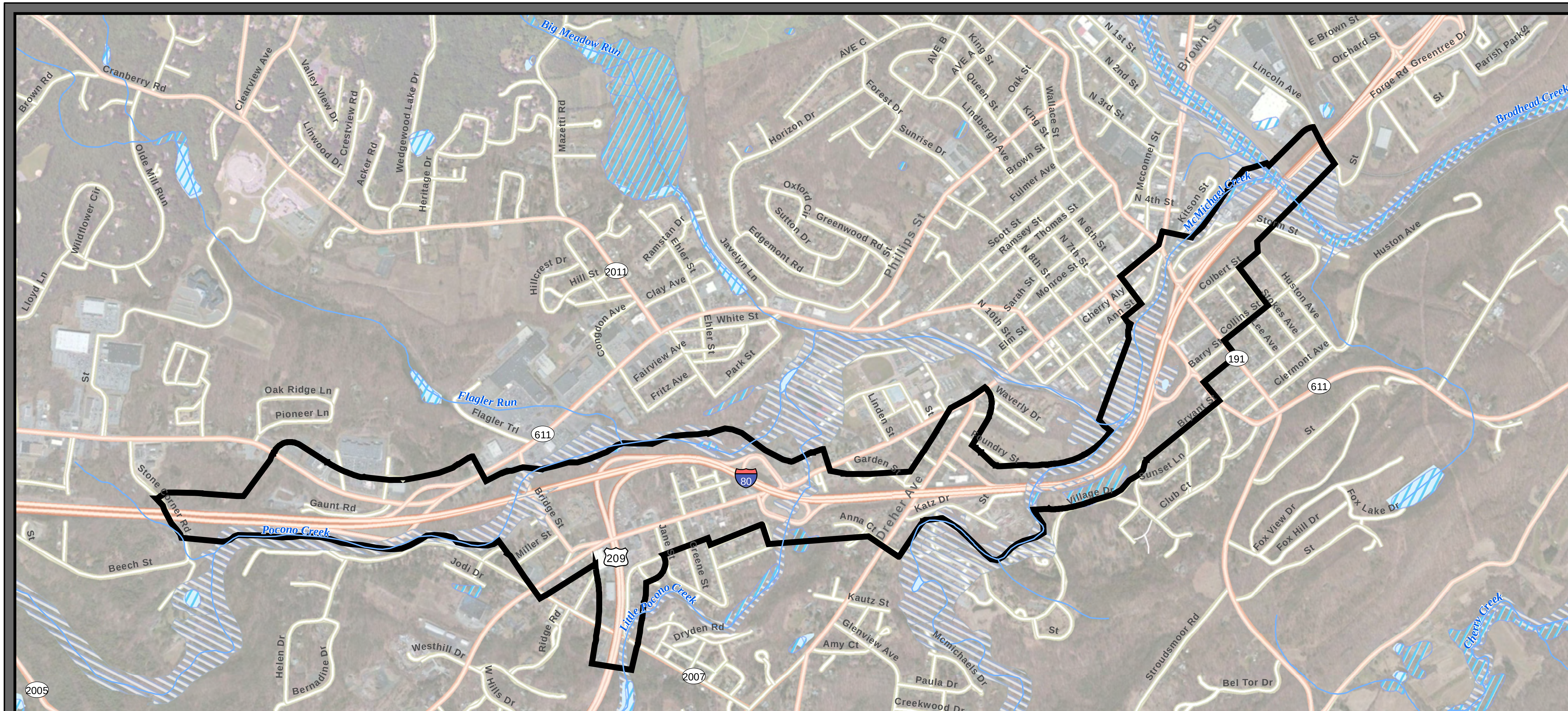


Figure 2N
Geomorphological Evaluation within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania



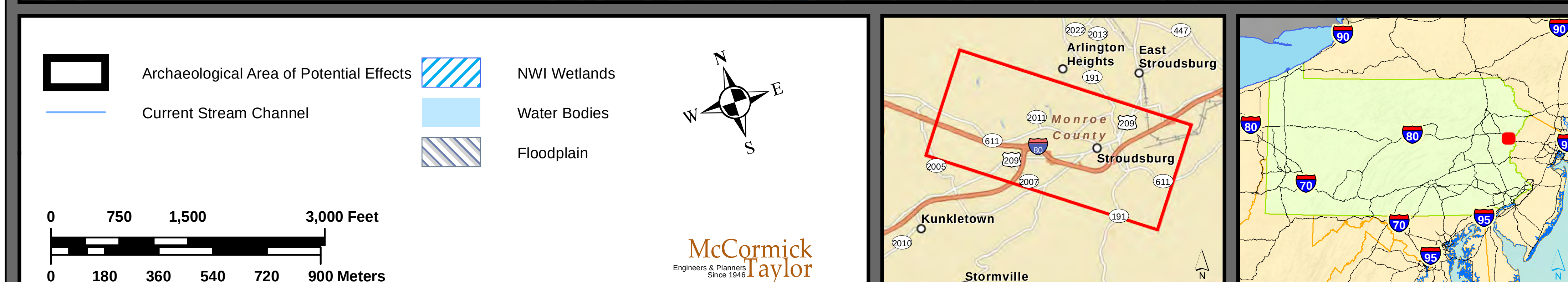


Figure 3
Hydrology within the Archaeological Area of Potential Effects
I-80 Reconstruction Project

Monroe County, Pennsylvania

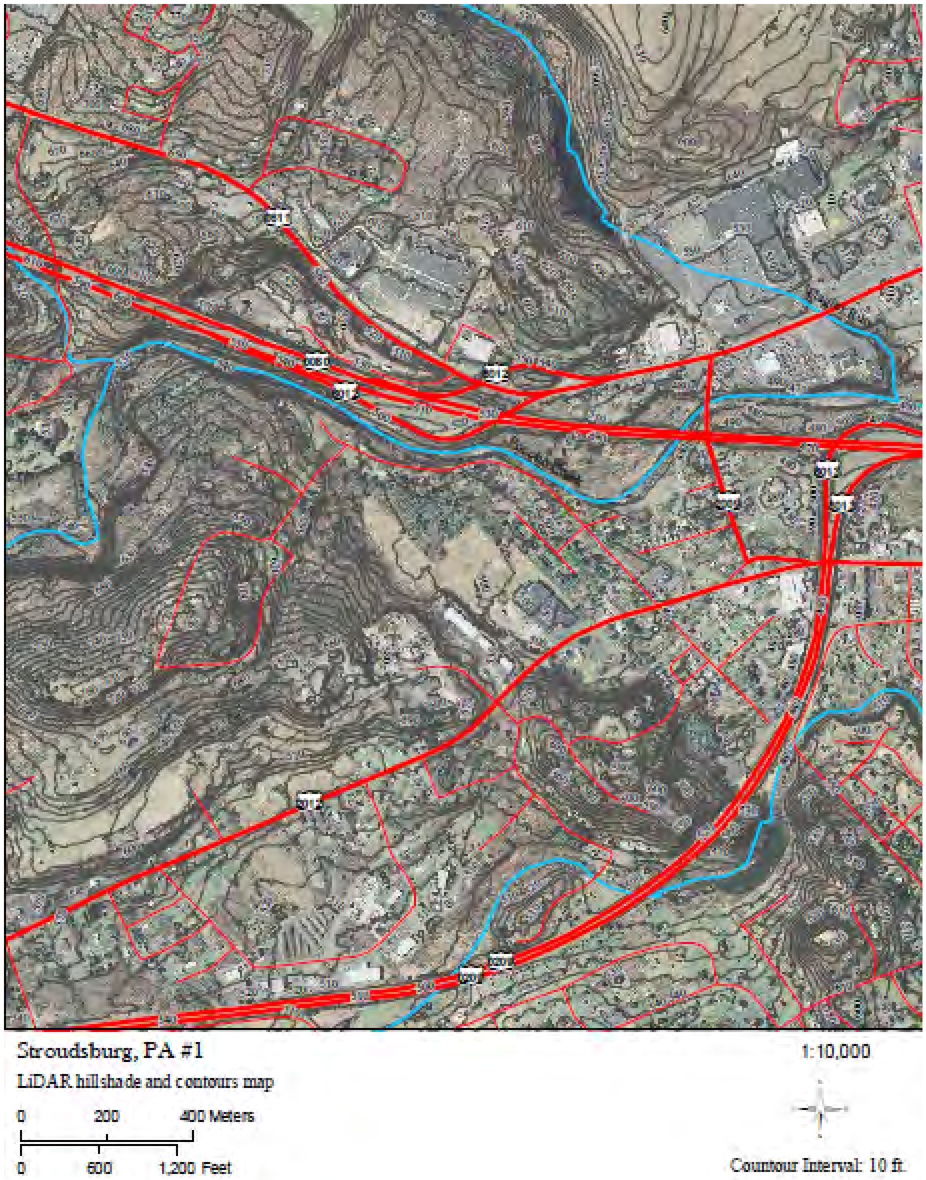


Figure 4. LiDAR ap of the western portion of the project area corridor.

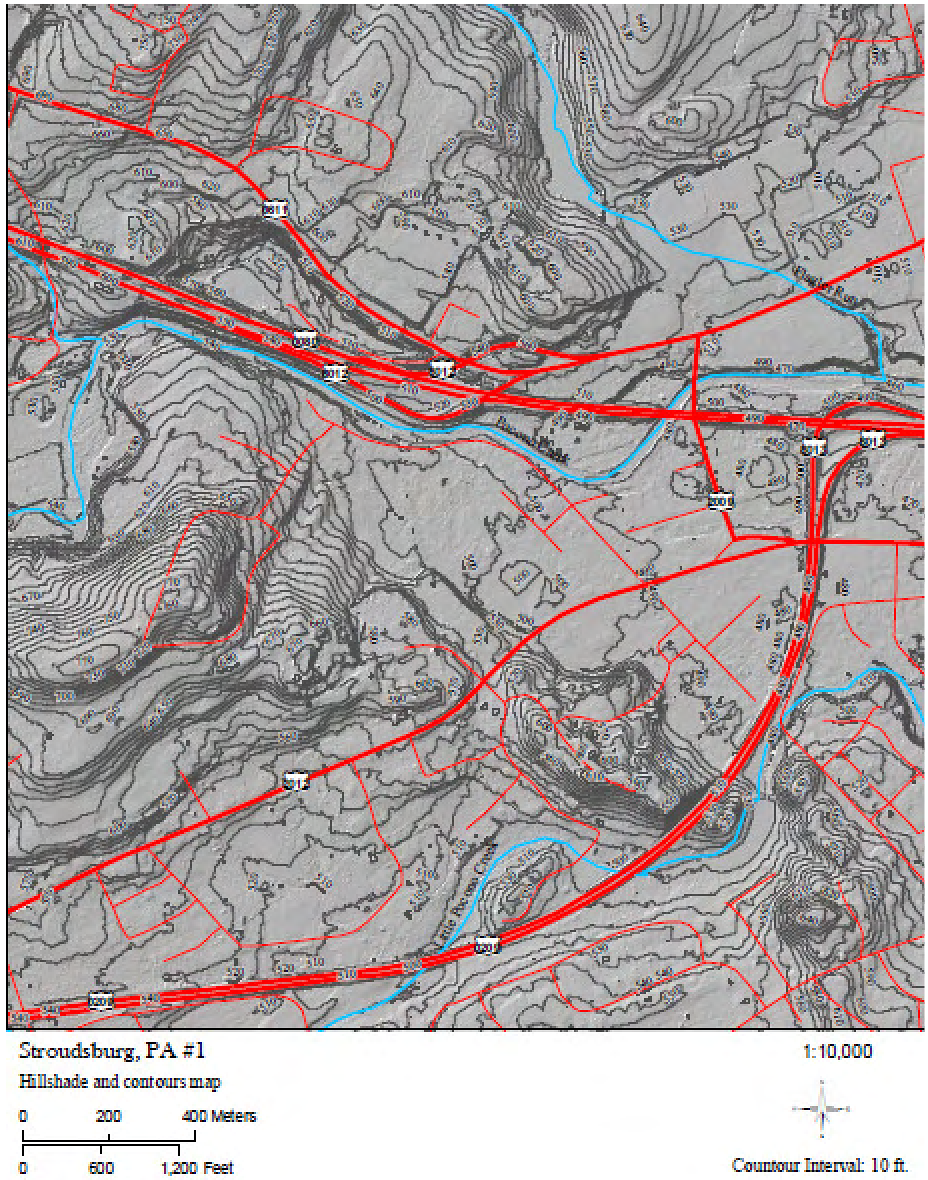


Figure 5. Shaded relief map of the western portion of the project area.

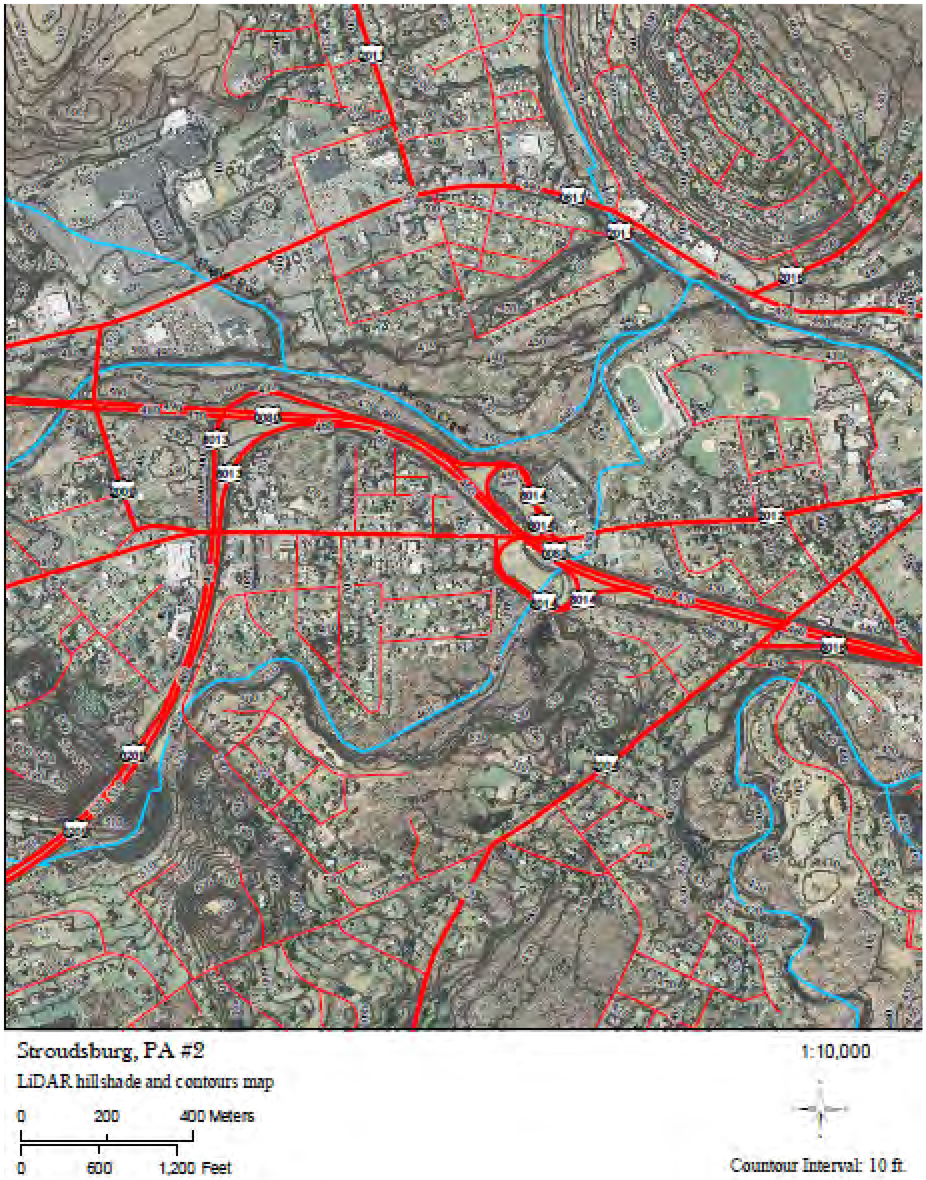


Figure 6. Lidar map of the central portion of the project area corridor.

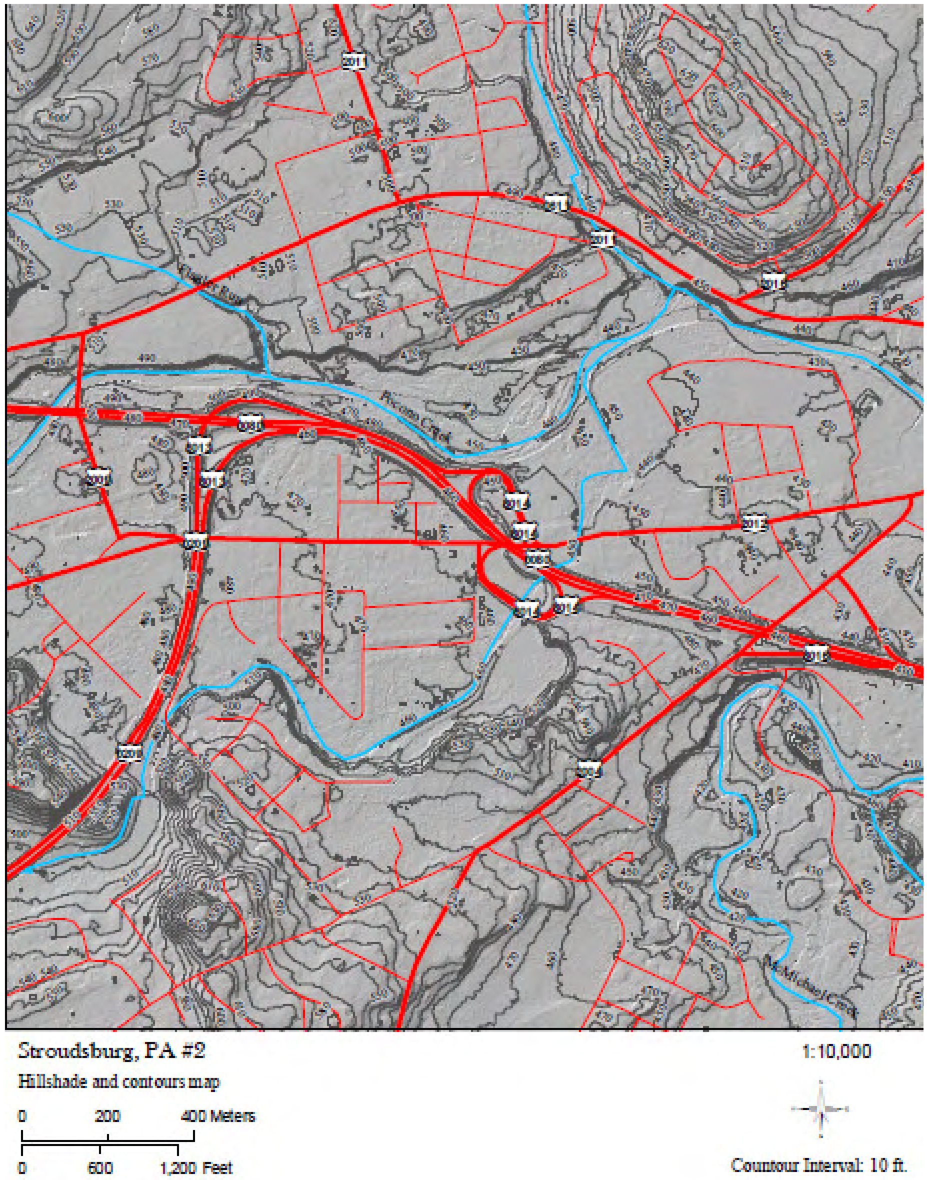


Figure 7. Shaded relief map of the central portion of the project area corridor.

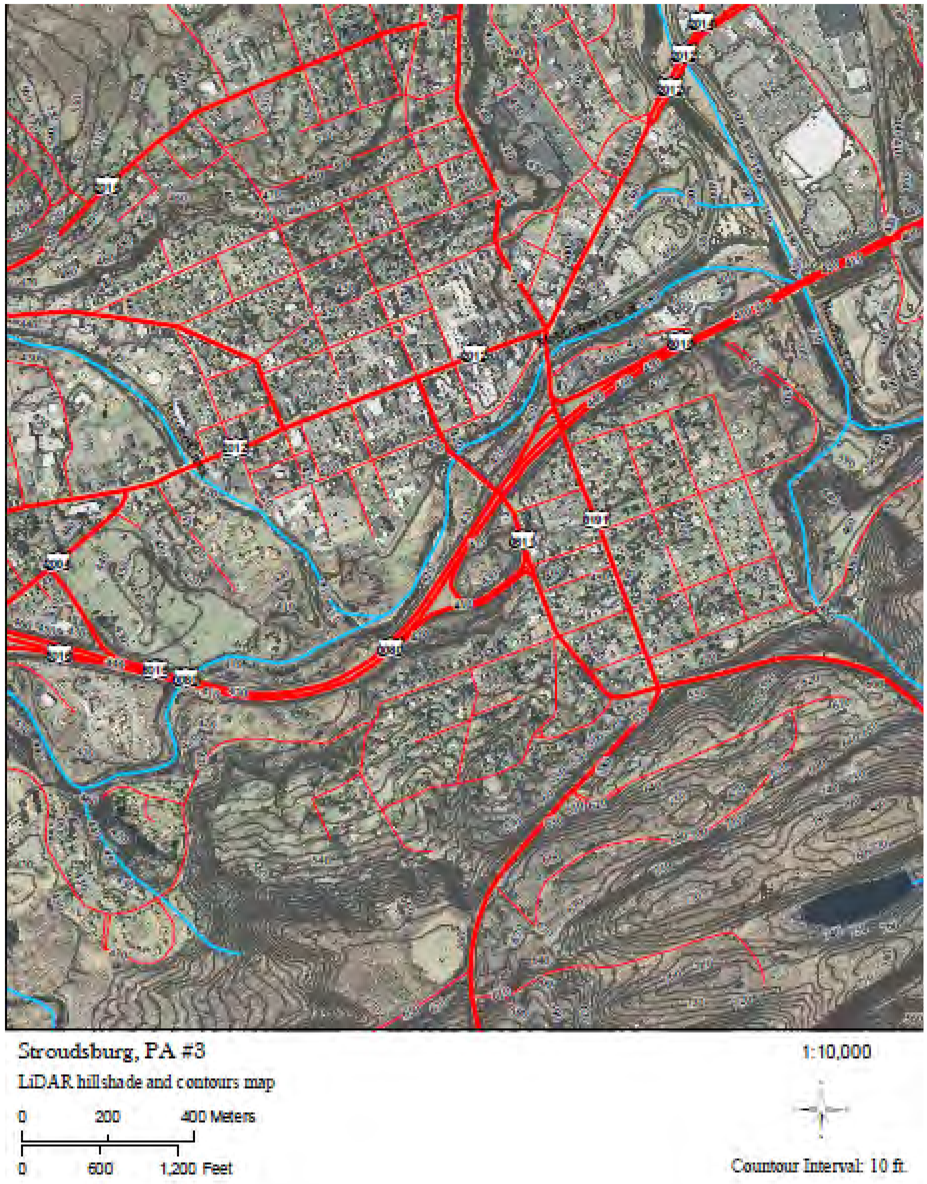


Figure 8. Lidar map of the eastern portion of the project area corridor.

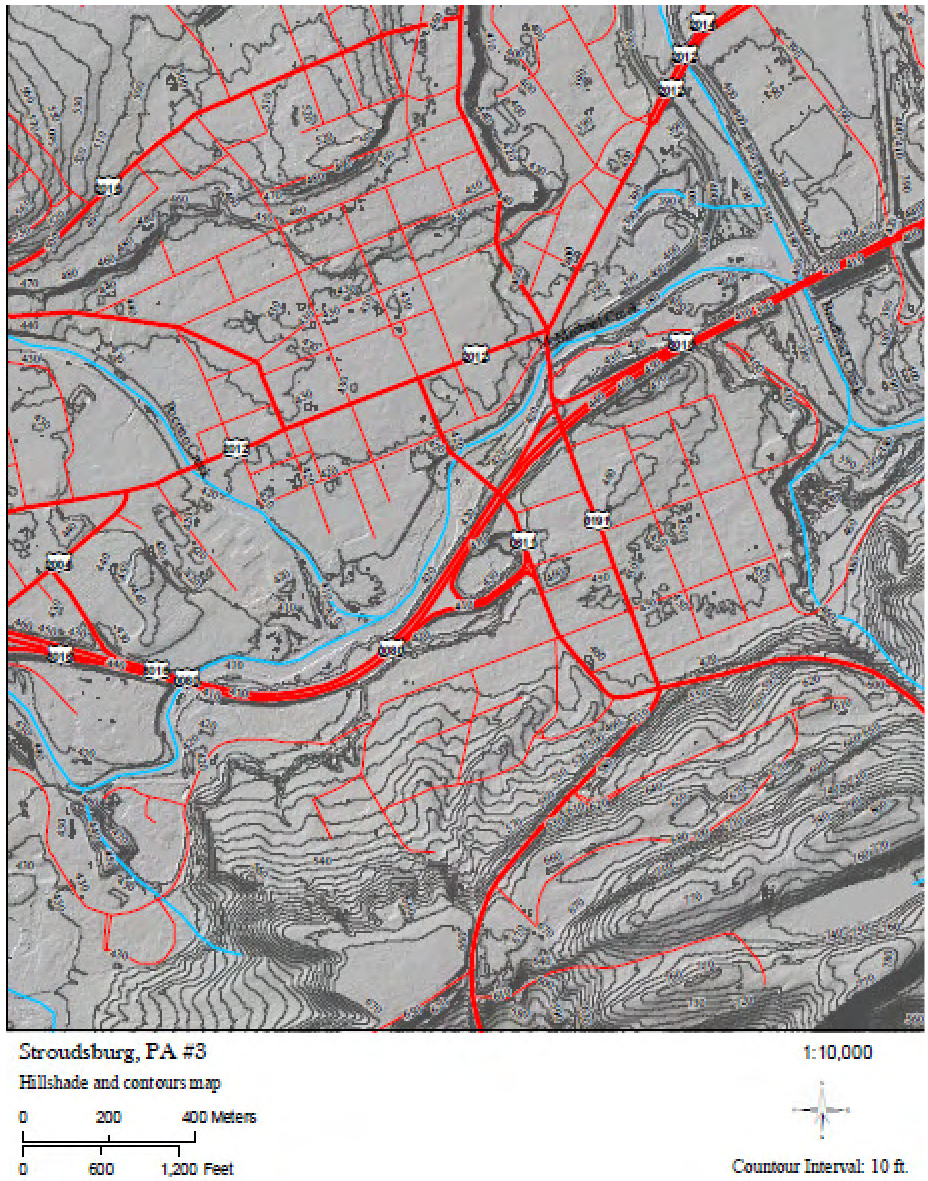


Figure 9. Shaded relief map of the eastern portion of the project area corridor.

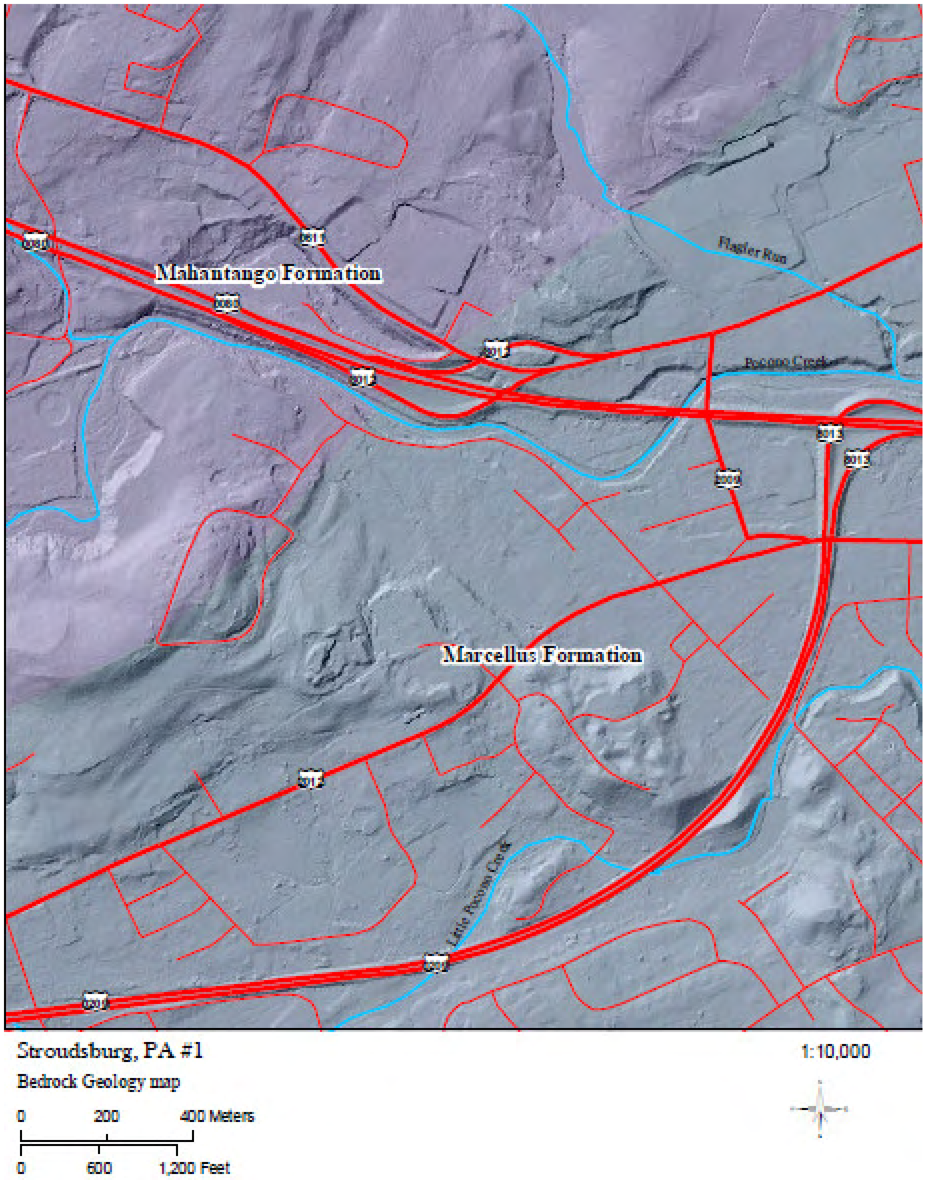


Figure 10. Geologic map of western portion of project area corridor.

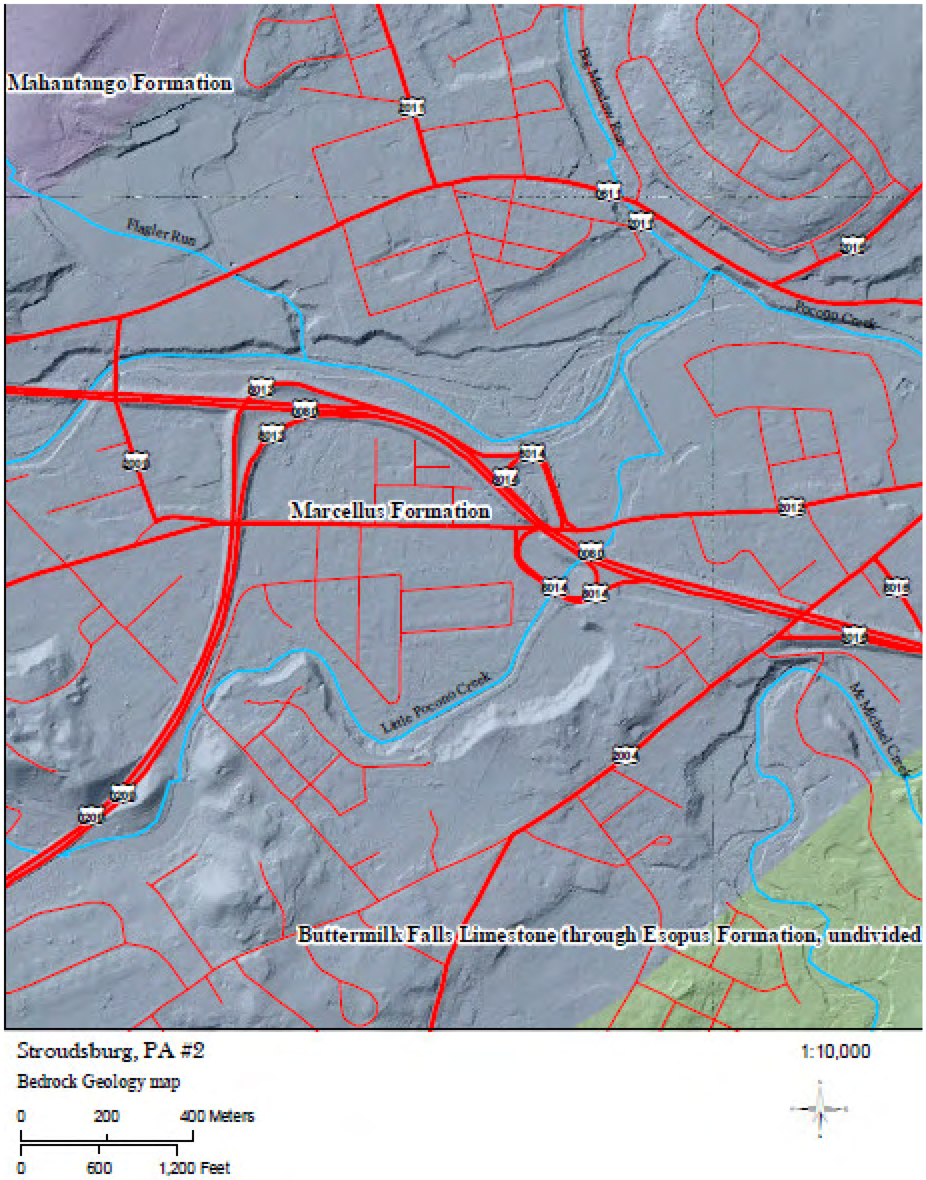


Figure 11. Geologic map of central portion of project area corridor.

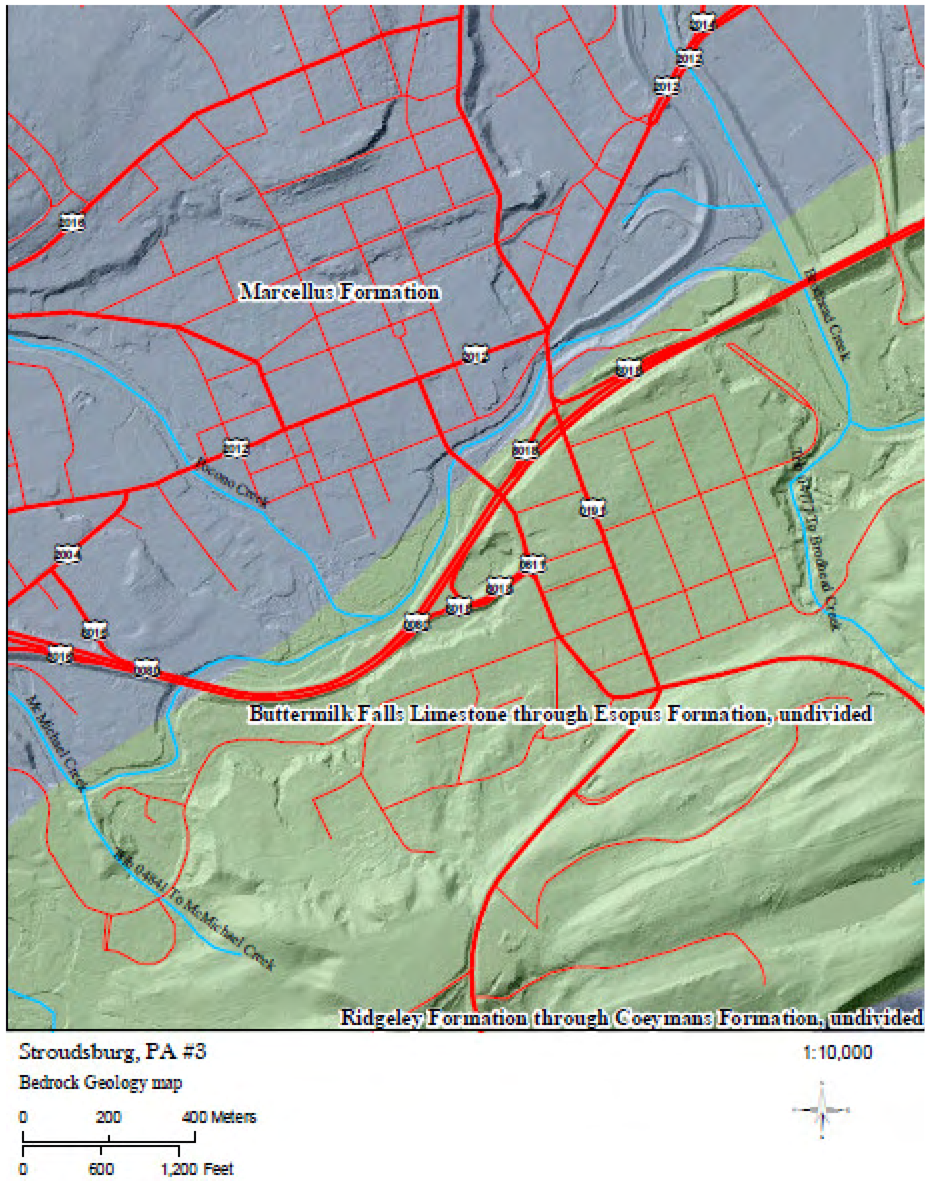


Figure 12. Geologic map of eastern portion of project area corridor.

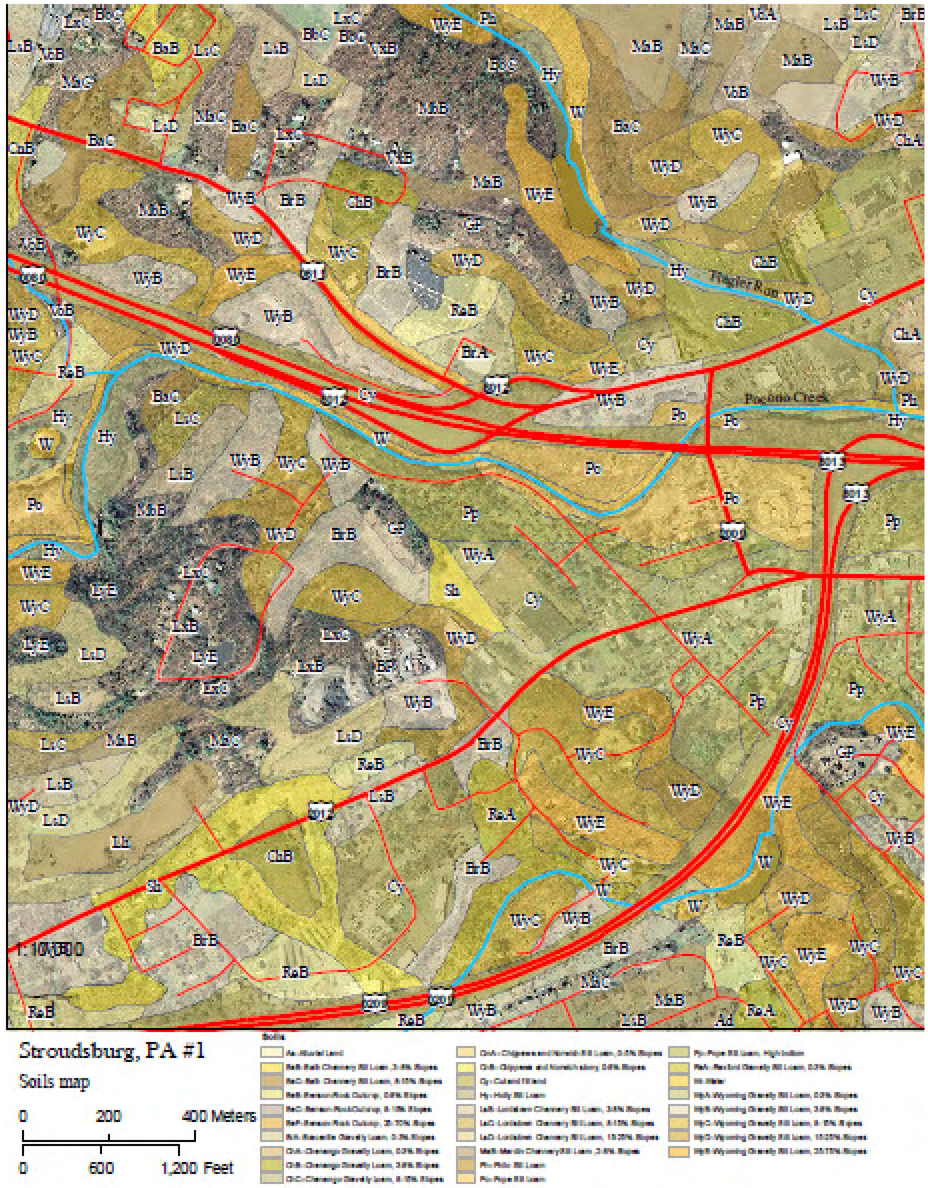


Figure 13. Soil map of western portion of project area corridor.

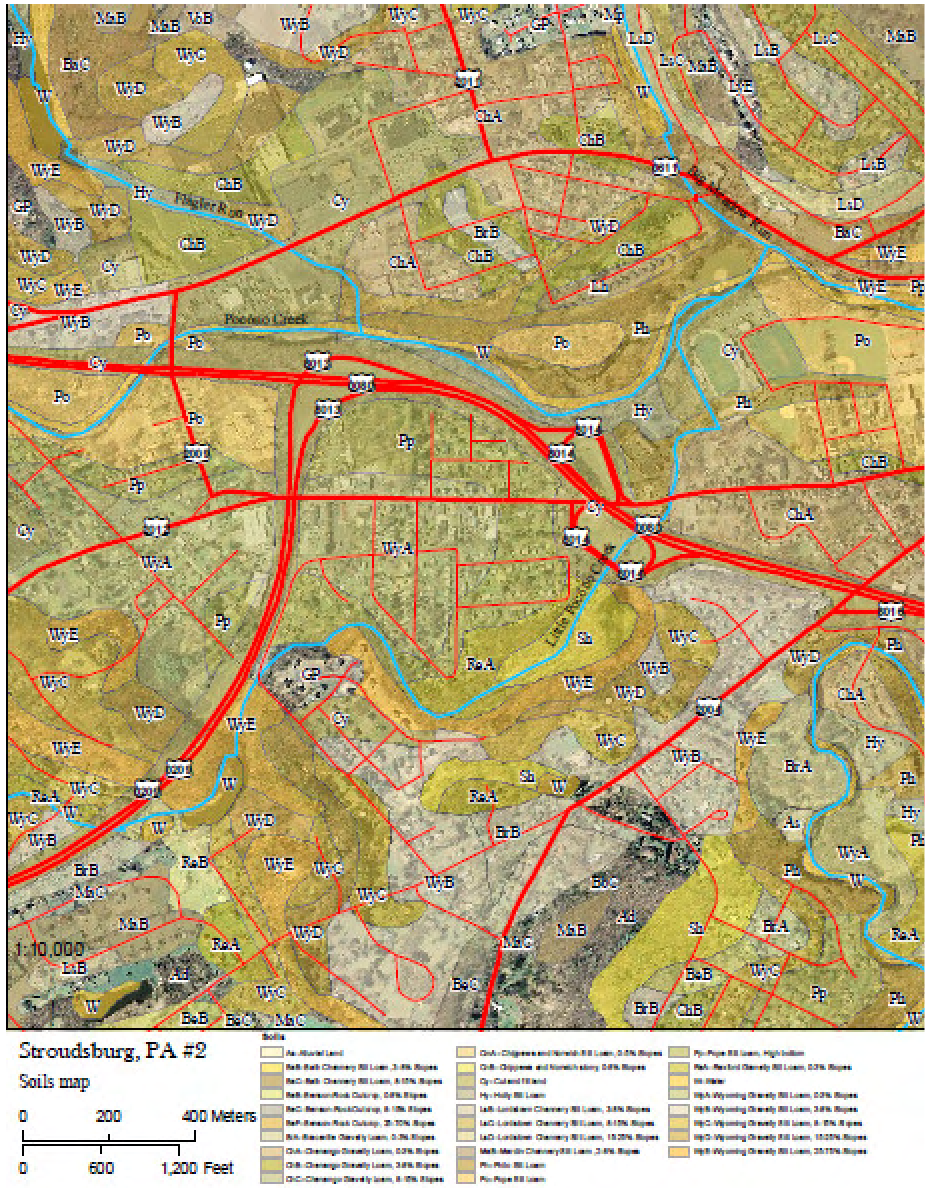


Figure 14. Soil map of central portion of project area corridor.

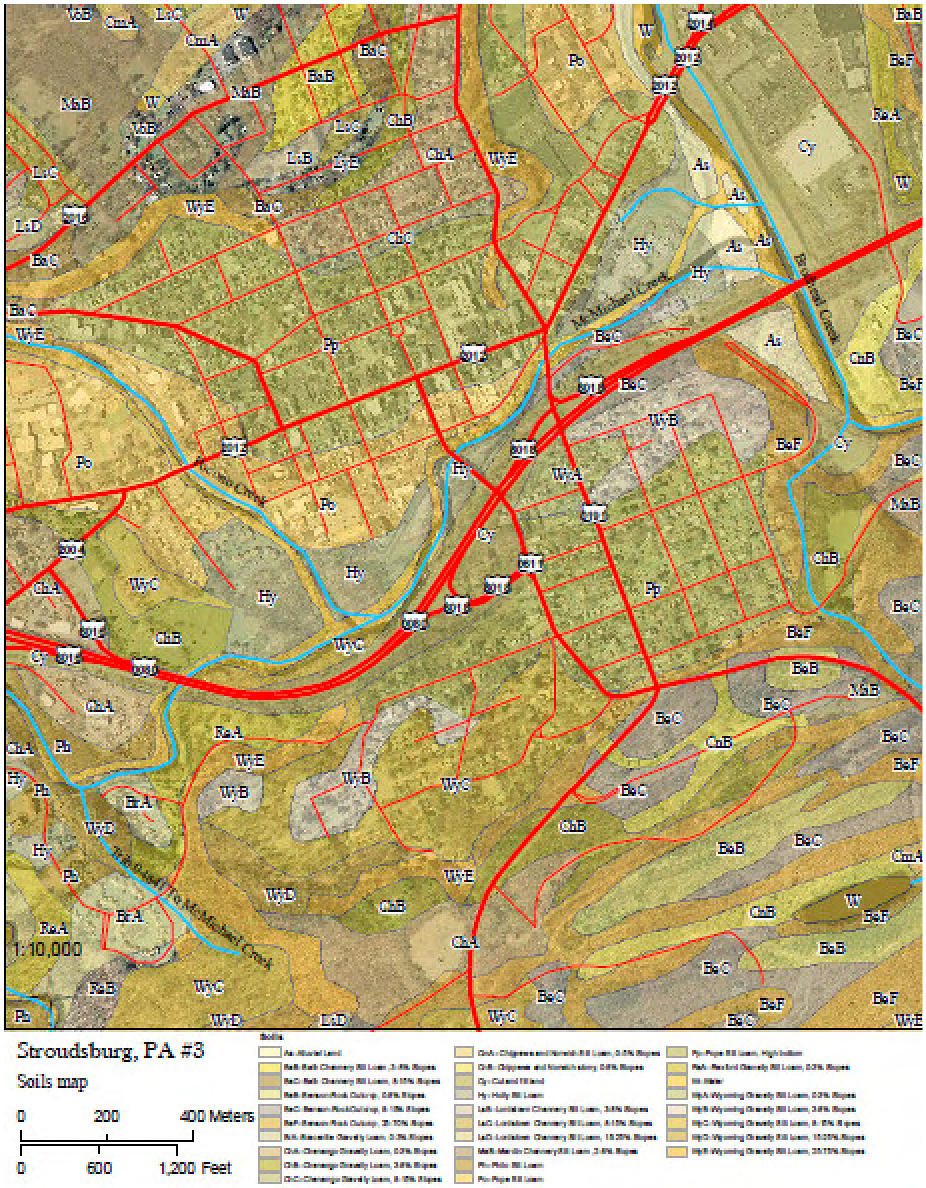


Figure 15. Soil map of eastern portion of project area corridor.

Photograph 1: General view of the Pocono Creek floodplain south of Flagler Street, facing east.

Photograph 2: General view of the T2 terrace and lower T1/floodplain on the northern bank of Pocono Creek south of Flagler Street, facing west.

Photograph 3: General view of the location of AP4, facing north. Note the presence of disturbance from underground utilities immediately adjacent to the Pocono Creek.

Photograph 4: General view of the soil profile of the northern bank of Pocono Creek in the location of AP5 and AP6, facing north.

Photograph 5: General view of the location of AP8, facing southwest.

Photograph 6: General view of the location of AP11 on the western bank of Little Pocono Creek, facing east.

Photograph 7: General view of the wetland adjacent to the eastern bank of Little Pocono Creek, facing south.

Photograph 8: General view of the location of AP12 on the eastern bank of Little Pocono Creek north of State Street/Main Street, facing southeast.

Photograph 9: General view of the location of AP14 on the northern bank of McMichael Creek along Katz Drive, facing west.

Photograph 10: General view of the location of AP15 on the northern bank of McMichael Creek along Katz Drive, facing east.

Photograph 11: General view of untested area along McMichael Creek adjacent to Dreher Avenue, facing southeast.

Photograph 12: General view of the location of AP16 on the northern bank of McMichael Creek east of its confluence with Pocono Creek, facing north.

Photograph 13: General view of the McMichael Creek stream channel and adjacent T00 east of its confluence with Pocono Creek, facing southwest.

Photograph 14: General view of the western bank of Brodhead Creek south of its confluence with McMichael Creek, facing southwest.

Photograph 15: General view of the locations of AP19 and AP20 on the eastern bank of McMichael Creek near Village Drive, facing east.

Photograph 16: General view of the valley bottom zone along McMichael Creek at Village Drive, facing west. Note low lying flood plain zone and higher outwash terrace on opposite bank.

Photograph 17: General view of the valley bottom zone and higher outwash terrace along McMichael Creek at Village Drive, facing southwest.

Table. 1. Previously Recorded Archaeological Sites

Previously Recorded Archaeological Sites.

Site Number	Topographic Setting	Prehistoric Component(s)	Historic Component(s)	Soil Type(s)
36MR16	Floodplain	Unknown Prehistoric	-	PP,CY,AS
36MR27	Terrace	MA, LA, MW	-	PP,WYA,CY
36MR28	Floodplain	Unknown Prehistoric	-	PP,BEF,CY
36MR29	Floodplain	LW	-	PP,AS,CY
36MR30	Floodplain	Unknown Prehistoric		WB,BEC,CHA
36MR43	Terrace	P, EA, MA. LA, T, W, EW, MW, LW	-	PP,WYB,AS
36MR44	Hillslope	Unknown Prehistoric	-	BEF,BEC,CY
36MR56	Stream Bench	LW	-	WYB,LYE
36MR57	Stream Bench	Unknown Prehistoric	-	WYB,AS
36MR58	Rise in Floodplain	-	1925+	As,Cy,BP
36MR152	Ridgetop	A, LA	-	VOB,LYE,CY
36MR183	Terrace	Unknown Prehistoric	1875-1900, 1900-1925	WyC,BaC,ReA
36MR184	Terrace	MA, LA, LW	Unknown Historic	BeC,BeF,CmA
36MR185	Terrace	Unknown Prehistoric	-	CmA,Ad,BeC
36MR186	Terrace	Unknown Prehistoric	Unknown Historic	ReA,WyC,WyE
36MR187	Terrace	Unknown Prehistoric	-	MaB,BeB,BeC
36MR194	Floodplain	Unknown Prehistoric	Unknown Historic	Hy,WyE,ReA,WyC
36MR195	Floodplain	Unknown Prehistoric	Unknown Historic	Hy,ReA,WyC
36MR196	Terrace	EW	-	Hy,WyA
36MR198	Lower Slopes	Unknown Prehistoric	-	BeC,W,BeF
36MR199	Terrace	Unknown Prehistoric	1875-1900, 1900-1925, 1925+	BeF,BeC,Cy
36MR200	Saddle	Unknown Prehistoric	-	BeC,LBE,BeF
36MR201	Upland Flat	-	1875-1900, 1900-1925	WyB,WyC,Cy
36MR215	Undefined	Unknown Prehistoric	-	Bp,Cy,As

P=Paleoindian, A=Archaic, EA=Early Archaic, MA=Middle Archaic, LA=Late Archaic, T=Transitional, W=Woodland, EW=Early Woodland, MW=Middle Woodland, LW=Late Woodland

Table 2. Previous archaeological surveys.

Previous Archaeological Surveys.

Survey Number	Survey Type	Surveyed Acres (Hectares)	# Sites Recorded
1981-0433-089-B	Water Treatment Plant	undefined	0
1986-0713-089-E	Water Treatment Plant	undefined	0
1986-0717-089-C	Water Treatment Plant	undefined	1
1991-1620-089-C	Sewer Plant	undefined	1
1991-4320-089-B	Gas Line	undefined	1
1994-0102-089-D	Park and Ride	10.1 (4.1)	0
1995-2731-089-C	Commercial Construction	<1 (<1)	1
1996-R020-042	Fort Hamilton	undefined	0
1997-2182-042-U	Trail Relocation	11.1 (4.5)	3 (within study area)
2004-0647-089-C	Subdivision	0.6 (0.2)	0
2005-0735-089-B	High School	17.0 (6.9)	0
2006-1477-042-C	Power Line	undefined	0
2006-6121-089-B	Roadway	undefined	0
2007-6147-089-B	Roadway	6.9 (2.8)	0
2007-1713-089-E	Business Development	8.6 (3.5)	0
2011-1333-089-B	Apartment Complex	2.7 (1.1)	0

Appendix C:

Predictive Model Metadata

Data Used:

LiDAR streams – downloaded from PASDA

Cut_Fill – areas of previous cut or fill

Disturbed – an override to show disturbed and moderate probability areas

Historic_roads_arch_model – roads that can be shown via historic maps to have existed over 50 years ago

Historic_structures – historic polygons

Historic_structures_arch_model – structures that can be shown via historic maps to have existed over 50 years ago

Hydric_soils_Arch_model – hydric soils

I_80_Archaeology_Historic_Study_Area – project study area

lidar_streams_arch_model1 – downloaded from PASDA, shows the stream edge

NHDFlowline – stream centerline feature used to calculate confluences

nwi_wetland – wetlands

PALocalRoads2011_01 – local road centerlines

PAStateRoads2011_01 – state road centerlines

Soil_drainage – soil feature to calculate the drainage quality

Slopes – made from LiDAR DEM

In the following explanation, the features are weighted. Lowest is 0, highest is 3 per feature.

Analysis to get "stream_order_12":

A "class" field was added to the LiDAR streams layer to show the order of the stream. The classification was designated by an archaeologist. It was projected to State Plane PA North NAD 83 Meters, and had multiple buffers created, at 75, 150, 200, and 100,000 meters. The buffers were clipped down to the study area extent and projected into State Plane PA North NAD 83 Feet. A field named "Prob_stream_order12" was created and coded that everything within the 75 meter boundary as 3, 150 meter boundary as 2, 200 meter boundary as 1, and the 100,000 meter boundary as 0. A field named

“Probability_Override_stream12” was created and coded as “low” where “Prob_stream_order12” equals 0. It was exported into the “final” geodatabase as “stream_order_12”

Analysis to get the “wetland_and_hydric”:

The “nwi_wetland” and the “hydric_soils_Arch_model” features were clipped to the study area boundary and unioned together. A field named “Probability_Override_wet_hydric” was created and coded as “Low” and the features were dissolved based on this field. It was exported into the “final” geodatabase as “Wetland_and_hydric”

Analysis to get the “slope”:

The 4 slope tifs were mosaiced into a new raster dataset and reclassified the Value field where 0-8 is 3, greater than 8-15 is 2, and above 15 is 0. The raster dataset was converted into a polygon feature and clipped to the study area boundary, and dissolved using the “gridcode” field. Those features were then unioned with “Area_needed_for_arch_model” and clipped to the study boundary. A field named “Prob_slope” was added and calculated to equal gridcode. A field named “Probability_Override_slope” was added and was calculated as where “Prob_slope” equals 0, “Probability_Override_slope” equals “low”, and It was exported into the “final” geodatabase as “Slope”.

Analysis to get the “confluences”:

The “NHDFlowline” features were clipped to the study area, the lines were unsplit and points were made where there were intersections. The intersections were projected into State Plane NAD 83 North Meters and a multiple ring buffer was made at 100 meter, 200 meter, and 100,000 meter intervals. A new field called “Prob_confluences” was added and when “distance” equaled 100, “Prob_confluences” equaled 3, 200 equaled 2, and 100,000 equaled 1, and It was exported into the “final” geodatabase as “confluences”.

Analysis to get the “stream_order_34”

Class 3 and 4 was selected from “nhdflowline_clip_34” and projected into State Plane Pennsylvania North NAD 83 Meters. A multiple ring buffer was made at 100 meters, 200 meters, and 100,000 meters, which was then clipped to the study area, and projected to State Plane Pennsylvania North NAD 83 Feet. A new field named “Prob_stream_order34” was added, and where the distance equaled 100 meters, “Prob_stream_order34” equaled 3, 200 meters equaled 2, and 100,000 equaled 0. Another field was added called “Probability_Override_stream34”, and where “Prob_stream_order34” equaled 0, “Probability_Override_stream34” equaled “low”, and It was exported into the “final” geodatabase as “stream_order_34”.

Analysis to get the “wetland_and_hydric”:

The “nwi_wetland” and the “hydric_soils_Arch_model” features were clipped to the study area boundary and unioned together. The data was then projected into State Plane PA North NAD 83 Meters. A multi ring buffer was made at 75 meters, 150 meters, and 100,000 meters and then projected into State Plane PA North NAD 83 Feet. Another field was added called “Prob_wetlands_buff” and was calculated as 3 where distance equaled 75, 2 where distance equaled 150, and 1 where the distance equaled 100,000, and It was exported into the “final” geodatabase as “Wetlands_buffer”.

Analysis to get the “historic_resources_for_Historic”:

The “Historic_structures_arch_mod” features were buffered by 200 feet and the ”historic_roads_arch_model” features were buffered by 100 feet. Polygons that dated after 1900 were merged together and polygons that dated before 1900 along with “historic_structures” that dated before 1900, were merged together. Both datasets were dissolved separately, and the dataset that dated after 1900 had the areas that dated previous to 1900 clipped out of it. A new field called “Prob_His_Resources_Historic” was added to the two datasets. This field was populated as 2 in the dataset dating after 1900 and 3 in the dataset previous to 1900. These 2 datasets were appended together to make a single file.

Features in the “historic_structures” dataset where “Prob_his_res” equaled 0 were selected and dissolved. A field called “Prob_His_Resources_Historic” was added and populated as 0. The appended dataset from the previous paragraph had the portions of the features erased where features equaling 0 existed. These 2 files were then appended to make a seamless file. It was then clipped to the study area boundary. A field named “Probability_Override_His_Res” was added and calculated where “Prob_His_Resources_Historic” equals “0”, “Probability_Override_His_Res” is “low”, where “Prob_His_Resources_Historic” equals “2”, “Probability_Override_His_Res” is “mod”, and where “Prob_His_Resources_Historic” equals 3, “Probability_Override_His_Res” is “high”. It was then exported into the “final” geodatabase as “historic_resources_for_Historic”.

Analysis to get the “previously_disturbed_Geo”:

The “Cut_Fill” data was erased where it overlaid on the “disturbed_arch_model” data. That was merged into the “disturbed_arch_model” and clipped to the study area. The features were dissolved based on “Probability_Overrided_prev_dist” and exported into the “final” geodatabase as “previously_disturbed_Geo”.

Analysis to get the "Drainage":

The "soil_drainage" dataset was clipped to the study area boundary and added the field "Prob_soils". The field was populated as "0" where "drainage" equaled "Poorly drained" or a blank value, "2" where "drainage" equaled "Somewhat poorly drained" or "Moderately well drained", and "3" where "drainage" = "Somewhat excessively drained", "Excessively drained", or "Well drained". A new field was created, named "Probability_Override_drainage" and is populated as "low" where "Prob_soils" equals "0", then dissolved based on the "Prob_Soils" field. The data is then exported into the "final" geodatabase as "Drainage".

Analysis to get the "historic_resources_for_Arch":

The 200 foot buffer of "Historic_structures_arch_model" was merged with the "historic_structures" dataset and the 100 foot buffer of "historic_roads_arch_model". The features were dissolved together and the "Prob_His_Resources_for_Arch_Override" field was added. These were all populated "low" and exported into the "final" geodatabase as "historic_resources_for_Arch".

All of the datasets above were unioned together and all identical features were deleted. This was clipped to the study area boundary and 3 fields were added, "Total_Score", "Adjusted_score", and "Probability". Probability was calculated as "Prob_soils"+ "Prob_stream_order12"+ "Prob_stream_order34"+ "Prob_confluences"+ "Prob_wetlands_buff"+ "Prob_slope", and "Adjusted_score" was populated by "Total_Score". This data was exported into 2 feature classes in the "final" geodatabase, "HISTORIC_PROBABILITY" and "ARCH_PROBABILITY".

Calculating the Historic Probability:

The Adjusted Score was calculated in this order: as "0" if "Probability_Override_slope", "Probability_Override_stream34", "Probability_Override_stream12", "Probability_Override_drainage", or "Probability_Override_wet_hydric" equaled "Low", calculated as "99" if "Probability_Override_His_Res" equaled "high", calculated as "50" if "Probability_Override_His_Res" equaled "Mod", calculated as "0" if "Probability_Override_His_Res" equaled "Low", calculated as "50" if "Probability_Override_prev_dist" equaled "Mod", and calculated as "0", if "Probability_Override_prev_dist" equaled "low". All data was then selected that resided where "historic_structures" "type" equaled "0" and the "type" calculated as "99". All features with the "Adjusted_score" less than or equal to "9" had the "Probability" field populated as "low". Where "Adjusted_score" was greater than or equal to "10" and less than or equal to "14" or equal to "50", "Probability" equaled "Moderate". Where "Adjusted_score" was greater than or equal to "15" and less than or equal to “18” or equal to “99”, “Probability” equaled “High”. The features were dissolved using the “Probability” field.

Calculating ARCH_PROBABILITY:

The Adjusted Score was calculated in this order: as “0” if “Probability_Override_slope”, “Probability_Override_stream34”, “Probability_Override_stream12”, “Probability_Override_drainage”, “Probability_Override_wet_hydric”, “Prob_His_Resources_for_Arch_Override”, or “Probability_Override_prev_dist] equaled “Low”, calculated as “50” if “Probability_Override_prev_dist” equaled “Mod”. All features with the “Adjusted_score” less than or equal to “9” had the “Probability” field populated as “low”. Where “Adjusted_score” was greater than or equal to “10” and less than or equal to “14” or equal to “50”, “Probability” equaled “Moderate”. Where “Adjusted_score” was greater than or equal to “15” and less than or equal to “18” or equal to “99”, “Probability” equaled “High”. The features were dissolved using the “Probability” field.

Eliminating existing roads:

Clip the “PaStateRoads2011_01” dataset to the study area boundary, and buffer the features 20 feet. Clip the “PaLocalRoads2011_01” dataset to the study area boundary, and buffer the features 10 feet. Union these two datasets together.

Final datasets:

Erase the road buffer data from the “HISTORIC_PROBABILITY_Dissolve” and “ARCH_PROBABILITY_Dissolve” features. Compact each geodatabase to save on space.

Appendix D:

Archaeological Report Summary Form

Archaeological Report Summary Form

ER# **2013-8131-089**

DATE July 25, 2014

PROJECT CHECKLIST: Please fill out a copy of this checklist and include it with your initial report submission, (including with management summaries or draft reports). This form may be downloaded and expanded as needed, but please do not eliminate any fields.

1. Report Title Phase IA Archaeological Predictive Model, I-80 Reconstruction Project, Monroe County, Pennsylvania

2. PI Allison Brewer (☒ MA, ☐ PhD) McCormick Taylor, Inc/**Firm** or Institution

3. Report Date (Month/Day/Year) July 25, 2014

4. Number of Pages 130

5. Agency Name FHWA Federal ☒ State ☐

6. Project Area County/Municipality (list all)

County	Municipality
Monroe	Borough of Stroudsburg Borough of East Stroudsburg Stroud Township

7. Project Area Drainage(s) (list all)

Sub-basin	Watershed
Upper Delaware River	E

8. Project Area Physiographic Zone(s) (list all)
(Use DCNR Map 13 compiled by W.D. Sevon, Fourth Edition, 2000)

Physiographic Zone
Blue Mountain Section

9. Report Type (some reports are combinations, check as many as apply to this report)

☒ Phase IA/Sensitivity Study
☐ Phase II
☐ Phase I
☐ Phase III
☐ Historic Structures
☒ Geomorphology
☐ Determination of Effects
☐ Other:

10. Total Project Area 208.413 hectares

11. Low Probability/Disturbed Areas 203(P)/155(H) hectares = 97(P)/75(H) % of project area

12. Phase I Methods used for total project (check as many as apply)

☐ shovel tests
☐ controlled test units/deep tests
☐ surface survey
☐ informant interview
☒ other: Predictive Model, including pedestrian reconnaissance and geomorphological evaluation

13. Total Number of Sites Encountered/Phase I – 0
Total Sites Tested/Phase II – 0
Total Sites Excavated/Phase III – 0

14. Updated PASS Information: Please complete an updated PASS form **for each site** reported by this report. Updated forms need only include the new information and the site number and name.

15. PASS Site Specific Information: In addition, the following pages must also be completed **for each site**. Complete only the portions that pertain to the current report. If the report is a stand-alone Phase II, you do not need to fill in the Phase I methods, since they should have been included in the summary form for the previous report.

15. PASS Site Specific Information

Please complete the following **for each site** reported by this report.

PASS NUMBER

A. Phase I Methods (how the site was located - check as many as apply)

- ☐ shovel tests
- ☐ controlled test units/deep tests
- ☐ surface survey
- ☐ informant interview
- ☐ other:

B. Phase II Methods

- ☐ controlled surface collection
- ☐ controlled excavation w. screening of plowzone, > 5 units
- ☐ mechanical stripping of plowzone (%)
- ☐ deep excavation units
- ☐ remote sensing
- ☐ other:

square meters of site tested: sq m
% of site area tested: %

C. Phase III Methods

- ☐ controlled surface collection
- ☐ controlled excavation w. screening of plowzone, > 5 units
- ☐ mechanical stripping of plowzone %
- ☐ deep excavation
- ☐ block excavations
- ☐ remote sensing
- ☐ environmental reconstruction (soils, floral, pollen)
- ☐ dietary reconstruction (floral, faunal)
- ☐ intensive lithic analysis (functional)
- ☐ intensive lithic analysis (technological)
- ☐ raw material sourcing
- ☐ ceramic analysis (seriation)
- ☐ ceramic analysis (functional)
- ☐ blood residue
- ☐ other:

square meters of site tested: sq m
% of site area tested: %

D. Recommendations (normally completed only after Phase II)**:**

-- NR Eligibility recommendation

☐ eligible ☐ ineligible ☐ undetermined

-- reasons for determination (check as many as apply; expands as needed)

☐ eligible: Criterion A Explain:

☐ eligible: Criterion B Explain:

☐ eligible: Criterion C Explain:

☐ eligible: Criterion D Explain:
- ☐ settlement patterning (intersite patterning)
- ☐ intrasite artifact patterning
- ☐ features
- ☐ radiocarbon dating
- ☐ organic preservation
- ☐ evidence of culture change through time
- ☐ stratified ☐ temporally discrete clusters
- ☐ burials/human remains
- ☐ technological
- ☐ economics
- ☐ ethnicity
- ☐ dietary
- ☐ other(specify):

☐ ineligible
- ☐ disturbed
- ☐ ephemeral occupation
- ☐ redundant information
- ☐ undatable
- ☐ other (specify):

E. Artifacts/Collections

☐ will be donated to the State Museum of Pennsylvania
- ☐ gift agreement from private owner enclosed

- or -

- ☐ transfer of responsibility from State Agency enclosed
- ☐ election of repository from Federal Agency enclosed
- ☐ artifacts washed/marked/cataloged following State Museum guidelines

-- collection will be submitted by (date)

☐ will be donated to other approved repository **(this option must be negotiated with the BHP and State Museum or stated as stipulation in MOA)**
- ☐ curation agreement enclosed
- ☐ artifacts washed/marked/cataloged following host guidelines

-- collection will be submitted by _(date)

☐ will be retained by land owner (☐ whole or ☐ partial collection)
- ☐ expanded documentation enclosed for items retained
- ☐ proof enclosed that owner was notified of the option to donate the collection to the State Museum and chose to retain the collection:
  - ☐ letter from owner indicating desire to retain collection

  - or -

  - ☐ agency or representative discussed donation option with owner on tion with owner on (date)

  - and -

  - ☐ copy of letter and certified letter receipt indicating that the owner was offered this option in writing.