Department of Energy

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JUL 2 1 2017

Dr. David Snyder
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Ohio History Connection
State Historic Preservation Office
800 East 17th Avenue
Columbus, Ohio 43211

PPPO-03-4334897-17

Dear Dr. Snyder:

TRANSMITTAL OF THE REPORT OF THE PHASE III DATA RECOVERY OF 33PK347 AT THE PORTSMOUTH GASEOUS DIFFUSION PLANT

Enclosed for your information is the report, *Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio*. Site 33PK347 was recommended to be considered a historic property following Phase I and Phase II surveys that took place in 2011 and 2012. Recovery of the site and preparation of a technical report fulfill a commitment made by the Department of Energy (DOE) in the Comprehensive Environmental Response Compensation Liability Act (CERCLA) Record of Decision for the Site-Wide Waste Disposition Evaluation Project.

Adverse impacts to Site 33PK347 occurred as a result of the selection of the location for siting the On-Site Waste Disposal Facility (OSWDF). Mitigation for the adverse effects included the recovery of the archaeological site prior to the construction of the OSWDF and preparation of a technical report to document the data recovery processes and results.

The site recovery took place in August 2015, prior to initiation of OSWDF construction, in the area of the archaeological site and was preceded by coordination with the Tribal Nations and with the State Historic Preservation Office. In addition to documenting the results and findings of the recovery, the report also provides a comprehensive summary of the results from the Phase I and Phase II surveys.

A summary-level report of the findings of the recovery is also in preparation. The summary level report is intended for a general audience and will support DOE's public outreach. DOE is also considering the range of alternatives for the preservation of recorded artifacts from the data recovery. A copy of the report is enclosed and can also be obtained at the Environmental Information Center by contacting 740-289-8898 or at portseic@pma-iss.com. Additionally, an electronic copy can be found at https://www.energy.gov/pppo/downloads/national-historic-preservation-act-documents-portsmouth.

If you have any questions, please contact Amy Lawson of my staff at 740-897-2112.

Sincerely,

Robert E. Edwards, III
Manager
Portsmouth/Paducah Project Office

Enclosure:
Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

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Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

GRAY & PAPE, INC.
ARCHAEOLOGY • HISTORY • HISTORIC PRESERVATION

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Gray & Pape Project No. 14-63201.001

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INC.
CULTURAL RESOURCES CONSULTANTS

Project No. 14-63201.001

Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

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June 7, 2017

ABSTRACT

Gray & Pape, Inc., of Cincinnati, Ohio, under contract with Fluor-BWXT Portsmouth LLC, and acting on behalf of the United States Department of Energy, has completed a Phase III archaeological data recovery at site 33PK347, Portsmouth Gaseous Diffusion Plant, Scioto Township, Pike County, Ohio. The mitigation of adverse effects to site 33PK347 was conducted as part of the Comprehensive Environmental Response, Compensation and Liability Act process, which is being used for the environmental clean-up, including Decontamination and Decommissioning and Waste Management, at the Portsmouth Gaseous Diffusion Plant. Impacts to site 33PK347 occurred as a result of the selection of the location for siting of the On-Site Waste Disposal Facility. The United States Department of Energy is the lead federal agency for the project.

Site 33PK347 is a small, multicomponent, prehistoric site located on a ridgetop, approximately 1,000 meters north-northeast of Little Beaver Creek, in the northeast quadrant of the Portsmouth Gaseous Diffusion Plant reservation. Phase I and Phase II investigations at site 33PK347 were completed by Ohio Valley Archaeology, Inc., in 2010 and 2012, respectively, and, based upon those results, site 33PK347 was recommended as eligible for inclusion in the National Register of Historic Places. Phase III data recovery efforts were recommended.

The Final Record of Decision for the Site-Wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant was concurred and finalized by the Ohio Environmental Protection Agency in June 2015. Coordination with federally recognized tribes and the Ohio Historic Preservation Office took place prior to, and during, fieldwork. In accordance with the commitments in the Final Record of Decision, Gray & Pape, Inc., on behalf of the United States Department of Energy, completed fieldwork at site 33PK347 in August 2015 and fulfilled its obligations to mitigate the site.

This report presents results from the Phase III data recovery, but also provides a comprehensive summary of results from all investigations completed at site 33PK347, including the Phase I survey, Phase II testing, and Phase III data recovery. Site 33PK347 is characterized by a total of 4,809 prehistoric artifacts and two fire-cracked rock-filled basin-shaped pits. The artifact assemblage consists mainly of fire-cracked rock, but also includes chipped stone debitage and lithic tools. In total, excavations at site 33PK347 have exposed 216.5 square meters of the site’s surface area. The strategic placement of 354 shovel test units and 128 excavation units across site 33PK347, as well as the use of geophysical survey and a multitude of special analyses, suggests that all significant cultural features have been identified and mitigated. Temporally diagnostic artifacts and radiocarbon dates indicate occasional site use over a span of approximately 7,500 years of prehistory. Results show that site 33PK347 is located on a severely eroded ridgetop that has, as a result, compromised site integrity. The absence of domestic debris, in the form of ceramics and food remains, suggests that habitation did not take place at site 33PK347. Low frequencies of cultural features and artifacts suggest that the site was likely formed through short, repeated visits by small groups. The focus of activities undertaken at site 33PK347 is unclear.

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LIST OF ACRONYMS

3-D	Three-Dimensional
A.D.	Anno Domini
AEC	Atomic Energy Commission
AMS	Accelerator Mass Spectrometry
B.C.	Before Christ
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
cmbd	Centimeters Below Datum
D&D	Decontamination and Decommissioning
DOE	United States Department of Energy
FBP	Fluor-BWXT Portsmouth LLC
FCR	Fire-cracked Rock
FS	Field Specimen
GC-MS	Gas Chromatography-Mass Spectrometry
GIS	Geographic Information Systems
GPS	Global Positioning System
ICP-AES	Inductively Coupled Plasma Atomic Emission Spectroscopy
LSA	Landform Sediment Assemblage
m/z	mass-to-charge
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
Ohio EPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
OSWDF	On-Site Waste Disposal Facility
OVAI	Ohio Valley Archaeology, Inc.
pH	Potential of Hydrogen
PORTS	Portsmouth Gaseous Diffusion Plant
ROD	Record of Decision
SMP	Shoemaker-McLean-Pratt
ST	Shovel Test
SU	Stratigraphic Units
ULMS	Upland Loess-Mantled Summit
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

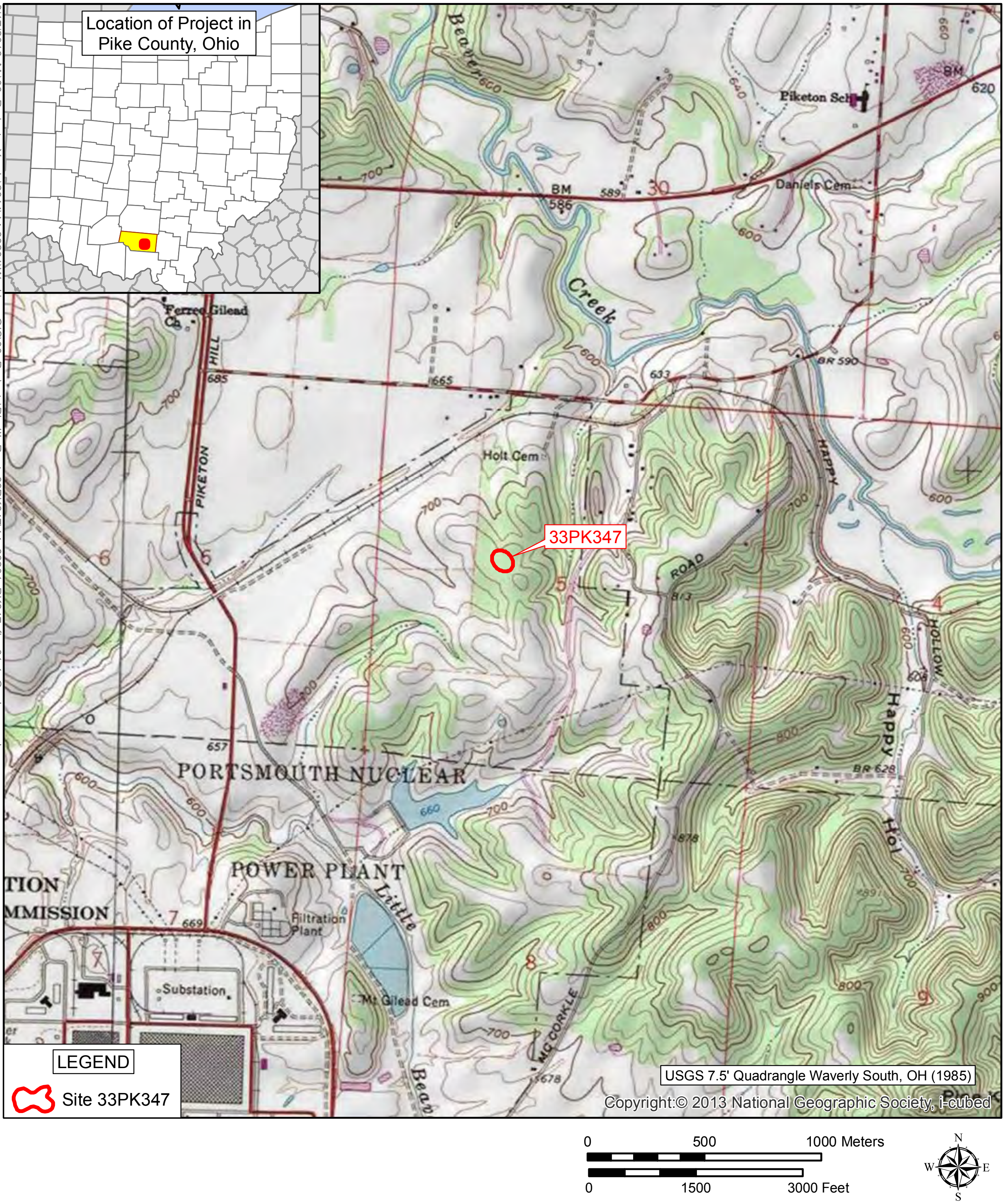
Gray & Pape, Inc. (Gray & Pape), of Cincinnati, Ohio, under contract with Fluor-BWXT Portsmouth LLC (FBP), and acting on behalf of the United States Department of Energy (DOE), has completed a Phase III archaeological data recovery at site 33PK347, Portsmouth Gaseous Diffusion Plant (PORTS), Scioto Township, Pike County, Ohio (Figure 1-1). The DOE is the lead federal agency for this project.

The mitigation of adverse effects to site 33PK347 was conducted as part of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process (U.S. Department of Energy 2015a), which is being used for the environmental clean-up, including Decontamination and Decommissioning (D&D) and Waste Management at PORTS. Impacts to site 33PK347 have occurred as a result of the selection of this specific location for siting of the On-Site Waste Disposal Facility (OSWDF), for the deposition of demolition debris as part of the D&D efforts.

The Final Record of Decision (ROD) for the Site-Wide Waste Disposition Evaluation Project at PORTS (DOE/PPPO/03-0513&D2) (U.S. Department of Energy 2015a) was concurred and finalized by the Ohio Environmental Protection Agency (Ohio EPA) in June 2015. The ROD acknowledges that historic properties will be impacted by construction of the OSWDF, and it outlines the commitments agreed to by the DOE to mitigate the impacts. The ROD identified site 33PK347 as a historic property, where avoidance or minimization was not practicable, and recommended five mitigation measures, as follows:

1. A data recovery effort (Phase III) of the affected site will be conducted,
2. Coordination will take place with Tribal Nations and the State Historic Preservation Office on the data recovery effort,
3. Recorded artifacts will be preserved at a recognized federal repository by a curation professional,
4. A technical report documenting the data recovery processes and results will be prepared and shared with the Ohio Historic Preservation Office (OHPO), and
5. A summary-level report intended for a general audience will be prepared.

Phase III data recovery fieldwork was completed at site 33PK347 prior to beginning construction of the OSWDF, fulfilling the first commitment. Once finalized, this report will be submitted to the OHPO to fulfill the fourth commitment. To date, three of the five mitigation measures (1, 2, and 4) outlined in the ROD have been completed.



Location of Site 33PK347
in Pike County, Ohio.

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Figure 1-1

1.1 Site Overview

Site 33PK347 is a small, multicomponent, prehistoric site located on an eroded ridgetop at an elevation of approximately 225 meters (m) above mean sea level, in the northeast quadrant of the PORTS facility (Figure 1-1). At the time of excavation, Site 33PK347 was wooded in secondary growth hardwoods and covers an area of approximately 3,600 square meters (m^2). Little Beaver Creek, the closest water source, lies approximately 1,000 m to the south/southwest.

Phase III fieldwork included: (1) utilization of magnetic susceptibility geophysical survey to identify and locate cultural features, (2) excavation of a series of shovel tests (STs) on a 5-m grid, and (3) extensive hand-excavation of larger exploratory units and blocks in search of cultural features. These tasks were completed between July 21 and August 20, 2015.

During Phase III data recovery efforts, 136 STs were excavated, accounting for 34 m^2 of excavated area. Five STs were positive for artifacts. A total of six artifacts were recovered from the positive STs, including two pieces of lithic debitage, one biface tool, and three pieces of fire-cracked rock (FCR). Hand-excavated blocks were placed over 22 anomalies identified during geophysical surveys, and two cultural features (partially excavated during Phase II investigations), accounting for 97 m^2 of excavated area. No new cultural features were identified from the anomalies investigated during Phase III data recovery efforts, but the remainder of the two features that were partially documented during Phase II investigations were fully excavated. Most of the investigated anomalies proved to be tree stumps, concentrations of tree roots and/or rock, and rodent burrows. The hand-excavated blocks produced a total of 965 artifacts, including 886 pieces of FCR, 75 pieces of chipped stone debitage, 2 projectile points, 1 biface tool, and 1 core. The total area excavated during Phase III data recovery investigations was 131 m^2. The total artifact count from Phase III data recovery investigations is 971, including 889 pieces of FCR (91 percent of the artifact assemblage), 77 pieces of chipped stone debitage, 2 biface tools, 2 projectile points, and 1 core.

1.2 Project Personnel and Acknowledgements

The Phase III data recovery investigations at site 33PK347 were conducted under the supervision of Karen Leone, Principal Investigator, M.A.; and Marcia Vehling, Field Director. Geophysical survey was conducted by Donald Handshoe. The archaeological field crew included Jennifer Ashbaugh, Paul Ashbaugh, Derrick Cole, Aubrey Richardson, Tim Martin, Nicole Coomer, Kirstyn Leque, and Keith Meuller.

Amy Lawson served as DOE Project Manager, Wendy Stewart served as FBP Project Manager, and Cinder Miller and Mike Striker served as Gray & Pape Project Managers. Dr. David Snyder served as the OHPO representative. Gary Weber, FBP, served as the site Health and Safety Supervisor. Earl Brinkerhoff, FBP, served as the site Field Supervisor.

Gray & Pape office personnel provided in-field support, analyses, and assistance in report preparation. These persons included: Sara Cole (Field Logistics), Melissa Lavender (Artifact Analyst), Ruth Myers (Geographic Information Systems Technician), Carly Meyer (Graphic Artist), and Sarah E Holland, Ph.D. (Editor and Production Coordinator). Karen Leone and Marcia Vehling authored the report. Mike Striker conducted a peer review.

Many specialists from inside and outside of Gray & Pape were used for expertise in their field of study. Donald Handshoe, M.S., of Gray & Pape, conducted the geophysical survey. The Accelerator Mass Spectrometry (AMS) radiocarbon dating was completed by Beta Analytic, Inc. (Appendix C). Nathan Scholl, M.A., of Gray & Pape, conducted the geomorphology and geoarchaeology, as well as the soil chemistry analyses (Appendices D and E). The soil chemistry tests were conducted by Spectrum Analytic, Inc. (Appendix E). Karen Leone and Marcia Vehling conducted the dendrochronology analysis (Appendix F). Karen Leone, of Gray & Pape, conducted the paleoethnobotanical analysis (Appendix G). Ruth Dickau, Ph.D., of HD Analytical Solutions, Inc., conducted starch grain analysis and phytolith analysis (Appendix H). Benjamin Stern, Ph.D., of the University of Bradford, Great Britain, conducted the lipid residue analysis (Appendix I). Melissa Lavender, of Gray & Pape, conducted FCR refit analysis (Appendix J).

2.0 RESEARCH DESIGN

The research design was developed on the premise that small upland archaeological sites in the greater Ohio Valley are not well understood (Church 1987; Genheimer 2000; Prufer 1967; Vickery 1980). These archaeological sites are frequently found as just remnant lithic scatters, or sites with single features; often with only a few artifacts. The ranges of variation, function, and length of occupation have not been well documented. Nearly all of these archaeological sites have been disturbed by plowing and other recent impacts. The data collected at site 33PK347 during the Phase I and Phase II investigations indicated that the site is in nearly undisturbed condition, and has likely never been cultivated (Pecora 2013a; Pecora and Burks 2014). However, previous disturbance due to timbering could not be ruled out. Previous geophysical surveys of site 33PK347 indicated that the site was likely to contain multiple features (Pecora and Burks 2014). The research design was based on the data collected during Phase I and Phase II investigations. The research design focuses on identifying and recovering data from activity areas, defined as cultural features and/or artifact concentrations. By focusing on activity areas during Phase III data recovery, the scope of mitigation efforts was narrowed to the areas of site 33PK347 most likely to yield significant data.

Phase II testing of site 33PK347 identified two intact cultural features (Pecora and Burks 2014). Directly below ground surface, two broad, shallow, flat-bottomed pits containing FCR and artifacts were partially excavated. One of the features contained charcoal dating to A.D. 1260–1290, suggesting a Late Prehistoric/Fort Ancient occupation. Additionally, a Brewerton/Matanzas projectile point associated with the Late Archaic period (3000–1000 B.C.) and a Hamilton Incurvate projectile point associated with the Late Prehistoric/Fort Ancient period (circa A.D. 1000–1650) were also recovered. Based on one radiocarbon date and the temporally diagnostic artifacts, site 33PK347 was characterized as a multicomponent archaeological site represented by Late Archaic and Late Prehistoric/Fort Ancient occupations (Pecora and Burks 2014).

Soil formation processes under which site 33PK347 developed were not investigated during the Phase I or Phase II surveys. Therefore, it is unclear how long the archaeological site was occupied, and what may have contributed to the inclusion of a Late Archaic point type in a feature dated to the Late Prehistoric/Fort Ancient period. The current research design is divided into three research domains focused on answering questions regarding (1) site formation and taphonomy, (2) settlement and subsistence, and (3) lithic selection, sourcing, and function. These research domains were developed based on results of previous investigations.

2.1 Previous Archaeological Investigations

Site 33PK347 was first documented by Ohio Valley Archaeology, Inc. (OVAI) during a Phase I archaeological survey that involved systematic shovel testing (Pecora 2013a). During the Phase I survey, 12 prehistoric artifacts were recovered from 10 positive STs. These artifacts included a biface tip, 10 pieces of chipped stone debitage, and a single fragment of FCR. Site 33PK347 was identified as a low density lithic scatter, representing a late stage lithic reduction trajectory. Historical aerial photographs of the area showed that site 33PK347 was located in a large wooded area, suggesting the possibility that the site had never been plowed. Because site 33PK347 contained FCR, and the possibility exists that it is unplowed, the conclusions derived from the

Phase I survey were that site 33PK347 had the potential to contain intact archaeological features. Therefore, it was recommended that a Phase II survey be conducted to assess the potential for inclusion of site 33PK347 in the National Register of Historical Places (NRHP) (Pecora 2013a).

The Phase II investigations at site 33PK347 were also conducted by OVAI (Pecora and Burks 2014) and included geophysical surveys to identify subsurface features. Following the geophysical surveys, STs were excavated on a 5-m grid across site 33PK347 to refine the site boundaries and to identify artifact concentrations. The testing effort also consisted of the excavation of 30.5 1- by 1-m units, to explore anomalies and features identified by the geophysical surveys and STs (Pecora and Burks 2014:46–47). The Phase II survey recovered 3,826 artifacts, including 3,723 pieces of FCR, 95 pieces of chipped stone debitage, and 8 stone tools. Two projectile points from the artifact assemblage represent the Late Archaic period (circa 3000–1000 B.C.) and the Late Prehistoric/Fort Ancient period (circa A.D. 1000–1650). Two cultural features were identified; they were defined as broad, shallow, flat-bottomed pits filled with FCR. Portions of both features were excavated to document their profile shapes and sample their contents. Charcoal from Feature 1 provided a radiocarbon date of A.D. 1260–1290 (calibrated), placing it in the Late Prehistoric/Fort Ancient period (Pecora and Burks 2014). Based on the possibility that site 33PK347 had not been previously plowed, Pecora and Burks (2014) recommended site 33PK347 as eligible for inclusion in the NRHP under Criterion D.

2.2 Environmental Overview

Human societies at all levels of complexity are linked to the natural environment in a systemic or ecological relationship. This relationship can best be understood as the differential use of available resources, coupled with the strategies employed for exploitation of those resources.

2.2.1 Physiography and Geomorphology

Physiographic Region

Site 33PK347 is in Pike County and lies within the Shawnee-Mississippian Plateau of the Allegheny (Kanawha) Plateaus of the Appalachian Plateaus (Brockman 1998). The Shawnee-Mississippian Plateau is characterized by areas of high, dissected plateaus of coarse- and fine-grained rock sequences. Remnants of the lacustrine, clay-filled, Teays drainage system are extensive in lowlands and absent in the uplands (Brockman 1998).

The extreme eastern part of Pike County is characterized by broad ridges and abrupt, steep hills, with streams in U-shaped valleys. The central part of the county consists of narrow, sharp ridgetops; steep gradual hillsides; and V-shaped stream valleys. The western part of the county consists of broad, nearly level ridgetops and steep, gradual, benched hillsides with small V-shaped stream valleys. Abandoned preglacial stream valleys are located in the southeastern, southern, northern, and northwestern parts of Pike County (Hendershot 1990:2–3).

Geology

Pike County bedrock consists of sedimentary rock. Exposed strata consist of four geologic systems including: Silurian, Devonian, Mississippian, and Pennsylvanian systems. The bedrock is overlain by fluvial Gallia sand and gravel, and by lacustrine Minford clay and silt of the Teays Formation (Slucher et al. 2006). The PORTS reservation, including site 33PK347, is underlain by a section of the ancestral Portsmouth River Valley (DOE 2014:3–9).

The bedrock is comprised of sandstone and shale deposited in an inland sea during the late Devonian and Mississippian periods (Coogan 1996; Slucher et al. 2006). The near-surface bedrock formations include Bedford shale, Berea sandstone, Sunbury shale, and Cuyahoga shale. Bedford shale consists of thinly bedded shale with thin interbeds and laminations of hard, gray, fine-grained sandstone and siltstone. Outcrops of Bedford shale are found in deeply incised streams and valleys on the PORTS reservation (DOE 2014:3–11). Berea sandstone consists of light gray, hard, thickly bedded, fine-grained sandstone, with thin shale laminations. It is present beneath the industrial section of PORTS. Berea sandstone underlies Sunbury shale on the eastern side of PORTS, and underlies Minford and Gallia members on the western side. Sunbury shale is a competent, black, very carbonaceous shale. It underlies the unconsolidated Gallia of the Teays Formation on the eastern side of industrialized PORTS, but is absent in the western half of the reservation. Sunbury shale underlies Cuyahoga shale outside of the Portsmouth River Valley. The Cuyahoga shale consists of moderately hard, thinly laminated shale with numerous interbedded sandstone and siltstone laminations. It forms the hills that surround PORTS and is not present in the industrial section of PORTS (DOE 2014:3–11).

Soils

Mapped soils for site 33PK347 include Rarden silt loam, 8 to 15 percent slopes; and Coolville silt loam, 8 to 15 percent slopes. Both, Rarden silt loam series soils and Coolville silt loam series soils are located on interfluves and summits of hills with convex-shaped slopes. The parent material is residuum. Both series consist of moderately well drained soils (Hendershot 1990; Web Soil Survey 2015).

2.2.2 Hydrology

The majority of Pike County is drained by the Scioto River and its associated tributaries. Sunfish Creek is the main tributary in the western part of the county. The western part of the county is also drained by Pee Pee Creek, Long Fork Creek, and Camp Creek. Big Beaver Creek is the main tributary in the eastern part of the county. The northeast is drained by Carrs Run and Meadows Run. The northwest corner of the county is drained by Bakers Fork, and the southeast is drained by tributaries of the Little Scioto River (Hendershot 1990:2). Site 33PK347 sits on a ridge flanked by two unnamed intermittent tributaries of Little Beaver Creek, located approximately 1,000 m south, southwest of site 33PK347.

2.2.3 Climate

Pike County is in the temperate region of North America, and the climate is typified by hot summers and cold winters. The average summer temperature is 22 degrees Celsius (ºC). The average maximum daytime temperature is 29ºC, while the average winter temperature is 0ºC, with an average daily minimum temperature of -5ºC. The average annual rainfall is 101.6 centimeters (cm), with over half (58 cm) occurring during the growing season between April and September. Average snowfall during the year is 55.8 cm, with 8 days of the year having 2.5 cm of snow on the ground (Hendershot 1990:2).

2.2.4 Flora and Fauna

White and black spruce dominated the vegetation at the close of the Wisconsin epoch, but these were slowly replaced by northern oaks (*Quercus* spp.) and pines (*Pinus* spp.) as the climate warmed (Transeau and Thompson 1934). The northern oak and pine species, in turn, eventually were dominated by beech (*Fagus grandifolia*) and maple (*Acer* spp.) as the boreal forests were replaced by deciduous species. Recurring episodes of a warm-dry climate also may have caused periodic invasion and retreat of prairie communities, similar to those found in Iowa and Illinois.

Thomas Hutchins, Geographer of the United States, began the earliest official American surveying of Ohio in 1786 (Sears 1925:139). Based on a variety of early survey data and historical records, Hutchins prepared the first reconstruction of Ohio's natural vegetation. Gordon (1966, 1969), elaborating on that work, described the natural vegetation in the study area and vicinity as Mixed Mesophytic Forest, Oak-Sugar Maple Forests, and Bottomland Hardwood Forest.

Mixed Mesophytic Forests, found in the uplands to the north and west of the Great Miami River, were characterized by broad-leaf deciduous species without any single species dominating the canopy. Climax associations in Ohio occur as segregates, including oak-chestnut-poplar, oak-hickory-poplar, white oak-beech-maple, and hemlock-beech-chestnut-red oak. Specific components of the Mixed Mesophytic Forests are dependent upon the aspect and degree of slope where they occur (Braun 1950, 1989).

Oak-Sugar Maple Forests also were found in upland areas to the north and west of the study area. Dominant species included white oak (*Quercus alba*), red oak (*Quercus rubra*), black walnut (*Juglans nigra*), and black maple (*Acer nigrum*), as well as sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), white ash (*Fraxinus americana*), red elm (*Ulmus rubra*), basswood (*Tilia* spp.), butternut (*Juglans cinerea*), and shagbark hickory (*Carya ovata*) (Gordon 1966, 1969).

Bottomland Hardwood Forests occupied the river valley and terraces, and included various vegetation types. Several variants are recognized, including beech-white oak, beech-maple, beech-elm-ash-yellow buckeye, elm-sycamore-river birch-red maple, and sweet gum-river birch. Of these, only the first three appear to be climax associations (Gordon 1966, 1969).

These forests were capable of supporting animal populations similar to those found throughout Ohio today. Economically useful species would have included white-tailed deer (*Odocoileus virginianus*), squirrel (*Sciurus* spp.), cottontail rabbit (*Sylvilagus floridanus*), opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), groundhog (*Marmota monax*), beaver (*Castor canadensis*), turkey (*Meleagris gallopavo*), and ruffed grouse (*Bonasa umbellus*). Other significant species that now are extinct in this region included the passenger pigeon (*Ectopistes migratorius*), wolf (*Canis lupus*), bear (*Ursus americanus*), mountain lion (*Felis concolor*), and elk (*Cervus canadensis*) (Guilday and Tanner 1969:41). River mussels and fish were available from the Great Miami River, and seasonal waterfowl also were abundant. Overall, the variety of floral and faunal resources seasonally available in these forests supplied a wide range of aboriginal needs, including food, medicines, and raw materials required for technological and ceremonial purposes (Cleland 1966).

2.3 Cultural Context

The following discussion is a synthesis of various sources regarding the known prehistory and history of southern Ohio. In reviewing the literature devoted to the archaeological resources of this region, the following cultural overview was developed to help reveal the significance of site 33PK347 and other data pertinent to the research domains.

Southern Ohio has been continuously inhabited since the Paleoindian period (12,000 B.C.). Table 2-1 provides a listing of all prehistoric cultural periods from the mid-Ohio Valley region. The beginning and end dates for each period are approximate and are known to change as ongoing research brings new information to light. The prehistoric periods of known association with site 33PK347 are the Early Archaic, Late Archaic, Early Woodland, Late Woodland, and Late Prehistoric/Fort Ancient. This cultural context focuses on brief descriptions of those periods and, additionally, includes a section on the historical era pertaining to the area. Other archaeological sites within PORTS that are contemporaneous with site 33PK347 are listed for each prehistoric period

Table 2-1. Prehistoric Cultural Periods Represented in Southern Ohio*.

Cultural Period	Sub Period	Cultural Phase	Date Range Calendar Years
Paleoindian		Clovis	12,000–8000 B.C
Archaic	Early		8000–5000 B.C.
	Middle		5000–3000 B.C.
	Late	Glacial Kame, Maple Creek	3000–1000 B.C.
Woodland	Early	Adena	1000–100 B.C.
	Middle	Hopewell	100 B.C.–A.D. 500
	Late	Newtown	A.D. 500–1000
Late Prehistoric	Early Fort Ancient	Anderson	A.D. 1000–1200
	Middle Fort Ancient	Anderson	A.D. 1200–1400
	Late Fort Ancient	Madisonville Horizon	A.D. 1400–1650

* Adapted from Ohio History Connection: www.OhioHistoryCentral.org

2.3.1 Archaic Period (8000–1000 B.C.)

Early Archaic (8000–5000 B.C.)

Transition from the Paleoindian period to the Early Archaic period (8000–5000 B.C.) occurred as a warmer, forested environment developed during the early Holocene. Group territories were better defined and the diversity of the artifact assemblages increased through time (Funk 1978). The period is marked by a greater variety of tools, in particular, projectile points (Justice 1987). Most of these points are basally notched, bifurcates, or corner notched, and many exhibit ground bases, beveled blades, and/or serrated edges. Early Archaic sites are more commonly found on outwash terraces within the river and stream valleys of the Till Plains and Allegheny Plateau (Purtill 1998). A predominance of projectile-type tools may indicate a greater reliance on hunting strategies; however, seasonal exploitation of plant foods and use of river biomes certainly were important aspects of subsistence strategies (Jefferies 1996). Other tools that characterize this period include end scrapers, utilized flakes, and some ground stone tools (Dragoo 1976). Early Archaic people lived in smaller groups and were highly mobile; population densities appear to rise dramatically by the end of the period (Purtill 2009).

Two sites with an Early Archaic component have been documented within PORTS, including site 33PK371 and site 33PK347.

Middle Archaic (5000–3000 B.C.)

During the Middle Archaic period (5000–3000 B.C.) the continuing moderation of climate led to a greater variety of available resources. The diversification of subsistence-related activities increased and an emphasis on the exploitation of seasonal resources began to grow in importance. The material remnants of the Middle Archaic culture reflect an increasingly sophisticated technology adapted to the intensive exploitation of forest and riverine biomes. Bifurcate or basally notched points that are present during the early stages of this period are supplanted by somewhat cruder side-notched and heavy stemmed varieties (Justice 1987). An increase in ground and polished stone tools, full grooved axes, pendants, and winged and cylindrical bannerstones used as atlatl weights is noted for this period (Jefferies 1996).

Relatively little is known about settlement patterns during the Middle Archaic. Archaeological investigations have identified few Middle Archaic sites. Based on a review of existing material, and radiocarbon dates, Purtill (2009) has suggested that this period witnessed significant population reduction, perhaps by as much as 80 percent from the preceding Early Archaic period. The reason for this depopulation is unclear but environmental evidence suggests considerable variation in climatic conditions (Shane et al. 2001). Such variation may have resulted in unpredictable resources from a year-to-year basis making the Ohio region unattractive for living during this time. Sites from this time period tend to occur on hilltops, as well as floodplain terraces (Purtill 2009).

Late Archaic Period (3000–1000 B.C.)

The Late Archaic period (3000–1000 B.C.) represents the blossoming of a great diversity of cultural traditions throughout eastern North America. The environment was more stable and the climate assumed modern conditions. Woodland game thrived and nut-bearing trees, such as hickories, black walnuts, and oaks, rapidly expanded in frequency throughout central and southeastern Ohio (Shane et al. 2001). These conditions were very favorable to hunter-gatherer societies and archaeological evidence suggests substantial population increases first in the southern part of the state and then to the north (Purtill 2009). The Late Archaic witnessed intensification of subsistence strategies engaged in during earlier times, especially the collection of wild plant foods and the practice of incipient horticulture. In southern Ohio, some evidence of year-round occupation of sites is found, indicating increased sedentism and greater population across the state (e.g., Purtill 2009; Vickery 2008).

An important model for the Late Archaic settlement pattern was developed by Winters (1969) for the Riverton Culture in the Wabash Valley of Illinois/Indiana. This model explains the increasing regionalization to local areas by a developing restriction of seasonal movement. During the Late Archaic, territory size becomes smaller and more restricted due to population growth and social circumscription, as neighboring groups become more closely packed into the landscape. According to Winters (1969), summer occupations were centered around base camps, while spring and fall settlements consisted of smaller, short-term camps. Winter settlements were longer term, larger camps. All three seasonal settlement types were supported by small hunting and gathering satellite camps.

For the Middle Ohio River Valley, several contemporary, geographically distinct Late Archaic complexes or phases have been proposed. In southwestern Ohio, Vickery (1980) has identified the Central Ohio Valley Archaic phase and Maple Creek phase. The Maple Creek phase dates from circa 1750–1000 B.C. (Vickery 1980). It is defined as a regional manifestation of Winters' (1969) Riverton Culture. Diagnostic materials include the Merom and Trimble, Matanzas, McWhinney, Brewerton, and Laurentian series projectile points, 'Maple Creek knives' (bifacial, with one straight and one curved edge), scrapers, microtools (perforators, drills and gravers), manos, and few ground stone tools (celts instead of grooved axes), as well as an absence or paucity of atlatl parts and bell pestles. Essentially, the Merom and Trimble point types are considered the "index" artifact for this phase. Thick, coarsely tempered ceramics are suggested to be in this phase's context as well. Riverine base camps and smaller upland camps are the suspected settlement pattern. Domestic house design appears varied, some representing rectangular structures such as at the Grayson site (Ledbetter and O'Steen 1991), whereas semicircular, open-walled structures have been identified at several archaeological sites (e.g., Purtill 2012; Vickery 1976). Features primarily include earth ovens, large midden-filled pits, rarer large pits with central hearths, chert-filled cache pits, and living floors. A number of flexed human burials, as well as dog burials, have been identified at several sites. Base camps and satellite camps are suggested by the data. Subsistence data from the Grayson site includes charred nutshell and wood (Ledbetter and O'Steen 1991). Hickory was the most abundant nut type, but walnut and acorn also were present. Hickory and oak were the most abundant wood species represented in the botanical assemblages (Ledbetter and O'Steen 1991).

The characterization of Late Archaic lifeways in southeastern Ohio can be confusing. Several phases (e.g., Dunlap phase) are poorly defined, often based on surface collections without excavation (Murphy 1975; Purtill 2008). Artifacts typically associated with the Laurentian Archaic Tradition of New York (Ritchie 1961), such as Brewerton Corner-Notched and Side-Notched points, are frequently recorded in southeastern Ohio (Cinadr 1985; Murphy 1975). It has long been presumed that Laurentian Archaic sites date to the early Late Archaic (3000–2000 B.C.), although new data from the Davisson Farm site in Lawrence County, Ohio, has suggested that these point types may have been in declining use well beyond 2000 B.C. (Purtill 2002).

Recent investigations have identified Late Archaic base camps at the Davisson Farm site, as well as the Mable Hall site, both in Lawrence County, Ohio (Purtill 2002, 2008). Reports indicate intensive exploitation of seasonal resources, primarily nuts, during this time. This proliferation corresponds with pollen evidence, suggesting local forest establishment of large mast-producing tree species of the oak-hickory-black walnut types. Along with continued use of nut resources, evidence also indicates the increasing importance of domesticated squash (*Cucurbita pepo*) (Purtill 2012). Moreover, at Davisson Farm, the predominance of Brewerton series points suggests close association with groups to the northeast, although southern and western influences also are apparent.

Four sites with a Late Archaic component have been documented within PORTS, including sites 33PK347, 33PK348, 33PK371, and 33PK372 (Pecora and Burks 2014).

2.3.2 Woodland Period (1000 B.C.–A.D. 1000)

The Woodland period in Ohio is characterized by three distinct phases. The Early Woodland, associated with the Adena culture, is followed by the Hopewell culture of the Middle Woodland. The least studied phase, the Late Woodland, transitions Ohio into the Late Prehistoric period/Fort Ancient culture.

Early Woodland (1000–100 B.C.)

The Early Woodland period appears to represent a cultural expansion of the Late Archaic. It is characterized by a greater tendency toward territorial permanence and an increasing elaboration of ceremonial exchange and mortuary rituals. However, some of these traits, once believed to be indicative of Early Woodland, are now known to have their origins in the Archaic (Dragoo 1976; Griffin 1978). Evidence exists that the Early Woodland diet was supplemented by domestication of various native and nonnative cultigens, like sunflower (*Helianthus annuus*) and chenopod (*Chenopodium berlandieri*).

Although the first manufacture of pottery generally is considered to mark the beginning of the Early Woodland period, there are questions (Seeman 1986) whether it has real cultural significance in being associated with new subsistence-settlement directions, or whether pottery is no more than a convenient marker for archaeologists to distinguish between cultural periods. Dates for the first appearances of pottery in the Ohio River valley range from somewhat earlier than 1000 B.C. to around 500 B.C. The dates become progressively younger westward from the upper Ohio River valley. The earliest pottery type in that region appears to have been a thick, plain-surfaced, grit-tempered ware known as Fayette Thick. Recent research in northern Kentucky at the West Runway site (15BE391 [Bergman et al. 1998]) provides some of the best information regarding the earliest ceramic-producing Early Woodland cultures. Importantly, this site was characterized by an association of Kramer projectile points and Fayette Thick ceramics dated as early as 770 B.C.

Munson (1976) argues that the first pottery represented an important technological innovation in food processing, possibly associated with the cultivation of indigenous seed plants such as chenopod (*Chenopodium berlandieri*), maygrass (*Phalaris caroliniana*), erect knotweed

(*Polygonum erectum*), little barley (*Hordeum pusillum*), sumpweed (*Iva annua*), and sunflower (*Helianthus annuus*). However, a consideration of the extreme scarcity of ceramic remains from the long, initial period of introduction is stronger evidence that the presence of ceramics does not necessarily imply the wholesale adoption of a new subsistence system. Early pottery function is somewhat unclear; it is possible that they were an extension of the basin-shaped pit-stone boiling receptacle, used for processing nuts and oily seeds. Unfortunately, ceramic remains do not always co-occur with nut resources. Whatever the function of these vessels, they were not essential to any process; merely a supplement to tools already in use.

In the central Ohio River valley, an important Early Woodland manifestation is referred to as Adena. The Adena people occupied semi-permanent village sites and constructed earthworks, such as conical mounds for interment. Adena burial mounds typically are small and usually located on high terraces or bluffs, overlooking major stream valleys (Abrams 1992). Because of their obvious appearances, Adena mounds have long been the subject of investigations, both systematic and for the purposes of relic collecting. Adena mounds are roughly conical in shape and often contain various structural elements, including bark-lined crypts, layered mound construction, extended burials, cremations, and associated grave furniture. Recent geographic information systems (GIS)-based analysis of distributional patterns of Adena-aged mounds suggests a high degree of intersite visibility, potentially signifying inter-hamlet communication (Waldron and Abrams 1999). Adena habitation sites, on the other hand, usually are small villages or hamlets located along low terraces and in the floodplain of stream valleys. These sites, which do not contain the exotic artifacts that have been associated with Adena mortuary complexes and mounds, have not been as intensively studied. Ceramics types that have been associated in the literature with Adena include Adena Plain and Montgomery Incised (Chapman and Otto 1976). Projectile points associated with Adena are large, stemmed, or ovate-based, with tapering blades and leaf-shaped blades (Justice 1987).

In the Hocking River valley, work by Abrams (1989, 1992) along Sunday Creek has identified numerous Adena sites. Based on this research, Abrams has proposed an Adena settlement system consisting of dispersed clusters of one to two mounds associated with small habitation sites. At the Boudinot #4 site (33AT521) and Boudinot Farm (33AT41/80) Abrams (1992) has documented an example of an Adena domestic setting. These sites are characterized by a wide range of domestic tool types, including hammerstones, pestles, a mano, Robbins points, and thick-walled ceramics (likely Adena Plain). Postmolds and cooking/roasting pits also were documented. Seasonal data suggest that these occupations were not year-round. Abrams (1992) argues that these sites acted as warm weather locales intermittently occupied from the mid-spring through mid-fall seasons.

Four archaeological sites with an Early Woodland component have been documented within PORTS, including sites 33PK347, 33PK348, 33PK371, and 33PK372 (Pecora and Burks 2014).

Middle Woodland (100 B.C.–A. D. 500)

The Middle Woodland period (100 B.C.–A.D. 500) represents a time of complex sociocultural integration across regional boundaries, spurred via trade networks. In Ohio, the predominant Middle Woodland culture is known as the Hopewell Tradition. It is characterized by elaborate geometric earthworks, enclosures, and mounds that are often associated with multiple burials and a wide array of exotic ceremonial goods. Materials used in the manufacture of Hopewell ceremonial items were acquired from various regions of North America (Griffin 1978; Vickery

1976). Hopewell ceramics were manufactured with grit or limestone tempering and have plain or cordmarked surfaces. The Vacant Center Settlement Model, originally advanced by Olaf Prufer in the 1960s and further developed by Dancey and Pacheco in the 1990s, contends generally that Hopewell peoples resided in dispersed agricultural hamlets surrounding the ceremonial centers (Dancey and Pacheco 1997; Pacheco 1996; Prufer 1967). A contrasting model suggests that Hopewell communities were semi-sedentary foragers and that most Hopewell sites represent seasonal camps (Yerkes 1994). Many of the distinctions drawn by scholars appear to be based on differences in the interpretation of archaeological data. The "Hopewell collapse" in Ohio is another topic of dispute among scholars. The height of use of the major earthworks dates to A.D. 200–400, after which changes in the landscape of Hopewell settlement are apparent. Dancey and Pacheco (1997) argue that as Hopewell societies became more stable in the early first millennium, hierarchical alliances formed and populations grew, resulting in competition for arable lands. In marginal areas, where good land was at a premium, aggregation began in the form of nucleated villages. By A.D. 500, these aggregated villages had come to dominate the region, and the small hamlets of classic Hopewell were usurped. This transition is seen as the advent of the Late Woodland period.

No archaeological sites within PORTS have been dated to the Middle Woodland period.

Late Woodland (A.D. 500–1000)

The Late Woodland period has not been well defined for most of Ohio (Dancey 1981). Fieldwork undertaken by Baby and Potter (1965), Murphy (1975), and Prufer and McKenzie (1966) have indicated that differential development of cultural trends was occurring on a regional basis. It is probable that established patterns existed longer in some areas than in others as a continuation of the Middle Woodland economy with the noticeable lack of earthwork construction and elaborate Hopewell ceremonialism. By the end of this period, the adoption of corn agriculture is evident. As a result, large nucleated villages were situated along terrace and bluff-base locations within the major river valleys.

Late Woodland ceramics in southern Ohio are defined by the Newtown focus, the Peters series, and the Chesser series (Prufer and McKenzie 1966). The Late Woodland lithic assemblage is represented by triangular side-notched points, triangular blades, Raccoon-notched points, Lowe Flared Base, Jack's Reef Corner Notched, and Chesser side-notched points (Justice 1987; Prufer 1967).

Ditches or earthen embankments have been documented encircling several larger sites such as the Zencor and Water Plant sites in Franklin County. These features, along with the concomitant rise in lethal projectile wounds, are thought to represent a rise in regional hostilities not witnessed in preceding Middle Woodland times. By the later stages of the Late Woodland period (A.D. 700–1000), large settlements are no longer established as local populations again concentrate in smaller, dispersed sites (Seeman 1992). Just east of Piketon, investigations in the late 1970s identified a Late Woodland component at site 33PK35, which is located on a high bluff overlooking the Scioto River valley to the west (White 1978a, 1978b). Data from limited excavations suggested that site 33PK35 represented a habitation camp of sorts.

Two archaeological sites with a Late Woodland component have been documented within PORTS, including sites 33PK347 and 33PK371 (Pecora and Burks 2014).

2.3.3 Late Prehistoric Period (A.D. 1000–1650)

The rise of large permanent villages, increased populations, and wholesale adoption of agriculture are seen as hallmarks of the Late Prehistoric period, better known in the mid-Ohio River valley as the Fort Ancient culture (e.g., Cowan 1986, 1987; Drooker 1997; Essenpreis 1978; Griffin 1943; Henderson 1992; Prufer and Shane 1970; Redmond 2000). Current research suggests that the Fort Ancient culture developed out of the local Late Woodland cultures (e.g., Henderson 1992), although varying degrees of influence from Mississippian communities have been suggested (e.g., Cook 2008; Cook and Fargher 2007; Essenpreis 1978; Prufer and Shane 1970).

Myriad of different phase typologies have been proposed by Fort Ancient researchers in southwestern Ohio. In general, these hierarchies diverge with regards to the explanation of variability observed in the archaeological record. These typologies can be organized into two general groups, which include (a) variability being explained as a product of regional and organizational differences (Essenpreis 1978, 1982; Griffin 1943); and (b) variability being explained in temporal and evolutionary terms (Cowan 1986, 1987; Henderson 1992; Prufer and Shane 1970; Riggs 1998). Although a specific phase typology has not received consensus, recent research has documented temporally sensitive changes in subsistence, settlement/organization patterns, and artifact assemblages (e.g., Nass and Hart 2000; Riggs 1998).

The Fort Ancient culture is characterized by large permanent villages located along major drainages on terrace and blufftop locations. From A.D. 1000–1400, villages tended to be organized around a central plaza with concentrically arranged rings of storage/refuse pits and houses. Burial mounds were not used extensively and by about A.D. 1250, are not constructed at all (Cowan 1986, 1987). Burial contexts for nonmound burials are varied and may occur around the central plaza, in cemeteries away from villages, or beneath house floors. Villages vary in size but can be quite large (e.g., State Line: 4–6 ha [Drooker 1997; Vickery et. al 2000]).

Fort Ancient pottery is characterized by an increase in the use of shell tempering through time (Pollack and Henderson 2000; Prufer and Shane 1970), although these percentages can vary dramatically according to region (e.g., Essenpreis 1982). Up to A.D. 1250, ceramic decorations show an increasing amount of decoration as designs, such as curvilinear and rectilinear guilloche, become popular. Vessel shapes are restricted to elongated and globular jar forms, although some pan forms have been documented. Projectile points are mostly thin, triangular arrow tips indicate the predominance of bow hunting.

Subsistence during the Fort Ancient period became more heavily dependent on maize-bean-squash (also known as the ‘three sisters’) agriculture, although evidence suggests that wild plant foods (e.g., nuts and berries) and native seed cultigens also remained an important part of the diet (Purtill and Leone 2014; Rossen 1992; Wheelersburg 1992). Population growth occurred as a result of increased sedentism and a shift to a more intensive agricultural base. Settlement continued in stockaded villages, many on blufftops above floodplains. Although village sites have received the bulk of archaeological investigations, recent research also has documented the existence of smaller, seasonally occupied extractive/hunting camps (Brose and White 1983; Purtill 1999).

Beginning around A.D. 1400, Fort Ancient sites demonstrate a significant reorganization of lifeways, which differ from earlier periods. Archaeologists have termed this the Madisonville Horizon, to reflect increased pan-regional interactions in artifact styles, including ceramic and lithic tools, with various groups within the Midcontinent (Drooker 1997; Henderson 1992). The traditional circular village pattern is replaced by roughly linear, poorly organized village plans (Cowan 1987). Evidence from the Driving Range site (33HA586) in southwestern Ohio suggests that seasonal abandonment of summer villages for winter camps, referred to as the Miami-Potawatomi settlement system was being practiced for the first time in the Fort Ancient culture area (Purtill 1998).

After A.D. 1400, a number of trends in artifact styles have also been documented. Ceramic decorations become dramatically plain, as curvilinear and rectilinear guilloche designs cease to be used in high frequencies (Cowan 1986, 1987). Also, the occurrence of ceramic salt pans is seen in high frequency for the first time. Similar trends in ceramic styles have been observed in Kentucky (Henderson 1992; Pollack and Henderson 2000) and West Virginia (Graybill 1981). Additional tool types that are argued to be diagnostic of the Madisonville Horizon include bifacial, tear-drop end scrapers; bi-pointed knives; and carved bone pins (Cowan 1987; Henderson 1992).

Evidence exists that some Fort Ancient sites were occupied into the Protohistoric period (after European contact). The Madisonville site (33HA14), in Hamilton County, and the Morrison Village site, in Ross County, have yielded European trade goods, suggesting occupation well into the seventeenth century (Drooker 1997). However, beginning in the mid-seventeenth century, aboriginal populations of Ohio were displaced when groups involved with the European fur trade in the Northeast began to expand the geographical range of their activities. The consequences of this, coupled with increasing displacement of eastern aboriginal groups, resulted in repopulation of the region by Native American groups from outside areas (Hunter 1978).

The current Ohio Archaeological Inventory lists 18 archaeological sites with Late Prehistoric components in Pike County, or six percent of the known sites, but the Piketon area is an archaeological void when it comes to identified Late Prehistoric period village sites. The nearest well-documented Fort Ancient village is the Feurt Village site (33SC6), located approximately 22 km south of PORTS. Near Lucasville, approximately 15 km south of PORTS, is the Schisler Village site (33SC9), although this site is less well documented. To the north of PORTS, no major villages south of the Morrison Village site (Prufer and Andors 1967) have been documented.

Two archaeological sites with a Late Prehistoric component have been documented within PORTS, including sites 33PK347 and 33PK372 (Pecora and Burks 2014).

2.3.4 Historic Era (A.D. 1650–Present)

Some Native American groups who inhabited central Ohio from around 1650 and through the end of the eighteenth century included the Delaware, Miami, Mingo, Shawnee, and Wyandot. These groups had been displaced from their homelands due to disease and territorial/trade wars. The Shawnee established their headquarters at the mouth of the Scioto River, where, beginning in the 1730s, they drew together bands that had been scattered since the Beaver Wars (Tanner 1987). Several Shawnee villages were located in Pickaway County during the last half of the eighteenth century. Among these were Kapok Town and Old Chillicothe. Magic and Hurricane Tom's Town, both Delaware villages, and the Shawnee villages of Cornstalk's Town and Grenadier Squaw's Town were situated south of Circleville along Skippy Creek. Later in the eighteenth century, Shawnee, Wyandot, and Delaware villages were concentrated along the Mad and Miami Rivers, which acted as transportation routes between central Ohio and the Ohio River Valley. The most important among these were Zane's town, Wapato Mica, Meacham, McKee's Town, Blue Jacket's Town, Lewistown, and Buckangehelas (Tanner 1987).

Few Euroamericans had settled in Pike County by the late eighteenth century. In 1795, the signing of the Treaty of Greenville at Fort Greenville (present day Greenville, Ohio) opened up Ohio for Euroamerican land claims and settlement (Howe 1902). In 1795, Hezekiah Merritt is given credit as the first European farmer to the area. And in 1807, he built the first mill in the area on Camp Creek. Three Chenoweth brothers, John Noland, and their families were the first to settle near present-day Piketon, in 1796 (McCormick 1958; Interstate Publishing Company 1884:689). Two other mills, both on Sunfish Creek, were in operation by 1812, as was a ferry boat across the Scioto River near Piketon (Interstate Publishing Company 1884:696). Pike County was established in 1815, as the Scioto River and its broad floodplains attracted large numbers of people who wanted to farm its rich alluvial bottomlands. The adjoining uplands were "...excellent stock ranges, the grass growing luxuriantly...[and] its hills abound in immense quantities of splendid freestone that is unsurpassed for building purposes" (Interstate Publishing Company 1884:697). The freestone, a fine sandstone in the lower strata of the Waverly Group, was quarried from early in the county's history, as were other rock and mineral deposits, including a siliceous sandstone (used in glass manufacture), cliff limestone, black slate, and beds of iron ochre (Interstate Publishing Company 1884:700). The mills and the ferry were aimed at processing and moving agricultural goods about the region in support of a burgeoning population. Early Euroamerican subsistence practices included corn agriculture on the floodplains and raising livestock on the sloping hillsides and rolling ridgetops (Jones 1983; McCormick 1958). By 1820, Pike County's population was 4,200 (Interstate Publishing Company 1884:696–697).

The Scioto River valley was once covered in a vast primeval forest. As European settlers laid claim to the land during the late eighteenth and early nineteenth century, they made every effort to clear it of trees as quickly as possible to enable cultivation. With the loss of foliage, the rich fertile soils that once covered the forest floor had no anchor to remain in place. Farming atop the higher elevations of the landscape was short-lived, as the soils eroded and flowed downhill with each passing storm. Creeks and rivers that once ran clear and deep eventually silted up, becoming shallow and murky. County histories of the late nineteenth century commonly make reference to this problem, noting that waterways that were once navigable to the early settlers soon ceased to support boats (Interstate Publishing Company 1884).

The county was serviced first by the Scioto River, then by the Ohio & Erie Canal (beginning in 1832), and subsequently by both railroads and major north-south and east-west roads. Publicly financed turnpikes began to crisscross the county beginning as early as 1866 with the construction of the Waverly to Latham "Sunfish" Turnpike. Over the next 20 years, four primary arteries were constructed (Interstate Publishing Company 1884:718). Railroads were fewer and somewhat less successful. They did, however, quarter the county and link it to major markets. The rail lines included the north-south Scioto Valley Railroad, which was finished in 1877 and ultimately absorbed by the Ohio Southern. Also constructed by 1878 was the east-west Springfield, Jackson & Pomeroy Narrow Gauge Railroad (Interstate Publishing Company 1884:718). While the county's transportation arteries led to early growth, the county's industry was focused on agriculture, lumbering, and stone quarrying. These focal industries were supplemented by recreational Lake White after its creation in 1935 and, more importantly, by the 1950s gaseous diffusion plant outside of Piketon (McCormick 1958).

The post-World War II period in Pike County saw a gradual shift from an agrarian and natural resource base to a mixed economy. From 1950–1990, the county's population increased about 64 percent from 15,500 in 1950 to about 24,250 in 1990 (U.S. Census Bureau 1995). Much of the growth can be attributed to three events: the creation and continued use of Lake White State Park, the construction of the gaseous diffusion plant in Piketon, and the introduction of new light industry to the area. While the creation of the park provided economic stimulus, industrialization played the major role. In 1940, approximately 1,700 farms existed in the county and most of these were family operations (Beekman n.d.). By 1970, the number of farms had dropped to 450 and many of these represented the consolidated holdings of large corporate farms (Adkins 2003; Beekman n.d.). The buyout of the small farms might have resulted in significant population loss or even economic downturn. However, in 1952 the Atomic Energy Commission (AEC) chose the Piketon area as the site of a gaseous diffusion plant. The plant was originally designed to enrich uranium for defense purposes, but by the mid-1960s, the enriched uranium was used for naval propulsion systems and nuclear power plants (Fluor-BWXT Portsmouth 2015; DOE 2015b). The plant, when in major production, employed more than 2,000 persons and provided a training ground for industrial workers. By the 1990s, the gaseous diffusion plant, while still a principal employer, was beginning to gear down. Since that period, a major county-wide emphasis has been on the development of light industry and enhancement of the existing industrial base. To this end, the Ohio State University South Centers research station at Piketon is developing new approaches to horticulture, aquaculture, soil, and bioenergy (The Ohio State University South Centers 2015); and Pike County white oak is used to make oak barrels for the Spanish and Australian wine industries (Lane 2012).

2.3.5 Archival History of Site 33PK347

The Pike County property deed records reveal that much of the acreage upon which site 33PK347 is located was transferred to private ownership from the United States Land Office to William Wright in 1815 and B.C. Dunham & B. Ward in 1837. The Phase I survey report provides a timeline of historical maps, aerial photographs, and property owners (Pecora 2013a). The 1859 Plat Map indicates that site 33PK347 was owned by William Holt, and the circa 1905 Oil and Gas Lease map shows the site was owned by Hugh Farmer. The Oil and Gas Lease map is the earliest known map to depict structure locations but no structures are located within site 33PK347. The 1906 Waverly, Ohio 15" USGS topographic map also shows no structures within site 33PK347. The 1952 AEC property map shows that site 33PK347 was owned by D.H. Farmer (157) at the time the property was acquired (Pike County Recorder's Office 1953). Within site 33PK347, no historical structures are illustrated on historical maps dated from 1859 to the present. An absence of historical artifacts recovered during Phase I, Phase II, and Phase III testing supports this record.

The 1938/9 and 1951 aerial photographs show wooded ground cover on site 33PK347. No earlier aerial photographs are available. It was suggested in the Phase II report that site 33PK347 has never been cultivated; however, timbering was not ruled out based on the young age of the standing forest (Pecora and Burks 2014:46). Historical, archival, and deed records were examined by Gray & Pape Historic Preservation specialists and they could find no specific information on agricultural, livestock, or timbering practices on the ridgetop where site 33PK347 is located, during the years prior to property acquisition by the AEC (D. Burden, personal communications 2015).

Numerous roadways and paths, old and new, traverse the ridges and slopes throughout the area surrounding site 33PK347. Many of the older roads and paths are probably associated with the historic-era farmsteads, but others may have been developed more recently, within the past 60 years. The most recent paths are associated with monitor well installation and observation. A two-track roadway was present, running northwest-to-southeast through site 33PK347. The roadways, regardless of age, all potentially affected archaeological sites. However, their construction and use should not have been sufficient to completely erase archaeological resources.

2.4 Research Domains

Data recovery efforts at site 33PK347 were focused on the recovery of data that would allow for the interpretation of site function, and incorporation of the site into existing models of settlement and subsistence in the middle Ohio River valley over the course of perhaps 7,500 years, from the Early Archaic period through to the Late Prehistoric/Fort Ancient period. The research design was based on the information collected during Phase I and Phase II investigations. The research design questions are grouped into three Research Domains.

2.4.1 Research Domain 1: Site Formation and Taphonomy

The shallow depth of site 33PK347 and the geomorphology that formed its deposits raise questions concerning the formation and interpretation of the archaeological deposits and soil development processes at the site. Due to the lack of data on the geological processes at site 33PK347, defining the depositional sequence is integral to interpreting the age and sequence of occupations. To this end, a geomorphologist was consulted to analyze soil sequences, and to assess the types of soils and methods of deposition. In addition, charcoal samples provided a range of absolute dating anchors for site 33PK347. The geological and chronological information was used to establish a sequence of occupation and archaeological site formation.

Soils mapped at site 33PK347 exhibit an Oe-Ap-BE-Bt1-Bt2-2Bt3-2Bt4-2Bt5-BC-2C sequence of soil horizons (Hendershot 1990:107). An O horizon is a soil horizon derived from dead organic material; the e modifier indicates that the organics are in an early stage of decomposition. An A horizon is a mineral horizon that contains sufficient decayed organic material to give the horizon a dark color; the p modifier indicates that the soil has been modified by human activity (i.e. plowing). An E horizon is a mineral horizon that has formed where maximum leaching of clay, iron, and aluminum oxides has occurred, leaving a pale-colored horizon that is lighter in color than the overlying A horizon. A B horizon is a mineral horizon that has undergone pedogenic modification (soil forming processes) to an extent that the parent material structure is no longer evident; the t modifier indicates that clay materials have accumulated in the horizon. A C horizon is a mineral horizon that exhibits little to no pedogenic modification and may or may not be composed of an unmodified parent material. These master soil horizon notations (O, A, E, B, and

C) can be combined to signify that a horizon has characteristics of multiple horizons; for example, a BE horizon is a B horizon that has characteristics of an E horizon. In soil horizon descriptions, numerical prefixes indicate changes in parent material, while a numerical suffix indicates difference within a given master soil horizon (Holliday 2004). Phase II investigations suggested that site 33PK347 is largely undisturbed and has not been plowed (Pecora and Burks 2014). At the time of these investigation site 33PK347 was wooded and had been for over 75 years. E horizons generally form in wooded areas and are found near the surface, immediately below O or A horizons; they can also be incorporated as part of a B horizon. The presence of an E horizon suggests a mature soil in which cultural activity may be preserved (Cremeens 2003:51; Holliday 2004:267; Schaetzl and Anderson 2005:441–442; Trader 2009:119; Vogel 2002:12). The presence of an E horizon also suggests that the landform on which site 33PK347 is situated has been wooded for a much longer period of time than 75 years. According to Holliday (2004:202), it can take as many as 4,000 years for an E horizon to develop; while Cremeens (2003:52–53) notes that a Bt horizon can take as many as 2,000 years to form.

The impact of bioturbation on archaeological site formation and development was also considered. Tree root movement and burrowing animals can result in mixing of artifact assemblages (Wood and Johnson 1978). Furthermore, if the landform had been used for pasture in the late nineteenth and early twentieth centuries, then trampling from pastured animals could also impact surface or shallow deposits.

In addition to identifying soils and their processes of deposition, soil samples, soil cores, and live tree cores were collected from feature/site contexts and nonfeature/site contexts, to provide additional information regarding formation processes at site 33PK347. Geomorphological, geoarchaeological, soil chemistry, and dendrochronology analyses were conducted on soil samples and soil cores to provided data concerning activity areas, and the geomorphic processes responsible for archaeological site formation.

2.4.2 Research Domain 2: Settlement and Subsistence

Settlement systems in the Late Archaic and Late Prehistoric/Fort Ancient periods have been the subject of much debate. Theories on the evolving nature of settlement and its component parts (Burks 2004; Church 1987; Dancey and Pacheco 1997; Genheimer 2000; Henderson 1992; Prufer 1967; Vickery 1980; and Winters 1969) have provided useful models for testing. However, the complex nature of archaeological site deposits, and the rarity of single component, undisturbed sites has made it difficult to clearly define how archaeological site structure has changed over time.

Mitigation of site 33PK347 provided an opportunity to look at a small, largely undisturbed upland site, to determine how it fits into the previously described settlement systems. During the Late Archaic period, dispersed spring-to-fall settlements focused on specific resources in river valleys and uplands, with large winter settlements in floodplain locations (e.g., Purtill 2009; Vickery 2008; Winters 1969). By Late Prehistoric/Fort Ancient times, settlement had changed dramatically and was characterized by large, permanent, stockaded villages located along major drainages on terraces and blufftops. These villages were supported by agriculture, with upland resource procurement sites that focused on hunting and/or gathering of wild plant materials. They may have also served as specialized extractive sites (e.g., Brose and White 1983; Purtill 1999). Harper (2000:357) suggests that Fort Ancient groups followed a settlement-subsistence pattern similar to that used by historical Miami and Potawatomi groups. These groups followed a scheduled settlement-subsistence pattern. From spring until fall, groups lived in permanent houses in a main village, and then, fragmenting into smaller family units, moved to winter hunting camps. Little is known concerning Fort Ancient settlement and/or subsistence in the Scioto River valley, particularly in upland contexts. Data recovery efforts collected data to assist in determining if site 33PK347 fits into the annual settlement-subsistence pattern described by Harper.

No food remains (botanical or faunal) were recovered during Phase II investigations that would suggest the features were utilized for domestic purposes. Domestic activity can refer to anything from low intensity use of a hearth to cook meals, to high intensity use of thermal features for plant processing activity (such as boiling or parching a seasonal nut harvest) or for use as earth ovens. Extensive soil analyses were planned for feature and nonfeature contexts, in the hopes of gathering additional information concerning domestic activity or subsistence practices. Data was collected to identify the range of feature type and feature function at site 33PK347. Analysis of the features confirmed occupation dates and identified resources being utilized at site 33PK347. Data collection included sampling to pinpoint the types of organic resources utilized. To this end, soil samples were collected for paleoethnobotanical and phytolith analyses in order to establish the types of plant remains present. Fire-cracked rock and adhering soils were examined for organic residues through starch grain and lipid residue analyses. Chipped stone tools were not recovered from cultural contexts; therefore, analyses such as protein residue, X-Ray fluorescence, and microwear were not conducted. To better understand feature function, traditional documentation of feature contents and profiles was combined with sample collection for specialized analyses. These data were then used to address questions regarding subsistence, seasonality, and mobility.

The majority (97 percent) of the artifact assemblage from the Phase II investigations consisted of FCR. While FCR was found scattered across site 33PK347, it was concentrated primarily within Features 1 and 2; however, investigations were unable to determine feature function. To determine whether the features were intact or represented reuse/cleaning episodes, a sample of FCR collected from feature and nonfeature contexts was subjected to refit analysis.

2.4.3 Research Domain 3: Lithic Selection, Sourcing, and Function

During Phase I and Phase II investigations, several observations were made concerning the composition of the raw materials represented in both chipped stone and FCR assemblages: (1) site 33PK347 contained few chipped stone artifacts, and a large proportion of them were manufactured from unidentified raw material; (2) most of the FCR at site 33PK347 consists of local sandstone that could have been obtained from nearby slopes; and (3) site 33PK347 is dominated by late stage biface thinning debris created from the manufacture or maintenance of bifaces; very little debris from the site represents core reduction. This demonstrates that most of the stone that entered site 33PK347 came in the form of early stage biface blanks. This is in contrast to the artifact assemblages of other nearby sites, such as 33PK348, 33PK371, and 33PK372, which were dominated by core reduction debris (i.e., cobbles were likely transported from the Scioto River floodplain for tool production) rather than biface reduction debris.

Data recovery efforts focused on locating activity areas within site 33PK347, in an attempt to collect a larger artifact sample that might highlight a wider range of raw materials at the site, as well as its ties to the local landscape and trade networks. Because site 33PK347 might not be previously plowed, the potential for identifying activity areas associated with the manufacture and production of chipped stone tools was greater than if the site had been plowed and plowzone artifacts dispersed. The chipped stone artifact assemblage from Phase I and Phase II investigations included unidentified cherts, Delaware, Upper Mercer/Zaleski, Brush Creek, Brassfield, and Vanport cherts (listed in decreasing percentages). Recovery of a larger sample during Phase III investigations was necessary for documenting the full range of raw materials utilized at site 33PK347. These data could be used to refine characterizations of local versus non-local material reliance, as well as to understand where the bulk of the raw material at the site originated.

2.5 Project Methods

Project methods include data management systems utilized during archaeological field work, gathering and processing of geospatial data, laboratory analysis of artifacts, laboratory analysis of specialized field samples, and artifact curation. All measurements are in metric, as outlined in the Society for American Archaeology Style Guide (Society for American Archaeology 2014:11).

2.5.1 Data Management

All data management was facilitated by GIS technologies and the ArcheoLINK™ data management software system. All geospatial data, including two new datums established for Phase III investigations, were collected using a Sokkia® SET610 total station and Trimble® TSC3 Collector Global Positioning System (GPS) unit. In order to produce a highly accurate digital site map of 33PK347, the total station and GPS unit were used to plot the location of (1) all positive STs, (2) the center location of all anomalies and features, and (3) the southwest corner of all excavated units. All geophysical survey data, field geospatial data, and artifact distribution data were analyzed via ESRI ArcView® GIS. All ST, unit, and feature form information, as well as artifact data, were entered into the ArcheoLINK™ data management software system. Photographs, profile sketches, and distribution data are all included within the structure of the ArcheoLINK™ database. Photographs were taken using a Pentax® K-x 35-millimeter (mm) digital single-lens reflex camera. A photo log recorded a description of all photographs taken. As an analytical tool, Agisoft PhotoScan® software was utilized to process photographs taken in the field to create three-dimensional (3-D) models of all blocks and features excavated. These models were converted into orthographically correct, measurable images that served in place of hand-drawn maps of features, although the use of photography was supplemented by drawings, when appropriate.

2.5.2 Archaeological Field Methods

The Phase III field data collection methods were designed to provide answers to the three research domains (Section 2.4) by focusing on locating and identifying activity areas, defined as cultural features and/or artifact concentrations. The process of identifying activity areas consisted of a three-stage approach including, (1) utilization of magnetic susceptibility geophysical survey to identify and locate possible cultural features, (2) excavation of a series of STs on a 5-m grid to locate artifact concentrations, and (3) extensive hand-excavation of larger exploratory units and blocks, as determined by the geophysical survey results. All data recovery efforts were conducted within site 33PK347 boundaries, as defined during Phase II investigations.

2.5.3 Grid Establishment

Before field investigations began, the 20-m grid system of wooden stakes set out during Phase II testing was reestablished. Two permanent rebar datums and all labeled wooden stakes were still in place; therefore, no additional steps were needed to re-establish the grid. Using the existing 20-m grid stakes, a 10-m grid was established, using measuring tapes placed between existing stakes. The 10-m grid facilitated the layout of all ST and block/unit locations. Although Universal Transverse Mercator (UTM) grid coordinates were recorded with the total station and GPS unit, local grid coordinates, measured in meters, were used to describe the locations of STs and excavation units. The local grid coordinates extended north (N), from N585–N660, and east (E), from E485–E545. Gray & Pape set two new datums to facilitate field work. Datum GP01 was located at grid coordinate N645 E485 (UTM Zone 17, NAD 27 N 4322645.000 E 328485.000) and datum GP02 was located at grid coordinate N625 E515 (UTM Zone 17, NAD 27 N 4322624.654 E 328515.674).

2.5.4 Geophysical Survey

The first stage of data recovery effort included a magnetic susceptibility geophysical survey that was conducted at site 33PK347 by Donald Handshoe, of Gray & Pape. A Geonics® EM38 magnetic susceptibility meter was utilized to detect enhanced magnetic susceptibility readings in the soil, to a maximum depth of 80 cm. Readings were taken along transects spaced 0.5 m apart on the 20-m grid re-established from the Phase II investigations (Figure 2-1). The grid consisted of seven 20- x 20-m blocks and two 10- x 20-m blocks. The Geonics® EM38 dual-coil/slingram instrument was chosen because of its ability to provide readings to a greater depth than the single-coil/coincident loop instrument used for the Phase II investigations, which provided readings to a maximum depth of 15 cm. Readings during the Phase II survey were taken at 10-m grid points. The fine-grained Phase III magnetic susceptibility survey provided readings that were more than five times deeper and 20 times more tightly spaced than readings taken during Phase II investigations.

On the geophysical survey results map, disturbances are marked as anomalies, which are spatially discrete areas characterized by geophysical values that differ from those of the surrounding area. The level of magnetic enhancement in soil depends on climate, the amount of iron present in parent materials, soil temperature, soil chemistry, soil porosity, and the presence of bacteria that use and produce small magnetic particles (Evans and Heller 2003; Fassbinder et al. 1990; Graham 1974; von Friese 1984). Soil temperature, chemistry, and porosity can also be directly impacted by human activity. Humans can increase soil temperature by using fire, depositing organic matter that alters soil chemistry, and increasing porosity by digging holes for any number of reasons. Certain soil horizons and components of soil, such as organic rich topsoil (A horizon), are generally more susceptible to induced magnetic fields than other soil horizons (LeBorgne 1955, 1960), such as subsoil (Bt horizons). If a hole dug a few feet into the ground is backfilled with mixed up sediments, the backfilled hole will likely have a different magnetic susceptibility reading than the surrounding, intact soils—especially if the topsoil ends up in the bottom of the hole adjacent to clay-rich (organic poor) subsoil. Thus, geophysical surveys provide measured readings that can be caused by both cultural as well as natural processes (Dalan 2006; Tite and Mullins 1971). Localized disturbances associated with tree roots, rodent activity, and other natural phenomena, as well as recent cultural activities (vehicle ruts, plow furrows, etc.), are also detectable.

Figure 2-1. Magnetic susceptibility survey conducted at site 33PK347, view to the north.

Prehistoric features, such as pits and hearths, are typically characterized by a low contrast with the surrounding soil matrix. Historical features frequently contain metal artifacts and architectural debris (brick, mortar, stone footings, etc.) and, thus, typically exhibit a stronger contrast with their surroundings. All geophysical data are to some extent affected by noise, attributable to the instrument itself, the operator's field technique, and variability in soils. Clutter refers to nonarchaeological, discrete phenomena that complicate feature detection. Clutter includes plow furrows, rocks, tree roots, rodent burrows, and modern metallic debris.

The magnetic susceptibility data were processed using TerraSurveyor™ software, developed by DW Consulting for archaeological applications. TerraSurveyor™ routines were used to identify and remove data defects, detect anomalies that could be associated with cultural features, and to cosmetically improve the appearance of the maps. The general processing sequence for the data was as follows. Data were first Clipped to remove extreme outlying values. The Despike routine was then used to further reduce the effects of isolated data spikes. The Zero Mean Traverse routine was used to set the background mean of each traverse to zero. This removed much of the striping that is often present in the raw data. The Interpolation routine was used to achieve square pixels. A Low Pass Filter was then conducted to smooth the data by removing high frequency, small-scale spatial detail. The Low Pass Filter is effective in improving the visibility of the larger, weaker cultural features. As a final step, the processed data were imported into ESRI ArcMap 10.3™ to produce the image maps.

2.5.5 Shovel Testing

As the second stage of data recovery effort, shovel testing was conducted across site 33PK347 at 5-m intervals. This 5-m grid was offset 2.5 m north and east of the Phase II 5-m ST grid. Shovel testing was conducted to identify areas of artifact concentration and was restricted to within the boundaries of site 33PK347, established during the Phase II investigations. Twelve transects (A through L) were placed across site 33PK347, west-to-east. Shovel tests on each of transects A through H were labeled 1 through 11 (south-to-north), while STs on each of transects I through L were labeled 1 through 12. A total of 136 STs were excavated.

Each ST measured 50 cm square and was excavated according to natural soil stratigraphy to a depth of 10 cm into archaeologically sterile subsoil. Shovel tests were excavated using shovels, with strata breaks cleaned, using the shovel flat-edge, before proceeding into the next stratum. The shovel test soil was screened through 6-mm mesh hardware cloth, from which all artifacts were collected. If breaks in the natural (or cultural) stratigraphy were identified, then artifacts were collected separately, by strata. Shovel Test Forms were completed for each ST; photographs were taken of the profiles of positive STs. All positive STs were recorded using the GPS and total station systems described in the Data Management section (Section 2.2.1), above.

2.5.6 Hand-Excavated Blocks

The third stage of data recovery effort included the hand excavation of up to 30 2- by 2-m blocks, centered over previously identified anomaly and feature locations, as indicated by the geophysical survey results. An additional 50 1- by 1-m excavation units were reserved for expanded investigation of artifact concentrations encountered during shovel testing, and for expansion of the 2- by 2-m blocks, as deemed necessary if new features were identified. All blocks were excavated in 1- by 1-m units, regardless of their size or configuration. For example, a 2- by 2-m block was excavated as four 1- by 1-m units. Each block had a numeric designation and its unit components also each had their own numeric designations (e.g., Block 10 consisted of Units 64, 65, 67 and 68). Within each unit, naturally occurring soil strata were excavated in 10-cm levels. The soil removed was screened through 6-mm mesh hardware cloth and all artifacts were collected. The center of all anomalies and features, as well as the southwest corner of all units, was recorded using the GPS and total station systems described in the Data Management section (Section 2.2.1), above.

Anomaly and Feature Excavations

Data collected during the Phase II and Phase III geophysical surveys were used to guide the placement of excavation blocks within the boundaries of site 33PK347. Investigations of the anomalies were accomplished by excavating a 2- by 2-m block centered over the coordinates of each anomaly. All anomalies were closely examined for potential cultural features. Within each 1- by 1-m unit, naturally occurring soil strata were excavated in 10-cm levels. Units were excavated using shovels and trowels. Strata breaks were cleaned using trowels, and examined before proceeding into the next stratum. The soil matrix removed was screened through 6-mm mesh hardware cloth and all artifacts were collected. If breaks in the natural (or cultural) stratigraphy were identified, then artifacts were collected separately, by strata. If no evidence of cultural features or possible buried cultural deposits was identified, excavation was terminated 10 cm into archaeologically sterile subsoil. All blocks were photographed and wall profile maps were sketched to show soil stratigraphy. Data for each unit, including soil stratigraphy depths and descriptions, artifacts collected, and any observed indicators that could explain the presence of the anomaly, were recorded on Unit Forms.

Two cultural features were identified and partially excavated during Phase II investigations (Pecora and Burks 2014). Back dirt from the previous excavation of Feature 1 and Feature 2 was removed to expose the partially excavated features. One 1- by 1-m unit was added to the boundaries of Feature 1 in order to expose the entire feature. No additional excavation units were required to completely expose Feature 2. Each feature was documented in planview, plotted geospatially, and photographed. Features were bisected along the long axis, then excavated in stratigraphic levels. Features were excavated using trowels, with strata breaks cleaned and examined before proceeding into the next stratum. The soil matrix removed was screened through 6-mm mesh hardware cloth and all artifacts were collected separately, by strata. Multiple soil samples were collected from each feature for special analysis, including samples for macrobotanical remains, phytoliths, starch grains, lipid residues, and soil chemistry. Excavation was terminated 10 cm into archaeologically sterile subsoil. Data for each feature, including soil stratigraphy descriptions, fill descriptions, artifacts collected, and samples collected were recorded on Feature Forms.

2.5.7 Laboratory Methods

The artifact assemblage consists of chipped stone tools, debitage, and FCR. Initial processing of artifacts included washing and sorting according to provenience, artifact type, and raw material. Provenience was maintained throughout the process by utilizing the ArcheoLINK™ data management system, which in turn generated an inventory of materials recovered. Lithic classification criteria, terminology, and analysis protocols, as well as FCR analysis protocols, are outlined below.

Current approaches to the analysis of lithic artifacts include a study of the procedures utilized by prehistoric knappers to make tools. The term used to describe this process is referred to as *chaîne opératoire* or reduction strategy (Sellet 1993). The production of any class of stone tools involves a process that must begin with the selection of suitable raw materials. Once the raw material is chosen, tool production, also called biface reduction, begins. Biface reduction can proceed along two different manufacturing trajectories: (1) reduction of a block of raw material, or (2) reduction of a flake blank. The categories used to describe biface reduction follow those proposed by Bradley and Sampson (1986), Callahan (1979), and Newcomer (1971).

Biface reduction involving a block of raw material, known as a core, begins with the detachment of flakes with cortical (natural) surfaces. Direct percussion flaking takes place at this stage, and usually involves a hard hammer (e.g., a quartzite cobble) that more effectively transmits the force of the blow through the outer surface. Next, a suitable flake is chosen for production of a biface. After removal of a series of debitage creates suitable striking platforms, the knapper begins the thinning and shaping stage of the flake/biface. The majority of the thinning and shaping is done with a soft hammer (e.g., an antler) and consists of marginal flaking. The pieces detached tend to be invasive, extending into the midsection of the biface. A later stage of thinning may follow, which consists of further platform preparation and the detachment of invasive flakes that progressively straighten profiles in order to obtain a flattened cross-section. By the end of this stage, the biface has achieved a lenticular or bi-convex cross-section. Finally, the tool's edge is prepared by a combination of fine percussion work and pressure flaking. It should be noted that flakes created as a byproduct of biface reduction are sometimes, themselves, selected for tool manufacture.

Biface reduction utilizing a flake blank, begins with the selection of a suitable flake blank. A flake blank is a relatively thin, sharp-edged flake that has been struck from a core (using the method described in the paragraph above). Flakes, in their original form, can be utilized as blades or crude tools, or they can be set aside as blanks, to be retouched later into tools/bifaces. The advantages of utilizing a flake blank for biface reduction include the following: (1) flakes are generally lightweight and can be more easily transported in larger numbers than cores; and (2) producing flake blanks to be used for later biface reduction allows the knapper to assess the quality of the material, thus avoiding transport of low-grade cores. Biface reduction on a flake blank involves the preparation of the edges in order to create platforms for the thinning and shaping stages that follow. The initial series of flakes detached from a flake blank may or may not bear cortex. However, they will display portions of the original dorsal or ventral surfaces of the flake from which they were struck. The subsequent reduction stages then follow those described for biface reduction involving a block of raw material/core (above), except that a flake blank often needs additional thinning at the proximal or bulbar end of the piece in order to reduce the pronounced swelling.

Prehistoric artifacts were sorted by artifact type based on standard references. Specific descriptive terminology for projectile points is based on Cambron and Hulse (1964) and Justice (1987). Debitage categories are based upon classification schemes currently used by both Old and New World prehistorians (Bordes 1961; Frison 1974; Tixier et al. 1980). The terminology presented below has been applied to the classification of prehistoric artifacts recovered from site 33PK347.

Lithic Analysis

The first level of analysis involves separating tools, debitage, cores, and FCR. Raw material type is recorded for all artifacts. Tools are further subdivided into subclasses including: bifaces/biface blanks, projectile points, scrapers, and other tools. All characteristics of the tools are described in detail.

Debitage is subdivided into classes that more specifically identify the reduction sequence to which they belong. The list below presents each of the debitage classes.

Class 1 - Initial Reduction Flake
Class 2 - Flake (Unspecified Reduction Sequence)
Class 3 - Biface Initial Reduction Flake
Class 4 - Biface Thinning Flake
Class 5 - Biface Finishing Flake
Class 6 - Chip
Class 7 - Flake Fragment
Class 8 - Angular Shatter
Class 9 - Microdebitage
Class 10 - Janus Flake

Cores often are difficult to describe as they represent blocks of raw material that have been flaked and discarded. Unless refitting is attempted, it is impossible to study the initial stages of reduction as only the final stages, immediately prior to abandonment, can be described. Thus, only a small portion of the reduction sequence, as evidenced by the remaining flake scars on a discarded core, are available for analysis.

FCR is classified according to raw material and the presence of evidence of thermal alteration.

Terminology Related to Chipped Stone Tool Classification

Tool: The ultimate product of knapping is the production of a tool. A tool is any flake that has been modified by secondary retouch. The term is used to separate those artifacts that are retouched debitage or unretouched pieces. Unretouched pieces may well have functioned as tools (unretouched flakes with good cutting edges are effective for skinning and butchery) but this is difficult to determine without microwear analysis.

Biface: A biface is any retouched tool, partially completed or finished, which has been flaked by percussion or exhibits pressure flaking over both of its surfaces.

Retouch: This term refers to the modification of a flake into a tool. Retouch can take the form of invasive bifacially detached flakes on a projectile point, or of tiny flakes on the edge of an end scraper. Retouch also may be caused unintentionally, by utilization. Utilization retouch typically is discontinuous along an edge. Retouch can be morphologically quite varied and the terms presented below describe the various types and positions of retouch. The description of retouch morphology on any given tool can, and often does, involve a combination of the terms discussed below.

> **Bifacial retouch:** Bifacial retouch is created when modification occurs on two opposing surfaces along the same edge of the tool.
>
> **Direct retouch:** Direct retouch occurs on the dorsal (exterior) surface of a flake.
>
> **Inverse retouch:** Inverse retouch occurs on the ventral (interior) surface of a flake.
>
> **Invasive retouch:** Invasive retouch generally is elongated and covers a large portion of the tool. Most often, this type of retouch occurs on bifaces or projectile points and can be the result of percussion or pressure flaking.
>
> **Semi-abrupt retouch:** This retouch type has a semi-abrupt inclination when the angle of the created edge is roughly 45 degrees (Tixier et al. 1980:89). The angle is measured from the chipped surface to the dorsal or ventral surface of the flake blank. Semi-abrupt retouch often is seen on end scrapers.
>
> **Short retouch:** Retouch that is short and produces small debitage such as those produced when manufacturing tools such as end scrapers.

Fine retouch: Fine retouch is characterized by small short flake removals that do not drastically modify the edge of a flake. Often, fine retouch is the result of utilization.

Retouched flake or piece: This category of retouched tool consists of flakes, or badly broken artifacts, which have limited amounts of retouch and are not standardized tool types. The retouch on these artifacts is highly varied in type, inclination, and position.

Core: A core is a block of raw material, other than a biface blank, from which flakes have been detached.

Terminology Related to Chipped Stone Debitage Classification

Debitage: The term debitage is used by archaeologists to describe flakes that have not been made into tools.

Angular Shatter: All angular or blocky waste resulting from stone toolmaking activities that are not otherwise diagnostic of the process.

Biface Initial Reduction Flakes: This debitage, a direct result of the biface reduction process, is typically thick, has cortex on part of the dorsal surfaces, and has large plain or simply faceted butts. Relatively few dorsal scars are present, but these may show removal from the opposite edge of the biface.

Biface Thinning Flakes: This debitage, produced during the biface reduction process, results from shaping the biface or reducing its thickness. These flakes generally lack cortex, are relatively thin, and have narrow, faceted butts, multidirectional dorsal scars, and curved profiles. Thinning flakes typically are produced by percussion flaking.

Biface Finishing Flakes: This debitage, a direct result of the biface reduction process, is produced during the preparation of the edge of the tool. It is similar in some respects to biface thinning flakes, but is generally smaller and thinner and can be indistinguishable from tiny flakes resulting from other processes such as platform preparation. Biface finishing flakes may be detached by either percussion or pressure flaking.

Broken Flake Fragments or Flake Shatter: During biface manufacture, the force of the hammer often results in the breaking of the flake into one or more pieces. The result is proximal, medial, or distal fragments of debitage that are not angular, and often show previous flake removal scars on their dorsal surface. These characteristics distinguish flake shatter from angular shatter. Flake shatter is a common component of percussion debitage but can occur at any time in the knapping process.

Chip: This term describes tiny flakes (less than 1 cm in length) that are detached during any stage of the tool manufacturing process.

Flake: A flake is a product of tool manufacture that has a one-to-one length/width ratio (Bordes 1961). In this report, two separate categories of flakes are discussed and the first is for those flakes to which a specific reduction sequence cannot be assigned (Class 2; Unspecified Reduction Sequence). It is impossible to tell whether these flakes have been detached during simple core reduction or during biface manufacture. The second category are those flakes that can be assigned to a specific reduction sequence, including initial reduction (Class 1), a flake fragment (Class 7), or a Janus flake (Class 10).

Flake Blank: When a flake is detached from a block of raw material, it may be regarded as 1) waste, 2) utilized without modification, or 3) used as a blank to be retouched into a tool.

Initial Reduction Flake: This flake type is typically thick, has cortex on the majority of its dorsal surfaces, and has a large plain or simply faceted butt. There are relatively few dorsal scars. Initial reduction flakes may show removals from the opposite edge of the biface.

Janus Flake: This flake type is produced during the initial reduction of a flake blank (Tixier et al. 1980). The removal of a flake from the ventral surface of a larger flake results in a flake with a dorsal surface that is completely or partially composed of the ventral surface of the larger flake blank.

Marginal and Nonmarginal Flaking: These terms denote two techniques of delivering the force of a hammer to detach a flake from a core or biface (Bradley and Sampson 1986). Marginal flaking involves the delivery of the blow of the percussor close to the edge of the piece being flaked. As the blow is close to the edge of the striking platform, the resulting flake has a small, narrow butt. Nonmarginal flaking involves the delivery of the blow at a point some distance from the edge of the flaked piece. Debitage detached in this manner often have large, wide butts.

Microdebitage: Microdebitage is small (less than 0.5 cm in length) debitage that is the result of platform abrasion or retouch (incidental and intentional). This debitage class often is not recovered at archaeological sites due to sampling bias; however, this debitage class can be produced in great quantities during the manufacturing process.

Percussion and Pressure Flaking: Percussion flaking involves the use of a hammer to strike a piece of chert in order to detach a flake. This hammer can be made of a relatively hard material, such as a quartzite hammerstone, or it can be made of a softer organic material, such as a deer antler tine. Direct percussion is a flaking technique that involves the delivery of the blow directly onto the striking platform, while indirect percussion utilizes an intermediary or punch. Pressure flaking, as suggested by the name, involves the chipping of stone by pressure.

Platform abrasion: When the blow of the percussor is aimed close to the edge of the piece being flaked (marginal flaking), it is necessary to prepare and strengthen that edge. The edge usually is prepared by abrasion, which entails rubbing the striking platform area with a hammerstone and detaching a series of chips from the surface where the flake will be removed. Evidence of platform abrasion usually is visible on biface thinning flakes at the intersection between the butt and dorsal surface.

Unspecified Reduction Flake: These flakes cannot be attributed to a specific reduction sequence and often have unidirectional or opposed dorsal scar patterns and some cortical surface. It is impossible to discern if this debitage class is the result of core or of bifacial reduction.

2.5.8 Specialized Sample Analysis Methods

A number of special analyses were conducted to aid in the interpretation of site 33PK347 deposits and provide answers to the research domains, described above. These special analyses consist of radiocarbon dating, geomorphology and geoarchaeology, soil chemistry, dendrochronology, paleoethnobotany, starch grains, phytoliths, lipid residues, and FCR refit. The methods used to perform each type of analysis are described below. Results of the analyses are reported in Chapter 5.0; detailed reports are included as appendices.

Radiocarbon Dating

Accelerator mass spectrometry (AMS) radiocarbon dating was conducted by Beta Analytic, Inc., Miami, Florida. Radiocarbon dating is a technique used to provide an approximate date of utilization of the features from which samples were collected. No charcoal was recovered during excavations of what remained of partially excavated Features 1 and 2; therefore, charred material for radiocarbon dating was extracted from the flotation-processed paleoethnobotanical soil samples. Four charcoal samples were submitted for AMS radiocarbon dating, including (1) pine (*Pinus* sp.) wood from Feature 1, (2) burned tree sap from Feature 1, (3) oak (*Quercus* sp.) wood from Feature 2, and (4) black walnut (*Juglans nigra*) nutshell from Feature 2. The full report, from Beta Analytic, Inc., is included in Appendix G; however, the following section provides a brief summary of the methods utilized.

All samples were pretreated using a series of acid/alkali/acid baths. This pretreatment is necessary to eliminate secondary carbon components that can contribute problems, such as the old wood effect, burnt intrusive roots, bioturbation, secondary depositions, secondary biogenic activity incorporating recent carbon (bacteria), and the analysis of multiple components of differing age. Samples were crushed/dispersed in deionized water and then given hot hydrochloric acid (HCl) washes to eliminate carbonates, and alkali washes in sodium hydroxide (NaOH) to remove secondary organic acids. A final acid rinse followed to neutralize the solution prior to drying.

The samples were radiocarbon dated using the AMS technique, which provides more precise dates and requires smaller quantities of charred material than conventional radiometric methods. AMS radiocarbon dating results are derived using a tandem electrostatic accelerator to count carbon 14 (^{14}C) atoms. Pretreated samples are converted into graphite, which is then put through a series of focusing devices in the tandem accelerator. Finally, the ^{14}C atoms are counted and each sample is calibrated, using the INTCAL13™ database, for radiocarbon age.

Geomorphology and Geoarchaeology

Geomorphological and geoarchaeological analyses, conducted by Nathan Scholl of Gray & Pape, were utilized to provide information regarding soil stratigraphy and integrity at site 33PK347. The full report can be found in Appendix D. During Phase III data recovery, soils data was recorded for all excavated STs and Units, including stratum depths, Munsell colors, textures, and inclusions. One profile wall was mapped and photographed for all excavated units. Soil column samples submitted for the analysis included two hand-excavated soil core extractions at a location immediately adjacent to Feature 1 (Core 1), and at a location that was noncultural (Core 2, control sample). The soil cores were extracted using an AMS® 6- by 30-cm Split Soil Core Sampler with Core Tip Signature Series attached to an AMS® Signature Slide Hammer. Two 30-cm long plastic liners were filled for each core sample. This 60 cm depth went into archaeologically sterile subsoil.

In conjunction with the archaeological field investigations, a geomorphological study was performed on the landform on which site 33PK347 is located, as well as on other landforms and contexts across the PORTS area. The geomorphological analysis of site 33PK347 investigated during this Phase III excavation employed the use of soils maps, aerial color and infrared photographs, observations of excavation profiles, and hand driven soil cores from the landform on which site 33PK347 is located. Soils maps, as accessed on Web Soil Survey (2015), were used for their ability to provide base-line interpretation of the composition and depositional history of landforms. Field data were used to ground truth the information gleaned from the soils maps. Descriptions of these profiles followed set standards in accordance with USDA (United States Department of Agriculture) terminology discussed in the *Soil Survey Manual* (Soil Survey Division Staff 1993). Such descriptions were done in the field or a lab setting while still in field-moistened condition and included: soil horizon, Munsell color, texture, mottling, soil structure, ped coatings, sedimentary structure and bedding characteristics, moisture content, boundary type, effervescence, and inclusions, such as organic material or artifacts. These descriptions were done in accordance to the observed master horizons (with suitable subdivisions), noting any possible lithologic discontinuities (Stafford 2004; Stafford and Creasman 2002).

While unit excavations provided information on the surface soil horizons, the soil coring was used to provide information on the underlying deposits to a depth of refusal, where bedrock or another rocky surface was encountered. Two soil core testing locations were selected, one adjacent to Feature 1 (Core 1) and one control sample (Core 2, approximately 8 m north northwest of Core 1) in order to compare cultural and noncultural profiles. The information provided by the cores helped to better inform the landform's depositional history below the level of the archaeological excavations.

Soil Chemistry

Soil chemistry analysis was conducted by Spectrum Analytic, Inc. and Nathan Scholl, of Gray & Pape, to provide information regarding taphonomy and cultural markers within activity areas of site 33PK347. The full report can be found in Appendix E. During archaeological field investigations, three soil samples were taken from (1) Feature 1 fill, (2) Feature 2 fill, and (3) a control sample. The control sample was taken from a soil column in a noncultural context: Block 11, Unit 71. All samples were taken using a trowel that was cleaned with water, and dried, between samples. Approximately 250 milliliters (ml) of soil was collected from each context at the same depth below surface (5–10 cm) and placed in zip-top polypropylene bags. The samples were submitted to Spectrum Analytic, Inc., for their S3 analysis, which includes quantification of soil pH (potential of Hydrogen), organic matter, cation exchange capacity (CEC), percent base saturation of cation elements, cation element ratios, available phosphorus, potassium, magnesium, calcium, sulfur, boron, copper, iron, manganese, and zinc. Results were sent to Nathan Scholl for interpretation.

In the laboratory of Spectrum Analytic, Inc., all samples were placed in cardboard containers, then dried in a forced air-drying room at 49ºC for 24 hours. Samples were ground and screened to pass a 14-mesh screen in a flail grinder® (Custom Laboratory Equipment, Inc.). Samples were processed using a variety of techniques.

Soil pH: Soil pH is determined on a volume basis. A 5-milliliter (ml) soil spoon is used to measure each sample. To each measured sample, 5.0 ml of deionized water is delivered with an automatic dispensette, which is checked daily for accuracy. For each batch of 40 samples, one in-house check sample is measured and carried throughout the entire analytical procedure. The pH meters are calibrated to three decimal places daily using commercial buffer solutions of pH's 7.00 and 4.01. Fresh buffers are used daily, and new buffers are purchased before the expiration date marked on each solution. New electrodes are checked for proper millivolt readings before each use. The pH 7.00 buffer should read 0+ 10 millivolts (mV), and the 4.01 buffer should read 177+ 10 mV. The electrode cannot be used if these requirements are not met, or the five in-house check samples are within +0.1 pH unit of the established values. At the beginning of each batch of 40 samples, an in-house check sample is checked. If the check sample is within + 0.1 pH unit of the established value, the samples are analyzed. The check sample is again checked at the end of each batch of 40 samples and both results are recorded daily.

Soil Buffer pH: Buffer pH is conducted on the same samples that were used for the pH determination if the pH was found to be 6.4 or below. To these samples, 5 ml of Modified SMP (Shoemaker-McLean-Pratt) buffer solution (Sikora 2006) is added using an automatic dispenser, then sets for 45 minutes. The pH of the samples is run again, along with the in-house check samples. The results of the check sample must agree with the established values within +0.1 unit. The results for the check samples are recorded daily.

Organic Matter: A 1-ml soil spoon is used to measure each soil sample into crucibles that are in groups of 40 samples. An assumed weight of 1.2 gram (g) per scoop is used in the calculations for organic matter. The samples are weighed and then ashed for 2 hours at 360ºC. After cooling, the samples are reweighed and the percent weight loss with ashing is entered into the regression equation for percent organic matter. An in-house check sample is included with each batch of 40 samples. The check sample results must agree with the established values + 0.3 percent for the batch to be analyzed. The results for the check samples are recorded daily. A visual check for any gross errors by an experienced operator is completed.

Available Nutrients (Mehlich III Extractant): A 1-ml soil spoon is used to measure each sample into plastic extraction bottles. A check sample is measured and carried through the run with each batch of 40 samples. Each sample is extracted with 10 ml of Mehlich III extraction solution (0.2N CH3COOH [acetic acid] + 0.25N NH4NO3 [ammonium nitrate] + 0.013N HNO3 [nitric acid] + 0.015N NH4F [ammonium fluoride] + 0.001M EDTA [ethylenediaminetetraacetic acid]), added using an automatic dispenser. The samples are shaken for five minutes and then filtered into plastic tubes. The samples are analyzed using Thermo Jarrel Ash TJA 61E® ICP-AES (inductively coupled plasma atomic emission spectroscopy). The instrument is calibrated after every 60 samples and a check sample is analyzed with every 40 samples. The check samples must agree within +10 percent of the established values or the instrument is recalibrated and the samples reanalyzed. The check sample results are recorded daily. Results are reported in parts per million (ppm).

Available Micronutrients: A 0.5-g soil sample was prepared with 10 ml nitric acid extracting solution. After digestion, 10 ml of water is added and the samples mixed. The samples are then run in the TJA 61E® ICP-AES for micronutrient quantification in ppm.

Dendrochronology

Dendrochronology was utilized to provide insight into the age of the forest surrounding site 33PK347, precipitation history, possible fire events, and any other growth stressors that may have taken place during its existence. Tree ring analysis was completed by Karen Leone and Marcia Vehling, of Gray & Pape. The full report can be found in Appendix F. During archaeological field investigations, four live tree cores were taken from (1) a median-sized oak (*Quercus* sp.) located within the boundaries of site 33PK347, (2) a large oak located within site boundaries, (3) a large oak located in the drainage area north of the site, and (4) a large shagbark hickory (*Carya ovata*) located in the drainage area south of site 33PK347. Sample 1 was taken at a height of 96 cm above surface, Sample 2 was taken at a height of 115 cm above surface, Sample 3 was taken at a height of 111 cm above surface, and Sample 4 was taken at a height of 118 cm above surface. Cores were taken using a Haglöf® 3-Thread Increment Borer 30.5 cm in length, with core diameter of 4.3 mm. Core length included outer cambium and bark layer and went beyond the tree's central pith, thus ensuring growth ring history of the lifetime of the tree in one core.

In the laboratory, cores were sanded lightly, first with medium-course general purpose sandpaper and then with extra-fine wet/dry sandpaper. After sanding, the cores were coated with linseed oil. Sanding, then oiling, the cores allows for clearer visibility of growth rings. Growth rings were analyzed using low microscopic magnification (Leica® EZ4D 13X to 56X binocular microscope). Growth rings were counted and patterns in the ring widths of each sample were compared to each other for environmental markers. Official records of precipitation kept by the National Oceanic and Atmospheric Administration (NOAA) were consulted for comparable environmental markers.

Paleoethnobotanical Analysis

Paleoethnobotanical analysis was conducted by Karen Leone, of Gray & Pape, in an attempt to gain insight into subsistence practices, environmental reconstruction, seasonality of occupation, and feature function. The full report is included as Appendix G; however, the following section provides a brief summary of the methods utilized.

A soil sample was collected from Feature 1 and Feature 2. The two samples were floatation-processed (using a Flote-Tech® Model A system) individually, to separate organics (light fraction) from the soil component (heavy fraction). Using low magnification (Leica® EZ4D 13X to 56X binocular microscope), all charred botanical material greater than 1.4 mm was sorted into general plant categories, such as wood and nutshell. Charred botanical material less than 1.4 mm in size was scanned for seeds and fragile plant remains, such as acorn nutshell and squash rind. All categories were weighed (to an accuracy level of 0.001 g), counted, and identified to the lowest possible taxonomic level. With each soil sample, a representative selection (20 pieces) of wood charcoal specimens were randomly chosen and taxonomically classified. The carbonized plant material recovered through flotation is a small and inherently biased sample (due to differential conditions of deposition, preservation, and recovery); however, it is likely that the recovered plant remains represent those most used and burned as a result of spillage, intentional thermal activity, or general refuse burning.

Starch Grain Analysis

Starch grain analysis was conducted by Ruth Dickau, of HD Analytical Solutions, Inc. The analysis was conducted to provide evidence regarding the function of the FCR-filled pits identified as Feature 1 and Feature 2. A sample of FCR from Feature 1 and Feature 2 was submitted for analysis. The full report is in Appendix H.

Starch analysis methods were based on published protocols. From each sample provided, the largest fragment of FCR was selected and placed in a beaker using sterilized tongs. The FCR fragments were covered with distilled water, and 2 ml of sodium hexametaphosphate ($[NaPO_3]_6$) was added to promote deflocculation of any existing clays. The artifacts were sonicated for five minutes and then gently brushed with a sterilized toothbrush to facilitate dispersal of adhering sediment. The FCR was then further sonicated for another five minutes. The resulting sediment was concentrated through centrifuge cycles of 2,500 revolutions per minute (rpm) for five minutes, and the water decanted from the pellet. Ten milliliters of sodium polytungstate ($Na_6[H_2W_{12}O_{40}]$) heavy liquid, prepared to a density of 1.75 grams per cubic centimeter (g/cm^3), was added to the residue pellet. The samples were mixed thoroughly to float any existing starch grains. After centrifuging at 2,500 rpm for five minutes, floating material was pipetted from the surface of the sample and deposited into a sterile centrifuge tube. The extracted material was rinsed several times with distilled water, and mounted in a 10 percent glycerin solution for microscope viewing. Slides were analyzed using a transmitted-light microscope equipped with polarization and digital imaging camera.

Modern starch is encountered during food preparation and can be transported by air, water, or on surfaces, such as clothing and skin. It is used commercially and industrially in numerous consumer products, including cosmetics, adhesives, and powdered detergents. For this reason, modern contamination is a concern when analyzing ancient starch, and a number of lab protocols were implemented to mitigate and control this threat.

1. Food is prohibited in the lab. Modern reference plant material is prepared and stored off site.
2. All glassware and equipment was sterilized under pressure for 30 minutes, handled with sterilized tongs, and stored in sealed, sterilized, plastic bins until needed. All consumables, such as paper towel and chemicals, were tested for starch presence. Only distilled water was used throughout testing and analysis.
3. Three blank microscope slides were placed at various locations around the lab and left for seven days prior to and during extraction to test for airborne starch contamination. Three drops of 10 percent glycerin solution were pipetted onto the slide at the end of the trial period, and covered with a coverslip. The slides were then examined for starch. All three slides, from the work bench, microscope table, and inside the fume hood, tested negative for starch.

4. The FCR samples were left sealed in bags until analysis. They were handled using only sterilized forceps or tongs during processing to prevent contamination. Samples were sealed or covered at all times, when not being actively processed.
5. A blank control sample was run alongside the two archaeological samples, undergoing all the same processes with the same equipment and same chemicals. This control sample tested negative for starch.

Phytolith Analysis

Phytolith analysis was conducted by Ruth Dickau, of HD Analytical Solutions, Inc. The analysis was conducted to provide evidence regarding the function of the FCR-filled pits identified as Feature 1 and Feature 2. Sediments around the FCR of Feature 1 and Feature 2 were submitted for analysis, along with a control sediment sample from Block 11, Unit 71. The full report is in Appendix H.

Phytolith extraction from the sediment samples submitted for analysis from site 33PK347 followed standard protocols. The bulk sediment samples were first pretreated to remove clays through deflocculation, agitation, and gravity sedimentation. One hundred grams of sediment from each sample was mixed with 750 ml warm water and 5 ml (NaPO3)6 and placed on an orbital shaker for 8 hours. This solution was poured into beakers and water added to make one liter. Clay particles were removed by repeated cycles of gravity sedimentation: silt and sand settled out for one hour, water containing the clay fraction was decanted, water was added to make one liter and mixed with the remaining sediment, which settled for another hour. After eight cycles, and the water was nearly clear, samples underwent a final decanting and then 4 ml of sediment was placed in a centrifuge tube. Twenty milliliters of 36 percent hydrochloric acid (HCl) was added to remove carbonates. When no reaction was observed, after 10 minutes, samples were rinsed three times. Samples were then treated with 70 percent nitric acid (HNO3) and placed in a hot water bath for four hours, to oxidize organic material. In the final 30 minutes, approximately 2 ml of potassium chlorate (KClO3) was added in small amounts to complete the oxidation reaction. After four cycles of rinsing, 10 ml of Na6(H2W12O40) heavy liquid solution prepared to a density of 2.37 g/cm^3 was added to the pellet and mixed to float phytoliths from the sediment. Samples were centrifuged at 2,500 rpm for 5 minutes and floating material pipetted into a new centrifuge tube. Extracted material was rinsed four times and then dried using acetone. Extracted material was mixed with Permount® mounting medium and mounted on microscope slides. This mounting medium permits rotation and 3-D viewing of phytoliths, which is important in identification.

A significant amount of mineral residue floated out during the first extraction of the samples and impeded visibility of phytoliths; therefore, a second extraction was conducted. The sediment and Na6(H2W12O40) heavy liquid solution remaining from the first extraction (approximately 5 ml) were remixed and centrifuged at 2,500 rpm for 5 minutes. All the remaining Na6(H2W12O40) heavy liquid solution was decanted into a new centrifuge tube. Extracted material was rinsed four times and dried using acetone, and then mounted on microscope slides, as described above.

Slides were scanned using a transmitted light microscope equipped with digital imaging. A minimum of 250 phytoliths were counted for statistical frequency of morphotypes, then the rest of the sample was scanned for diagnostic phytoliths of economic species, such as maize, squash, and any new morphotypes not seen during the statistical count. Identifications were made using comparative material and published sources.

Lipid Residue Analysis

Lipid residue analysis was conducted by Benjamin Stern, of the University of Bradford, Great Britain. Lipid (fatty acid) residue analysis was performed on soils that surrounded FCR from Feature 1 and Feature 2. Additionally, a control soil sample from Block 11, Unit 71, was analyzed. Lipid residue analysis was utilized to learn more about feature function. The technique of combined gas chromatography-mass spectrometry (GC-MS) was used for lipid residue analysis of the samples. In general terms, the mass spectrometer ionizes molecules, then identifies the ions according to their mass-to-charge (m/z) ratio, resulting in the generation of a mass spectrum (ion abundance against the m/z value) (University of Bradford 2014). The full report is in Appendix I.

Sample Preparation

Three soil samples were subsampled for analysis: Control soil, Feature 1 soil, and Feature 2 soil. From each soil sample, a 4-g subsample was taken using a solvent cleaned metal spatula. The soils were prepared using an extraction solvent of approximately 4 ml of dichloromethane:methanol, 2:1 ratio by volume, with ultrasonication for 5 minutes. After transferring the supernatants into test tubes, centrifugation (5 minutes, 2,000 rpm, approximately 650 relative centrifugal force [g]) was used to separate any remaining material. Excess N,O-bis (trimethylsilyl) trifluoroacetamide with one percent trimethylchlorosilane was added, to derivatise the samples to methyl esters, which were then heated at 70°C for one hour. Excess derivatizing agent was removed under a stream of nitrogen. The samples were diluted in dichloromethane for analysis by GC-MS. A method blank (to which no archaeological material was added) was prepared and analyzed alongside the two archaeological soil samples and one control sample, to evaluate background contamination.

Instrumentation

Analysis was carried out by combined GC-MS, using an Agilent 7890A Series® GC connected to an 5975C Inert XL® mass selective detector. The splitless injector and interface were maintained at 300°C and 340°C, respectively. Helium was the carrier gas at constant flow. The temperature of the oven was programmed from 50°C (2 minutes) to 350°C (10 minutes) at 10°C/minute. The GC was fitted with a 30-m by 0.25-mm, 0.25-micrometer (µm) film thickness Agilent® HP-5MS (5 percent phenyl-methylpolysiloxane) phase fused silica column. The column was directly inserted into the ion source where electron impact/ionization spectra were obtained at 70 eV (electron volt) with full scan from m/z 50 to 800.

Lipids are a heterogeneous group of molecules that are more resistant to water leaching and degradation than proteins. Lipid analysis can identify materials, such as pine and fir resins, bitumen, waxes, fats, and oils (sometimes separating animal from plant). Characterization of organic residues relies upon the principles of chemotaxonomy, where the presence of a specific compound or distribution of compounds in an unknown sample is matched to known quantities in modern samples. The use of such biomarkers is not without its challenges since many compounds are widely distributed in a range of natural substances. Additionally, degradation of archaeological samples is a problem, in that residue composition can change significantly during burial (University of Bradford 2014).

FCR Refit Analysis

FCR refit analysis was conducted by Melissa R. Lavender, of Gray & Pape. Fire-cracked rock collected during Phase II and Phase III investigations were subjected to refit analysis. Evaluating relationships between pieces of FCR recovered from both within and outside of feature contexts can provide insight into the potential cleaning, reuse, and disturbance of features. The full report is in Appendix J.

To begin the process of refitting, the FCR pieces recovered during Phase II testing were assigned Field Specimen (FS) numbers, ranging from 0501 to 0577, based on provenience. If two or more pieces of FCR came from the same provenience, they would have the same FS number. The FCR pieces recovered during Phase III investigations already had FS numbers that were assigned during the routine laboratory artifact analysis process; these numbers ranged from 0002 to 0096.

With the exception of pieces deemed too small, too eroded/deteriorated, or otherwise unsuitable to be effectively refitted, each piece of FCR from the Phase II and Phase III investigations was labeled with its corresponding FS number using ink pen on a layer of archival adhesive. Of the 4,599 pieces of FCR that were cataloged, a total of 2,082 pieces were labeled suitable for refit analysis; this number included 1,487 from Phase II investigations and 595 from Phase III investigations.

After labeling, the FCR was spread out on tables and roughly sorted according to similarities, taking into account variations in color, texture, and type/condition of any cortex present. The FCR specimens were examined, and sometimes placed into subgroups for comparison; for example, all specimens that exhibited obvious banding were set aside and considered as a subgroup. Specimens were rearranged as more details were observed, and were placed next to other pieces of similar material, which also had a similar shape and/or size to see if a match could be made. Matches, which can be two or more pieces, were assigned Refit Group numbers and recorded in a Refit Log.

2.5.9 Curation

The DOE is examining a variety of options for the long-term storage and curation of artifacts recovered at PORTS. All materials deemed suitable for curation will be curated at a facility that meets the federal standards (36 CFR 79: *Curation of Federally Owned and Administered Archaeological Collections*) for the curation of archaeological artifacts, such as the Ohio Historical Connection.

3.0 RESULTS OF THE FIELD INVESTIGATIONS

This chapter presents the results of the Phase III field investigations, as well as summaries of the results from the Phase I and Phase II investigations. Results of analyses of artifacts and samples collected during excavations will be discussed in subsequent chapters.

3.1 Results of the Phase I Investigations

Site 33PK347 was first documented by OVAI during a Phase I archaeological survey that involved systematic shovel testing on a 15-m grid (Pecora 2013a). Shovel tests measured 50 cm square and extended to no more than 30 cm below surface. During the Phase I survey, 12 prehistoric artifacts were recovered from 10 positive STs. These artifacts included a biface tip (n=1), chipped stone debitage (n=10), and FCR (n=1). Site 33PK347 was identified as a low density lithic scatter and the artifact assemblage represented a late stage lithic reduction trajectory that differed from other lithic scatter sites recorded within the wider survey area at PORTS (Pecora 2013a).

Additionally, aerial photographs taken in 1938, 1939, and 1951 show that site 33PK347 was located in a large wooded area, suggesting the possibility that the site had never been plowed. Because the site contained FCR and the possibility existed that it was unplowed, the conclusions derived from the Phase I survey were that site 33PK347 had the potential to contain intact archaeological features. Therefore, it was recommended that a Phase II survey be conducted to assess the potential for inclusion of site 33PK347 in the NRHP (Pecora 2013a).

3.2 Results of the Phase II Investigations

The Phase II investigations at site 33PK347 were also conducted by OVAI, and included geophysical surveys to identify archaeological features. Following the geophysical surveys, 197 STs were excavated on a 5-m grid across site 33PK347 to refine the site boundaries and to identify artifact concentrations. The final phase of testing consisted of the excavation of 30.5 1- by 1-m units, to explore anomalies identified by the geophysical surveys and STs (Pecora and Burks 2014:46–47). The Phase II investigations recovered 3,826 artifacts, including FCR (n=3,723), chipped stone debitage (n=95), and stone tools (n=8). The artifact assemblage was dominated (97.3 percent) by FCR. Pecora and Burks (2014:58) indicate that nearly all lithic debitage in the artifact assemblage is characterized as primary reduction debris. The eight stone tools recovered included a pitted stone (n=1), a nodule/blank (n=1), nodule cores (n=2), and biface fragments (n=4) that included a projectile point associated with the Late Prehistoric/Fort Ancient period (circa A.D. 1000–1200) and a projectile point associated with the Late Archaic period (circa 3000–1000 B.C.) (Pecora and Burks 2014: 60–62).

The artifact distribution from the ST data was interpreted as showing small and tightly defined artifact concentrations across site 33PK347. Given the small size of the artifact concentrations identified, it was suggested that not all of the extant features and artifact concentrations had been identified (Pecora and Burks 2014:257).

The geophysical surveys detected a number of magnetic anomalies; 27 were identified as potential archaeological features. Ten anomalies (2, 6, 10, 11, 13, 19, 22, 23, 25, and 27) were selected for further investigation. This selection was made solely on the magnetic signature; ground truthing of anomalies (looking for cultural material in soil cores taken from the center of each anomaly) could not be performed due to excessively hard soils encountered during drought conditions that year. Two of the 10 investigated anomalies (11 and 25) proved to be cultural features (Feature 1 and Feature 2, respectively), described as broad, shallow, flat-bottomed pits filled with FCR. Portions of both features were excavated to document their profile shapes and sample their contents. Charcoal from Feature 1 provided a radiocarbon date of A.D. 1260–1290 (2-sigma, calibrated), placing it in the Late Prehistoric/Fort Ancient period (Pecora and Burks 2014). Of the eight remaining anomalies, the source of seven of them could not be determined and no cultural features were identified. The eighth anomaly was a piece of metal rebar.

Two large soil samples were collected from Feature 1 and from Feature 2 and analyzed for paleoethnobotanical remains. A low density of charred wood was the only plant material recovered from the Features (Leone 2014). No nuts or seeds were recovered to indicate that the occupants had used this location to harvest upland food resources.

Pecora and Burks (2014:67) identified four overlapping data clusters that included all three data classes: FCR, lithic artifacts, and high magnetic susceptibility values. However, the function of these clusters was not apparent. The low artifact density and shallow, spatially discreet, thermal features were interpreted to reflect short-term occupations (at least several days).

Pecora and Burks (2014:256) acknowledged that small upland archaeological sites in the greater Ohio River valley are rarely preserved and documented in an unplowed state, making site 33PK347 a significant cultural resource for providing an opportunity to study how Late Prehistoric/Fort Ancient populations utilized the uplands surrounding their floodplain-based communities. Site 33PK347 was recommended eligible for inclusion in the NRHP under Criterion D. In addition, several suggestions were made regarding any future archaeological work that might be conducted at site 33PK347, including (1) only hand-excavations be conducted (no mechanical stripping) so that shallow subsurface features be uncovered intact, (2) consider utilization of a magnetic susceptibility meter to assist in the identification of elusive anomalies, and (3) conduct additional shovel testing on a 5-m grid, offset by 2.5 m from the Phase II grid so that small concentrations of artifacts would not be missed.

3.3 Results of the Phase III Investigations

Phase III investigations were conducted according to a research design that was based on the information collected during Phase I and Phase II investigations. It focused on identifying and recovering data from activity areas, defined as cultural features and artifact concentrations. Phase III fieldwork included a three-staged approach: (1) utilization of magnetic susceptibility geophysical survey to identify and locate cultural features, (2) excavation of a series of STs on a 5-m grid, and (3) extensive hand-excavation of larger exploratory units and blocks in search of cultural features. These tasks were completed from July 21 to August 20, 2015 and are described in detail below.

3.3.1 Grid Establishment

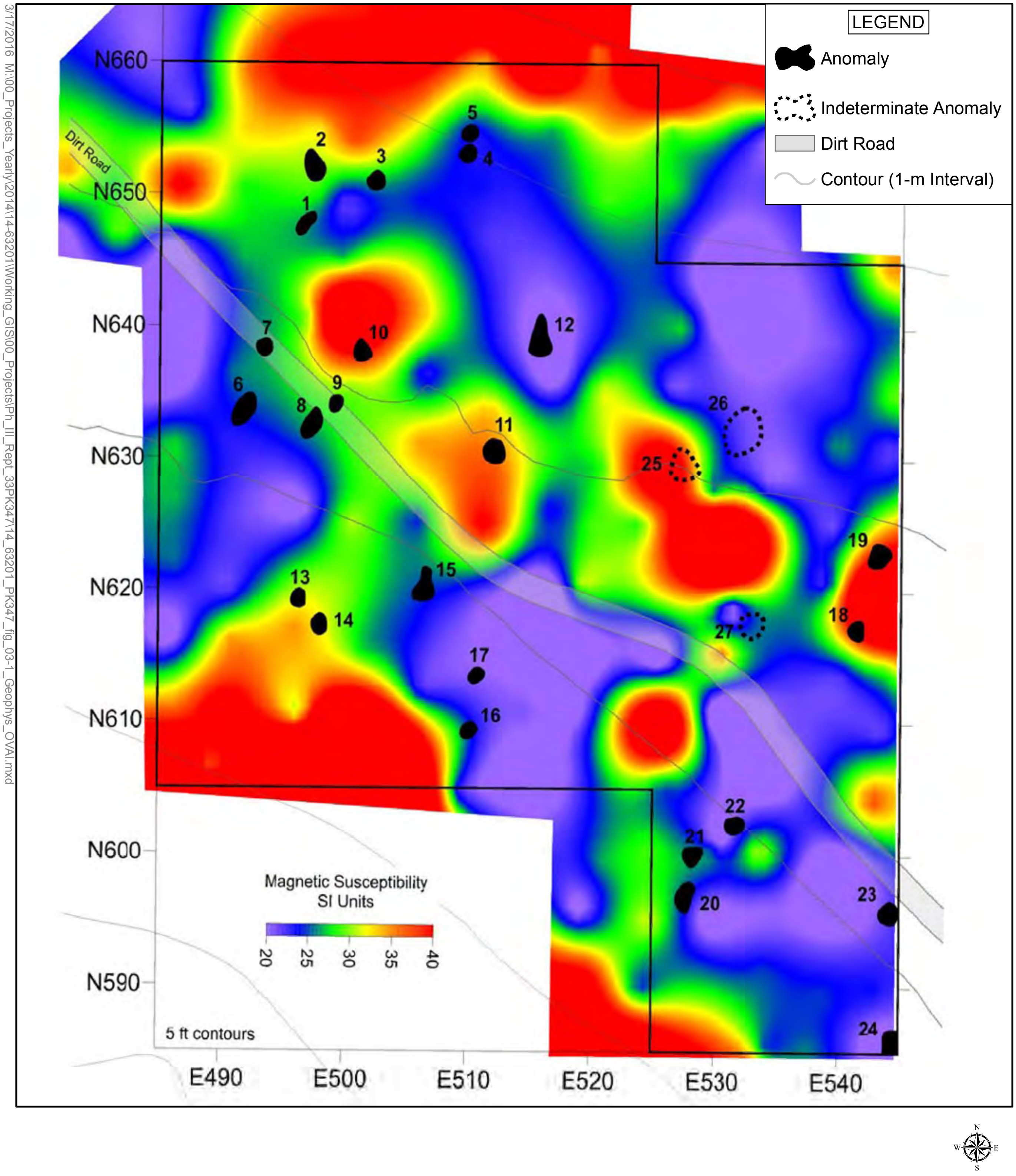
Before field investigations began, the 20-m grid set out during Phase II testing was reestablished. Two rebar datums (Datum 1 and Datum 2) and labeled wooden stakes were still in place and no additional steps were needed to reestablish the grid. Using the existing 20-m grid stakes and measuring tapes, a 10-m grid was laid out across site 33PK347. Two new datum stakes were set in locations more accommodating to the Phase III investigations. Datum GP01 was located at grid coordinate N645 E485 (UTM Zone 17, NAD 27 N 4322645.000 E 328485.000) and datum GP02 was located at grid coordinate N625 E515 (UTM Zone 17, NAD 27 N 4322624.654 E 328515.674). Elevations reported in this document, although taken from Datum GP01 or GP02 locations, were calibrated to the elevation of Datum 2, from the Phase II investigations.

3.3.2 Geophysical Survey

The first stage of the data recovery effort included a magnetic susceptibility geophysical survey over the entire site 33PK347. Geophysical surveys were utilized as a noninvasive technique to locate cultural features and/or activity areas. Soils and ferromagnetic substances that have high magnetic susceptibility react when they are in the presence of a magnetic field that, on archaeological sites, is the earth’s own magnetic field. This reaction is what is measured by the magnetic susceptibility meter.

During Phase II investigations, two geophysical surveys were conducted, including a magnetic gradient survey (using a Geoscan® Research FM256 fluxgate gradiometer) and a magnetic susceptibility survey (using a Bartington® MS2 magnetic susceptibility meter with an attached MS2D field loop) (Pecora and Burks 2014). Figure 3-1 shows the results of both Phase II geophysical surveys, including the anomalies identified during the magnetic gradient survey superimposed on the results of the magnetic susceptibility survey (Pecora and Burks 2014:60).

The Phase III geophysical survey consisted of a more fine-grained magnetic susceptibility survey than those conducted during Phase II testing. A Geonics® EM38 dual-coil/slingram magnetic susceptibility meter was chosen because of its ability to detect magnetic susceptibility readings in the soil, to a maximum depth of 80 cm. The single-coil/coincident loop instrument used for the Phase II investigations, provided readings to a maximum depth of 15 cm. Readings during the Phase II survey were taken at 10-m grid points. The fine-grained Phase III magnetic susceptibility survey provided readings that were more than five times deeper and 20 times more tightly spaced than readings taken during Phase II investigations. The purpose of the more fine-grained survey was to relocate and better define previously identified anomalies and features, as well as to identify new anomalies, if present.



Results from the Phase II Magnetic susceptibility survey, including anomalies identified for testing based on magnetic gradient survey data (Pecora and Burks 2014).

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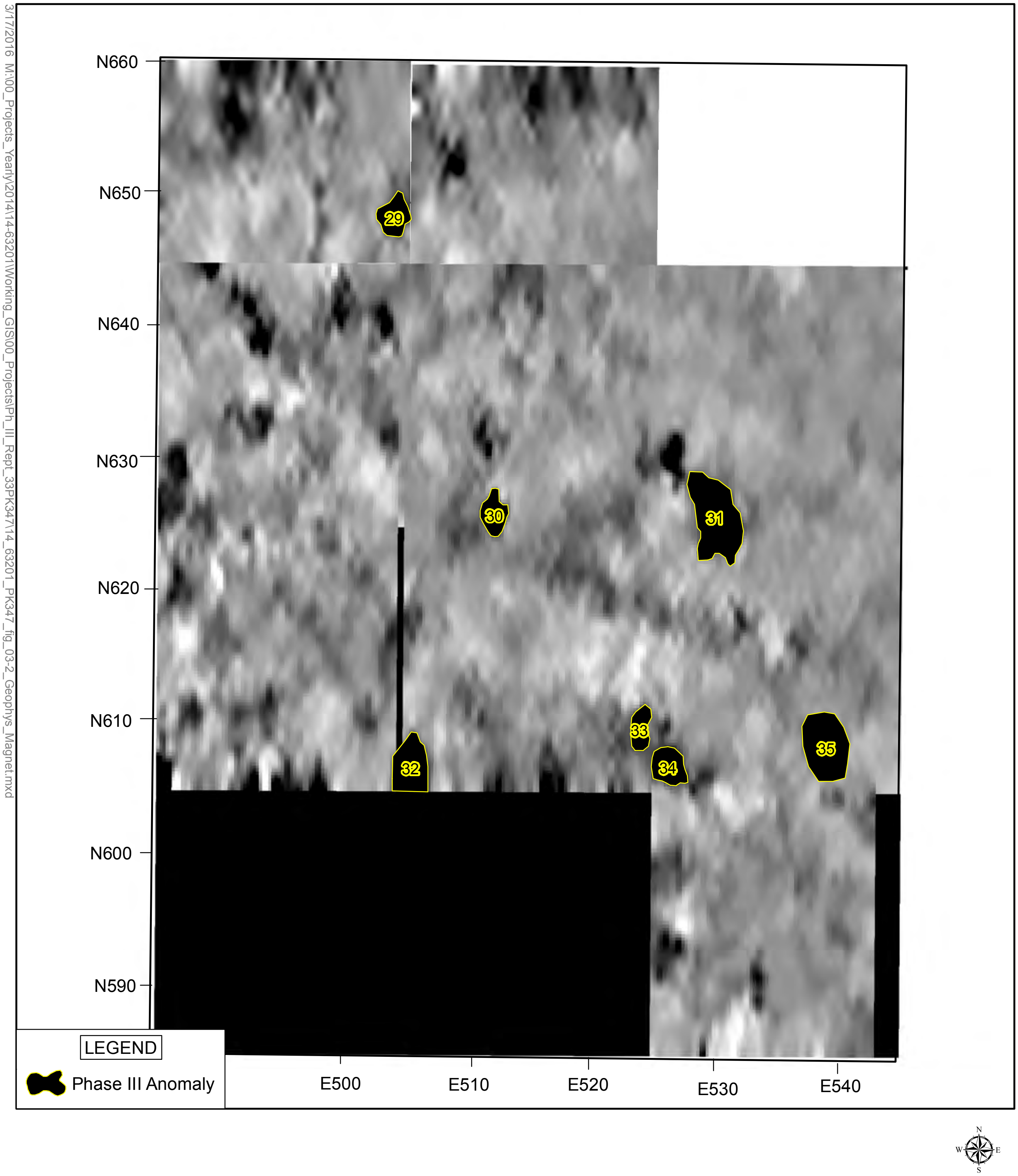
Figure 3-1

The area where site 33PK347 is located was found to be naturally highly magnetic, likely due to the high iron content of the bedrock (Hendershot 1990). Despite these challenges, the magnetic susceptibility survey identified seven new targets of interest (in addition to those previously identified during the Phase II survey), which possessed the potential to be cultural features (Figure 3-2). The Phase II anomalies were numbered sequentially (Anomalies 1–27). The newly targeted Phase III sequence of anomalies skipped one numeral and were numbered Anomalies 29–35. The data collected from both the Phase II and Phase III geophysical surveys was combined and used to target identified anomalies and features for excavation (Figure 3-3).

Twenty-seven anomalies (Anomalies 1–27) were identified by the Phase II geophysical surveys (Figure 3-1). Ten anomalies were investigated (two were cultural features), leaving 17 anomalies uninvestigated. Seven new anomalies (Anomalies 29–35) were identified during the Phase III magnetic susceptibility survey (Figure 3-2), providing a combined total of 24 uninvestigated anomalies. Figure 3-3 illustrates the Phase II and Phase III comprehensive geophysical survey results map that was utilized for Phase III investigations. Based on geophysical data from the Phase II and Phase III surveys, excavation plans included: (1) excavate all 24 uninvestigated anomalies; (2) complete excavations of Features 1 and 2, which were partially excavated during Phase II investigations; and (3) determine the location of Anomaly 10 that, in the Phase II report, was mapped at one location (N638.07 E501.27) but its artifacts were reported at a different location (N637.5 E511) (Pecora and Burks 2014). In total, the location of 25 anomalies and 2 features were targeted for investigation.

The field investigations revealed all targets to be natural features, such as rodent burrows, tree root concentrations, and non-cultural rock concentrations, with the exception of one anomaly that proved to be a modern metal pail. No new cultural features were identified based on the Phase III magnetic susceptibility survey data. This is not an uncommon occurrence, as natural features often emulate the variables of cultural features in geophysical data. Given the geographic setting and lack of identification of additional cultural features during Phase III excavations, it is unlikely that any substantial cultural features went undetected.



Results from the Phase III magnetic susceptibility survey.

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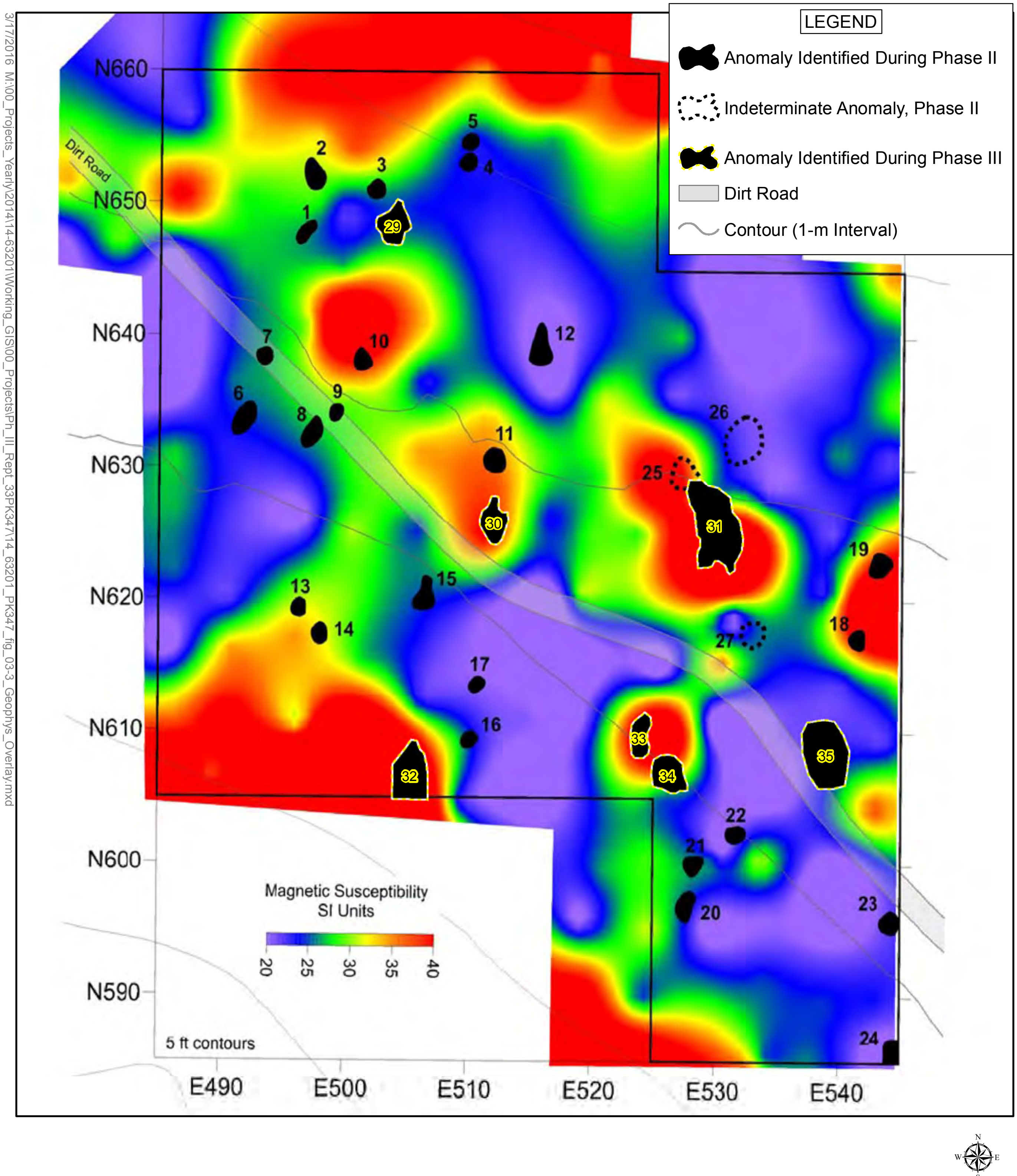
Figure 3-2



Phase II and Phase III comprehensive geophysical survey results.

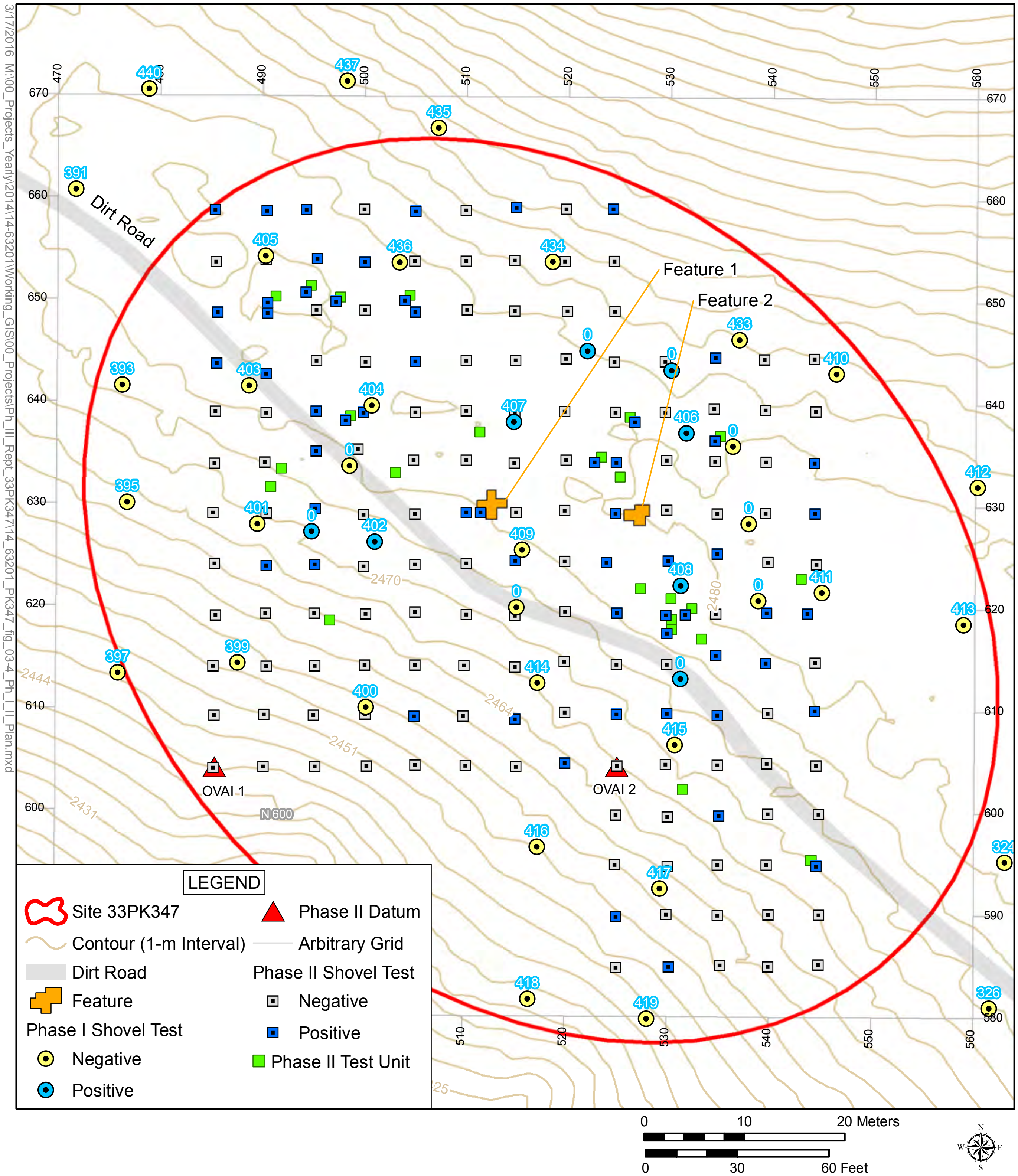
3.3.3 Results of Excavations

Shovel Tests

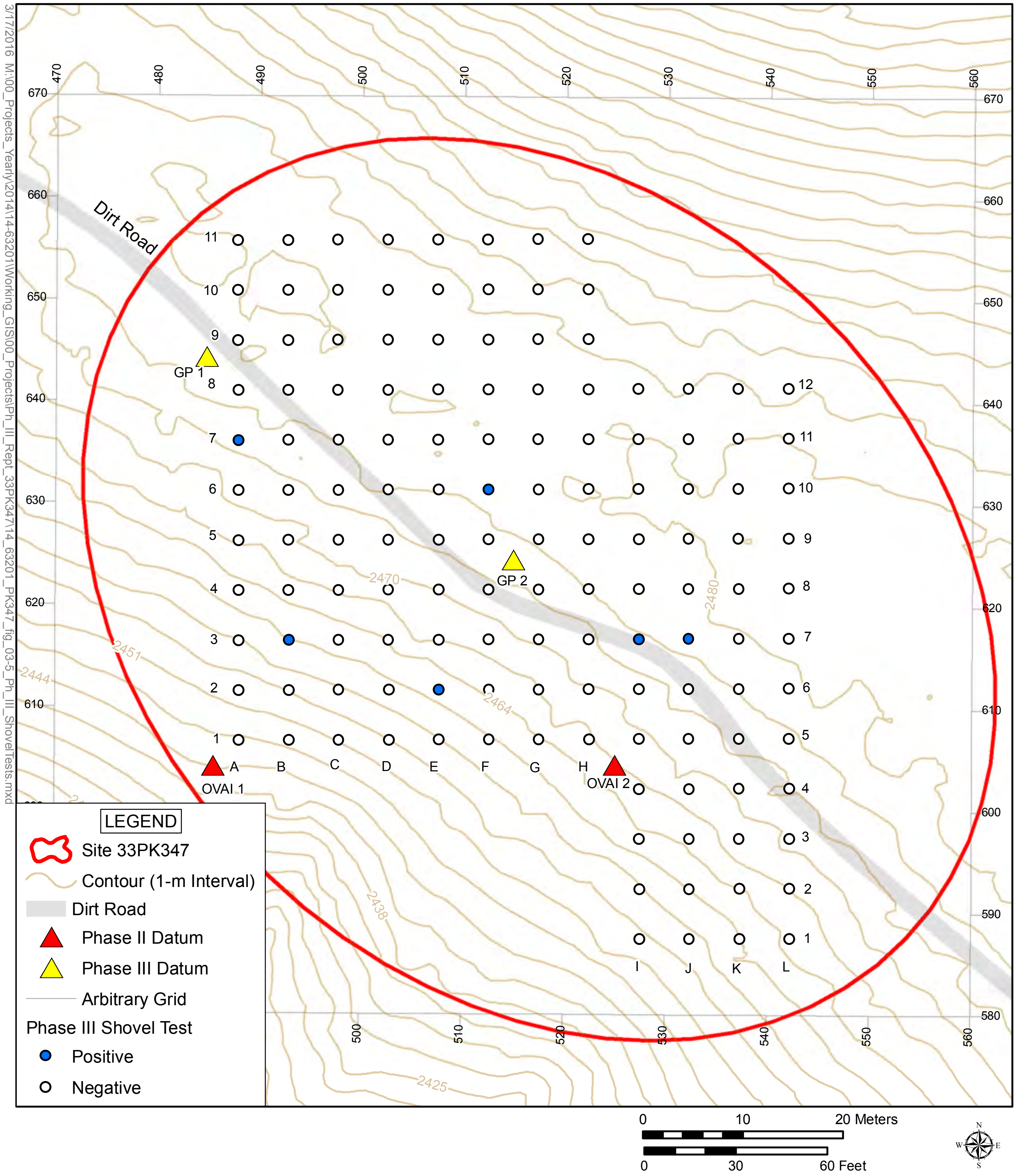
In the second stage of the data recovery effort, shovel testing was conducted across site 33PK347 at 5-m intervals. This 5-m grid was offset 2.5 m north and east of the Phase II 5-m ST grid. Shovel testing was restricted to within the boundaries of site 33PK347, established during the Phase II investigations (Figure 3-4). Twelve transects (A through L) were placed across site 33PK347, west-to-east, with no more than 12 STs in each transect. Shovel tests on each of transects A through H were labeled 1 through 11 (south-to-north), while STs on each of transects I through L were labeled 1 through 12 (Figure 3-5). A total of 136 STs were excavated. Each ST measured 50 cm square and was excavated to a depth of 10 cm into sterile subsoil. The ST fill was screened through 6-mm mesh hardware cloth, from which all artifacts were collected.

Phase III ST excavations accounted for 34 m² of excavated area. Five STs (A7, B3, F6, I7, and J7) were positive for artifacts. A total of six artifacts were recovered from the positive STs, including three pieces of FCR (ST B3 and ST F6), two pieces of chipped stone debitage (ST I7 and ST J7), and a biface tool (ST A7) (Figure 3-5).

Two distinct soil strata were observed in the STs: Stratum I and Stratum II. Soils observed in STs consisted of brown (10YR 5/3) to brownish yellow (10YR 6/6) silt loam (Stratum I) over yellowish brown (10YR 5/6) to brownish yellow (10YR 6/6) silt loam or silty clay loam subsoil (Stratum II). The maximum depths of Stratum I ranged from 12–30 cm below surface. Shovel tests were dug 10 cm into culturally sterile subsoil (Stratum II). All artifacts recovered from STs came from Stratum I.



Phase I and Phase II shovel tests and excavation units at Site 33PK347.



Phase III shovel tests conducted at Site 33PK347.

Hand-Excavated Blocks

The third stage of the data recovery effort, included the hand excavation of up to 30 2- by 2-m blocks located over anomalies and features, as indicated by the geophysical survey results. An additional 50 1- by 1-m excavation units were reserved for expanded investigation of artifact concentrations encountered during shovel testing, and for expansion of the 2- by 2-m blocks, as deemed necessary. All blocks were excavated in 1- by 1-m units, regardless of their size or configuration.

The low number of positive STs (n=5) and low count of artifacts recovered during shovel testing (n=6) provided no evidence of artifact concentrations. Therefore, none of the 50 1- by 1-m excavation units held in reserve were utilized to expand on ST investigations.

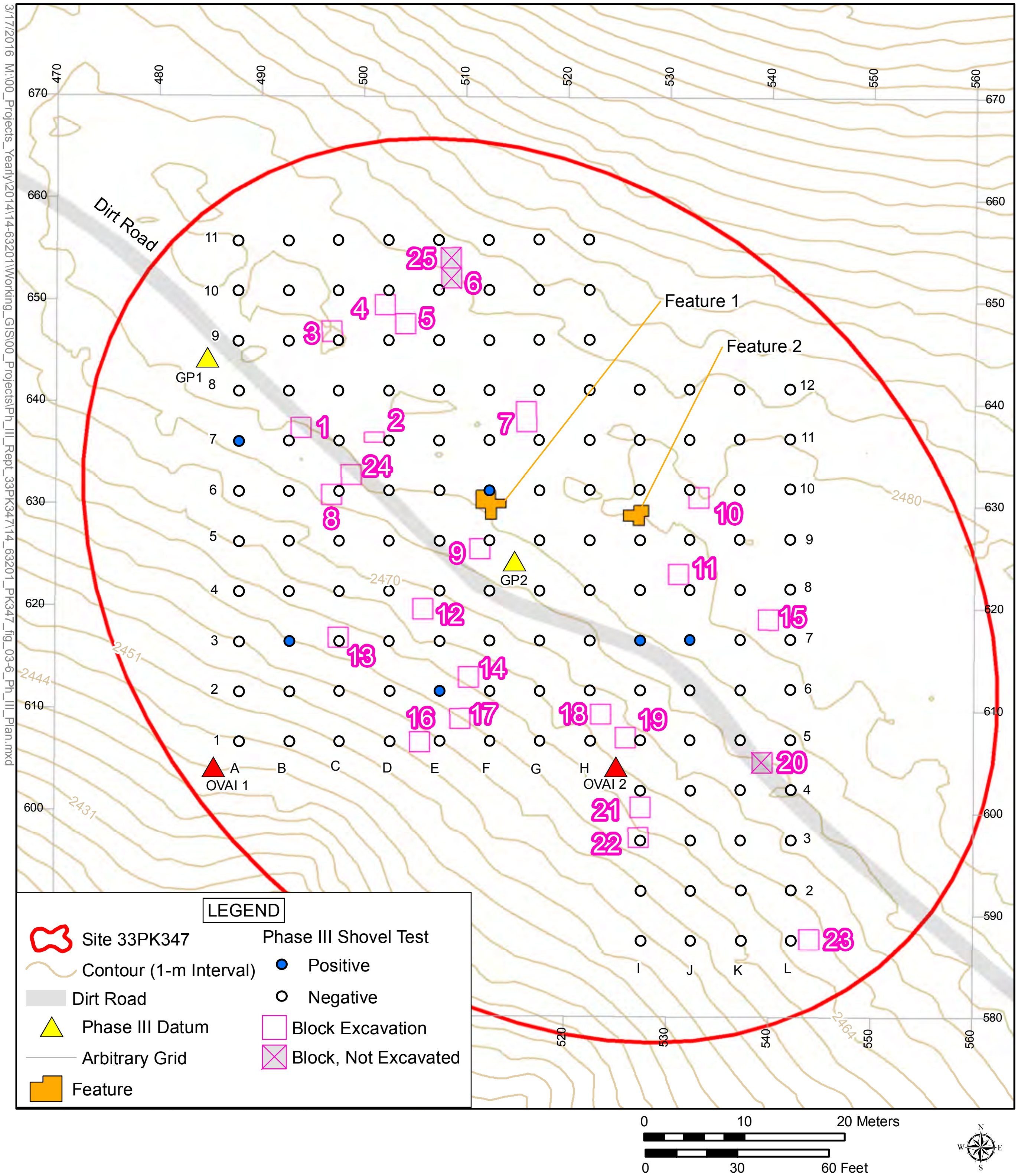
Based on geophysical data from the Phase II and Phase III surveys, excavation plans included: (1) excavation of all 24 uninvestigated anomalies; (2) complete excavations of Features 1 and 2, which were partially excavated during Phase II investigations; and (3) determine the location of Anomaly 10 that, in the Phase II report, was mapped at one location (N638.07 E501.27) but its artifacts were reported at a different location (N637.5 E511) (Pecora and Burks 2014). In total, the location of 25 anomalies and 2 features were targeted for block excavations.

At the outset, a 2- by 2-m block (four 1- by 1-m units) was placed over the center point of each of the 25 anomalies (Blocks 1–25). This block size provided a large enough investigation area to ensure discovery of the anomaly, with the intention to expand the block, as needed, in order to define anomaly boundaries. Before excavations began, unit numbers were assigned to each block, depending on the potential size of each anomaly. Many of the assigned unit numbers were not used/excavated; therefore, unit numbers are not all in consecutive order. The majority (n=21) of anomalies were identified within the initial 2- by 2-m block. Of the remaining four blocks, one block was expanded and three blocks were not excavated. All anomalies were identified as noncultural, with the exception of Anomaly 30 (Block 9) that was a modern metal pail.

Feature 1 and Feature 2 were reopened and excavations were completed. Two additional 1- by 1-m units were added to Feature 1 and one additional 1- by 1-m unit was added to Feature 2 to better define feature boundaries. Specialized samples were taken from both features that might aid in interpretation of functionality.

A total area of 97.5 m^2 was excavated during investigation of 25 anomalies (Blocks 1–25) and two features (Feature 1 and Feature 2). No new cultural features were identified during the Phase III investigations. Table 3-1 provides a list of all 25 Blocks and 2 Features, their associated anomaly number, assigned unit numbers, area excavated, and a brief interpretation of results. Figure 3-6 provides a map of the location of all Blocks, Features, and STs investigated at site 33PK347 during Phase III investigations. Below, is a detailed description of the investigations of all blocks and features.

Table 3-1. Blocks and Features Investigated During Phase III Data Recovery				
Block	**Anomaly**	**Unit Numbers**	**Area Excavated (m^2)**	**Interpretation**
1	7	1, 2, 3, 4	4.0	noncultural; root concentration
2	10	5, 6	2.0	noncultural; re-located previously excavated Anomaly 10
3	1	9, 10, 11, 12	4.0	noncultural; root concentration and rock
4	3	13, 14, 15, 16	4.0	noncultural; root concentration and animal burrow
5	29	17, 18, 20, 21	4.0	noncultural; root concentration
6	4	-	0	not excavated; safety hazard
7	12	35, 36, 37, 38, 41, 42	6.0	noncultural; animal burrow
8	8	39, 40, 43, 44	4.0	noncultural; root concentration and rock
9	30	55, 56, 57, 58	4.0	modern metal pail
10	26	64, 65, 67, 68	4.0	noncultural; root concentration and rock
11	31	71, 72, 75, 76	4.0	noncultural; rock concentration
12	15	88, 89, 90,91	4.0	noncultural; tree stump
13	14	94, 95, 96, 97	4.0	noncultural; rock concentration
14	17	98, 99, 100, 101	4.0	noncultural; root concentration and rock
15	18	102, 103, 104, 105	4.0	noncultural; root concentration
16	32	107, 108, 111, 112	4.0	noncultural; root concentration and rock
17	16	118, 119, 120,121	4.0	noncultural; animal burrow
18	33	125, 126, 130, 131	4.0	noncultural; root concentration and rock
19	34	148, 149, 152, 153	4.0	noncultural; rock concentration
20	35	-	0	not excavated; disturbed context
21	21	164, 165, 166, 167	4.0	noncultural; root concentration and rock
22	20	170, 171, 172, 173	4.0	noncultural; root concentration
23	24	174, 175, 176, 177	4.0	noncultural; tree stump
24	9	45, 46, 49, 50	4.0	noncultural; large rock and tree stump
25	5	-	0	not excavated; safety hazard
Feature 1	11	22 + 5 Ph II units	6.0	FCR-filled pit
Feature 2	25	3.5 Ph II units	3.5	FCR-filled pit
Total			**97.5**	



Phase III shovel tests and excavation units investigated at Site 33PK347.

Block 1

Block 1 (Units 1, 2, 3, and 4) was excavated over Anomaly 7 (Figures 3-6 and 3-7). Block 1 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 7 was identified at coordinates N638.33 E493.56 during the Phase II geophysical survey. Anomaly 7 was centrally located within Block 1, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.45 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 7 was identified at 20 cm below datum (cmbd) in Units 1, 2, 3, and 4, and was determined to be a dense cluster of tree roots. Within this 2- by 2-m excavation block, ground surface elevations ranged from 0 cmbd in the center of Unit 2, to 10 cmbd at the southwest corner of Unit 1. All units were excavated to a depth of 40 cmbd (30 cm below surface).

Figure 3-7. North and west wall profiles of Block 1, Anomaly 7.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silty clay. The majority of cultural materials in Block 1 were collected from Stratum I at depths of up to 30 cmbd. One piece of debitage and one piece of FCR were recovered from the top of Stratum II, at 32 cmbd.

Artifact Assemblage

A total of 132 artifacts were recovered from Block 1, including 17 pieces of chipped stone debitage and 115 fragments (2.76 kilograms [kg]) of FCR (Table 3-2). The artifact assemblage consists primarily (87 percent) of sandstone FCR.

Table 3-2. Artifact Assemblage from Block 1

Class	Type	Material	Total
Debitage	Class 2 - Flake (Unspecified Reduction Sequence)	Unidentified Chert	1
		Local Pebble Chert	1
		Paoli Chert	1
		Upper Mercer	1
	Class 4 - Biface Thinning Flake	Unidentified Chert	2
		Paoli Chert	1
	Class 7 - Flake Fragment	Unidentified Chert	8
		Paoli Chert	2
Debitage Total			**17**
Fire-cracked Rock		Sandstone	115
Artifact Total			**132**

The chipped stone debitage assemblage from Block 1 is comprised of Class 2 flakes from an unspecified stage of the reduction sequence (n=4), Class 4 biface thinning flakes (n=3), and Class 7 flake fragments (n=10). Although the assemblage is small, the presence of biface thinning flakes suggests that later stages of reduction or tool maintenance were taking place at site 33PK347.

Table 3-3 presents the frequency and percentage of chipped stone debitage by raw material type and class. Unidentified chert is the most common raw material in the debitage assemblage, accounting for 65 percent (n=11) of the recovered specimens. Of the identified chert types, Paoli is the most prevalent (n=4). Other material types include Upper Mercer (n=1), and local pebble chert (n=1). Overall, the raw materials present in Block 1 indicate a strategy of concentrated exploitation of higher quality local materials with a lesser reliance on lower-quality materials.

Table 3-3. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 1

Raw Material	Class											
	1	2	3	4	5	6	7	8	9	10	Total	Percent (%)
Unidentified Chert	-	1	-	2	-	-	8	-	-	-	**11**	**65**
Paoli Chert	-	1	-	1	-	-	2	-	-	-	**4**	**23**
Local Pebble Chert	-	1	-	-	-	-	-	-	-	-	**1**	**6**
Upper Mercer Chert	-	1	-	-	-	-	-	-	-	-	**1**	**6**
Total Count	**-**	**4**	**-**	**3**	**-**	**-**	**10**	**-**	**-**	**-**	**17**	
Percent (%)	**-**	**23**	**-**	**1**	**-**	**-**	**59**	**-**	**-**	**-**		**100**

Block 2

Block 2 (Units 5 and 6) was excavated over Anomaly 10 (Figures 3-6 and 3-8). Block 2 covered a 2- by 1-m area and consisted of two 1- by 1-m units. Initially, a four-unit block (Units 5, 6, 7, and 8) was placed at the location mapped for excavation of Anomaly 10 during Phase II investigations (N638.07 E501.27). This relocation of Anomaly 10 was conducted to clear up a Phase II report discrepancy where the artifact inventory listed Anomaly 10 at a different location (N637.5 E511) (Pecora and Burks 2014). The Phase II excavation units were relocated at the mapped location after Units 5 and 6 were excavated. Excavation of Block 2 was then terminated; Units 7 and 8 were not excavated. During Phase II investigations, Anomaly 10 was determined to be noncultural. Anomaly 10 was centrally located within Block 2 with a vertical control datum line set at 10 cm above the ground surface (elevation 1.37 m). The previous Anomaly 10 excavation unit was identified at 21 cmbd in Units 5 and 6. Ground surface elevations within Units 5 and 6, ranged from 6 cmbd in the center of Unit 6 to 11 cmbd at the southwest corner of Unit 5. All units were excavated to a depth of 21 cmbd (11 cm below ground surface).

Figure 3-8. North wall profile of Block 2, Anomaly 10.

The soil profile consisted of two distinct strata. Stratum I was a brownish yellow (10YR 6/6) silt loam that was at least 11 cm thick. Since excavations were terminated upon relocation of the previous excavation unit for Anomaly 10, Phase III excavations were not taken into the subsoil (Stratum II). All artifacts were recovered from Stratum I, 6–21 cmbd.

Artifact Assemblage
A total of three artifacts were recovered from Block 2, including two pieces of chipped stone debitage and eight pieces (18 g) of sandstone FCR (Table 3-4).

Table 3-4. Artifact Assemblage from Block 2			
Class	**Type**	**Material**	**Total**
Debitage	Class 4 - Biface Thinning Flake	Unidentified Chert	1
		Breathitt Chert	1
Debitage Total			**2**
Fire-cracked Rock		Sandstone	8
Artifact Total			**10**

The chipped stone debitage assemblage from Block 2 is comprised exclusively of Class 4 biface thinning flakes (n=2). Although the assemblage is small, the presence of biface thinning flakes suggests that later stages of reduction or tool maintenance were taking place at site 33PK347.

Table 3-5 presents the frequency and percentage of chipped stone debitage by raw material type and class. Raw material types include Breathitt chert (n=1) and an unidentified chert (n=1).

Table 3-5. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 2												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Unidentified Chert	-	-	-	1	-	-	-	-	-	-	**1**	**50**
Breathitt Chert	-	-	-	1	-	-	-	-	-	-	**1**	**50**
Total Count	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	
Percent (%)	**-**	**-**	**-**	**100**	**-**	**-**	**-**	**-**	**-**	**-**		**100**

Block 3

Block 3 (Units 9, 10, 11, and 12) was excavated over Anomaly 1 (Figures 3-6 and 3-9). Block 3 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 1 was identified at coordinates N647.74 E496.69 during the Phase II geophysical survey. Anomaly 1 was centrally located within Block 3, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.16 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 1 was identified at 20 cmbd in Units 9, 10, 11, and 12, and was determined to be a dense cluster of tree roots and unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 6 cmbd in the northeast corner of Unit 11 to 16 cmbd in the northeast corner of Unit 12. All units were excavated to a depth of 40 cmbd (30 cm below surface).

Figure 3-9. East and south wall profiles of Block 3, Anomaly 1.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silty clay. All artifacts were recovered from Stratum I.

Artifact Assemblage
A total of 10 artifacts were recovered from Block 3, including 3 pieces of chipped stone debitage and 7 pieces (0.2 kg) of FCR (Table 3-6). The artifact assemblage consists primarily (70 percent) of sandstone FCR.

Table 3-6. Artifact Assemblage from Block 3			
Class	**Type**	**Material**	**Total**
Debitage	Class 2 - Flake (Unspecified Reduction Sequence)	Brassfield Chert	1
	Class 4 - Biface Thinning Flake	Paoli Chert	1
	Class 7 - Flake Fragment	Unidentified Chert	1
Debitage Total			**3**
Fire-cracked Rock		Sandstone	7
Artifact Total			**10**

The chipped stone debitage assemblage from Block 3 is comprised of Class 2 flakes from an unspecified stage of the reduction sequence (n=1), a Class 4 biface thinning flake (n=1), and a Class 7 flake fragment (n=1). Although the assemblage is small, the presence of a biface thinning flake may suggest that later stages of reduction or tool maintenance were taking place at site 33PK347.

Table 3-7 presents the frequency and percentage of chipped stone debitage by raw material type and class. Raw materials in the debitage assemblage consist of Paoli chert (n=1), Brassfield chert (n=1), and unidentified chert (n=1).

Table 3-7. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 3												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Unidentified Chert	-	-	-	-	-	-	1	-	-	-	**1**	**33.4**
Paoli Chert	-	-	-	1	-	-	-	-	-	-	**1**	**33.3**
Brassfield Chert	-	1	-	-	-	-	-	-	-	-	**1**	**33.3**
Total Count	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	
Percent (%)	**-**	**33.3%**	**-**	**33.3%**	**-**	**-**	**33.4%**	**-**	**-**	**-**		**100**

Block 4

Block 4 (Units 13, 14, 15, and 16) was excavated over Anomaly 3 (Figures 3-6 and 3-10). Block 4 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 3 was identified at coordinates N651.01 E502.32 during the Phase II geophysical survey. Anomaly 3 was centrally located within Block 4, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.83 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 3 was identified at 20 cmbd in Units 13, 14, 15, and 16, and was determined to be a dense cluster of tree roots and an animal burrow. Within this 2- by 2-m excavation block, ground surface elevations ranged from 8 cmbd in the southeast corner of Unit 13 to 35 cmbd in the northeast corner of Unit 16. All units were excavated to a depth of 35 cmbd (25 cm below surface).

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 15 cm thick. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam. All artifacts were recovered from Stratum I.

Figure 3-10. South wall profile of Block 4, Anomaly 3.

Artifact Assemblage
A total of three pieces of chipped stone debitage were recovered from Block 4 (Table 3-8). No FCR was recovered.

Table 3-8. Artifact Assemblage from Block 4			
Class	**Type**	**Material**	**Total**
Debitage	Class 1 - Initial Reduction Flake	Local Pebble Chert	1
	Class 2 - Flake (Unspecified Reduction Sequence)	Unidentified Chert	1
	Class 7 - Flake Fragment	Unidentified Chert	1
Debitage Total			**3**
Artifact Total			**3**

The chipped stone debitage assemblage from Block 4 is comprised of a Class 1 initial reduction flake (n=1), a Class 2 flake from an unspecified stage of the reduction sequence (n=1), and a Class 7 flake fragment (n=1). Although the assemblage is small, the presence of an initial reduction flake may suggest that some initial reduction of raw material was taking place at site 33PK347.

Table 3-9 presents the frequency and percentage of chipped stone debitage by raw material type and class. Raw materials in the debitage assemblage consist of unidentified chert (n=2) and local pebble chert (n=1).

Table 3-9. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 4												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Unidentified Chert	-	1	-	-	-	-	1	-	-	-	**2**	**67**
Local Pebble Chert	1	-	-	-	-	-	-	-	-	-	**1**	**33**
Total Count	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**3**	
Percent (%)	**33.4**	**33.3**	**-**	**-**	**-**	**-**	**33.3**	**-**	**-**	**-**		**100**

Block 5

Block 5 (Units 17, 18, 20, and 21) was excavated over Anomaly 29 (Figures 3-6; and 3-11). Block 5 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 29 was identified at coordinates N649.00 E504.50 during the Phase III geophysical survey. Anomaly 29 was centrally located within Block 5, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.99 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 29 was identified at 20 cmbd in Unit 17 and was determined to be a dense cluster of tree roots. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the southeast corner of Unit 17 to 35 cmbd in the northeast corner of Unit 21. All units were excavated to a depth of 40 cmbd (30 cm below surface).

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam. All artifacts were recovered from Stratum I.

Figure 3-11. South wall profile of Block 5, Anomaly 29.

Artifact Assemblage
A single artifact consisting of chipped stone debitage was recovered from Block 5 (Table 3-10). No FCR was recovered. The debitage consists of a Class 2 flake of an unspecified reduction sequence (n=1) made from an unidentified chert type.

Table 3-10. Artifact Assemblage from Block 5			
Class	**Type**	**Material**	**Total**
Debitage	Class 2 - Flake (Unspecified Reduction Sequence)	Unidentified Chert	1
Artifact Total			**1**

Block 6

Block 6 was placed over Anomaly 4 (Figure 3-6). Block 6 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 4 was identified at coordinates N653.10 E509.77 during the Phase II geophysical survey. Block 6 was located directly beneath a large, dead leaning tree and was not excavated due to safety concerns.

Block 7

Block 7 (Units 35, 36, 37, 38, 41, and 42) was excavated over Anomaly 12 (Figures 3-6 and 3-12). Block 7 initially covered a 2- by 2-m square area consisting of four 1- by 1-m units (Units 35, 36, 37, and 38) but was expanded to the west by two additional 1-by 1-m units (Units 41 and 42) to better define anomaly boundaries. Anomaly 12 was identified at coordinates N638.85 E515.65 during the Phase II geophysical survey. Anomaly 12 was centrally located within Block 7, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.34 m). Anomaly 12 was identified at 15 cmbd in all units and was determined to be an animal burrow. Within this 2- by 3-m excavation block, ground surface elevations ranged from 0 cmbd in the southwest corner of Unit 41 to 29 cmbd in the northeast corner of Unit 38. All units were excavated to a maximum depth of 36 cmbd (26 cm below surface). Excavations were terminated once Anomaly 12 was determined to be a rodent burrow.

The soil profile consisted of two distinct strata. Stratum I was a dark grayish brown (10YR 4/2) loam that was approximately 13 cm thick. Excavations were terminated at the interface of Stratum

I and Stratum II. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam. All artifacts were recovered from Stratum I.

Figure 3-12. South wall profile of Block 7, Anomaly 12.

Artifact Assemblage

One artifact was recovered from Block 7. The artifact assemblage consists of the distal fragment of a Stage 4 formed biface manufactured from Upper Mercer chert (Table 3-11). No chipped stone debitage or FCR was recovered. The presence of a biface fragment may suggest that some level of tool manufacturing was taking place at site 33PK347.

Table 3-11. Artifact Assemblage from Block 7

Class	Type	Material	Total
Chipped Stone Tool	Stage 4 - Formed Biface; Distal Fragment	Upper Mercer Chert	1
Artifact Total			**1**

Block 8

Block 8 (Units 39, 40, 43, and 44) was excavated over Anomaly 8 (Figures 3-6 and 3-13). Block 8 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 8 was identified at coordinates N632.71 E497.35 during the Phase II geophysical survey. Anomaly 8 was centrally located within Block 8, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.38 m) in order to facilitate measurements across the varying surface elevations of the Block. Anomaly 8 was identified at 28 cmbd in Units 39 and 40, and was determined to be a dense cluster of tree roots and unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 11 cmbd in the southeast corner of Unit 44 to 18 cmbd in the southwest corner of Unit 39. All units were excavated to a depth of 38 cmbd (28 cm below surface).

Figure 3-13. South and east wall profiles of Block 8, Anomaly 8.

The soil profile consisted of two distinct strata. Stratum I was a brownish yellow (10YR 6/6) silt loam that was approximately 18 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silty clay loam. All artifacts were recovered from Stratum I.

Artifact Assemblage
A total of 14 artifacts were recovered from Block 8, including 5 pieces of chipped stone debitage, 1 Adena Stemmed, Dickson Cluster projectile point, 1 core, and 7 pieces (0.5 kg) of sandstone FCR (Table 3-12; Figure 3-14, Figure 3-15). The projectile point was recovered from the surface of Unit 44 and, therefore, its integrity of location is poor.

Table 3-12. Artifact Assemblage from Block 8

Class	Type	Material	Total
Debitage	Class 1 - Initial Reduction Flake	Local Pebble Chert	1
	Class 2 - Flake (Unspecified Reduction Sequence)	Unidentified Chert	1
	Class 5 - Biface Finishing Flake	Unidentified Chert	1
	Class 8 - Angular Shatter	Unidentified Chert	2
Debitage Total			**5**
Projectile Point	Adena Stemmed; Dickson Cluster	Brush Creek Chert	1
Core		Columbus Chert	1
Fire-cracked Rock		Sandstone	7
Artifact Total			**14**

Figure 3-14. Adena Stemmed, Dickson Cluster projectile point, Block 8.

Figure 3-15. Core from Block 8.

Table 3-13 presents the frequency and percentage of chipped stone debitage by raw material type and class. The chipped stone debitage assemblage from Block 8 is comprised of a Class 1 initial reduction flake (n=1), a Class 2 flake from an unspecified reduction sequence (n=1), a Class 5 biface finishing flake (n=1), and Class 8 angular shatter (n=2). Raw material in this assemblage includes local pebble chert (n=1) and unidentified chert (n=4). Although the assemblage is small, the presence of an initial reduction flake, a biface thinning flake, a core, and a projectile point suggests that early and late stages of reduction and tool manufacturing were taking place at site 33PK347. However, raw material types of the projectile point (Brush Creek chert) and the core (Columbus chert) do not correspond to the raw material types of the debitage.

Table 3-13. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 8.

Raw Material	Class											
	1	2	3	4	5	6	7	8	9	10	Total	Percent (%)
Unidentified Chert	-	1	-	-	1	-	-	2	-	-	**4**	**80**
Local Pebble Chert	1	-	-	-	-	-	-	-	-	-	**1**	**20**
Total Count	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**-**	**-**	**5**	
Percent (%)	**20**	**20**	**-**	**-**	**20**	**-**	**-**	**40**	**-**	**-**		**100**

Block 9

Block 9 (Units 55, 56, 57, and 58) was excavated over Anomaly 30 (Figures 3-6 and 3-16). Block 9 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 30 was identified at coordinates N634.15 E499.31 during the Phase III geophysical survey. Anomaly 30 was centrally located within Block, 9 with a vertical control datum line set at 10 cm above the ground surface (elevation 1.46 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 30 was identified at 15 cmbd in Unit 57 and was a modern metal pail. Within this 2- by 2-m excavation block, ground surface elevations ranged from 0 cmbd in the southeast corner of Unit 56, to 11 cmbd in the southwest corner of Unit 57. All units were excavated to a depth of 15 cmbd (5 cm below surface) when the metal pail was discovered, then excavations ceased. No artifacts were recovered from Block 9. The soil in Stratum I was a dark grayish brown (10YR 4/2) loam. Excavations terminated before Stratum II subsoil was encountered.

Figure 3-16. North wall profile of Block 9, Anomaly 30.

Block 10

Block 10 (Units 64, 65, 67 and 68) was excavated over Anomaly 26 (Figures 3-6 and 3-17). Block 10 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 26 was identified at coordinates N632.28 E532.94 during the Phase II geophysical survey. Anomaly 26 was centrally located within Block 10, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.44 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 26 was identified at 20 cmbd in all units, and was determined to be a dense cluster of tree roots. Within this 2- by 2-m excavation block, ground surface elevations ranged from 6 cmbd in the northeast corner of Unit 64 to 15 cmbd in the northeast corner of Unit 68. All units were excavated to a depth of 30 cmbd (20 cm below surface).

Figure 3-17. South wall profile of Block 10, Anomaly 26.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 14 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage

A total of four artifacts were recovered from Block 10, including three pieces of chipped stone debitage and one Adena Stemmed, Dickson Cluster projectile point (Table 3-14; Figure 3-18). No

FCR was recovered. The presence of a projectile point may suggest that some level of tool manufacturing or repair was occurring at site 33PK347.

Table 3-14. Artifact Assemblage from Block 10			
Class	**Type**	**Material**	**Total**
Debitage	Class 2 - Flake (Unspecified Reduction Sequence)	Delaware Chert	1
	Class 7 - Flake Fragment	Unidentified Chert	2
Debitage Total			**3**
Projectile Point	Adena Stemmed; Dickson Cluster	Delaware Chert	1
Artifact Total			**4**

Figure 3-18. Adena Stemmed, Dickson Cluster projectile point, Block 10.

Table 3-15 presents the frequency and percentage of chipped stone debitage by raw material type and class. The chipped stone debitage assemblage from Block 10 is comprised of a Class 2 flake from an unspecified reduction sequence (n=1), and Class 7 flake fragments (n=2). Raw material in this assemblage includes Delaware chert (n=1) and unidentified chert (n=2). The Delaware chert of the flake matches the raw material of the projectile point.

Table 3-15. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 10												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Unidentified Chert	-	-	-	-	-	-	2	-	-	-	**2**	**67**
Delaware Chert	-	1	-	-	-	-	-	-	-	-	**1**	**33**
Total Count	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	
Percent (%)	**-**	**33**	**-**	**-**	**-**	**-**	**67**	**-**	**-**	**-**		**100**

Block 11

Block 11 (Units 71, 72, 75, and 76) was excavated over Anomaly 31 (Figures 3-6 and 3-19). Block 11 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 31 was identified at coordinates N624.50 E530.00 during the Phase III geophysical survey. Anomaly 31 was located on the west edge of Block 11, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.66 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 31 was identified at 18 cmbd in Unit 71 and was determined to be a column of unaltered sandstone that had settled into a decayed tree root line. Within this 2- by 2-m excavation block, ground surface elevations ranged from 8 cmbd in the northeast corner of Unit 71 to 15 cmbd in the center of Unit 72. Units 72, 75, and 76 were excavated to a depth of 40 cmbd (30 cm below surface). Unit 71 was excavated to a depth of 60 cmbd (50 cm below surface) to determine the depth of bedrock.

Figure 3-19. West wall profile of Block 11, Anomaly 31.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 30 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silty clay loam. All artifacts were recovered from Stratum I.

Artifact Assemblage
A total of 61 artifacts were recovered from Block 11, including 15 pieces of chipped stone debitage and 46 pieces (1.22 kg) of sandstone FCR (Table 3-16).

Table 3-16. Artifact Assemblage from Excavation Units in Block 11			
Class	**Type**	**Material**	**Total**
Debitage	Class 2 - Flake (Unspecified Reduction Sequence)	Unidentified Chert	3
		Unknown Fossiliferous	1
	Class 7 - Flake Fragment	Paoli Chert	1
		Unidentified Chert	6
		Unknown Fossiliferous	1
	Class 8 - Flake Fragment	Unidentified Chert	1
		Unknown Fossiliferous	2
Debitage Total			**15**
Fire-cracked Rock		Sandstone	46
Artifact Total			**61**

The chipped stone debitage assemblage from Block 11 is comprised of Class 2 flakes from an unspecified stage of the reduction sequence (n=4), Class 7 flake fragments (n=8), and Class 8 angular shatter (n=3).

Table 3-17 presents the frequency and percentage of chipped stone debitage by raw material type and class. Raw material in this assemblage includes Paoli chert (n=1), unknown fossiliferous chert (n=4), and unidentified chert (n=10). Although the assemblage is small, raw materials utilized suggest an emphasis on readily available materials.

Table 3-17. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 10												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Unidentified Chert	-	3	-	-	-	-	6	1	-	-	**10**	**67**
Paoli Chert	-	-	-	-	-	-	1	-	-	-	**1**	**6**
Unknown Fossiliferous	-	1	-	-	-	-	1	2			**4**	**27**
Total Count	**-**	**4**	**-**	**-**	**-**	**-**	**8**	**3**	**-**	**-**	**15**	
Percent (%)	**-**	**27**	**-**	**-**	**-**	**-**	**53**	**20**	**-**	**-**		**100**

Block 12

Block 12 (Units 88, 89, 90, and 91) was excavated over Anomaly 15 (Figures 3-6 and 3-20). Block 12 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 15 was identified at coordinates N620.16 E506.50 during the Phase II geophysical survey. Anomaly 15 was centrally located within Block 12, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.16 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 15 was identified at 19 cmbd in Unit 88 and was a large, decaying tree stump. Within this 2- by 2-m excavation block, ground surface elevations ranged from 12 cmbd in the center of Unit 88 to 19 cmbd in the southwest corner of Unit 91. The Block was excavated to a depth of 29 cmbd (19 cm below surface). Excavation was terminated after the anomaly was identified as being the buried tree stump.

Figure 3-20. South and west wall profiles of Block 12, Anomaly 15.

The soil in Stratum I was a brownish yellow (10YR 6/6) silt loam. Excavations terminated before Stratum II subsoil was encountered.

Artifact Assemblage

No artifacts were recovered from Block 12.

Block 13

Block 13 (Units 94, 95, 96 and 97) was excavated over Anomaly 14 (Figures 3-6 and 3-21). Block 13 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 14 was identified at coordinates N617.41 E498.13 during the Phase II geophysical survey. Anomaly 14 was centrally located within Block 13, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.64 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 26 was identified at 17 cmbd in Unit 95, and was determined to be a concentration of large pieces of unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the southwest corner of Units 96 and 97 to 17 cmbd in the southwest corner of Unit 94. The Block was excavated to a depth of 27 cmbd (17 cm below surface). Excavation was terminated after the anomaly was determined to be a concentration of large pieces of unaltered sandstone.

Figure 3-21. East wall profile of Block 13, Anomaly 14.

The soil in Stratum I was a brownish yellow (10YR 6/6) silt loam. Excavations terminated before Stratum II subsoil was encountered.

Artifact Assemblage
No artifacts were recovered from Block 13.

Block 14

Block 14 (Units 98, 99, 100 and 101) was excavated over Anomaly 17 (Figures 3-6 and 3-22). Block 14 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 17 was identified at coordinates N613.62 E510.94 during the Phase II geophysical survey. Anomaly 17 was centrally located within Block 14, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.87 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 17 was identified at 20 cmbd in all units, and was determined to be a dense cluster of tree roots and unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 0 cmbd in the northeast corner of Unit 100 to 14 cmbd in the southwest corner of Unit 98. All units were excavated to a depth of 30 cmbd (20 cm below surface).

Figure 3-22. East wall profile of Block 14, Anomaly 17.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/8) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage

Three artifacts were recovered from Block 14, including one piece of chipped stone debitage and two pieces (76 g) of sandstone FCR (Table 3-18).

Table 3-18. Artifact Assemblage from Block 14

Class	Type	Material	Total
Debitage	Class 7 - Flake Fragment	Unidentified Chert	1
Fire-cracked Rock		Sandstone	2
Artifact Total			**3**

The chipped stone debitage assemblage from Block 14 consists of one Class 7 flake fragment made from an unidentified type of chert.

<u>**Block 15**</u>

Block 15 (Units 102, 103, 104 and 105) was excavated over Anomaly 18 (Figures 3-6 and 3-23). Block 15 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 18 was identified at coordinates N617.15 E541.40 during the Phase II geophysical survey. Anomaly 18 was centrally located within Block 15, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.73 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 18 was identified at 20 cmbd in Unit 103, and was determined to be a concentration of tree roots. Within this 2- by 2-m excavation block, ground surface elevations ranged from 5 cmbd in the southwest corner of Unit 104 to 15 cmbd in the northeast corner of Unit 103. All units were excavated to a depth of 40 cmbd (30 cm below surface).

Figure 3-23. East wall profile of Block 15, Anomaly 18.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 6/6) silt loam.

Artifact Assemblage
No artifacts were recovered from Block 15.

Block 16

Block 16 (Units 107, 108, 111 and 112) was excavated over Anomaly 32 (Figures 3-6 and 3-24). Block 16 covered a 2- by 2-m area and consisted of four 1- by1-m units. Anomaly 32 was identified at coordinates N606.50 E506.00 during the Phase III geophysical survey. Anomaly 32 was centrally located within Block 16, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.22 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 32 was identified at 30 cmbd in Unit 108, and was determined to be a decaying tree stump. Within this 2- by 2-m excavation block, ground surface elevations ranged from 12 cmbd in the northeast corner of Unit 112 to 30 cmbd in the southwest corner of Unit 107. All units were excavated to a depth of 40 cmbd (30 cm below surface).

Figure 3-24. North wall profile of Block 16, Anomaly 32.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage
Two artifacts, identified as Class 7 flake fragments, were recovered from Block 16 (Table 3-19). No FCR was recovered from this block.

Table 3-19. Artifact Assemblage from Block 16			
Class	**Type**	**Material**	**Total**
Debitage	Class 7 - Flake Fragment	Paoli Chert	1
		Unidentified Chert	1
Artifact Total			**2**

Table 3-20 presents the frequency and percentage of chipped stone debitage by raw material type and class. Raw material types include Paoli chert (n=1) and an unidentified chert (n=1).

Table 3-20. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 16												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Paoli Chert	-	-	-	-	-	-	1	-	-	-	**1**	**50**
Unidentified Chert	-	-	-	-	-	-	1	-	-	-	**1**	**50**
Total Count	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	
Percent (%)	**-**	**-**	**-**	**-**	**-**	**-**	**100**	**-**	**-**	**-**		**100**

Block 17

Block 17 (Units 118, 119, 120 and 121) was excavated over Anomaly 16 (Figures 3-6 and 3-25). Block 17 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 16 was identified at coordinates N609.31 E510.29 during the Phase II geophysical survey. Anomaly 16 was centrally located within Block 17, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.58 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 16 was identified at 20 cmbd in all units, and was determined to be a rodent burrow. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the northeast corner of Unit 121 to 25 cmbd in the southwest corner of Unit 118. Excavation Units 119, 120, and 121 were excavated to a depth of 40 cmbd (30 cm below surface). Unit 118 was excavated to a depth of 50 cmbd (40 cm below surface) to fully investigate the rodent burrow.

Figure 3-25. South wall profile of Block 17, Anomaly 16.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 25 cm thick. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage

A total of 12 artifacts were recovered from Block 17, including 2 pieces of chipped stone debitage and 10 pieces (0.2 kg) of sandstone FCR (Table 3-21).

Table 3-21. Artifact Assemblage from Block 17			
Class	**Type**	**Material**	**Total**
Debitage	Class 7 - Flake Fragment	Upper Mercer Chert	1
		Unidentified Chert	1
Debitage Total			**2**
Fire-cracked Rock		Sandstone	10
Artifact Total			**12**

The chipped stone debitage assemblage from Block 17 is comprised of two Class 7 flake fragments. Table 3-22 presents the frequency and percentage of chipped stone debitage by raw material type and class. Raw materials in the debitage assemblage consist of Upper Mercer chert (n=1) and unidentified chert (n=1).

Table 3-22. Frequencies of Chipped Stone Debitage by Raw Material and Class in Block 17												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Upper Mercer Chert	-	-	-	-	-	-	1	-	-	-	**1**	**50**
Unidentified Chert	-	-	-	-	-	-	1	-	-	-	**1**	**50**
Total Count	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	
Percent (%)	**-**	**-**	**-**	**-**	**-**	**-**	**100**	**-**	**-**	**-**		**100**

Block 18

Block 18 (Units 125, 126, 130 and 131) was excavated over Anomaly 33 (Figures 3-6 and 3-26). Block 18 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 33 was identified at coordinates N609.50 E524 during the Phase III geophysical survey. Anomaly 33 was centrally located within Block 18, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.22 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 33 was identified at 39 cmbd in all units, and was determined to be a dense cluster of roots and unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the northeast corner of Unit 131 to 29 cmbd in the southwest corner of Unit 125. All units were excavated to a depth of 49 cmbd (39 cm below surface).

Figure 3-26. East wall profile of Block 18, Anomaly 33.

The soil profile consisted of two distinct strata. Stratum I was a brownish yellow (10YR 6/6) silt loam that was approximately 39 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage
A total of 19 pieces (1.13 kg) of sandstone FCR were recovered from Block 18 (Table 3-23). No chipped stone artifacts were recovered.

Table 3-23. Artifact Assemblage from Block 18			
Class	**Type**	**Material**	**Total**
Fire-cracked Rock		Sandstone	19
Artifact Total			**19**

Block 19

Block 19 (Units 148, 149, 152 and 153) was excavated over Anomaly 34 (Figures 3-6 and 3-27). Block 19 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 34 was identified at coordinates N609.50 E524 during the Phase III geophysical survey. Anomaly 34 was centrally located within Block 19, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.16 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 34 was identified at 38 cmbd in Unit 149, and consisted of a concentration of unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd below datum in the northeast corner of Unit 153 to 21 cmbd in the northwest corner of Unit 148. Units 152 and 153 were excavated to a depth of 30 cmbd (20 cm below surface). Units 148 and 149 were excavated to a depth of 40 cmbd (30 cm below surface) to fully investigate the anomaly. Excavation was terminated after Anomaly 34 was determined to be a concentration of unaltered sandstone.

Figure 3-27. East wall profile of Block 19, Anomaly 34; showing unaltered sandstone (not *in situ*).

The soil profile consisted of two distinct strata. Stratum I was a brownish yellow (10YR 6/6) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silt loam.

Artifact Assemblage

No artifacts were recovered from Block 19.

Block 20

Block 20 was placed over Anomaly 35 (Figure 3-6). Block 20 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 35 was identified at coordinates N 608.50 E 539 during the Phase III geophysical survey. After comparison of the geophysical signatures of Anomaly 35 and a matching anomaly that was encountered in ST H11, Anomaly 35 was determined to be linear road ruts that follow the edge of a two-track road that currently extends across site 33PK347. Additionally, a soil core taken from the center of the anomaly showed no evidence of cultural material. Therefore, Block 20 was not excavated.

Block 21

Block 21 (Units 164, 165, 166, and 167) was excavated over Anomaly 21 (Figures 3-6 and 3-28). Block 21 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 21 was identified at coordinates N600.03 E528.46 during the Phase II geophysical survey. Anomaly 21 was centrally located within Block 21, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.91 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 21 was identified at 20 cmbd in Unit 164, and was determined to be a dense concentration of roots and unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the northwest corner of Unit 166 to 19 cmbd in the southeast corner of Unit 164. Units 166 and 167 were excavated to a depth of 30 cmbd (20 cm below surface). Units 164 and 165 were excavated to a depth of 40 cmbd (30 cm below surface) to fully investigate the anomaly.

Figure 3-28. East wall profile of Block 21, Anomaly 21.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/8) silty clay.

Artifact Assemblage

No artifacts were recovered from Block 21.

Block 22

Block 22 (Units 170, 171, 172, and 173) was excavated over Anomaly 20 (Figures 3-6 and 3-29). Block 22 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 20 was identified at coordinates N596.89 E527.94 during the Phase II geophysical survey. Anomaly 20 was centrally located within Block 22, with a vertical control datum line set at 10 cm above the ground surface (elevation 0.76 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 20 was identified at 20 cmbd in all units, and was determined to be a concentration of tree roots. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the northeast corner of Unit 173 to 18 cmbd in the southwest corner of Unit 172. All units were excavated to a depth of 30 cmbd (20 cm below surface).

Figure 3-29. West wall profile of Block 22, Anomaly 20.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 10 cm thick. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam.

Artifact Assemblage
No artifacts were recovered from Block 22.

Block 23

Block 23 (Units 174, 175, 176, and 177) was excavated over Anomaly 24 (Figures 3-6 and 3-30). Block 23 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 24 was identified at coordinates N586.84 E544.54 during the Phase II geophysical survey. Anomaly 24 was centrally located within Block 23, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.04 m) in order to facilitate measurements across the varying surface elevations of the Block. Anomaly 24 was identified at 30 cmbd in all units, and was determined to be a tree stump. Within this 2- by 2-m excavation block, ground surface elevations ranged from 10 cmbd in the northeast corner of Unit 177 to 23 cmbd in the southwest corner of Unit 174. All units were excavated to a depth of 40 cmbd (30 cm below surface).

Figure 3-30. West wall profile of Block 23, Anomaly 24.

The soil profile consisted of two distinct strata. Stratum I was a light yellowish brown (10YR 6/4) silt loam that was approximately 20 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silt loam.

Artifact Assemblage
No artifacts were recovered from Block 22.

Block 24

Block 24 (Units 45, 46, 49, and 50) was excavated over Anomaly 9 (Figures 3-6 and 3-31). Block 24 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 9 was identified at coordinates N634.15 E499.31 during the Phase II geophysical survey. Anomaly 9 was centrally located within Block 24, with a vertical control datum line set at 10 cm above the ground surface (elevation 1.46 m) in order to facilitate measurements across the varying surface elevations of the block. Anomaly 9 was identified at 20 cmbd in all units, and was determined to be a decaying tree stump and a large piece of unaltered sandstone. Within this 2- by 2-m excavation block, ground surface elevations ranged from 5 cmbd in the northeast corner of Unit 50 to 15 cmbd in the northwest corner of Unit 45. All Units were excavated to a depth of 35 cmbd (25 cm below surface).

Figure 3-31. South and west wall profiles of Block 24, Anomaly 9.

The soil profile consisted of two distinct strata. Stratum I was a brownish yellow (10YR 6/6) silt loam that was approximately 15 cm thick. The underlying subsoil, Stratum II, was yellowish brown (10YR 5/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage
Four pieces (0.14 kg) of sandstone FCR were recovered from Block 24 (Table 3-24). No chipped stone artifacts were recovered from this block.

Table 3-24. Artifact Assemblage from Block 24

Class	Type	Material	Total
Fire-cracked Rock		Sandstone	4
Artifact Total			**4**

Block 25

Block 25 was placed over Anomaly 5 (Figure 3-6). Block 25 covered a 2- by 2-m area and consisted of four 1- by 1-m units. Anomaly 5 was identified at coordinates N654.80 E510.03 during the Phase II geophysical survey. Block 25 was located directly beneath a large, dead leaning tree and was not excavated due to safety concerns.

Feature 1

Feature 1 was initially identified as Anomaly 11 at coordinates N630.62 E512.12 during the Phase II geophysical survey (Figure 3-6). During Phase II testing, five 1- by 1-m units were excavated across the anomaly to expose and define Feature 1; the majority of the feature was excavated (Pecora and Burks 2014) (Figure 3-32). During Phase III investigations, the Phase II excavation units were relocated and one additional 1- by 1-m unit (Unit 23) was added to the northwest corner to better define the northwest Feature boundary; all other boundaries of the Feature were defined during Phase II testing (Figure 3-33). Excavation of Feature 1 was completed. Within Unit 23, ground surface elevations ranged from 8 to 11 cmbd. Unit 23 was excavated to a depth of 18 cmbd (8 cm below surface). Five soil and FCR samples were taken from the center of Feature 1 to be submitted for special analyses. All feature fill that was not collected for samples was screened for artifacts.

The feature fill consisted of a yellowish brown (10YR 5/4) silt loam that was approximately 8 cm thick. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage

A total of 251 artifacts were recovered from Feature 1 during Phase III excavations, including 13 pieces of chipped stone debitage and 238 pieces (14.28 kg) of sandstone FCR (Table 3-25).

Table 3-25. Artifact Assemblage from Feature 1

Class	Type	Material	Total
Debitage	Class 5 - Biface Finishing Flake	Columbus Chert	1
	Class 7 - Flake Fragment	Unknown Fossiliferous	1
	Class 8 - Angular Shatter	Unidentified Chert	1
	Class 9 - Microdebitage	Unidentified Chert	10
Debitage Total			**13**
Fire-cracked Rock		Sandstone	238
Artifact Total			**251**

The chipped stone debitage assemblage from Feature 1 is comprised of a Class 5 biface finishing flake (n=1), a Class 7 flake fragment (n=1), Class 8 angular shatter (n=1), and Class 9 microdebitage (n=10). Although the assemblage is very small, the presence of a biface finishing flake may suggest that later stages of reduction or tool maintenance were taking place at site 33PK347.

Table 3-26 presents the frequency and percentage of chipped stone debitage by raw material type and class. Unidentified chert is the most common raw material in the debitage assemblage, accounting for 84 percent (n=11) of the recovered specimens. Other material types include Columbus chert (n=1) and unknown fossiliferous material (n=1).

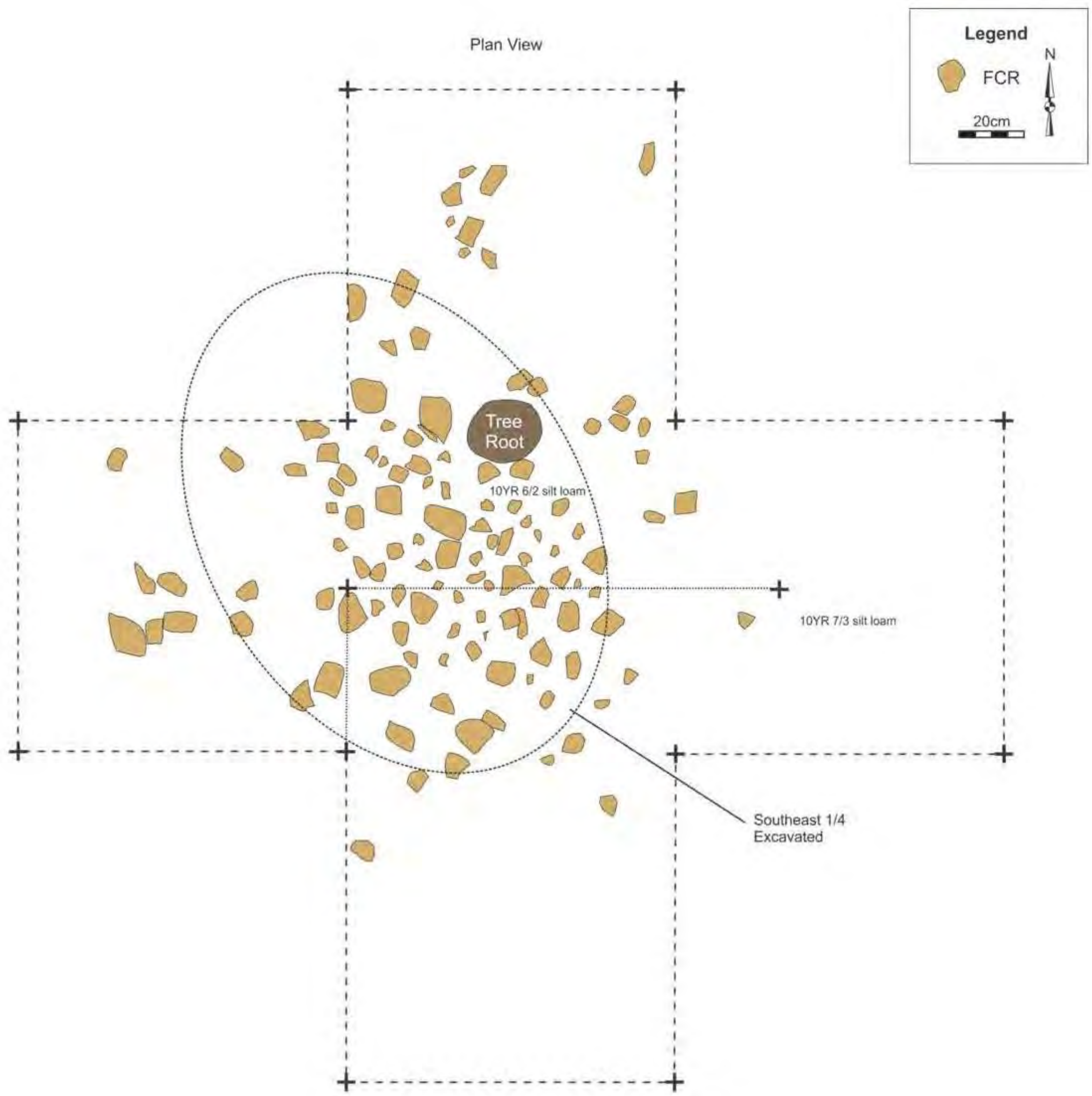


Illustration of Feature 1 from Phase II excavations (Pecora and Burks 2014).

Figure 3-32

Plan view, using a 3-D model, of Feature 1 before
excavations were completed.

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Figure 3-33

Table 3-26. Frequencies of Chipped Stone Debitage by Raw Material and Class in Feature 1.												
Raw Material	**Class**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Percent (%)**
Unidentified Chert	-	-	-	-	-	-	-	1	10	-	**11**	**84**
Columbus Chert	-	-	-	-	1	-	-	-	-	-	**1**	**8**
Unknown Fossiliferous	-	-	-	-	-	-	1	-	-	-	**1**	**8**
Total Count	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**10**	**-**	**13**	
Percent (%)	**-**	**-**	**-**	**-**	**8**	**-**	**8**	**8**	**76**	**-**		**100**

A total of 948 artifacts were recovered from Feature 1 during Phase II excavations, including a core nodule (n=1) made of an unidentified chert, a notched Brewerton or Matanzas projectile point (n=1) made of Upper Mercer chert, chipped stone debitage (n=23), and 923 pieces (28.45 kg) of sandstone FCR (Table 3-27). The notched Brewerton/Matanzas projectile point is associated with the Late Archaic time period, and dates to between 3000 and 1000 B.C. (Ritchie 1961).

The nomenclature used to describe the chipped stone debitage assemblage from Feature 1 during Phase II excavations is different from that used by the Gray & Pape lithic analysts and has been adjusted, for comparative purposes, to fit the Phase III descriptive nomenclature. The Phase II assemblage is comprised of Class 2 flake fragments from an unspecified reduction sequence (OVAI decortication flake; n=2), Class 4 biface thinning flakes (OVAI late percussion biface thinning flake; n=4), a Class 6 chip (OVAI interior, nonbifacial, edge preparation flake; n=1), Class 7 flake fragments (OVAI nondiagnostic flake fragment; n=8), and Class 8 angular shatter (OVAI flint shatter; n=8).

Table 3-27. Phase II Artifact Assemblage from Feature 1			
Class	**Type**	**Material**	**Total**
Debitage	Class 2 - flake (unspecified reduction sequence)	Upper Mercer Chert	1
		Brassfield Chert	1
	Class 4 - biface thinning flake	Brush Creek Chert	2
		Delaware Chert	1
		Vanport Chert	1
	Class 6 - chip	Upper Mercer Chert	1
	Class 7 - flake fragment	Upper Mercer Chert	1
		Unidentified Chert	7
	Class 8 - angular shatter	Unidentified Chert	8
Debitage Total			**23**
Core Nodule		Unidentified Chert	1
Projectile Point	Notched Brewerton or Matanzas	Upper Mercer Chert	1
Fire-cracked Rock		Sandstone	923
Artifact Total			**948**

Table 3-28 presents the frequency and percentage of chipped stone debitage by raw material type and class identified during Phase II investigations. Unidentified chert is the most common raw material in the debitage assemblage, accounting for 66 percent (n=15) of the recovered specimens. Other material types include Upper Mercer chert (n=3), Brush Creek chert (n=2), Brassfield chert (n=1), Delaware chert (n=1), and Vanport chert (n=1).

Table 3-28. Frequencies of Chipped Stone Debitage by Raw Material and Class in Feature 1, Phase II.

Raw Material	Class											
	1	2	3	4	5	6	7	8	9	10	Total	Percent (%)
Unidentified Chert	-	-	-	-	-	-	7	8	-	-	**15**	**66**
Upper Mercer Chert	-	1	-	-	-	1	1	-	-	-	**3**	**13**
Brush Creek Chert	-	-	-	2	-	-	-	-	-	-	**2**	**9**
Brassfield Chert	-	1	-	-	-	-	-	-	-	-	**1**	**4**
Delaware Chert	-	-	-	1	-	-	-	-	-	-	**1**	**4**
Vanport Chert	-	-	-	1	-	-	-	-	-	-	**1**	**4**
Total Count	**-**	**2**	**-**	**4**	**-**	**1**	**8**	**8**	**-**	**-**	**23**	
Percent (%)	**-**	**9**	**-**	**17**	**-**	**4**	**35**	**35**	**-**	**-**		**100**

Combined (Phase II and Phase III), the artifact assemblage for Feature 1 totals 1,199 artifacts, including a core (n=1), a projectile point (n=1), chipped stone debitage (n=36), and FCR (n=1,161). Fire-cracked rock dominates (97 percent) the assemblage, while chipped stone debitage accounts for 3 percent of the assemblage and lithic tools make up less than one percent of the assemblage.

Feature 1 was a large shallow (16 cm) flat-bottomed, basin-shaped pit filled with a concentration of FCR that was approximately one meter in diameter and circular in shape. Additional, displaced, pieces of FCR were diffusely scattered beyond the Feature borders. Although the FCR-filled feature was likely utilized for thermal activity, no evidence was found of burnt earth or ash layers.

Feature 2

Feature 2 was initially identified as Anomaly 25 at coordinates N629.68 E527.36 during the Phase II geophysical survey (Figure 3-6). During Phase II testing, four and one-half 1- by 1-m units were excavated across the anomaly to expose and define the Feature; the majority of the feature was excavated (Pecora and Burks 2014) (Figure 3-34). During Phase III investigations, the Phase II units were relocated; no additional units were needed to define the Feature boundaries that were well-defined during Phase II testing (Figure 3-35). Excavation of Feature 2 was completed. Five soil and FCR samples were taken from the center of Feature 2 to be submitted for special analyses. All feature fill that was not collected for samples was screened for artifacts.

The feature fill consisted of a light yellowish brown (10YR 6/4) silt loam that was approximately 26 cm thick. The underlying subsoil, Stratum II, was brownish yellow (10YR 6/6) silt loam. All artifacts were recovered from Stratum I.

Artifact Assemblage

A total of 438 artifacts were recovered from Feature 2, including 8 pieces of chipped stone debitage and 430 pieces (11.65 kg) of sandstone FCR (Table 3-29).

Table 3-29. Artifact Assemblage from Feature 2

Class	Type	Material	Total
Debitage	Class 1 - Initial Reduction Flake	Local Pebble Chert	1
	Class 2 - Flake (Unspecified Reduction Sequence)	Unidentified Chert	1
	Class 4 - Biface Thinning Flake	Unidentified Chert	1
	Class 5 - Biface Finishing Flake	Unidentified Chert	1
	Class 7 - Flake Fragment	Upper Mercer	2
	Class 9 - Microdebitage	Unidentified Chert	2
Debitage Total			**8**
Fire-cracked Rock		Sandstone	430
Artifact Total			**438**

The chipped stone debitage assemblage from Feature 2 is comprised of a Class 1 initial reduction flake (n=1), a Class 2 flake from an unspecified reduction sequence (n=1), a Class 4 biface thinning flake (n=1), a Class 5 biface finishing flake (n=1), Class 7 flake fragments (n=2), and Class 9 microdebitage (n=2). Although the assemblage is small, the presence of an initial reduction flake, as well as biface finishing flakes, may suggest that all stages of reduction and tool manufacturing were taking place at site 33PK347.

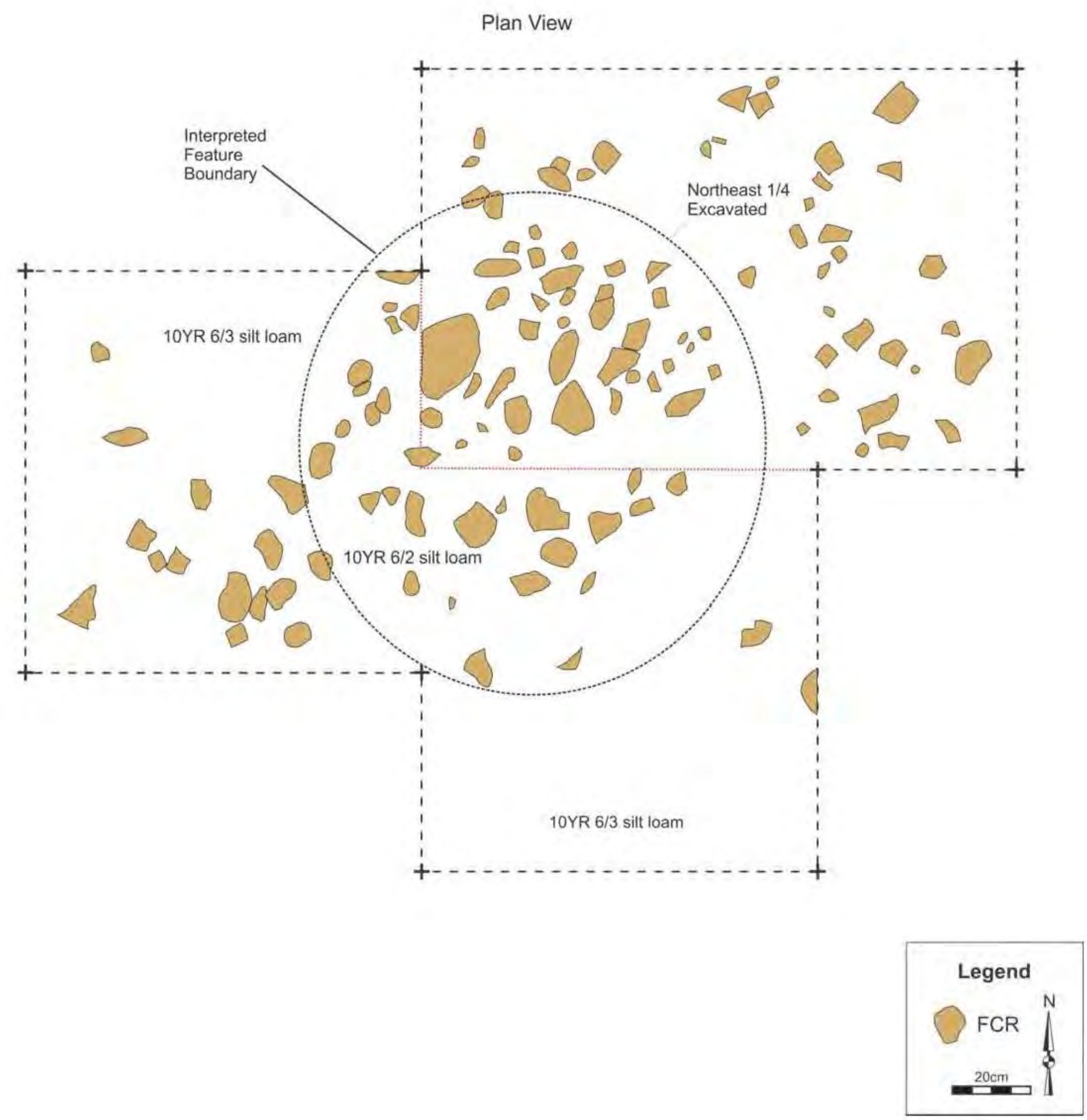

Illustration of Feature 2 from Phase II excavations
(Pecora and Burks 2014).

Plan view, using a 3-D model, of Feature 2 before excavations were completed.

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Figure 3-35

Table 3-30 presents the frequency and percentage of chipped stone debitage by raw material type and class. Unidentified chert is the most common raw material in the debitage assemblage, accounting for 84 percent (n=11) of the recovered specimens. Other material types include Columbus chert (n=1) and unknown fossiliferous material (n=1).

Table 3-30. Frequencies of Chipped Stone Debitage by Raw Material and Class in Feature 2

Raw Material	Class											
	1	2	3	4	5	6	7	8	9	10	Total	Percent (%)
Unidentified Chert	-	1	-	1	1	-	-	-	2	-	**5**	**62.5**
Upper Mercer Chert	-	-	-	-	-	-	2	-	-	-	**2**	**25**
Local Pebble Chert	1	-	-	-	-	-	-	-	-	-	**1**	**12.5**
Total Count	**1**	**1**	**-**	**1**	**1**	**-**	**2**	**-**	**2**	**-**	**8**	
Percent (%)	**12.5**	**12.5**	**-**	**12.5**	**12.5**	**-**	**25**	**-**	**25**	**-**		**100**

Artifacts were recovered from Feature 2 during Phase II excavations included 2,185 pieces (31.74 kg) of sandstone FCR, exclusively (Table 3-31). No lithic tools or chipped stone debitage were recovered.

Table 3-31. Phase II Artifact Assemblage from Feature 2

Class	Type	Material	Total
Fire-cracked Rock		Sandstone	2,185
Artifact Total			**2,185**

Combined (Phase II and Phase III), the artifact assemblage for Feature 2 totals 2,623 artifacts, including chipped stone debitage (n=8) and FCR (n=2,615). Fire-cracked rock dominates (99.7 percent) the assemblage, while chipped stone debitage accounts for less than one percent of the assemblage.

Feature 2, like Feature 1, was a large, shallow (26 cm), flat-bottomed, basin-shaped pit filled with a concentration of FCR that was approximately one meter in diameter and circular in shape. Additional, displaced, pieces of FCR were diffusely scattered beyond the Feature borders. Although the FCR-filled feature was likely utilized for thermal activity, no evidence was found of burnt earth or ash layers.

4.0 LITHIC ARTIFACTS

This chapter provides a comprehensive analysis of the artifact assemblage from all phases of investigation, including Phase I survey, Phase II testing, and Phase III mitigation. In total, 4,809 artifacts were recovered from site 33PK347, including lithic tools (n=14), chipped stone debitage (n=182), and FCR (n=4,613) (Table 4-1). FCR dominates (96 percent) the assemblage, while chipped stone debitage accounts for 4 percent of the assemblage and lithic tools make up less than 1 percent of the artifact assemblage. The lithic tool-to-debitage ratio is moderate at 1:13.

Table 4-1. Artifact Totals for Phase I, Phase II, and Phase III Investigations at Site 33PK347

Context	Tools	Debitage	FCR	Totals
Phase I				
Shovel Tests	1	10	1	12
Phase II				
Shovel Tests	5	58	392	455
Excavation Units	1	14	223	238
Feature 1	2	23	923	948
Feature 2	-	-	2,185	2,185
Subtotals	**8**	**95**	**3,723**	**3,826**
Phase III				
Shovel Tests	1	2	3	6
Excavation Blocks	4	54	218	276
Feature 1	-	13	238	251
Feature 2	-	8	430	438
Subtotals	**5**	**77**	**889**	**971**
Total	**14**	**182**	**4,613**	**4,809**

During Phase I survey of site 33PK347, 12 artifacts were recovered from 10 shovel tests, including a biface tip (n=1), early biface thinning flakes (n=3), late biface thinning flakes (n=2), late biface thinning flakes/thinning pressure flakes (n=4), a pressure flake (n=1), and a piece of FCR (n=1). Raw materials included Delaware (n=7), Vanport (n=3), and Brassfield (n=1) cherts, which are non-local; however, they were likely available in local river deposits (Pecora 2013a). Pecora (2013a) suggests the lithic assemblage likely represents later stages of stone tool manufacture and use.

During Phase II testing of site 33PK347, 3,826 artifacts were recovered from shovel tests, 1- by 1-m excavation units, Feature 1, and Feature 2. General artifact classes include lithic tools (n=8), chipped stone debitage (n=95), and sandstone FCR (n=3,723; 76.18 g) (Pecora and Burks 2014). Fire-cracked rock dominates (97 percent) the assemblage, while chipped stone debitage accounts for 2.5 percent and lithic tools comprise less than 1 percent of the assemblage.

Lithic tools include cores (n=2), projectile points (n=2), a biface fragment (n=1), a biface blank (n=1), a nodule blank (n=1), and a sandstone pitted stone (n=1). Cores are the base chert nodule from which chipped stone tools are made. The projectile points include a triangular point type dated to the early Late Prehistoric period (A.D. 1000–1200) and a notched Brewerton or Matanzas point type dated to the Late Archaic period (3000–1000 B.C.). The biface fragment resembles a projectile point fragment and the biface blank had not yet been formed. The nodule blank is a tabular piece of chert that could have been utilized to make a chipped stone tool. The function of the pitted stone is unclear. These are often used to process nuts; however, nuts were not recovered from site 33PK347. It is also possible that the pitted stone was utilized in a lithic reduction technique (Pecora and Burks 2014).

The chipped stone debitage consists primarily of debris created from early and late stage biface reduction processes. Approximately 30 percent of the debitage was from the (earliest) core reduction stages (Pecora and Burks 2014).

During Phase III investigations of site 33PK347, 971 artifacts were recovered from shovel tests, excavation blocks, Feature 1, and Feature 2. General artifact classes include lithic tools (n=5), chipped stone debitage (n=77), and sandstone FCR (n=889; 33.97 kg). Fire-cracked rock dominates (92 percent) the assemblage, while chipped stone debitage accounts for eight percent and lithic tools comprise less than one percent of the assemblage. Appendix A contains a full inventory of the lithic artifact assemblage.

Lithic tools include projectile points (n=2), biface fragments (n=2), and a core (n=1). The projectile points include one complete and one nearly complete Adena Stemmed, Dickson Cluster type dated to the Late Archaic period (3000–1000 B.C.).

The chipped stone debitage consists primarily of debris created from early and late stage biface reduction processes. Approximately 23 percent of the debitage was from the (earlier) core reduction stages.

Table 4-2 lists class, type, and raw material of the complete artifact assemblage from site 33PK347. Lithic tools, chipped stone debitage, and FCR will be discussed, separately, in the sections following.

Table 4-2. Artifact Assemblage from Site 33PK347: Phase I, Phase II and Phase III

Class	Type	Material	Total
Projectile Point	Notched, Brewerton/Matanzas Type	Upper Mercer	1
	Triangle	Delaware Chert	1
	Adena Stemmed, Dickson Cluster	Brush Creek Chert	1
		Delaware Chert	1
Biface	Fragment	Brassfield Chert	1
		Delaware Chert	1
		Upper Mercer Chert	1
		Unidentified Chert	1
	Blank	Unidentified Chert	1
Core		Columbus Chert	1
		Delaware Chert	1

Table 4-2. Artifact Assemblage from Site 33PK347: Phase I, Phase II and Phase III (con't)			
Class	**Type**	**Material**	**Total**
		Unidentified Chert	1
Nodule	Blank	Unidentified Chert	1
Pitted Stone		Sandstone	1
Tool Total			**14**
Debitage	Class 1 - Initial Reduction Flake	Delaware Chert	2
		Local Pebble Chert	3
		Unidentified Chert	1
	Class 2 - Flake (Unspecified Reduction Sequence)	Brassfield Chert	3
		Delaware Chert	8
		Paoli Chert	1
		Upper Mercer Chert	2
		Local Pebble Chert	2
		Unidentified Chert	14
		Unknown Fossiliferous	1
	Class 3 - Biface Initial Reduction Flake	Delaware Chert	8
		Unidentified Chert	2
	Class 4 - Biface Thinning Flake	Brassfield Chert	2
		Breathitt Chert	1
		Brush Creek Chert	7
		Delaware Chert	12
		Paoli Chert	2
		Upper Mercer Chert	9
		Vanport Chert	1
		Unidentified Chert	7
	Class 5 - Biface Finishing Flake	Brush Creek Chert	2
		Columbus Chert	1
		Delaware Chert	2
		Vanport Chert	3
		Unidentified Chert	2
	Class 6 - Chip	Delaware Chert	1
		Upper Mercer Chert	1
	Class 7 - Flake Fragment	Brassfield Chert	1
		Delaware Chert	2
		Paoli Chert	4
		Upper Mercer Chert	7
		Unidentified Chert	36
		Unknown Fossiliferous	2
	Class 8 - Angular Shatter	Delaware Chert	1
		Unidentified Chert	15
		Unknown Fossiliferous	2
	Class 9 - Microdebitage	Unidentified Chert	12
Debitage Total			**182**
Fire-cracked Rock		Sandstone	4,613
Grand Total			**4,809**

4.1 Lithic Tools

A total of 14 lithic tools were recovered from site 33PK347 (Table 4-2). Lithic tools comprise less than one percent of the lithic artifact assemblage. Lithic tools recovered include projectile points (n=4), bifaces (n=5), cores (n=3), a chert nodule blank (n=1), and a pitted stone (n=1). Raw materials were identified macroscopically and included a total of six unique raw materials, including Delaware chert (29 percent), Upper Mercer chert (14 percent), Brassfield chert (7 percent), Brush Creek chert (7 percent), Columbus chert (7 percent), and sandstone (7 percent) (Table 4-3). Almost one-third (29 percent) of the raw material was unidentified. Lithic tools recovered at site 33PK347 were most commonly produced from Delaware and Upper Mercer cherts.

Table 4-3. Frequencies of Lithic Tools by Type and Raw Material at Site 33PK347

Raw Material	Tool Type						
	Projectile Point	Biface	Core	Nodule	Pitted Stone	Total	Percent (%)
Brassfield Chert	-	1	-	-	-	**1**	**7**
Brush Creek Chert	1	-	-	-	-	**1**	**7**
Columbus Chert	-	-	1	-	-	**1**	**7**
Delaware Chert	2	1	1	-	-	**4**	**29**
Upper Mercer Chert	1	1	-	-	-	**2**	**14**
Unidentified Chert	-	2	1	1	-	**4**	**29**
Sandstone	-	-	-	-	1	**1**	**7**
Total Count	**4**	**5**	**3**	**1**	**1**	**14**	
Percent (%)	**29**	**36**	**21**	**7**	**7**		**100**

Raw materials from the lithic tool assemblage correlate with the raw materials from the chipped stone debitage assemblage. Most of the chert types identified would have been locally available, including Brassfield, Brush Creek, and Upper Mercer cherts (Stout and Schoenlaub 1945), as well as sandstone. Non-local chert types include Columbus and Delaware cherts. Outcrops of Columbus chert are found as far south as Pickaway County on the Scioto River (Stout and Schoenlaub 1945); therefore, river cobbles could have made their way into Pike county. The same scenario holds true for Delaware chert, whose most southern outcroppings are in Delaware County (Stout and Schoenlaub 1945). As stated in the Phase II report, the non-local cherts could have been traded or obtained locally as secondary source river cobbles (Pecora and Burks 2014).

4.1.1 Projectile Points

Four projectile points were recovered from site 33PK347. A small, nearly complete, notched Brewerton or Matanzas projectile point was recovered from the top of Feature 1, during Phase II excavations (Pecora and Burks 2014). The projectile point type is difficult to identify with certainty as it has been extensively resharpened, thus altering its original form. Both projectile point types date to the Late Archaic period and are described as thick, broad, trianguloid-bladed forms (Cook 1976; Justice 1987; Ritchie 1961:16))

A nearly complete triangular projectile point, with a missing tip, was recovered from the excavation unit over Anomaly 6 during Phase II investigations (Pecora and Burks 2014). The projectile point was typed to be either a Hamilton Incurvate type, dated to the Late Woodland period, or an “arrow point” type, dated to the Late Prehistoric/Fort Ancient period. After further analysis by Gray & Pape, the point has been typed as a Late Prehistoric/Fort Ancient Type 2.1 (Flared Base with ears) Fine Triangular point (Henderson 1998; Miller 2001) that exhibits convex basal margins and distinctive “ears” at the junction of the base and blade. It is these “ears” that distinguish them from Type 2 (Flared Base) Fine Triangular points. Further, the flared bases are intentionally made at the inception of manufacture and not the result of resharpening (Miller and Henderson 2002). Type 2.1 Fine Triangles are indicative of the Early to Middle Fort Ancient cultural period in the central Ohio River valley. They appear circa 1100 A.D. but are rarely found as late as the Madisonville Horizon, circa 1400 A.D. A period of transition exists between the Type 2 and 2.1 into the Type 3 (Coarsely Serrated) and Type 3.1 (Finely Serrated) Fine Triangles, where all basal and blade margin attributes are present, and indicates the transition from Early to Middle Fort Ancient circa 1200–1300 A.D (Henderson 1998; Miller 2001).

A complete Adena Stemmed, Dickson Cluster point was recovered on the surface as leaf litter was being cleared to excavate Block 8, during Phase III investigations (Figure 4-1). This projectile point is made of Brush Creek chert and was reworked extensively; one shoulder is nearly nonexistent. Adena Stemmed, Dickson Cluster points date to the Early Woodland period (Justice 1987:192). This specimen is 67.5 mm long, 32.0 mm wide, 11.7 mm thick, and weighs 19.8 g. The basal width is 13.1 mm. The stemmed base is straight and shows no evidence of basal grinding. The blade shape is excurvate and the blade shoulder is inversely tapered. The base cross-section is biconvex, the mid-section cross-section is biconvex, and the tip cross-section is rhomboid-shaped.

Figure 4-1. Adena Stemmed projectile points from Block 8 (left) and Block 10 (right).

A nearly complete (basal edge is missing) Adena Stemmed, Dickson Cluster point was recovered from Block 10 (Figures 3-19 and 4-1), during Phase III investigations. This projectile point is made of Delaware chert and it, too, was heavily resharpened, leaving a stunted blade. This specimen is 44.8 mm long, 28.3 mm wide, 9.5 mm thick, and weighs 11.5 g. The stemmed base is contracted and evidence of basal grinding is undistinguishable. The blade shape is excurvate and the blade shoulder is tapered. The cross-sections of the base, mid-section, and tip are all biconvex.

4.1.2 Bifaces

Four biface fragments and one biface blank fragment were recovered from site 33PK347. One biface fragment was recovered from a ST (407.5 NE) during the Phase I survey (Pecora 2013a). This fragment is made of Delaware chert and was described as resembling a portion of a projectile point blade.

The second biface fragment was recovered from a ST (N610 E515), during Phase II investigations (Pecora and Burks 2014). The fragment is made of Brush Creek chert and was described as resembling a fragment of a projectile point.

The third biface fragment was recovered from a ST (A7) during Phase III investigations. The fragment is made of an unidentified chert and is described as a small heat-damaged specimen of an indeterminate stage of manufacture.

The fourth biface fragment was recovered from Block 7 during Phase III investigations. The fragment is made of Upper Mercer chert and is described as a Stage 4 (formed) heat-damaged distal fragment that is possibly a projectile point tip.

The biface blank fragment was recovered from a ST (N626 E535) during Phase II investigations (Pecora and Burks 2014). A biface blank represents the earliest stages of biface manufacture/thinning. The specimen is made of an unidentified chert.

4.1.3 Cores

Three cores were recovered from site 33PK347. One core nodule was recovered from Feature 1 during Phase II investigations (Pecora and Burks 2014). This core nodule was made of an unidentified chert that was likely obtained from secondary deposits, such as river cobbles.

A second core nodule was recovered from a ST (N635 E525) during Phase II investigations (Pecora and Burks 2014). This core nodule was made of Delaware chert that was likely obtained from secondary river deposits.

The third core was recovered from Block 8 during Phase III investigations (Figure 3-16). It is a freehand multidirectional core with four striking platforms that is made of Columbus chert.

4.1.4 Nodule

One chert nodule blank was recovered from a ST (N660 E525, during Phase II investigations (Pecora and Burks 2014). The nodule blank is a tabular-shaped piece of unidentified chert. It is unknown what the intended use was for the nodule blank; however, it was likely intended for tool production.

4.1.5 Pitted Stone

One pitted stone is the only ground stone artifact recovered from site 33PK347. The stone was recovered from a ST (N651 E504) during Phase II investigations (Pecora and Burks 2014). The artifact is described as a rectangular-shaped block of sandstone with one centrally located pit. No evidence was found to suggest the use of the stone.

4.2 Chipped Stone Debitage

A total of 182 pieces of chipped stone debitage were recovered from site 33PK347 (Tables 4-1 and 4-2). Chipped stone debitage comprises 4 percent of the lithic artifact assemblage. In order of decreasing frequency, Class 7 flake fragments comprise 29 percent of the debitage assemblage, followed by Class 4 biface thinning flakes (23 percent), Class 2 flakes (17 percent), Class 8 angular shatter (10 perccent), Class 9 microdebitage (7 percent), Class 5 biface finishing flakes (5 percent), Class 3 biface initial reduction flakes (5 percent), Class 1 initial reduction flakes (3 percent), and Class 6 chips (1 percent) (Table 4-4). No Class 10 Janus flakes were identified in the chipped stone debitage assemblage.

Table 4-4. Frequencies of Chipped Stone Debitage by Raw Material and Class at Site 33PK347

Raw Material	Class											
	1	2	3	4	5	6	7	8	9	10	Total	Percent (%)
Brassfield Chert	-	3	-	2	-	-	1	-	-	-	**6**	**3**
Breathitt Chert	-	-	-	1	-	-	-	-	-	-	**1**	**0.5**
Brush Creek Chert	-	-	-	7	2	-	-	-	-	-	**9**	**5**
Columbus Chert	-	-	-	-	1	-	-	-	-	-	**1**	**0.5**
Delaware Chert	2	8	8	12	2	1	2	1	-	-	**36**	**20**
Paoli Chert	-	1	-	2	-	-	4	-	-	-	**7**	**4**
Upper Mercer Chert	-	2	-	9	-	1	7	-	-	-	**19**	**10**
Vanport Chert	-	-	-	1	3	-	-	-	-	-	**4**	**2**
Local Pebble Chert	3	2	-	-	-	-	-	-	-	-	**5**	**3**
Unidentified Chert	1	14	2	7	2	-	36	15	12	-	**89**	**49**
Unknown Fossiliferous	-	1	-	-	-	-	2	2	-	-	**5**	**3**
Total Count	**6**	**31**	**10**	**41**	**10**	**2**	**52**	**18**	**12**	**-**	**182**	
Percent (%)	**3**	**17**	**5**	**23**	**5**	**1**	**29**	**10**	**7**	**-**		**100**

The debitage classes are in an order representing early stages of lithic tool production (Class 1), through the late finishing stages of tool manufacture (Classes 3–6), to retouching and maintenance stages (Classes 7–10). Class 2 flakes belong to an unspecified stage of the reduction sequence. The frequencies of Class 9 microdebitage (7 percent) and Class 6 chips (1 percent) is typically attributed to sampling bias associated with excavation techniques. Only when fine screening and flotation techniques are utilized are these debitage classes identified in archaeological assemblages. At site 33PK347, these debitage classes were recovered from Features 1 and 2 (during both Phase II and Phase III investigations) through the water flotation process undertaken for botanical analysis. These classes were not recovered from shovel tests or excavation units.

The frequency of Class 1 initial reduction flakes is low (3 percent), suggesting that the earliest stages of core reduction occurred rarely at site 33PK347 (Table 4-4). Of note, is the fact that local pebble chert makes up half of the Class 1 assemblage, suggesting that river cobbles were utilized to make chipped stone tools. The argument that river cobbles were utilized as raw materials is further strengthened by the presence of Delaware chert in this reduction class. Delaware chert accounts for 33 percent of the Class 1 assemblage and was likely picked up as river cobbles. As a group, Class 3 biface initial reduction flakes, Class 4 biface thinning flakes, Class 5 biface finishing flakes, and Class 6 biface finishing chips comprise 34 percent of the debitage assemblage and can be directly attributed to the production of bifacial tools. As a group, Class 7 flakes, Class 8 angular shatter, and Class 9 microdebitage comprise 46 percent of the debitage assemblage and are associated with tool repair and resharpening. Debitage assigned as Class 2 flakes of unspecified reduction sequences account for 17 percent of the assemblage. These data suggest that some tool production was taking place at site 33PK347, but the majority of lithic-related activity focused on tool maintenance.

4.2.1 Raw Materials

Chert raw materials were identified macroscopically and a total of nine unique raw materials were identified at site 33PK347 (Table 4-4). The raw materials comprising the chipped stone debitage assemblage consist of Delaware chert (20 percent), Upper Mercer (10 percent), Brush Creek (5 percent), Paoli (4 percent), Brassfield (3 percent), local pebble (3 percent), Vanport (2 percent), Breathitt (0.5 percent), and Columbus (0.5 percent) cherts. Almost half (49 percent) of the debitage chert is unidentified and 71 percent of the unidentified chert comes from Classes 7–9, whose small size makes it difficult to identify raw material with certainty. A small portion (3 percent) of the assemblage is not made from chert at all, but from unidentified fossiliferous material.

Raw materials from the chipped stone debitage assemblage correlate with the raw materials from the chipped stone tool assemblage. Half of the chert types identified would have been locally available, including Brassfield, Brush Creek, Upper Mercer, and Vanport cherts (Stout and Schoenlaub 1945). Non-local chert types include Columbus, Delaware, Breathitt, and Paoli cherts (DeRegnaucourt and Georgiady 1998; Stout and Schoenlaub 1945). Outcrops of Columbus and Delaware cherts are found in counties north of Pike County, along the Scioto River (Stout and Schoenlaub 1945); therefore, river cobbles could have made their way, through stream action, into Pike County. Breathitt and Paoli chert outcrops are most commonly found in northern Kentucky and along the Ohio River (DeRegnaucourt and Georgiady 1998). As stated in the Phase II report, the non-local cherts could have been traded, or obtained locally as secondary source river cobbles (Pecora and Burks 2014).

Class 1 initial reduction flakes (n=6) are comprised of local pebble chert (50 percent), Delaware chert (33 percent), and unidentified chert (17 percent).

Class 2 flakes from unspecified reduction sequences (n=31) are comprised of unidentified chert (45%), Delaware chert (27 percent), Brassfield chert (10 percent), Upper Mercer chert (6 percent), local pebble chert (6 percent), Paoli chert (3 percent), and unknown fossiliferous material (3 percent).

Class 3 biface initial reduction flakes (n=10) are comprised of Delaware chert (80 percent) and unidentified chert (20 percent).

Class 4 biface thinning flakes (n=41) are comprised of Delaware chert (30 percent), Upper Mercer chert (22 percent), Brush Creek chert (17 percent), unidentified chert (17 percent), Brassfield chert (5 percent), Paoli chert (5 percent), Breathitt chert (2 percent), and Vanport chert (2 percent).

Class 5 biface finishing flakes (n=10) are comprised of Vanport chert (30 percent), Brush Creek chert (20 percent), Delaware chert (20 percent), unidentified chert (20 percent), and Columbus chert (10 percent).

Class 6 biface finishing chips (n=2) are comprised of Delaware chert (50 percent) and Upper Mercer chert (50 percent).

Class 7 flakes (n=52) are comprised of unidentified chert (69 percent), Upper Mercer chert (13 percent), Paoli chert (8 percent), Delaware chert (4 percent), unknown fossiliferous material (4 percent), and Brassfield chert (2 percent).

Class 8 angular shatter (n=18) is comprised of unidentified chert (83 percent), unknown fossiliferous material (11percent), and Delaware chert (6 percent).

Class 9 microdebitage (n=12) is all (100 percent) unidentified chert.

4.3 Fire-Cracked Rock

A total of 4,613 pieces of FCR, weighing 110.15 kg, were recovered from site 33PK347. All of the material was sandstone, which is the bedrock of the area and visible as outcrops in eroded areas on the slopes around site 33PK347.

5.0 SPECIALIZED SAMPLE ANALYSES

Given the nature of the archaeological deposits present at site 33PK347, and their potential to provide significant data on small prehistoric sites in the Ohio uplands, a number of specialized analyses were conducted to aid in the interpretation of the deposits at site 33PK347. During fieldwork, samples were collected and subsequently submitted to specialists in their respective fields. Fields of analyses included site chronology based on radiocarbon dates, geomorphology and geoarchaeology, soil chemistry, dendrochronology, paleoethnobotany, starch grains, phytoliths, lipid residue, and FCR refit. Preliminary field results were used to determine which of these proposed analyses were performed. The results assist in site interpretation, including archaeological site formation and taphonomy; settlement and subsistence; and lithic selection, sourcing, and function, as outlined in the research domains.

5.1 Radiocarbon Dates and Site Chronology

The dating technique utilized to determine direct dates of site 33PK347 occupations includes AMS radiocarbon dating. In addition, artifacts that are diagnostic of a certain time period were utilized as an indirect source of dating and compared to the AMS radiocarbon dates.

5.1.1 Previous Investigations

The Phase II investigations at site 33PK347 produced one AMS radiocarbon date and two temporally diagnostic artifacts (Pecora and Burks 2014); results are presented in Table 5-1. One wood charcoal sample, taken from the base of Feature 1 produced a Late Prehistoric AMS radiocarbon date of A.D. 1260–1290 (2-sigma calibrated [95 percent probability]). A Late Archaic (4000–1000 B.C.) corner-notched Brewerton/Matanzas projectile point was recovered from the top of Feature 1, directly below the humus layer. A triangular-shaped projectile point, likely a Hamilton Incurvate type or possibly a Fort Ancient type lacking serrated edges, was recovered from the fill of Anomaly 6, which was determined to be noncultural. Hamilton Incurvate points are characteristic of the Late Woodland period (A.D. 500–1000) (Justice 1987:229) and Fort Ancient points are characteristic of the Late Prehistoric period (A.D. 1000–1650) (Justice 1987:227).

Table 5-1. AMS Radiocarbon and Diagnostic Artifact Dates for Site 33PK347, Phase II

Context	Material Dated	Conventional C14 Age	2-Sigma Calibrated Age	Time Period
Feature 1	Wood Charcoal	?	A.D. 1260–1290	Late Prehistoric
Feature 1	Corner-Notched Brewerton/Matanzas Projectile Point	n/a	n/a	Late Archaic 3000–1500 B.C.
Anomaly 6	Triangle Projectile Point	n/a	n/a	Late Prehistoric A.D. 1000–1200

5.1.2 Phase III Results

The Phase III investigations at site 33PK347 produced four AMS radiocarbon dates and two temporally diagnostic artifacts; results are presented in Table 5-2.

Table 5-2. AMS Radiocarbon and Diagnostic Artifact Dates for Site 33PK347, Phase III

Context	Material Dated	Conventional C14 Age	2-Sigma Calibrated Age	Time Period
Feature 1	Pine Wood Charcoal	2990 +/- 30 B.P.	1365–1360 B.C. 1290–1120 B.C.	Late Archaic
Feature 1	Charred Tree Sap	7320 +/- 30 B.P.	6235–6085 B.C.	Early Archaic
Feature 2	Oak Wood Charcoal	1880 +/- 30 B.P.	A.D. 770–900 A.D. 925–945	Late Woodland
Feature 2	Charred Black Walnut Nutshell	3380 +/- 30 B.P.	1745–1615 B.C.	Late Archaic
Anomaly 8	Adena Stemmed Projectile Point	n/a	n/a	Early Woodland 800–200 B.C.
Anomaly 26	Adena Stemmed Projectile Point	n/a	n/a	Early Woodland 800–200 B.C.

Four charcoal samples from the data recovery efforts at site 33PK347 were submitted to Beta Analytic, Inc., for AMS radiocarbon dating (Appendix C). Charcoal samples were taken from the Feature 1 and Feature 2 flotation-processed botanical samples, as no visible charcoal was recovered from feature fill during excavations. Samples included (1) pine (*Pinus* sp.) wood from Feature 1 (Lab ID# 33PK347F1pin; Beta ID# 421584), (2) burned tree sap from Feature 1 (Lab ID# 33PK347F1org; Beta ID# 421585), (3) oak (*Quercus* sp.) wood from Feature 2 (Lab ID# 33PK347F2oak; Beta ID# 421586), and (4) black walnut (*Juglans nigra*) nutshell from Feature 2 (Lab ID# 33PK347F2wal; Beta ID# 421587). Charcoal from Feature 1 dates to the Early Archaic period (6235-6085 B.C.) and the Late Archaic period (1365-1120 B.C.). Charcoal from Feature 2 dates to the Late Archaic period (1745-1615 B.C.) and to the Late Woodland period (A.D. 770-945).

Two Adena Stemmed, Dickson Cluster projectile points, temporally diagnostic of the Early Woodland period, were recovered from noncultural contexts at site 33PK347. One projectile point was on the ground surface of Block 8, Unit 44 (Anomaly 8), and the other was 5 cm below the surface of Block 10, Unit 67 (Anomaly 26). Both, Anomaly 8 and Anomaly 26 are interpreted as non-cultural root concentrations that included rock.

5.2 Geomorphology and Geoarchaeology

Geomorphological and geoarchaeological analyses, conducted by Nathan Scholl of Gray & Pape, were utilized to provide information regarding the nature of the buried geological deposits, examine the depositional history of the landform, and compare the data to similar landforms within the region. This information provided context to the landform on which site 33PK347 developed, and how these taphonomic processes have shaped the archaeological record at the site. During Phase III excavations, soils data were recorded and two soil cores were extracted and submitted for analysis. In conjunction with the field data, a geomorphological study was performed on the landform where site 33PK347 is located, as well as on other landforms across the PORTS area.

5.2.1 Site Overview

The ridge upon which site 33PK347 is located, rises at a less than five percent slope to the east, towards a ridge-line summit. The ridge is located approximately 50 m above the Big Beaver Creek stream channel. From site 33PK347, the landform continues to extend approximately 500 m to the west, then narrows while descending 25 m to end in a much broader, lower upland surface that may be part of a remnant glacial lake bed. The heads of two small southeast-to-northwest running erosional swales occur to the north and south of this toe-ridge landform, sloping down to the broad lower upland surface to the west of the site. East of site 33PK347, is a much longer and deeper incised drainage that has its head to the southwest (approximately 300 m) of the site; it empties into Big Beaver Creek, to the north. This eastern drainage swale, which likely contains a seasonal or spring fed stream, is a prominent topographic feature on the landscape.

The upland landscape around site 33PK347 consists of up to three landform sediment assemblage map units, including rolling uplands, uplands dissected by low order streams, and erosional swales. This landscape has been dominated and formed through a combination of glacial events and by weathering and erosion of underlying bedrock. Residual material derived from bedrock weathering and erosion mantles the bedrock surface. This residuum may have been subject to (1) remobilization and resedimentation *during* erosional cycles, and (2) additional weathering *between* erosional cycles. The interpretation of this geomorphological study of site 33PK347 proposes that Wisconsin age loess (e.g., the Wisconsin Peoria Loess) blankets the surface of the landscape. While this deposit is not conclusively loess, this and other regional interpretations (Bettis et al. 2003), as well as the county soil survey (Web Soil Survey 2015), hold it as the most likely origin of the surficial deposits. No Quaternary deposits are thought to be present in the upland surfaces of this study area.

5.2.2 Results

Mapped soils for site 33PK347 include Coolville silt loam and Rarden silt loam (Hendershot 1990). Soil profile data recorded across site 33PK347 appear consistent, both within the site boundaries and within the known profiles of the upland areas of the PORTS reservation. Site 33PK347 contained a single basic soil profile. The site surface is composed of an Ap horizon (anthropogenically disturbed A horizon) followed by an E horizon (soil with the primary organic and mineral coating stripped away leaving the natural lighter color of quartz), then by a series of Bt horizons (well-developed soil horizons that have accumulated clay through its downward vertical movement) that extend down to the interface with bedrock. The typical site soil profile, as taken in core samples and described in Tables 5-3 and 5-4, was an Ap-E-Bt-Bt2-2Bt-2Bt2 sequence (See *Section 2.4.1* for a detailed description of soil sequences). Figure 5-1 shows the profile of soil Core 1 and Figure 5-2 shows this same typical soil profile as it was encountered during excavations (Block 19). Soil profile descriptions most closely match the description for the Coolville soil series, which is well drained eolian loess on bedrock residuum found on hill summits and benches (Hendershot 1990).

Table 5-3. Profile Descriptions of Soil Core 1 (Feature 1)				
Depth Below Surface (cm)	**Landform Sediment Assemblage**	**Stratigraphic Unit**	**Soil Horizon**	**Description**
0–6	Loess-Mantled Summits (ULMS)	Wisconsin Glacial loess (SU 1)	Ap	Dark grayish brown (10YR 4/3); silt loam; strong medium granular structure; friable; many very fine roots; clear lower boundary.
6–14			E	Pale brown (10YR 6/3); silt loam; strong fine platy structure; firm clear lower boundary.
14–22			Bt	Brownish yellow (10YR 6/6); silt loam; strong medium angular blocky structure; firm; many fine distinct very pale brown (10YR 7/3) clay skins some on ped (a unit of soil structure) faces; clear lower boundary.
22–31			Bt2	Yellowish brown (10YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; clear lower boundary.
31–45		Residuum (SU 2)	2Bt	Strong brown (7.5YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; gradual lower boundary.
45–60			2Bt2	Strong brown (7.5YR 5/6); silty clay loam; strong medium subangular blocky structure; very firm; many prominent light yellowish brown (10YR 6/4) clay skins on ped faces; many coarse shale and few coarse sandstone gravels.

Table 5-4. Profile Descriptions of Soil Core 2 (Control Sample)				
Depth Below Surface (cm)	**Landform Sediment Assemblage**	**Stratigraphic Unit**	**Soil Horizon**	**Description**
0–5	Loess-Mantled Summits (ULMS)	Wisconsin Glacial loess (SU 1)	Ap	Dark grayish brown (10YR 4/3); silt loam; strong medium granular structure; friable; many very fine roots; clear lower boundary.
5–15			E	Pale brown (10YR 6/3); silt loam; strong fine platy structure; firm clear lower boundary.
15–23			Bt	Brownish yellow (10YR 6/6); silt loam; strong medium angular blocky structure; firm; many fine distinct very pale brown (10YR 7/3) clay skins some on ped faces; clear lower boundary.
23–30			Bt2	Yellowish brown (10YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; clear lower boundary.
30–60		Residuum (SU 2)	2Bt	Strong brown (7.5YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; gradual lower boundary.

Figure 5-1. Profile of soil Core 1, exhibiting Ap-E-Bt soil horizon sequence.

Figure 5-2. East wall profile of Block 19, exhibiting Ap-E-Bt-Bt2 soil horizon sequence.

Two distinct Stratigraphic Units (SU) were observed in the soil profiles (Figure 5-3). At the surface of site 33PK347 is SU 1, a silty loam unit that appears to have formed in glacial loess, likely deposited after the Wisconsin glacial period. The second unit, SU 2, directly underlies SU 1; it is a silty clay loam formed in the residuum of the shale and sandstone bedrocks present in the area. These units are characterized by the soils that comprise them (Tables 5-3 and 5-4); SU 1 consists of the Ap-E- Bt-Bt2 horizons, while SU 2 consists of the 2Bt-2Bt2 horizons. No buried A horizon is located at the interface between the two SUs, indicating that some period of erosion occurred at site 33PK347 just prior to the deposition of the SU 1 loess sediments.

Figure 5-3. Soil Core 1 and soil Core 2 samples, exhibiting the SU 1 and SU 2 profile sequence.

5.2.3 Discussion

The landform site 33PK347 is located on falls under the Upland Loess-Mantled Summit (ULMS) Landform Sediment Assemblage (LSA) (Table 5-5). Site 33PK347 sits on part of a relatively broad, but heavily dissected, upland divide that serves as the drainage divide between the Big Beaver Creek and the Scioto River. A majority of the PORTS area appears to be made up of this LSA.

Table 5-5. Landform Sediment Assemblage at Site 33PK347

LSA	Stratigraphic Unit		Description
Loess-Mantled Summits (ULMS)	SU 1	Wisconsin Glacial loess	Dark grayish brown to yellowish brown/ silt loam - silty clay loam/ massive.
	SU 2	Residuum	Strong brown/ silty clay loam-clay loam with bedrock fragment inclusions/ massive

The ULMS LSA surface is underlain by two SUs, which consist of what appears to be a cap of silty late Wisconsin Peoria Loess (SU 1). SU 1 is approximately 30 cm thick. It is preserved on almost all upland landscape locations, but may be somewhat eroded, as the A horizon is only 5–6 cm thick. SU 1 has a silt loam texture that exhibits grayish brown to yellowish brown colors (10YR hues) and is too thin to be calcareous. SU 1 is underlain by a silty clay loam bedrock residuum that makes up SU 2. SU 2 has a silty clay loam texture, with matrix-supported pebble to cobble sized rocks ranging from few to abundant. Colors appear to be predominately strong brown (7.5YR hues). The contact between the Wisconsin loess (SU 1) and the residuum (SU 2) is differentiated by the somewhat sudden increase in the clay particle size of SU 2. The maximum thickness of SU 2 is not known; however, bedrock was encountered at 60 cm below surface in Block 11. The Coolville soil profile description indicates that this soil can reach depths of 1.5 m below surface.

Out of these units, the late Wisconsin Peoria Loess is the youngest of the upland material. The Wisconsin depositional period is generally considered to have ended by about 10,500–10,000 B.C. (Willman and Frye 1970), before the verifiable age of the peopling of this part of Ohio. As such, cultural deposits from any period will be surface manifestations where the ULMS LSA is found or, at best, buried shallowly (less than 25 cm) by loess-derived erosion deposits.

5.2.4 Summary and Conclusions

In sum, the toe ridge landform was formed primarily through erosional processes. The landform is comprised of two stratigraphic units: SU 1 is a late Wisconsin-age loess deposit, while SU 2 is a residuum that has been forming in place since the bedrock it derives from first began to weather. No significant additional sediment has been deposited on site 33PK347 since SU 1. Given the antiquity of these sediments and soils, any cultural deposits would have been deposited on essentially the modern surface of the landform. It is possible that some ground surface erosion has taken place that may have washed sediments onto site 33PK347 from higher surfaces to the east; however, it is likely that any such erosional processes would have also removed sediments from the site, making any sediment loss or gain neutral. Such a process may have helped shallowly bury cultural deposits below the modern surface.

Surface erosion has likely occurred at site 33PK347 in the recent past. The denuding of the landscape in historical times for agricultural or logging purposes created a situation where upland sediments could easily erode due to a lack of vegetation cover to hold them in place. This most certainly took place at site 33PK347, as the A horizon is much thinner (0–6 cm) than the average thickness of 20 cm for a Coolville soil series A horizon. If the A horizon eroded after agricultural clearing of the landform occurred and has only just begun to reform in the last 60 years (since being purchased by the AEC), then an incipient A horizon has formed from the addition of decayed organic material to the top of the E horizon. The E horizon itself (and the soil horizons below it) appear to be undisturbed by anthropogenic processes. Any artifacts found in the soils below the A horizon likely have been transported there through natural bioturbation. Due to the erosion of the A horizon, it may be that any artifact not from a feature context at site 33PK347 is not in its original context.

5.3 Soil Chemistry Analysis

Soil chemical data have the potential to provide important clues to feature function and activity areas within an archaeological site, when interpretation is difficult to determine from artifact data alone. Soil chemical analysis as an interpretive tool in archaeology lies in its ability to predict archaeologically significant features based on chemical signatures. Soil chemical analysis was conducted to gain insight into site taphonomy and to look for the presence of cultural markers within activity areas at site 33PK347.

5.3.1 Results

During data recovery efforts, three soil samples were taken from (1) Feature 1 fill, (2) Feature 2 fill, and (3) a control sample (Block 11, Unit 71) for purposes of better understanding the differences between the natural and cultural modification of site soils. The samples were submitted to Spectrum Analytic, Inc. for chemical analysis; results were sent to Nathan Scholl, of Gray & Pape, for archaeological interpretation.

Chemical analysis of the soils at site 33PK347 indicate that some differences exist in element concentrations between Feature 1 and Feature 2; however, the majority of element frequencies are indistinguishable between cultural (features) and natural (control sample) contexts. Results of the multi-element analysis of three soil samples (Feature 1, Feature 2, and a control sample) by Spectrum Analytic, Inc. are presented in Table 5-6. The original analysis contained a large suite of measurements, some of which do not pertain to this study and are, therefore, not included in Table 5-6. The complete report, including results and interpretations, can be found in Appendix E. While no statistical analysis was performed to mathematically prove the elemental relationships discussed, frequency differences thought to be significant to site 33PK347 and its interpretation are presented.

Table 5-6. Soil Chemical Analysis of Samples from Site 33PK347			
Element	**Feature 1**	**Feature 2**	**Control Sample**
Soil pH	4.5	4.8	4.8
Organic Matter	1.80%	1.00%	0.10%
CEC	12.9	13.5	12.9
K Saturation	0.90%	1.00%	0.80%
Mg Saturation	2.80%	3.60%	2.40%
Ca Saturation	3.40%	6.80%	3.90%
Phosphorus	3 ppm	32 ppm	2 ppm
Potassium	54 ppm	64 ppm	46 ppm
Magnesium	50 ppm	66 ppm	42 ppm
Calcium	118 ppm	246 ppm	136 ppm
Sulfur	11 ppm	10 ppm	12 ppm
Boron	0.3 ppm	0.1 ppm	0.1 ppm
Copper	0.2 ppm	0.6 ppm	0.4 ppm
Iron	240 ppm	70 ppm	101 ppm
Manganese	10 ppm	13 ppm	6 ppm
Zinc	1.2 ppm	2.8 ppm	1.7 ppm

Human activity generates waste and debris, most of which eventually finds their way into the soil. Large debris are typically deposited in designated midden/trash areas. The remaining fine-grained or liquid material, however, enters the soil directly where it was discarded. Fine-grained debris would include material from craft activities (flint knapping, woodworking, ceramic manufacture, etc.), cooking and consumption (including ash from fires), detritus carried in on feet and clothing, and human waste. Because activity is not conducted uniformly across an occupied surface, some residues will be more concentrated than others. Research has consistently linked higher concentrations of select elements (barium, calcium, lead, phosphorus, potassium, strontium, and zinc) to functional areas, while other elements (boron, copper, magnesium, manganese, and sulfur) are, at the moment, less understood (Arrhenius 1963; Middleton and Price 1996).

Food preparation and consumption activities involving organic matter result in the production and deposition of elemental phosphorus (from organic food or human waste) and calcium (from faunal bone and shell) (Cook and Heizer 1962, 1965). Identifying concentrations of these chemical elements is one way to detect activity areas. Phosphorus levels are high in Feature 2 when compared to the other two samples; the levels in Feature 1 and the control sample appear to be almost depleted (Table 5-6). This evidence suggests that Feature 2 is anthropogenic. Additionally, Feature 2 has an elevated calcium level, which adds to the evidence that it is a cultural feature that was utilized for domestic purposes.

Areas of thermal activity are characterized by high levels of potassium, due to elemental deposits of wood ash/charcoal. No concentrations of potassium were noted in the samples analyzed (Table 5-6). This is surprising, since Features 1 and 2 are FCR-filled pits, which suggests that they were thermal features from which wood ash should have left a potassium marker. However, it is possible that the potassium has leached out of the features over time.

The elevated level of iron in Feature 1 is likely attributable to the amount of iron-rich sandstone FCR in the Feature (Table 5-6). But that brings up the question of why Feature 2, also filled with iron-rich sandstone FCR, would not have high levels of iron as well.

5.3.2 Discussion

Results of soil chemical analysis appear to provide information regarding the natural ridgetop soils at site 33PK347, rather than providing evidence of anthropogenic activity (Table 5-6). Acidic soil pH corresponds to the acidity of soils in the region, which originate from acidic, clayey shale and siltstone parent materials. Low levels of organic matter, cation exchange capacity, potassium saturation, magnesium saturation, calcium saturation, and boron provide evidence of nutritionally depleted soils. This depletion may be from erosional forces and/or historical agricultural activity. Concentration levels of magnesium, sulfur, copper, manganese, and zinc are indistinguishable between the cultural features and the non-cultural control sample, providing no clear evidence of anthropogenic activity at the site. What the results do confirm, however, is that the soils within Feature 1 and Feature 2 are from the ridgetop and were not brought in for any special purposes.

Many human activities (food preparation, hearths, midden, human waste, and craft activities) can add element loadings to soils; however, there are a host of natural and anthropogenic processes may ultimately affect total soil concentrations. For example, background variation linked to differences in geology and hydrology can result in patterns of element concentrations not connected to archaeology. Additionally, post-depositional soil processes, such as leaching, gleying, podsolization, erosion, and historical farming, may influence element concentrations in the soil. Interpretation of element concentration patterns in the soils at site 33PK347 are problematic for two reasons. First, given that just two features characterize the site, the test sample may be too small to effectively show chemical soil patterns associated with feature function. And second, the effects of post-depositional soil processes (erosion, historical logging, and possible agricultural/pasture use) at an archaeological site where prehistoric features are shallow, are likely to affect results.

5.3.3 Summary and Conclusions

In sum, a basic multielement chemical analysis of three soil samples (Feature 1, Feature 2, and a control sample) from site 33PK347 provide some evidence for domestic activity in Feature 2, but not in Feature 1, based on elevated levels of potassium and calcium. A lack of potassium (indicative of wood ash/charcoal) in both FCR-filled features is surprising. Given that only two features characterize site 33PK347, enough data to provide patterns for site activity areas was not identified. Generally speaking, results of the chemical analysis demonstrates that the ridgetop soils are depleted of nutrients and organic matter, which is likely associated with erosion.

5.4 Dendrochronology

A dendrochronology study was conducted by Karen Leone and Marcia Vehling, of Gray & Pape, to provide insight into the age of the forest surrounding site 33PK347, as well as any environmental stressors that may have affected tree growth in the area. During data recovery efforts, four live tree cores were taken from (1) a median-sized oak (*Quercus* sp.) located within site 33PK347 boundaries, (2) a large oak located within site boundaries, (3) a large oak located in the drainage area north of the site, and (4) a large shagbark hickory (*Carya ovata*) located in the drainage area south of the site. The complete report, including results and interpretations, can be found in Appendix F.

5.4.1 Results

Analysis of a small sample of hardwood oak (*Quercus* sp.; n=3) and hickory (*Carya ovata;* n=1) tree cores within and around site 33PK347 provides a wide range of ages. The core samples were taken from live trees; therefore, tree ring data is complete from the center to the bark edge—showing early wood and late wood components of each growth ring from the time the tree sprouted through to August 2015. Tree ring dates from the four trees analyzed show ages of 29 years and 92 years within the boundaries of site 33PK347, 38 years in the north drainage, and 128 years in the south drainage (Table 5-7). No fire scars were observed on the trees sampled nor on any surrounding trees; however, without cutting down the trees sampled to see a complete cross-section of the growth rings, minor fire damage in any given year cannot be ruled out.

Table 5-7. Tree Ring Data from Site 33PK347, Phase III

Sample	Provenience	Taxonomic Classification	Number of Rings	Calendar Years
1	On-Site median-sized 96 cm above surface	Oak (*Quercus* sp.)	29	1986–2015
2	On-Site largest tree 115 cm above surface	Oak (*Quercus* sp.)	92	1923–2015
3	Off Site North Drainage largest tree 111 cm above surface	Oak (*Quercus* sp.)	38	1977–2015
4	Off Site South Drainage largest tree 118 cm above surface	Shagbark Hickory (*Carya ovata*)	128	1887–2015

Sample 1 represented a median-sized tree within the boundaries of site 33PK347. This tree size was chosen intentionally, to demonstrate the average age of the forest on the ridgetop. Sample 1 came from an oak and provided a tree ring date of 29 years, representing a chronology dating from 1987–2015. The core was extracted 96 cm up from the base of the tree (ground surface).

Examination of the growth ring sizes over its lifespan exhibited short periods of growth stress and growth spurts (Figure 5-4). Annual growth was greatest in the first three years of life (8–10 mm ring widths) and slowest from 2011–2014 (1.4–2 mm ring widths).

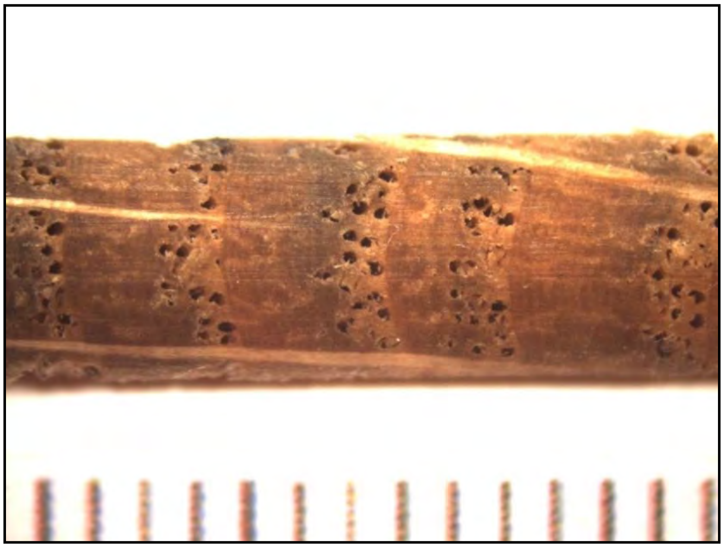

Figure 5-4. Growth rings, Sample 1 (oak); mm scale at the bottom.

Sample 2 represented the oldest tree (based on its circumference) within the boundaries of site 33PK347. The sample came from an oak and provided a tree ring date of 92 years, representing a chronology dating from 1923–2015. The core was extracted 115 cm up from the base of the tree. Examination of the growth ring sizes over its lifespan exhibited periods of growth stress and growth spurts (Figure 5-5). Annual growth was highest from 1978–1980 (6–7.5 mm ring widths) and slowest from 1947–1972 (1 mm ring widths).

Figure 5-5. Growth rings, Sample 2 (oak); mm scale at the bottom.

Sample 3 represented the oldest tree (based on its circumference) located in the north drainage outside the boundaries of site 33PK347. The sample came from an oak and provided a tree ring date of 38 years, representing a chronology dating from 1977–2015. The core was extracted 111 cm up from the base of the tree. Examination of the growth ring sizes over its lifespan exhibited short periods of growth stress and growth spurts (Figure 5-6). Annual growth was highest from 1986–1995 (4–5 mm ring widths) and slowest from 2011–2014 (2–3 mm ring widths).

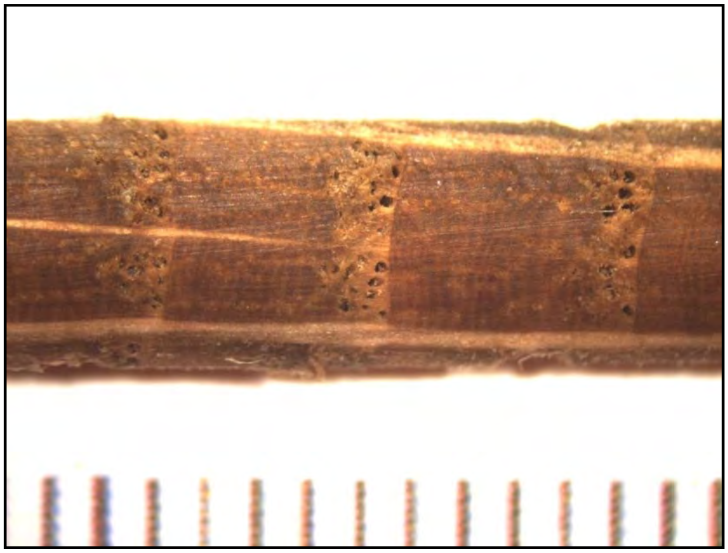

Figure 5-6. Growth rings, Sample 3 (oak); mm scale at the bottom.

Sample 4 represented the oldest tree (based on its circumference) located in the south drainage outside the boundaries of site 33PK347. The sample came from a shagbark hickory and provided a tree ring date of 128 years, representing a chronology dating from 1887–2015. The core was extracted 118 cm up from the base of the tree. Examination of the growth ring sizes over its lifespan exhibited periods of growth stress and growth spurts (Figure 5-7). Annual growth was highest in the first two years of life (5 mm ring widths) and slowest from 1935–1964 (0.3 mm ring widths).

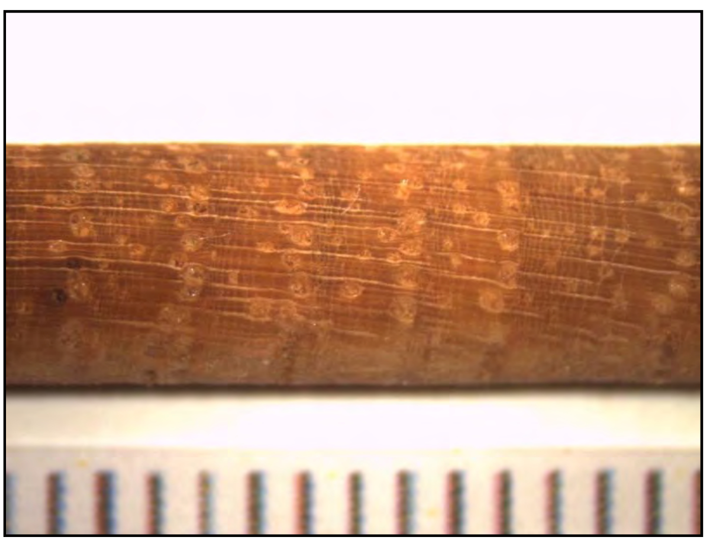

Figure 5-7. Growth rings, Sample 4 (shagbark hickory); mm scale at the bottom.

5.4.2 Discussion

The sample size of the dendrochronology study at site 33PK347 is small, but provides some important information regarding forest age and landscape utilization. Based on the age of the median-sized tree on-site (Sample 1), the evidence supports a generally young age (29 years) of the forest on the ridgetop landform. The young age of the forest, however, does not necessarily imply clearcutting was taking place on this ridgetop. Given that it was possible to locate some older trees on-site (Sample 2; 92 years) and in the south drainage (Sample 4; 128 years), the evidence seems to contradict the possibility of clearcutting of the forest after 1887. However, selective logging, which includes only the cutting of trees with the highest value while leaving those with lower value, cannot be ruled out.

Periods of slow growth in the trees sampled provided an indicator of environmental stress. To determine the source of this stressor, the sample data were compared to precipitation records for the area. Figure 5-8 illustrates the annual growth ring width for each sample analyzed. Growth stress from 2011–2014 was notable for all of the oaks: the on-site median oak (Sample 1), the north drainage oak (Sample 3), and to a slightly lesser degree for the large on-site oak (Sample 2). Sample 2 showed growth stress from 1947–1972, before Sample 1 and Sample 3 existed. In contrast, the old hickory in the south drainage (Sample 4) did not show any growth stress from 2011–2014 but showed a great degree of growth stress from 1935–1964. Annual climatological data from the National Weather Service/National Oceanic & Atmospheric Administration (NOAA) for Piketon AEC Pump Station, Waverly, and Portsmouth, Ohio stations, shows monthly and annual precipitation totals as far back as 1898. No records for consecutive years of low rainfall data were found (NOAA 2015). Furthermore, droughts or severe dry spells occur about one year per decade in Ohio, rather than for years at a time. Notable droughts have occurred in 1895, 1931, 1934, 1954, 1961, 1987, and 1999 (Ohio Memory 2014). No drought lasted for more than a single year; therefore, the conclusion is that the growth stress affecting the sampled trees was not caused by lack of water.

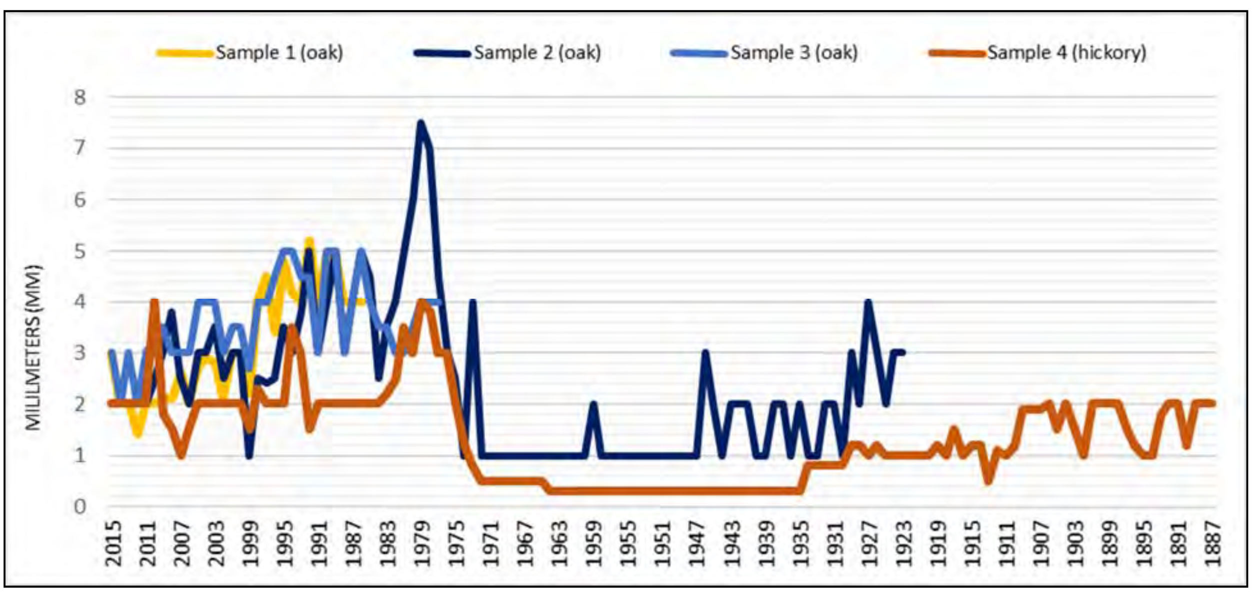

Figure 5-8. Annual growth ring widths of tree cores at site 33PK347.

Other factors that can affect tree growth include pests and disease. Pest infestations and disease can affect areas for many years at a time and, therefore, are most likely the cause of the growth stress seen in the sampled trees. Periodic occurrences of decline and death of oaks over widespread areas have been recorded in Ohio since 1900 (Wargo et al. 1983). These outbreaks are caused by a complex interaction of environmental stresses and pests. Trees are weakened by environmental stresses, such as drought, excess rain, frosts, or pests. The weakened trees are then invaded by pests and diseases that cannot otherwise successfully attack healthy trees. Usually the progression of decline is slow, occurring over many years. Of these potential pests, European Gypsy Moth (*Lymantria dispar*), common oak moth (*Phoberia atomaris*), half-wing geometer (*Phigalia titea*), Scarlet Oak Sawfly (*Caliroa quercuscoccineae*), tent caterpillar (*Malacosoma americanum*), jumping oak gall (*Neuroterus* sp.), oak wilt (*Ceratocystis fagacearum*), *Armillaria* root rot, two-lined chestnut borers (*Agrilus bilineatus*), *Hypoxylon* canker, and *Phytophthora* can work singly or in multiples to defoliate and weaken oak trees in Ohio. The most recent outbreaks affecting oak forests in southern Ohio have taken place from 2010 through 2013 (2013 is the latest report available) and are attributed to a Gypsy Moth infestation following drought conditions in 2009 (ODNR 2013). These dates correspond to the stress growth dates reported in Samples 1, 2, and 3, from 2011-2014. The Gypsy Moth was first eradicated in Ohio in 1914 and there have been over forty eradication projects in the state since then (ODNR 2015). No details could be found indicating exactly where these infestations and eradications took place.

The growth ring data for the hickory show different patterning than for the oaks. Hickories are affected by at least 133 known fungi and other diseases. Most of the fungi are saprophytes (feeding on trees that are already dead) but a few can cause damage to foliage, produce cankers, or cause trunk/root rot (Hepting 1971:658). No reports were found of large-scale hickory blights or infestations in Ohio, but this may be due to growth habit. Hickories are consistently present in oak-hickory forest associations at a rate of 20–30 percent; however, they grow singly and not in solid stands where infestations and blights might spread more quickly and completely. Sample 4 shows growth stress from 1935–1964. This is not attributed to a three-decade-long drought; therefore, pests or diseases are the most likely explanation.

5.4.3 Summary and Conclusions

Four tree core samples were analyzed within and outside the boundaries of site 33PK347. Despite the small sample size, some important information was gathered. Although median tree size of the forest provides an age of about 29 years, the forest was not previously clear-cut. Much older tree ages of 92 and 128 years suggest that this landform may have been subjected to selective logging during historical times. Growth stress indicators in the annual growth rings of the samples are more indicative of pest and disease infestation and infections rather than drought conditions. Such indicators include (1) a one-time period of stress (2011–2014), affecting all oak samples, that corresponds to a recorded Gypsy Moth outbreak in the region; (2) growth stress periods are generally similar in the oaks, but different than the hickory, which likely indicates species-specific infestation and/or infection outbreaks; and (3) the growth stress periods indicated in the analyzed samples last longer than any droughts recorded in Ohio.

5.5 Paleoethnobotanical Analysis

Paleoethnobotanical analysis was conducted by Karen Leone, of Gray & Pape, to gain insight into subsistence practices, environmental reconstruction, seasonality of occupation, and feature function. During Phase III data recovery, one soil sample from each feature were collected for flotation-processing and macrobotanical analysis. Similar analysis was conducted during Phase II archaeological investigations: two soil samples from each feature were analyzed for macrobotanical remains (Leone 2014). This section includes a comprehensive discussion of the botanical assemblages from Feature 1 and Feature 2. The full report is in Appendix G.

Three soil samples from Feature 1 and three soil samples from Feature 2 had a combined volume of 106 liters (L) and produced a total of 627 pieces (7.18 g) of charred plant remains, yielding a plant density of 5.91 specimens per liter (n/L), or 0.07 grams per liter (g/L) (Table 5-8). Individually, Feature 1 had a plant density of 10.24 n/L (0.11 g/L), while Feature 2 had a plant density of 2.05 n/L (0.03 g/L). Two plant categories were identified, including (1) wood and (2) nuts; however, the nut assemblage is represented by a single tiny (0.006 g) nutshell fragment—likely an incidental inclusion. No seeds were recovered.

Table 5-8. Botanical Summary for Site 33PK347, Phase II and Phase III.

Plant Class	Count (n)	Weight (g)	Density n / L	Density g / L	Percent of Plant Assemblage (%)	Context Ubiquity (n=2) (%)
Wood	626	7.17	5.91	0.07	99.8	100
Nuts	1	0.006	<.01	<.01	0.2	50
Total	627	7.18	5.91	0.07	100	
Number of Samples: 6		Number of Contexts: 2			Total Liters of Soil: 106	

5.5.1 Environmental Reconstruction

Site 33PK347 is located on an upland ridgetop setting in Pike County, Ohio. It lies within the Mesophytic Forest region of the deciduous forests of North America, as described by Braun (1950, 1989), and, more specifically, within mixed-oak forest associations, as described by Gordon (1969). Mixed-oak forests include a number of oak species and are interspersed with hickory and other secondary growth hardwoods. The wood assemblage was dominated by oak, but also included hickory and pine. These taxa correspond with those that would have been available to the occupants of site 33PK347. The fuel wood was likely gathered deadfall from the general area; no evidence was found in the botanical assemblage to suggest that any one species was targeted as a fuel choice.

5.5.2 Subsistence, Seasonality, and Feature Function

Given that the botanical assemblage consisted almost solely of wood charcoal (99.8 percent), no subsistence or seasonality information can be gleaned from the data. No plant food remains were recovered and it is often from their season of ripening, as well as the ripening season of incidental seed rain, that season of occupation is inferred.

Furthermore, little can be said regarding feature function other than what the features were *not* used for at site 33PK347. Based on the macrobotanical assemblage, the shallow FCR-filled pits (Feature 1 and Feature 2) were not used for domestic purposes that might include plant food harvesting/processing or plant food preparation in large quantities, where accidental spillage leaves behind evidence of the activity. Although the wood quantity recovered from Feature 1 is approximately 3.5 times (by weight) that of Feature 2, wood species diversity is similar enough between the two features to suggest that the two pits were likely used for the same purpose.

In sum, site 33PK347 is a multicomponent archaeological site that contained extremely low frequencies of wood charcoal, suggesting that this was not a locale used for plant food harvest/processing or large quantity food preparation. Wood accounts for 99.8 percent of the botanical assemblage. This fact, along with the concentration of FCR within shallow pit features indicates that thermal activity was a component of feature function and site function, which may have focused on nondomestic logistical activities requiring short durations of stay.

5.6 Starch Grain Analysis

Starch grain analysis was conducted by Ruth Dickau, of HD Analytical Solutions, Inc. The analysis was conducted in order to provide evidence regarding the function of the FCR-filled pits identified as Feature 1 and Feature 2. A sample of FCR and adhering soils from Feature 1 and Feature 2 was submitted for analysis. The results are summarized below. For the full report, see Appendix H.

Starch grains are microscopic particles used by plants to store energy, usually for regrowth or germination. They are made up of alternating layers of amylose and amylopectin, which gives them a quasi-crystalline molecular structure that, when undamaged, causes birefringence (the formation of an interference cross) under cross-polarized light (Fullagar 2006; Haslam 2004; Loy 1994). Starch grains have been found to preserve for long periods of time on the surface of archaeological artifacts used in processing plant material, presumably in micro-crevices where they are protected from enzymatic degradation. Their morphology can be diagnostic to the level of genus or species, permitting taxonomic identification of plants used and processed by people in the past (Dickau et al. 2007; Loy 1994; Messner 2011; Piperno and Holst 1998; Reichert 1913; Torrence and Barton 2006).

5.6.1 Results

No starch was recovered from the FCR in Feature 1 or Feature 2. This suggests that either no starchy plants were being processed in the features, or that starch residues did not preserve. Given that the concentration of FCR in the two features indicates thermal activity, and the FCR was formed through exposure to high temperatures, a high probability exists that any starch residues that might have been present at the time of feature use have been destroyed.

5.6.2 Discussion

Generally, starch grains begin to gelatinize and deteriorate in the presence of moisture at temperatures as low as 65°C, and most are destroyed when exposed to temperatures above 80°C for sustained periods of time (Biliaderis 2009; Gott et al. 2006; Henry et al. 2009; Reichert 1913). However, evidence is accumulating that some starch grains are resistant to heat, and can survive baking in earth ovens, dry roasting, or even on FCR from hearth features (e.g., Chandler-Ezell et al. 2006; Crowther 2012; Cummings 2006; Messner and Schindler 2010; Thoms et al. 2014). Based on the sample evidence, it is not possible to determine whether the absence of starch residues represents evidence of absence, or if it represents taphonomic processes resulting in poor preservation.

5.6.3 Summary and Conclusions

In sum, starch analysis was undertaken on FCR from Feature 1 and Feature 2 at site 33PK347. Results revealed that either no starchy plants were being processed in the features, or alternatively that starch grains did not preserve, possibly due to exposure to high temperatures during feature formation.

5.7 Phytolith Analysis

Phytolith analysis was conducted by Ruth Dickau, of HD Analytical Solutions, Inc. The analysis was conducted in order to provide evidence regarding the function of the FCR-filled pits identified as Feature 1 and Feature 2. Sediments around the FCR of Feature 1 and Feature 2 were submitted for analysis along with a control sediment sample from Block 11, Unit 71. The results are summarized below. For the full report, see Appendix H.

Phytoliths are bodies of biosilica, formed in the cells or cell walls of certain plants. These plants take up dissolved silica from ground water, and deposit it in certain tissues for structural support, physiological functions, or protection against herbivores and fungi. The formation of phytoliths is under genetic control, and only occurs in certain plant taxa. Phytolith systematics are complicated by the factors of multiplicity (more than one phytolith morphotype may be produced in the same species) and redundancy (similar morphotypes may be produced across different taxa) (Piperno 2006; Rapp and Mulholland 1992; Rovner 1971). For this reason, taxonomic levels of identification vary considerably. Because phytoliths are made of silica, they preserve well in most contexts. They may be recovered from artifact residues, dental calculus, and terrestrial sediments, where they left behind long after the decay of the original plant material. Phytoliths can also be recovered from lake cores, where they have been introduced from the surrounding vegetation.

5.7.1 Results

Table 5-9 presents a summary of phytolith morphotypes and their taxonomic associations, recovered from the three contexts sampled. Results are reported as a percent of the total count. No economic crop species were identified in any of the samples. The phytoliths documented represent vegetation from the environment. Some small quantifiable differences between the samples were noted, which is discussed in the paragraphs below.

Table 5-9. Summary of Phytolith Frequencies from Site 33PK347				
Phytolith Morphotype	**Taxonomic Association**	**Feature 1 (%)**	**Feature 2 (%)**	**Control Sample (%)**
Cross Body	Poaceae	2.9	2.5	2.4
Rectangular Short Cell	Poaceae: cf. Arundinoideae	0	8.4	4.7
Trapezoid/Rondell	Poaceae	14.7	14.6	14.2
Domed Rondel	Poaceae: *Bromus* sp.	0.4	0	0.2
Thin Long-Shafted Bilobate	Poaceae: *Aristida* sp.	0	0.9	0.2
Bilobate	Panicoideae	39.6	31.0	29.9
Scooped Bilobate	Ehrhartoideae	0	0	0.7
Polybate	Poaceae	1.2	1.6	1.3
Collapsed Saddle	Poaceae	0.4	1.6	0.9
Saddle	Chloridoideae	3.3	4.0	4.2
Sinuate Trapezoid	Pooideae	22.9	11.1	10.2
Large Conical Polygonal Body	Cyperaceae: cf. *Carex* sp.	0.4	0	1.1
Small Conical Body	Cyperaceae	2.4	0	0.2
Faceted Elongate	woody eudicot	0	0	0.4
Sclereid	woody eudicot	0.4	1.2	0.7
Granulate Globular	woody eudicot	3.3	4.3	4.0
Echinate Globular	Arecaceae	3.3	11.2	4.4
Dendritic Irregular Body	woody eudicot	0.4	0.3	0.2
Granulate Polygonal Epidermal	woody eudicot	0.4	1.2	10.2
Blocky Irregular Body	woody eudicot	2.0	4.3	3.8
Hair Cell		0	0.3	0.7
Armed Hair Cell	select plant families	0	0	0.2
Curved Spatulate		0	0.6	3.6
Unidentified		2.0	0.9	1.6
Total		**100.0**	**100.0**	**100.0**

The phytolith assemblage from Feature 1 was dominated (88 percent) by the grass family (Poaceae). Among these, forms associated with the Panicoideae subfamily were the most frequent (40 percent) (Figure 5-9[A]), followed by forms from the Pooideae subfamily (23 percent). The majority of members in the Panicoideae subfamily are adapted to warm and humid conditions in temperate and tropical regions of the world. The Pooid grasses are adapted to cool and dry conditions and found mainly in temperate regions of the world. No maize or wild rice phytoliths were identified, despite specific scanning for them. Several phytolith types representative of arboreal (tree/shrub) taxa were documented (Figure 5-9[O]). Several arboreal phytolith morphotypes (3 percent) were found in the sample that are typically associated with tropical tree species; however, this association has not been verified for Eastern North America. In other parts of North America, the morphotype has been documented in oak trees (Blinnikov et al. 2013; McCune and Pellatt 2013; McNamee 2013), which is consistent with the forest environment at site 33PK347. More comparative work on arboreal taxa needs to be done before this morphotype can be confirmed as indicative of arboreal taxa in the eastern woodlands. Another arboreal phytolith recovered in the sample (3 percent) is diagnostic of the palm family (Arecaceae); it has not been observed in any other plant family. The presence of this morphotype in temperate zone sediment samples from Ohio is unexpected. However, this morphotype has been encountered elsewhere in North American sediments, where it has been argued that they may represent (1) ancient sediments deposited during periods of tropical climatic conditions, (2) erosion and Aeolian transportation of sediments (e.g., loess deposits), (3) modern contamination, or (4) arboreal species that have yet to be identified (Johnson and Bozarth 1996; Strömberg 2004). In addition to these arboreal morphotypes, fragments of particulate charcoal were observed in the sample from Feature 1. Despite the presence of micro-charcoal, few burnt phytoliths were observed. Only three percent of total counted phytoliths were burnt.

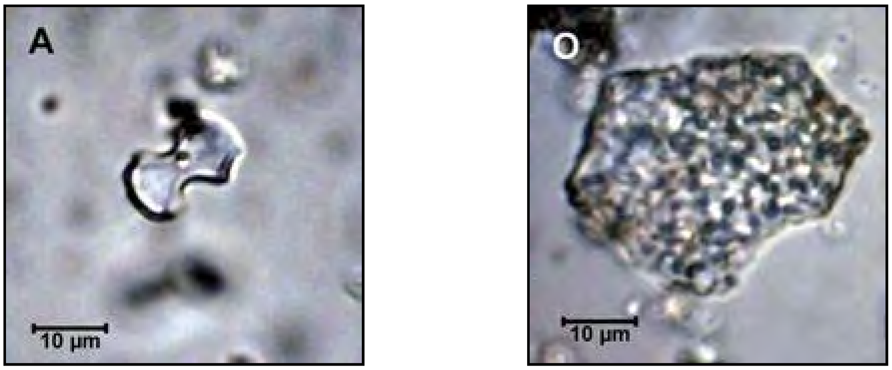

Figure 5-9. Select phytolith images from Feature 1:
A) Panicoideae bilobate; O) granulate polygonal epidermal platelet.

The phytolith assemblage from Feature 2, like Feature 1, was dominated by the grass family (76 percent), represented predominantly by Panicoideae (31 percent). Several grass phytoliths were identified that were not seen in Feature 1, including Aristida sp. (Figure 5-10[F]) and possibly the Arundinoideae subfamily. Aristida is a large grass genus found in warm and dry regions of the world. Arundinoideae is adapted to warm and humid conditions in temperate and tropical regions of the world. And conversely, grass phytoliths including Bromus sp. were observed in Feature 1 but not in Feature 2. Bromus is a large genus of the Pooideae subfamily, found in temperate regions. Cyperaceae phytoliths, representative of plants that prefer wetland habitats (e.g., *Carex* spp.), were also present in Feature 1 but absent in Feature 2. Phytoliths from trees/shrubs occurred at a higher frequency in Feature 2 (22 percent) (Figure 5-10[L]) than in Feature 1 (10 percent). Micro-charcoal was also present in Feature 2.

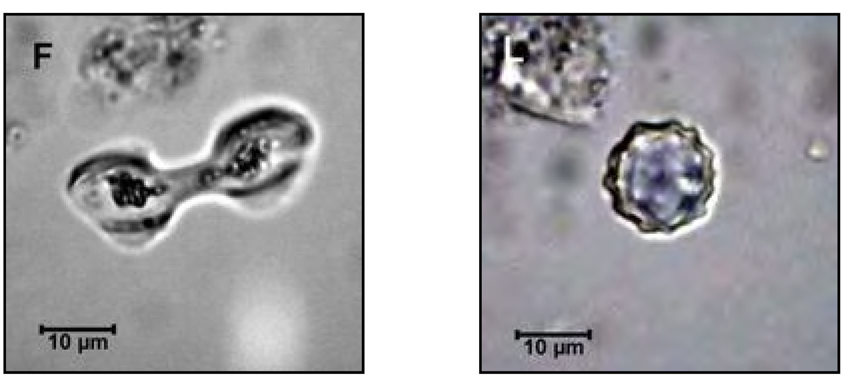

Figure 5-10. Select phytolith images from Feature 2:
F) *Aristida* thin bilobates; L) echinate globular.

The control sample yielded many of the same phytolith types observed in Feature 1 and Feature 2. Grass family phytoliths, again, dominated the assemblage (70 percent), but phytoliths from trees/shrubs were also well represented (24 percent). A few new grass (Figure 5-11[E]) and tree/shrub (Figure 5-11[K]) phytolith types were encountered in the control sample, but not in Features 1 or 2. Another morphotype recovered is produced in a limited number of plant families in the tropics, but preliminary work by Bozarth (1992) has identified it in temperate members of the legume (Fabaceae) and aster (Asteraceae) subfamilies.

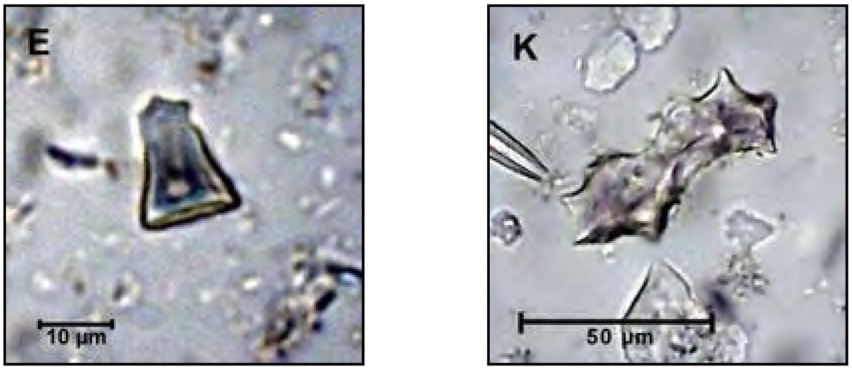

**Figure 5-11. Select phytolith images from the Control Sample:
E) Poaceae tower rondel; K) faceted elongate associated with woody eudicots.**

5.7.2 Discussion

A comparative examination of the phytolith assemblages from the two feature samples and the control sample shows that in general, they are taxonomically similar, with only some small differences. The following observations can be made.

1. In terms of grasses versus arboreal taxa frequencies, Feature 2 is more similar to the control sample than Feature 1. Feature 1 had a higher frequency of grass phytoliths and a corresponding lower frequency of arboreal phytoliths than either Feature 2 or the control sample. This higher frequency of grass phytoliths is mainly attributable to higher levels of Pooideae phytoliths, which suggests more Pooid grasses were growing near Feature 1, or were being intentionally introduced into the feature for unknown reasons.
2. In terms of morphotype frequencies, Feature 2 is more like the control sample. However, in terms of taxonomic diversity, Feature 1 is more like the control sample. Both Feature 1 and the control sample contained phytoliths from *Bromus* sp. grasses and from Cyperaceae wetland plants—taxa that were absent in Feature 2. On the other hand, Feature 2 and the control sample contained phytoliths from *Aristida* sp. grasses. It should be noted that most of these phytolith types occur in low frequencies, and their absence in a sample may simply reflect their rarity, rather than statistically significant patterns.
3. Given the composition of the feature assemblages and their similarities to the control sample, it appears that the phytolith assemblage of each feature represents background vegetation. No economic crop species were identified in the features or the control sample.

4. It is surprising that no crop species were found, given the quantity of micro-charcoal observed in the samples and the concentrations of FCR in the features. Feature 2 and the control sample had the highest percentage of burnt phytoliths (7 percent and 9 percent, respectively), whereas Feature 1 only had 3 percent burnt phytoliths. These frequencies suggest that phytolith producing plants were not being intentionally burned in the features in large quantities. Instead, the low frequencies likely reflect infrequent fire events within the general environment, such as the occasional forest or grass fire. Burnt particles and vegetation fragments from such fires, including phytoliths, can travel long distances once airborne on thermal updrafts.

The dominance of grass phytoliths in all three samples should not be interpreted as suggesting that the surrounding environment of site 33PK347 was open prairie grassland. Arboreal phytoliths are reasonably well represented within the samples. Most grasses are heavy silica producers and some of their phytoliths are often quite robust (resistant to dissolution and degradation), leading to potential over-representation in analysis (Kalisz and Boettcher 1990). Overall, the vegetation environment represented by the site 33PK347 assemblage appears to be an open wooded area, with enough light penetrating the forest canopy to permit growth of a variety of grasses and herbaceous plants. Low frequencies of wetland-adapted taxa suggest that the area was not inundated or situated in proximity to a wetland, which corresponds to the location of site 33PK347 on an upland ridge. The few phytoliths recovered from these taxa may represent occasional transport of plant parts or sediment (intentionally, or unintentionally, such as mud adhering to clothing or objects) to site 33PK347 from wet lowland areas.

5.7.3 Summary and Conclusions

Phytolith analysis was undertaken on sediment samples from Feature 1, Feature 2, and a control sample at site 33PK347. Results did not yield any evidence of economic plants, but did show that the local vegetation around site 33PK347 was an open forest with enough understory light to allow the growth of grasses. Comparison of the phytolith assemblages from the two features shows that they are quite similar. The low frequency of burnt phytoliths in both features contrasts with the artifactual evidence that FCR-filled pits are indicative of thermal activity, and reinforces the interpretation that the phytolith assemblage represents background vegetation, rather than plants being processed or burned in the features.

5.8 Lipid Residue Analysis

Lipid residue analysis was utilized to learn more about feature function. Lipid residue analysis was conducted by Benjamin Stern, of the University of Bradford, Great Britain. Lipid (fatty acid) residue analysis was performed on soils adhering to FCR from Feature 1 and Feature 2. Additionally, a control soil sample from Block 11, Unit 71, as well as a method blank created in the lab, were analyzed to determine base values and to check for contamination of the archaeological samples.

Results indicate that the three samples (Feature 1, Feature 2, and control) from site 33PK347 contain a similar range of lipid components; however, quantities were low. Lipid components and their frequencies vary in each sample; the lipids present are typical of natural soils and are not diagnostic of a particular input to the soil (see full report in Appendix I).

Identified lipid components include fatty acids (C14 to C16, and C24), unsaturated fatty acids (C18:1), sugars, triterpenoids, caffeic acid, long chain alcohol, and dicarboxylic acids. The fatty acids and unsaturated fatty acids were recovered in low quantities and are those commonly found in natural soils, including the method blank. Sugars and triterpenoids were not individually identified, but are typical plant constituents found in most soils. Lipid biomarkers for more exotic materials (such as bark, tar, and resins) were not identified. Caffeic acid is a component of lignin, a common plant material, and present in most soils. Long chain alcohol and dicarboxylic acids are also typical plant components and, therefore, not diagnostic—especially at such low levels.

In conclusion, lipids extracted from the soils of Feature 1 and Feature 2 were similar to those present in the natural soils and as such, provide no evidence for feature function.

5.9 FCR Refit Analysis

FCR refit analysis was conducted by Melissa R. Lavender, of Gray & Pape. Based on research domains outlined for Phase III data recovery at site 33PK347, the FCR collected during investigations was evaluated for refitting alongside the FCR that was collected by OVAI during the Phase II testing (Pecora and Burks 2014). Evaluating relationships between pieces of FCR recovered from both within and outside of feature contexts can provide insight into the potential cleaning, reuse, and disturbance of features.

5.9.1 Results

Of the 2,082 pieces of FCR that were examined as part of this analysis (1,487 from Phase II and 595 from Phase III), refits were found among 20 pieces. This amounts to approximately 1 percent of the specimens. The 20 pieces of FCR comprised eight Refit Groups; the details are summarized in Table 5-10. Four Refit Groups (1, 2, 6, and 7) consisted of two-piece refits, each from the same provenience (same FS numbers). The remaining four Refit Groups consisted of FCR pieces recovered from different proveniences (different FS numbers), which ranged from different levels to different locations. Refit Groups are discussed in more detail below.

Table 5-10. Fire-cracked Rock Refit Groups at Site 33PK347				
Refit Group	FCR Field Specimen Numbers and Provenience			
1	FS# 0015 Feature 2, Unit 19 628.5N 526E 0–26cmbd	FS# 0015 Feature 2, Unit 19 628.5N 526E 0–26cmbd		
2	FS# 0096 Block 17, Unit 121 609N 510E 30–40cmbd	FS# 0096 Block 17, Unit 121 609N 510E 30–40cmbd		
3	FS# 0078 Feature 1, Unit 22 630N 512E Unknown Depth	FS# 0078 Feature 1, Unit 22 630N 512E Unknown Depth	FS# 0539 50x50cm Unit 630N 511E Unknown Depth	FS# 0078 Feature 1, Unit 22 630N 512E Unknown Depth
4	FS# 0015 Feature 2, Unit 19 628.5N 526E 0–26cmbd	FS# 0574 Feature 2 16–26cmbd	FS# 0574 Feature 2 16–26cmbd	FS# 0060 Feature 2, Unit 19 628.5N 526E 0–26cmbd
5	FS# 0540 Feature 1 630N 512E 0–8cmbd	FS# 0545 Feature 1 631N 512E 0–12cmbd		
6	FS# 0575 Feature 1 6–16cmbd	FS# 0575 Feature 1 6–16cmbd		
7	FS# 0067 Feature 1, Unit 23 630N 512E 8–18cmbd	FS# 0067 Feature 1, Unit 23 630N 512E 8–18cmbd		
8	FS# 0541 Feature 1 630N 513E 0–10cmbd	FS# 0575 Feature 1 6–16cmbd		

Two pieces of FCR comprise Refit Group 1. Both pieces were recovered from Feature 2, Unit 19, 0–26 cmbd (Figure 5-12).

Figure 5-12. **Fire-cracked rock, Refit Group 1.**

Two pieces of FCR comprise Refit Group 2. Both pieces were recovered from Unit 121, 30–40 cmbd, in Stratum II (Figure 5-13).

Figure 5-13. **Fire-cracked rock, Refit Group 2.**

Four pieces of FCR comprise Refit Group 3. Three pieces were collected during Phase III investigations in Feature 1, Unit 22 (630N 512E). The fourth piece was collected during Phase II investigations in a 50- by 50-cm test unit (630N 511E) along the northern edge of the Feature. No depths were recorded for either of these two proveniences (Figure 5-14).

Figure 5-14. **Fire-cracked rock, Refit Group 3.**

Refit Group 4 also consists of four pieces of FCR. All four pieces were recovered from Feature 2. Two of the specimens were collected during Phase II investigations, at a depth of 0-26 cmbd, and two were collected during Phase III investigations, at a depth of 16-26 cmbd (Figure 5-15).

Figure 5-15. **Fire-cracked rock, Refit Group 4.**

Two pieces of FCR comprise Refit Group 5. Both pieces were recovered from 1- by 1-m units within Feature 1 during Phase II testing. One piece was recovered from Unit 630N 512E, at a depth of 0–8 cmbd; the other was recovered from Unit 631N 512E, at a depth of 0-12 cmbd (Figure 5-16).

Figure 5-16. Fire-cracked rock, Refit Group 5.

Two pieces of FCR comprise Refit Group 6. Both pieces were recovered from Feature 1, at a depth of 6–16 cmbd, during Phase II testing (Figure 5-17).

Figure 5-17. Fire-cracked rock, Refit Group 6.

Two pieces of FCR comprise Refit Group 7. Both pieces were recovered from Feature 1, Unit 23, at a depth of 8–18 cmbd during Phase III investigations (Figure 5-18).

Figure 5-18. Fire-cracked rock, Refit Group 7.

Two pieces of FCR comprise Refit Group 8. Both pieces were recovered from Feature 1 during Phase II testing. One piece was recovered from Unit 630N 513E, at a depth of 0–10 cmbd; the other had no Unit coordinates listed, but came from a depth of 6–16 cmbd (Figure 5-19).

Figure 5-19. Fire-cracked rock, Refit Group 8.

5.9.2 Discussion

Refits are made by matching specimens that possess similar qualities. Using attributes, such as color, texture, porosity, size, and fracture patterns, like pieces can be brought together. However, in the case of FCR from site 33PK347, the overall homogeneity of the FCR assemblage made refitting a difficult prospect and resulted in a low number of matches. Fine grained tabular sandstone is abundant at site 33PK347; fewer than a dozen pieces of non-sandstone FCR were observed. In fact, the local sandstone is so abundant, that after looking at the assemblage, it appears that much of what was collected during the Phase II testing, and some of what was collected during the Phase III investigations, may not be FCR but, rather, naturally occurring broken stone. Some of the sandstone showed signs of erosion; for other pieces, it was difficult to ascertain whether they were truly cracked due to thermal activity. Up to 65 percent (n=967) of the Phase II FCR assemblage and up to 25 percent (n=149) of the Phase III FCR assemblage is unmodified raw material - in other words, not FCR.

Overall, the refit results do not indicate any cleaning out of, or reuse of, FCR used in Feature 1 or Feature 2. Nor does it appear from this analysis that any significant disturbance of the FCR artifacts occurred from their initial placement. Of the eight refit matches that were made, all but one included refits that came from the same feature. The lone standout (Refit Group 3) consisted of three pieces recovered from Feature 2 and one piece that was recovered from the unit along the northern edge of Feature 2. When Feature 2 was initially described by Pecora and Burks (2014) during Phase II investigations, they noted that additional FCR was scattered around the edges of the Feature concentration. The concentration of FCR within Feature 2 was not that much denser than the scatter around it, so it could be argued that the scatter was, itself, part of the Feature. The one piece of FCR from "outside" Feature 2 could easily have been moved further away from the concentration through bioturbation, tree-fall, or a number of other mild disturbances.

5.9.3 Summary and Conclusions

All of the FCR collected during Phase II and Phase III investigations at site 33PK347 was evaluated for refitting potential. Of the 4,599 pieces recovered, 2,082 were deemed possible candidates for refit; these were labeled and analyzed. Twenty pieces were found to have matches as eight Refit Groups. The components of all matches were found within the same feature or excavation unit context, with the exception of Refit Group 3, whose matches occurred in two different contexts. However, the excavation units were in such proximity to each other that they are likely the same context (Feature 2). Much of the material showed signs of erosion and about half (54 percent) of the Phase II and Phase III refit analysis assemblage is considered to be unmodified material. This evidence, along with the homogeneity of the assemblage that derives from iron-rich (reddish) sandstone outcrops visible on the slopes around the site, suggests that much of the sandstone within the boundaries of site 33PK347 is likely natural stone eroding from the ridge, rather than prehistoric FCR created by thermal activity.

6.0 DISCUSSION

Data recovery efforts at site 33PK347 were focused on the recovery of data that would allow for the interpretation of site function, and incorporation of the site into existing models of settlement and subsistence in the middle Ohio River valley over the course of about 7,500 years, from the Early Archaic period through to the Late Prehistoric/Fort Ancient period.

In this chapter, the results presented in the body of this report are applied to the research domains that were developed to guide the research. All research domains are described in detail in Chapter 2.4. The research design was developed to provide a diversity of datasets in order to better understand this possibly undisturbed representative of small prehistoric upland sites. These archaeological site types are characterized as remnant lithic scatters or sites with single features, often with few artifacts. The ranges of variation, function, and length of occupation have not been well documented.

Investigations employed a wide range of investigative techniques, including geophysical survey, hand excavations, geomorphological analysis of soils, soil chemistry analysis, dendrochronology analysis of samples from the extant forest, paleoethnobotanical analysis of feature soils, phytolith analysis of site and feature soils, starch grain analysis of feature soils, lipid residue analysis of feature soils, artifact analysis, FCR refit analysis, radiocarbon dating of features, and an extensive document review.

Site 33PK347 covers an area of approximately 3,600 m² on an upland ridge in the northeast quadrant of the PORTS property. Excavations within the boundary of site 33PK347 have covered the site area and exposed 216.5 m², or approximately six percent, of the surface area. Table 6-1 lists the area excavated during each phase of investigations and Figure 6-1 illustrates placement of the investigative techniques across site 33PK347. This work yielded 4,809 prehistoric artifacts and two cultural features, described as large, shallow, FCR-filled, basin-shaped pits. Based on radiocarbon dates and diagnostic artifacts, site 33PK347 was the location of multiple occupations dating to the Early Archaic, Late Archaic, Early Woodland, Late Woodland, and Late Prehistoric/Fort Ancient periods (Tables 5-1 and 5-2).

Table 6-1. Investigation Summary at Site 33PK347.

Description	Value	
Phase I		
50- by 50-cm Shovel Tests	(n=21.0)	5.25 m²
Phase II		
50- by 50-cm Shovel Tests	(n=197.0)	49.25 m²
1- by 1-m Excavation Units	(n=30.5)	30.50 m²
Phase III		
50- by 50-cm Shovel Tests	(n=136.0)	34.00 m²
1- by 1-m Excavation Units	(n=97.5)	97.50 m²
Total Area Excavated		**216.50 m²**

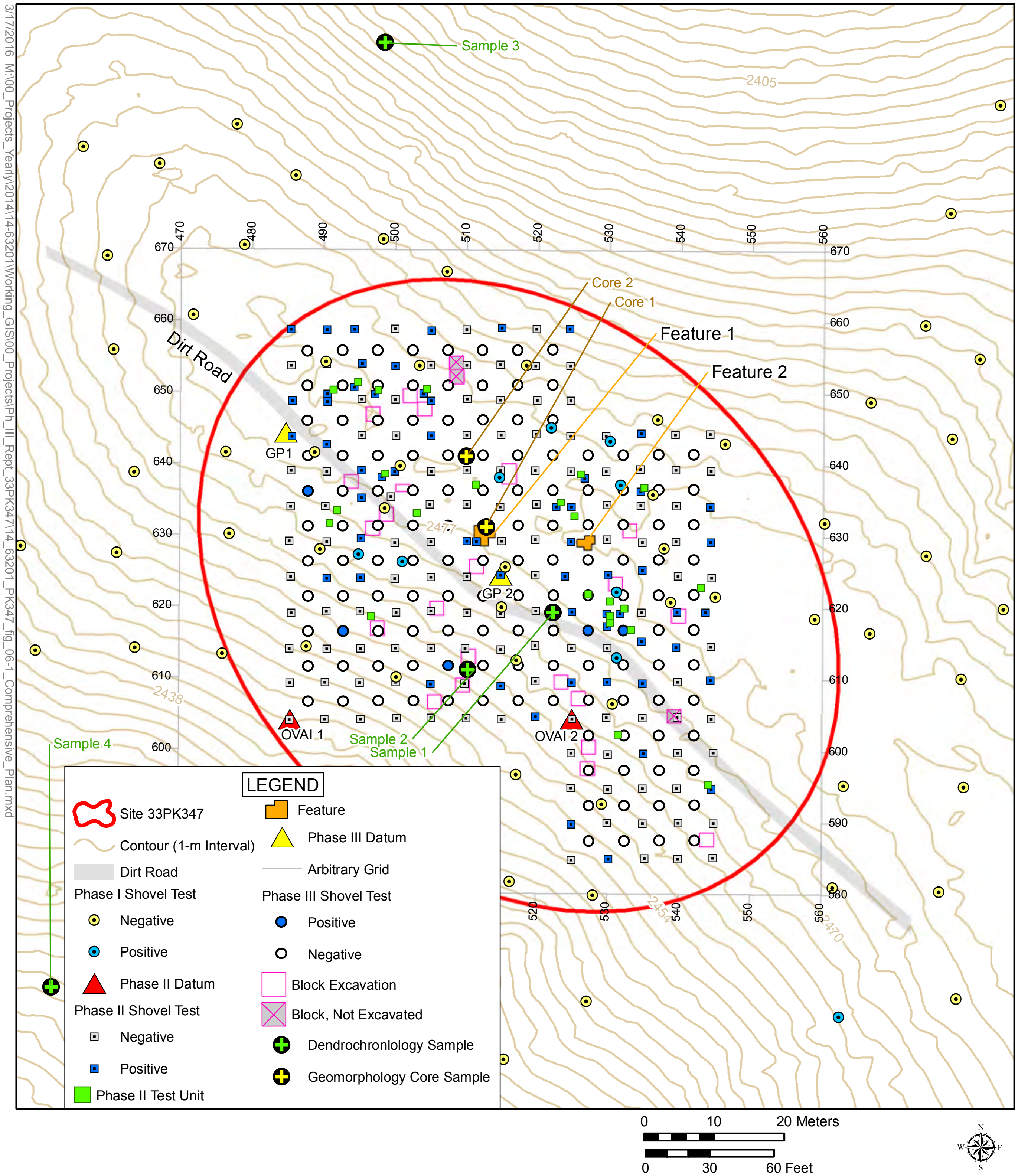

Illustration of Phase I, Phase II, and Phase III investigations, Site 33PK347.

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ARCHAEOLOGY - HISTORY - HISTORIC PRESERVATION

Figure 6-1

6.1 Research Domain 1: Site Formation and Taphonomy

The significance of site formation data for site 33PK347 lies with the possibility that the site is undisturbed by historical plowing. It is rare to encounter an archaeological site in the region that has not been affected by the plow. Therefore, obtaining near-surface data from a relatively undisturbed archaeological site would be considered extremely valuable. Geomorphology, dendrochronology, soil chemistry, radiocarbon dates, and historical document review have all been utilized to provide insight into site formation and taphonomy at site 33PK347. More specifically, these datasets were utilized to describe soil development processes that, in turn, could establish a sequence of occupation and site formation.

6.1.1 Site Formation

The geomorphological analysis describes site 33PK347 as being located on a relatively broad but heavily dissected upland ridge that serves as the drainage divide between the Big Beaver Creek and the Scioto River. The landform was formed primarily through erosional processes. Soil profiles, obtained from extensive excavation and core data, are consistent across the landform and most closely match that of the Coolville soil series described for the area (Hendershot 1990). Stratigraphic units are described as well-drained silty loam eolian loess (Stratum I) on silty clay loam bedrock residuum (Stratum II) developed from iron-rich shale and sandstone bedrock. Stratum I consists of an Ap horizon (anthropogenically disturbed A horizon) followed by an E horizon (soil with the primary organic and mineral coating stripped away leaving the natural lighter color of quartz). Stratum II includes a series of Bt horizons (well-developed soil horizons that have accumulated clay through its downward vertical movement) that extend down to the interface with bedrock. Stratum II has been forming in place since the bedrock it derives from first began to weather. Stratum I is a late Wisconsin-age loess deposited about 10,000 B.C. No additional sediment has been deposited on site 33PK347 since Stratum I was deposited. Given the antiquity of these sediments and soils, any cultural deposits would have been on, essentially, the modern surface of the landform.

6.1.2 Site Taphonomy

Surface erosion is evident at site 33PK347. The A horizon is much thinner (0–6 cm) than average (20 cm) for the Coolville soil series and it sits atop an undisturbed E horizon. Two possible explanations for the thin A horizon are suggested in the geomorphological analysis. First, the A horizon is thin because it is severely eroded. And second, the A horizon is reforming since historical clearing activity ceased.

The severe surface erosion argument for a thin A horizon is supported by several lines of evidence. The forest at site 33PK347 is not an old-growth forest; therefore, it was cleared at some time in the past—likely in the nineteenth century when the land was first settled. Dendrochronological analysis provides evidence of a generally young forest (29 years), based on average tree diameters; few older trees (92 and 128 years old) were also identified. A generally young forest with some older trees dispersed throughout may be indicative of selective logging or near-complete clearing practices. Direct evidence of clearing at site 33PK347 was not found. Historical, archival, and deed records did not provide specific information on agricultural, livestock, or timbering practices on the ridgetop where site 33PK347 is located (D. Burden, personal communication 2015). Descriptions of the area simply list ‘farming’ in the land use category, which could include agricultural and/or pasture lands. However, it is unlikely that crops have been planted on this ridge, based on the soil profile. An anthropogenically undisturbed E horizon at 5–6 cm below surface indicates that a plow, which disturbs the soils up to 20 cm below surface, did not disturb these soils. Logging as a capital venture, or as a method of clearing the land for pasture, cannot be ruled out. Nineteenth century text descriptions for Pike County, in general, describe excessive land-clearing activity (Interstate Publishing Company 1884); however, no evidence of clearing in the twentieth century texts, maps, or aerial photographs was found (Pecora 2013a).

Soil chemistry analysis provided multiple elemental indicators of depleted soils. Low levels of organic matter, cation exchange capacity, potassium saturation, magnesium saturation, calcium saturation, and boron provide evidence of nutritionally depleted soils. This evidence of depletion on a ridgetop landform is likely the result of erosional forces.

Radiocarbon dates from Feature 1 provide three dates from charred botanical material associated with the Early Archaic (6235–6085 B.C.), the Late Archaic (1365–1120 B.C.), and the Late Prehistoric/Fort Ancient (A.D. 1260–1290) periods. Radiocarbon dates from Feature 2 provide two dates from charred botanical material from the Late Archaic (1745–1615 B.C.) and the Late Woodland (A.D. 770–945) periods. The occupations represented in both features are thousands of years apart and were found mixed together in the shallow feature fill (2–14 cm below surface in Feature 1 and 6-26 cm below surface in Feature 2), which may be indicative of a deflated A horizon. Naturally accumulating forest organic material should typically separate these deposits. When erosional forces remove the lighter particles from archaeological sites, cultural deposits are ‘deflated’, resulting in debris from many occupations settling together and becoming almost impossible to interpret (Schiffer 1987:239). Erosion of soils resulting in a deflated A horizon is a likely explanation for these shallow and mixed materials that were deposited thousands of years apart.

There is little evidence to support the argument that the A horizon is new and has been reforming since clearing ceased in the nineteenth century. If it was a new, historical, A horizon, the soil chemical analysis should have identified soils that were high in organic matter and nutrient-rich, yet the analysis identified soils that were the opposite—more in accord with eroded, depleted soils. Furthermore, if the A horizon was of historical age, no artifacts would be expected to come from this level, and that was not the case; the majority of artifacts were recovered within 10 cm of the surface and one Late Archaic projectile point was recovered from the surface. Feature 1 was encountered 2–4 cm below surface.

In sum, site 33PK347 is located on an eroding ridgetop that, based on geomorphology, soil chemistry, dendrochronology, radiocarbon dates, and historical document review evidence appears to have left a deflated A horizon. The A horizon at site 33PK347 contains ephemeral archaeological evidence from prehistoric occupations spanning thousands of years that have eroded into one another and cannot be teased apart. A deflated and eroded A horizon implies that the archaeological deposits are not technically *in situ* (Schiffer 1987; Wood and Johnson 1978). Furthermore, despite considering these deposits to be in an unplowed context, it can be argued that they are, ultimately, not from an undisturbed context.

Having the opportunity to evaluate an unplowed archaeological site has proven to be less significant than expected as a result of its location on an eroding landform. The eroding upland locale has been disturbing the contexts since they were deposited. The numerous forms of special analyses conducted have provided multiple lines of evidence to support this conclusion. What does this mean for interpretation of ephemeral upland lithic scatters on eroding landforms? The answer appears to be the same as for most other archaeological sites. If a significant site is present, the evidence will remain, even if the upper levels of features are truncated and displaced from their primary context. Unfortunately, deflated A horizons that compress all temporal data into one thin stratum, do not allow for accurate temporal or cultural interpretations. The end result is similar to an archaeological site at which all cultural material is located in a plowzone, in that no vertical stratigraphy separates the occupation levels. Had there been horizontal segregation of the occupations, it may have been possible to separate material by time periods, but horizontal segregation was also lacking at site 33PK347.

6.2 Research Domain 2: Settlement and Subsistence

The significance of settlement and subsistence data for site 33PK347 lies with the possibility that the site is undisturbed by historical plowing. An undisturbed upland archaeological site may provide site structure and feature function data that often elude researchers of these site types that are typically described as ephemeral lithic scatters. Geophysical survey, geomorphology, paleoethnobotany, starch grain analysis, phytolith analysis, lipid residue analysis, soil chemistry, artifact analysis, FCR refit analysis, and radiocarbon dates have all been utilized to provide insight into settlement and subsistence at site 33PK347. More specifically, these datasets were utilized to identify site structure, feature function, subsistence-related activity, seasonality of site occupation, and to determine how site 33PK347 fits into previously described settlement systems in the region.

Site 33PK347 is characterized by two large, shallow, FCR-filled, basin-shaped pits; 14 lithic tools; 182 pieces of chipped stone debitage; and 4,613 pieces of FCR. Four diagnostic projectile points and five AMS radiocarbon dates place site 33PK347 within five temporal periods, spanning 7,500 years of prehistory, including the Early Archaic, Late Archaic, Early Woodland, Late Woodland, and Late Prehistoric/Fort Ancient periods. An exhaustive testing strategy over three phases of investigations (Figure 6-1) confirms that no other cultural features are present at site 33PK347.

6.2.1 Site Structure

The site structure of 33PK347 was well defined during Phase II investigations (Pecora and Burks 2014). Site 33PK347 includes Feature 1, Feature 2, and small areas of artifact clusters. Despite extensive Phase III investigations that were designed to enhance the understanding of site structure, no new features or artifact clusters were identified.

Artifacts at site 33PK347 have been recovered across the entire site area, with no definitive activity areas other than Feature 1 and Feature 2. Artifacts recovered during Phase III investigations added an additional 20 percent to the Phase I and Phase II artifact count; the majority (71 percent) of those came from the features (Table 4-1). For site 33PK347 as a whole, FCR frequencies are high (n=4,613) while the yield of chipped stone tools and debitage is low (n=196). One lithic tool was recovered for every 15 m^2 excavated, one piece of chipped stone debitage was recovered for every

1 m² excavated, and 21 pieces of FCR were recovered for every 1 m² excavated. Although the areas of artifact concentrations and geophysical anomalies identified during Phase II investigations were tested extensively, no cultural features other than the two FCR-filled basins were identified. Although just two prehistoric cultural features characterize site 33PK347, the lithic evidence informs us that tool maintenance was also occasionally taking place at this location. The low frequency of artifacts tells us that visits were likely for short durations.

The high frequency of FCR recovered from site 33PK347 is an important topic for discussion since it was a key factor in determining the significance of the site. Research has shown that the presence of FCR is a good indicator of subsurface thermal features (Black and Thoms 2014; Burks 2004; Ng 2004). During Phase II investigations, high frequencies of FCR were recovered in four general areas; two of those areas were Feature 1 and Feature 2. Furthermore, soil susceptibility survey data from the Phase II investigations showed high readings on the slopes flanking site 33PK347. These data were interpreted as possible evidence of dumping of FCR that was cleaned out of cultural features. During Phase III investigations, the FCR dataset and its significance to site interpretation came into question for several reasons. During shovel testing and block excavations across site 33PK347, quantities of FCR recovered provided no evidence that the slopes were more densely covered in FCR than the ridgetop. Although the FCR collected from site 33PK347 is blocky and has red/orange streaked markings, it is likely that much of this material is not FCR, but simply naturally occurring bedrock. This argument is based on the following lines of evidence: 1) the bedrock of this area is an iron-rich sandstone and outcroppings are visible all around site 33PK347 where soils have eroded away (Figure 6-2); 2) the sandstone bedrock naturally breaks into blocky chunks similar in size and configuration to what is typically collected as FCR (Figure 6-3); 3) ferric-stained sandstone looks similar to fire-reddened rock (Figure 6-4); 4) little of the sandstone FCR recovered had char-blackened fire markings; 5) only those pieces recovered from Features 1 and 2 were associated with a thermal feature containing charcoal; and 6) attempts at refitting the FCR resulted in only eight refits, all from within a feature and none with non-feature material. Conversely, it is not uncommon for FCR to be scattered some distance from a thermal feature; therefore, collecting FCR from nonfeature contexts is common practice. Moreover, it is not uncommon for evidence of burning to have long-ago been washed away or abraded from rock surfaces. Therefore, it can be difficult to be certain of FCR identification or, conversely, to say unequivocally that a specimen is *not* FCR.

Figure 6-2. Natural outcrops of sandstone west of site 33PK347, view to the east.

Figure 6-3. **Close-up of natural sandstone eroding from the slope west of site 33PK347.**

Figure 6-4. **Iron-streaked natural sandstone resembles fire-reddened FCR; two iron-streaked examples from site 33PK347.**

6.2.2 Feature Function

Features 1 and 2 were the only cultural features identified at site 33PK347. Following Phase II analysis, feature function was unclear; therefore, a number of additional analyses were conducted as part of the Phase III investigations. Features 1 and 2 are the same feature type: they are both large, shallow, FCR-filled, basin-shaped pits. The paleoethnobotanical analysis demonstrated that no plant materials were processed in these features. Furthermore, the frequency of charred wood within the features was low given their large size. Chipped stone lithic artifacts and FCR were recovered from the features; no ceramics were recovered. Starch grain analysis on FCR from each feature yielded negative results; no starchy plants, such as nuts, tubers, or corn, were processed on the FCR in the features. Lipid residue analysis on FCR from each feature also yielded negative results; no animal fats or plant fats (such as from nuts) made its way onto the FCR in these features. Phytolith analysis of soils surrounding the FCR from each feature yielded no evidence of economically important plant phytoliths. Surprisingly, almost no burned phytoliths were found in these contexts where at least burned wood phytoliths were to be expected. Generally, phytolith analysis results from the features were similar to those of the noncultural control sample, suggesting that no cooking of plants for domestic purposes was being conducted in the features. The soil chemistry analysis showed generally similar results for the two features; however, differences were identified. Soil chemistry for Feature 1 was similar to that of the natural ridgetop soils; no elemental concentrations were present to suggest anthropogenic activity of any kind. Soil chemistry for Feature 2 had higher levels of phosphorus and calcium, which may be an indicator of anthropogenic activity. Phosphorus can be introduced into the soil when phosphates are produced in organic waste, which can come from food preparation, food consumption, or from human/animal waste. Calcium can be introduced into the soil from bone and/or shell (Cook and Heizer 1962, 1965; Skinner 1986; Terry et al. 2000). Soil chemical markers are measured relative to other areas at a site; therefore, when only two features and a control sample are analyzed, the results may be biased. Lastly, FCR refit was conducted to determine whether these basins were ever cleaned out and the stone reused in a different location. Eight refits were found and they were concentrated in the features; all refits were contained within their respective features. These results indicate that FCR at site 33PK347 was not cleaned out of one context and reused elsewhere. The sum of results to determine feature function indicate that these basins were simply utilized for fire on one, or few, occasions. Radiocarbon dates from Feature 1 date to the Early Archaic (6235–6085 B.C.), the Late Archaic (1365–1120 B.C.) and the Late Prehistoric/Fort Ancient (A.D. 1260–1290) periods.

6.2.3 Subsistence and Seasonality

No evidence of subsistence-related activity is present at site 33PK347. As stated above, paleoethnobotanical analysis recovered no plant remains in the features besides wood charcoal. No evidence of starch grains (as might come from nuts, tubers, or corn, to give a few examples), plant or animal fats, phytoliths from economically important plants, or definitive soil chemical markers indicative of plant or animal processing were identified. No animal bone or ceramics were recovered from site 33PK347. The lack of subsistence-related evidence suggests that activity taking place at site 33PK347 did not have a domestic focus. Furthermore, occupations at site 33PK347 must have been for short durations, where thermal activity left an ephemeral archaeological footprint.

Seasonality of occupation is determined using floral and faunal evidence. Given that no plant seeds or animal bone were recovered, seasonality of occupation cannot be determined.

6.2.4 Settlement Patterns

Site 33PK347 is located on an eroding ridgetop that appears to have been utilized occasionally over a span of 7,500 years for short-term occupations that left archaeological evidence of small-scale lithic production and repair, but no evidence of domestic activity. No evidence that reveals what site 33PK347 was utilized for was identified. These types of sites are often interpreted as overnight hunting campsites that left almost no archaeological footprint. Occupations for longer periods of time should provide more evidence of thermal and domestic activity. Diagnostic artifacts and radiocarbon dates associate site use with the Early Archaic, Late Archaic, Early Woodland, Late Woodland, and Late Prehistoric/Fort Ancient time periods. Settlement patterns for these temporal periods have been summarized in Chapter 2.3. Given that no evidence of 'settlement' at site 33PK347 was identified, discussions will, instead, focus on a comparison of site structure between archaeological sites within the PORTS reservation, where years of cultural resource management have identified all prehistoric sites within the area. A total of 54 prehistoric sites have been documented within the PORTS reservation (Garrard and Burden 2012; Hazel 2003; Klinge 2009, 2012; Klinge and Mustain 2011; Mustain 2012; Mustain and Klinge 2011; Mustain and Lamp 2012; Norr 2012; Pecora 2013a, 2013b; Pecora and Burks 2012a, 2012b, 2013; 2014, and Schweikart et al. 1997). This discussion will not include archaeological sites with an unknown temporal affiliation or sites that were isolated finds. That leaves seven prehistoric archaeological sites to be discussed in comparison to site 33PK347, including 33PK203, 33PK211, 33PK218, 33PK317, 33PK348, 33PK371, and 33PK372 (Table 6-2).

Table 6-2. Comparative Sites Discussed in the Text

Site	Site Type	Temporal Affiliation	Reference
33PK203	Lithic Scatter	Early Archaic, Late Archaic, Early Woodland	Schweikart et al. 1997; Pecora and Burks 2012b; Pecora and Burks 2013
33PK211	Lithic Scatter	Middle–Late Archaic	Schweikart et al. 1997; Pecora and Burks 2012b; Pecora and Burks 2013
33PK218	Lithic Scatter	Late Archaic	Schweikart et al. 1997; Pecora and Burks 2012b; Pecora and Burks 2013
33PK317	Lithic Scatter	Late Archaic	Pecora and Burks 2012a
33PK348	Lithic Scatter	Late Archaic, Late Archaic–Early Woodland	Pecora 2013a; Pecora and Burks 2014
33PK371	Lithic Scatter	Early Archaic, Late Archaic, Late Archaic–Early Woodland, Early Woodland, Late Woodland	Pecora 2013b; Pecora and Burks 2014
33PK372	Lithic Scatter	Late Archaic, Early Woodland, Late Prehistoric	Pecora 2013b; Pecora and Burks 2014

Site 33PK203 is a prehistoric lithic scatter, with diagnostic artifacts dating to the Early Archaic, Late Archaic, and Early Woodland periods (Table 6-2). The site is located on a narrow, heavily dissected terrace along Little Beaver Creek in the northwestern corner of PORTS. Site 33PK203 was relocated during Phase II testing of the Ruby Hollow Farmstead by Pecroa and Burks (2012b), then investigated at a Phase II level in 2013 (Pecora and Burks 2013). Phase II testing included geophysical survey, systematic shovel testing, and test unit excavations. A total of 816 prehistoric artifacts were recovered but no cultural features were identified (Pecora and Burks 2013). Artifacts included chipped stone tools (n=8), chipped stone debitage (n=188), and FCR (n=616). The chipped stone tools included a core fragment (n=1), modified flake blanks (n=2), biface fragments (n=2), and projectile points (n=3). The projectile points are diagnostic and include an Early Archaic corner-notched, Kirk Cluster projectile point with serrated blades, a Late Archaic stemmed Lamoka type projectile point, and a reworked basal portion of an Early Woodland Stemmed Cluster point. Raw materials included Brassfield, Delaware, Paoli (possibly), Upper Mercer, and Vanport cherts. The authors report that all stages of lithic production, use, and rejuvenation are represented in the chipped stone lithic assemblage and that the raw materials were likely taken from gravel deposits in the Scioto River floodplain, given the water-worn cortex on nearly 20 percent of the lithic debris.

Site 33PK211 is a prehistoric lithic scatter, with one diagnostic artifact dating to the Middle–Late Archaic period (Table 6-2). The site is located on a broad ridge overlooking a tributary of Little Beaver Creek in the northwestern quadrant of PORTS. Site 33PK211 was relocated during Phase II testing of the Bamboo Farmstead by Pecora and Burks (2012b), then investigated at a Phase II level in 2013 (Pecora and Burks 2013). Phase II testing included systematic shovel testing and a limited number of test unit excavations. A total of 89 prehistoric artifacts were recovered but no cultural features were identified (Pecora and Burks 2013). Artifacts included chipped stone tools (n=2), chipped stone debitage (n=13), and FCR (n=74). The chipped stone tools included a drill fragment (n=1) and Matanzas Type projectile point (n=1). Raw materials included Brassfield, Delaware, and Upper Mercer cherts. The authors report that the lithic debris represents the primary reduction process and that the raw materials were likely taken from gravel deposits in the Scioto River floodplain, given the water-worn cortex on some of the debitage.

Site 33PK218 is a prehistoric lithic scatter with one diagnostic artifact dating to the Late Archaic period (Table 6-2). The site is located on a small dissected toe-ridge along the northeastern edge of PORTS. Site 33PK218 was relocated during Phase II testing of the Cornett Farmstead by Pecroa and Burks (2012b), then investigated at a Phase II level in 2013 (Pecora and Burks 2013). Phase II testing included systematic shovel testing and a limited number of test unit excavations. A total of 72 prehistoric artifacts were recovered but no cultural features were identified (Pecora and Burks 2013). Artifacts included chipped stone tools (n=4), chipped stone debitage (n=11), and FCR (n=57). The chipped stone tools included a uniface (n=1), a modified flake tool (n=1), a flint nodule (n=1), and a projectile point fragment that resembles a Lamoka Type point (n=1). Raw materials included Brassfield, Delaware, Paoli (possibly), Upper Mercer, and Vanport cherts. The authors report that lithic reduction was focused on the primary stages but also includes pressure flakes from the later stages of use and rejuvenation. They also suggest that the raw materials were likely taken from gravel deposits in the Scioto River floodplain. However, two artifacts were made from possibly Paoli or Carter County chert, which comes from northern Kentucky and must have been transported northward either by trade or direct acquisition.

Site 33PK317 is a small, prehistoric lithic scatter that was identified during a Phase I survey of the Mechling House historical farmstead (Pecora and Burks 2012a). The site is located on a broad ridge on the northeastern edge of PORTS. Four artifacts were recovered, including a notched projectile point that likely dates to the Late Archaic period (Table 6-2). . The other three artifacts included chipped stone debitage (n=2) and one piece of FCR. Given the scarcity of artifacts, no interpretations were drawn.

Site 33PK348 is a prehistoric lithic scatter, with radiocarbon dates from the Late Archaic, Late Archaic-Early Woodland, and Early Woodland periods (Table 6-2). The site is located in the northwestern corner of PORTS. Site 33PK348 was first identified during a Phase I survey and recommended for Phase II testing based on its potential eligibility for inclusion on the NRHP (Pecora 2013a). Phase II investigations were conducted and included geophysical survey, systematic shovel testing, and test unit excavations. Phase I and Phase II investigations yielded a total of 9,479 prehistoric artifacts, and four cultural features were identified (Pecora 2013a; Pecora and Burks 2014). Artifacts included chipped stone tools (n=17), chipped stone debitage (n=545), and FCR (n=8,917). The assemblage was dominated (94 percent) by FCR, while debitage accounted for six percent of the assemblage and chipped stone tools comprised less than one percent of the assemblage. The chipped stone tools included cores/chert nodules (n=7), biface fragments (n=2), chipped stone hoes (n=2), a modified flake (n=3), a burnishing stone (n=1), a pitted stone (n=1), and a preform/projectile point (n=1). None of the artifacts were temporally diagnostic; however, micro-drills associated with Early Woodland contexts at site 33PK372 were also recovered from site 33PK348. Radiocarbon dates represent the late Late Archaic period for Feature 1 (1060–1290 B.C.) and the Late Archaic–Early Woodland period for Feature 2 (1000–840 B.C.) and Feature 4 (1010–900 B.C.). Raw materials included Brassfield, Brush Creek, Delaware, Upper Mercer, and Vanport cherts. The authors report that nearly all (98 percent) of the chipped stone debitage consists of primary reduction debris, created during production of tools. Just two percent of the debitage derived from tool maintenance and rejuvenation. They also suggest that the raw materials were likely taken from gravel deposits in the Scioto River floodplain, given the water-worn cortex on some of the lithic debris. Three of the four features were FCR-filled basins designed as thermal features of unknown utility. The forth feature was a midden. All features were defined by large quantities of FCR. Artifact concentrations were found in areas of midden, rather than in, or near, the thermal features. Paleoethnobotanical analysis of feature fill from each of the four features, revealed low wood densities in all. Furthermore, nuts were absent from Features 1, 2, and 3, but present in Feature 4 in low quantities. No evidence was found to support that nut processing, or any other food processing, was the function of the FCR-filled pit/basins.

Site 33PK371 is a large, prehistoric lithic scatter with diagnostic artifacts and radiocarbon dates from the Early Archaic, Late Archaic, Late Archaic–Early Woodland, Early Woodland, and Late Woodland periods (Table 6-2). The site is located on a dissected toe ridge at PORTS. Site 33PK371 was first identified during a Phase I survey and recommended for Phase II testing based on its potential eligibility for inclusion on the NRHP (Pecora 2013b). Phase II investigations were conducted, and included geophysical survey, systematic shovel testing, and test unit excavations. At site 33PK371, a total of 7,942 prehistoric artifacts were recovered and 10 cultural features were identified (Pecora 2013b; Pecora and Burks 2014). Artifacts included pottery (n=27), chipped stone tools (n=39), chipped stone debitage (n=658), and FCR (n=7,218). The assemblage was dominated (91 percent) by FCR, while debitage accounted for eight percent of the assemblage. Pottery and chipped stone tools each comprised less than one percent of the assemblage. The pottery assemblage included one rim sherd, two body sherds, and 24 sherdlets. Pottery was recovered from two of the features and resembles Adena Plain type (Early Woodland period) pottery, based on granitic grit-temper and plain exteriors. The chipped stone tools included biface fragments (n=24), cores (n=7), projectile points (n=2), modified blanks (n=2), unifaces (n=2), a biface tool (n=1), and a celt fragment (n=1). The two projectile points resemble Early Archaic types. One specimen is similar to the Big Sandy or Graham Cave Side Notched types and the other specimen is similar to a Kirk Cluster type with a serrated blade. Radiocarbon dates represent the late Late Archaic period for Feature 6 (1210–1000 B.C.), the Late Archaic–Early Woodland period for Feature 3 (1010–830 B.C.), the Early Woodland period for Feature 2 (810–670 B.C.) and Feature 8 (380–180 B.C.), and the Late Woodland period for Feature 1 (A.D. 660–780). Raw materials included Brassfield, Delaware, Upper Mercer, Kanawha, Paoli, and Vanport cherts. The authors report that nearly all (97 percent) of the chipped stone debitage consists of primary reduction debris, created during production of tools. They also suggest that the raw materials were likely taken from gravel deposits in the Scioto River floodplain, given the water-worn cortex on some of the lithic debris, but the non-local cherts (Kanawha and Paoli) were likely transported to site 33PK371 in the form of blanks, preforms, or finished tools. The features were identified mostly as FCR-filled basin/pits designed as thermal features of unknown utility. Other feature types included refuse/midden deposits and a possible house location. All features were defined by large quantities of FCR. Artifact concentrations were found in areas of midden and the possible house location, rather than in or near the thermal features. Paleoethnobotanical analysis of feature fill from 4 of the 10 features, revealed extremely low wood and nut densities in all features analyzed. There was no evidence to support that nut processing, or any other food processing, was taking place at the site, and there was no evidence to indicate the function of the FCR-filled pit/basins.

Site 33PK372 is a large, prehistoric lithic scatter with diagnostic artifacts and radiocarbon dates from the Late Archaic, Early Woodland, and Late Prehistoric/Fort Ancient periods (Table 6-2). The site is located on a broad ridgetop at PORTS. Site 33PK372 was first identified during a Phase I survey and recommended for Phase II testing based on its potential eligibility for inclusion in the NRHP (Pecora 2013b). Phase II investigations were conducted and included geophysical survey, systematic shovel testing, and test unit excavations. At site 33PK372, a total of 13,920 prehistoric artifacts were recovered and 9 cultural features were identified (Pecora 2013b; Pecora and Burks 2014). Artifacts included pottery (n=4), chipped stone tools (n=61), chipped stone debitage (n=1,034), and FCR (n=12,821). The assemblage was dominated (92 percent) by FCR, while debitage accounted for seven percent of the assemblage. Pottery and chipped stone tools, combined, constitute the remaining one percent of the assemblage. The pottery assemblage consisted of four thick body sherds that had plain surfaces and granitic grit temper. The pottery sherds were recovered from Feature 8, a possible semi-subterranean house. The chipped stone tools included micro-drills (n=20), cores/nodules (n=15), modified flakes (n=7), biface blanks (n=6), projectile point fragments (n=3), biface fragments (n=3), pitted stones (n=2), ground stone celt fragments (n=2), a possible ground stone hoe (n=1), a sandstone ball (n=1), and a drilled cube of sandstone (n=1). None of the artifacts are temporally diagnostic. Radiocarbon dates represent the Late Archaic period for Feature 3 (2460–2200 B.C.), the Early Woodland period for Feature 9 (750–400 B.C.), and the Late Prehistoric/Fort Ancient period for Feature 8 (A.D. 1270–1390).

Raw materials included Brassfield, Brush Creek, Delaware, Upper Mercer, Paoli, and Vanport cherts. The authors report that nearly all (99 percent) of the chipped stone debitage consists of primary reduction debris, created during production of tools. They also suggest that the raw materials were likely taken from gravel deposits in the Scioto River floodplain, given the water-worn cortex on some of the lithic debris, but the non-local Paoli chert was likely transported to site 33PK372 in the form of blanks, preforms, or finished tools. The features were identified mostly as FCR-filled basin/pits designed as thermal features of unknown utility. Other feature types included refuse/midden deposits and a possible semi-subterranean house location. Of interest, is the fact that the entire cache of micro-drills was recovered from Feature 8, the possible semi-subterranean house location. All features were defined by large quantities of FCR. Artifact concentrations were found in areas of midden and the possible house location rather than in or near the thermal features. Paleoethnobotanical analysis of feature fill from five of the nine features, revealed extremely low wood densities in all analyzed features. Furthermore, nuts were absent from three of the five features analyzed, but present in two features in low quantities. There was no evidence to support that nut processing, or any other food processing, was taking place at the site, and there was no evidence to indicate the function of the FCR-filled pit/basins.

In sum, site 33PK347 shows many similarities and some differences with the comparative sites described above. Similarities include FCR-filled features, a general littering of FCR across the comparative sites, chert types, lack of evidence to identify feature function, and an upland topography. The differences show up in frequency/intensity and diversity of what is similar between the comparative sites. For example, sites 33PK371 and 33PK372 are larger in area than the rest of the comparative sample; because of this, higher frequencies and diversity of artifacts and features are noted. Sites 33PK371 and 33PK372 are the only prehistoric archaeological sites in the area that show evidence of possible houses. Although the quantity and diversity of artifacts varies between sites, the frequencies are remarkably similar. For example, all artifact assemblages are dominated (more than 90 percent) by FCR, but also have chipped stone debitage (6–8 percent) and chipped stone tools (less than 1 percent). Pottery, when present, is minimally represented (less than 1 percent). The features are all characterized by FCR concentrations. Most features are described as FCR-filled basin/pits; few are described as midden, trash deposits, and houses. Lithic raw materials were obtained mainly from secondary river deposits, while small quantities were brought north from the Ohio River area. Most of these sites are multicomponent. Temporal periods of occupation range from the Early Archaic through to the Late Prehistoric/Fort Ancient, with a noticeable absence during the Middle Woodland period. The distinguishing characteristics of all of these sites, that transcends time periods, is the utility of easily accessible sandstone bedrock for reasons that are unclear, and the surprisingly low frequency of wood charcoal and food remains within them.

6.3 Research Domain 3: Lithic Selection, Sourcing, and Function

This research domain focuses on the composition of the lithic assemblage at site 33PK347, in an attempt to better understand site structure and function. More specifically, the diversity and source of raw materials as well as identification of reduction stages, can provide information regarding who was occupying site 33PK347 and why. It was suggested, after Phase II investigations, that because site 33PK347 had likely not been plowed, the potential for recovering a large *in situ* artifact sample was great. From a large *in situ* artifact assemblage, well-defined activity area interpretations were expected. Unfortunately, expectations fell short of the mark. The majority of the artifacts were recovered during Phase II investigations; Phase III investigations added just 20 percent to the artifact count. Furthermore, no new features or artifact clusters were identified. As such, little more can be added to the lithic selection, sourcing, and functions described in the Phase II report (Pecora and Burks 2014). Artifact analysis of the Phase III lithic assemblage, combined with interpretations regarding the Phase II assemblage, are summarized below.

The lithic assemblage at site 33PK347 is characterized by a total of 14 chipped stone tools, 182 pieces of chipped stone debitage, and 4,613 pieces of FCR, for a total of 4,809 lithic artifacts (Table 4-1). During Phase III investigations, none of the lithic tools recovered were from cultural contexts; therefore, no special analyses (such as protein residue analysis, lithic microwear analysis, or x-ray fluorescence analysis) regarding feature function were conducted.

Lithic sourcing shows us that while all the FCR and pitted stone material (4,614) was obtained from local eroded sandstone outcrops, the chipped stone tools/debitage assemblage (n=195) was comprised of ten unique raw materials that include eight sources considered to be locally available and two non-local sources. The chipped stone tools/debitage assemblage includes Delaware (20 percent), Upper Mercer (10 percent), Brush Creek (5 percent), Paoli (4 percent), Brassfield (4 percent), local pebble (3 percent), Vanport (2 percent), Columbus (1 percent), and Breathitt (0.5 percent) cherts (Table 6-3). Almost half (47.5 percent) of the chert is unidentified and 61 percent of the unidentified chert comes from debitage Classes 7–9, whose small size makes it difficult to identify raw material with certainty. This seemingly high percentage of unidentified chert is common in lithic assemblages where the smallest debitage classes are included. A small portion (3 percent) of the assemblage is not made from chert at all, but from unidentified fossiliferous material.

Delaware chert is the chert type most commonly utilized at site 33PK347; it comprises 39 percent of identified raw materials (n=102). Upper Mercer chert was utilized half as often (21 percent of identified raw materials) as Delaware chert. And Brush Creek chert was utilized half as often as Upper Mercer chert. The remaining raw material types are minimally represented. These raw materials were most likely obtained locally, as secondary source river cobbles. The evidence for this is found in the high frequency of cortex found on the chipped stone debitage from the Phase II investigations (Pecora and Burks 2014) and the high frequency of Class 1 initial reduction flakes made of local pebble chert, discussed in the Raw Materials section (Chapter 4.2.1). All raw materials appear to be locally sourced, with the exception of Paoli and Breathitt cherts, which were most likely traded or carried into the area. These cherts derive from outcrops in northern Kentucky and along the Ohio River. A canoe trip down the Scioto River to the Ohio River would have been a distance of approximately 40 km.

Selection of mostly local lithic raw material demonstrates that site 33PK347 occupants too, were likely local. Table 6-3 demonstrates that raw material types from the debitage assemblage matched those of the tool assemblage. No patterns of raw material selection were observed.

Table 6-3. Frequencies of Lithics by Type and Raw Material at Site 33PK347						
Raw Material	**FCR**	**Pitted Stone (Tool)**	**Chipped Stone Tools**	**Chipped Stone Debitage**	**Total Count**	**Chipped Stone Assemblage (%)**
Sandstone	4,613	1	-	-	**4,614**	**-**
Delaware Chert	-	-	4	36	**40**	**20**
Upper Mercer Chert	-	-	2	19	**21**	**10**
Brush Creek Chert	-	-	1	9	**10**	**5**
Paoli	-	-	-	7	**7**	**4**
Brassfield Chert	-	-	1	6	**7**	**4**
Local Pebble Chert	-	-	-	5	**5**	**3**
Vanport Chert	-	-	-	4	**4**	**2**
Columbus Chert	-	-	1	1	**2**	**1**
Breathitt Chert	-	-	-	1	**1**	**0.5**
Unidentified Chert	-	-	4	89	**93**	**47.5**
Unknown Fossiliferous	-	-	-	5	**5**	**3**
Total Count	**4,613**	**1**	**13**	**182**	**4,809**	
Percent (%)	**96**	**<1**	**<1**	**4**		**100**

Interpreting archaeological site function by defining activity areas requires a significant number and diversity of cultural features and artifacts. This was not achieved at site 33PK347. Site 33PK347 is characterized by just two FCR-filled, basin-shaped pits, and artifact distribution does not appear to be clustered in defined activity areas. The chipped stone debitage assemblage consists predominantly of late stage biface thinning debris (34 percent) created from the manufacture of bifaces and of debris associated with tool repair/maintenance and rejuvenation (46 percent). Little (20 percent) debris from site 33PK347 represents core reduction, demonstrating that most of the stone that entered site 33PK347 came in the form of early stage biface blanks. The emphasis of tool repair and maintenance at site 33PK347 contrasts with the artifact assemblages of other archaeological sites at PORTS, such as 33PK348, 33PK371, and 33PK372, which were dominated by core reduction debris.

In sum, while the FCR assemblage is large, the chipped stone assemblage at site 33PK347 is small. The FCR assemblage is locally sourced and clustered in two cultural features, with no other patterns observed. The function of the FCR-filled, basin-shaped pits is unclear. The chipped stone assemblage consists predominantly of locally available raw materials. The small quantity of non-local material could have been traded or brought in to site 33PK347, as those outcrops are not too far distant. Chipped stone artifacts show no observable distribution patterns that might be interpreted as activity areas, other than around the FCR-filled features. The significance of the chipped stone debitage assemblage is that it demonstrates the type of lithics-related activity taking place at site 33PK347. Site occupants were maintaining, repairing, and reworking tools at this site, rather than producing the tools. This type of activity could be associated with hunting parties.

6.4 Special Analyses

After Phase I survey and Phase II testing was completed at site 33PK347, the Phase III research design was specifically developed to include an extensive array of special analyses. This was done for two main reasons. First, this was a unique opportunity to test an archaeological site that had possibly never been plowed. And second, a challenge was expected in determining site structure and function at 33PK347, and it was hoped that special analyses might help define these site characteristics. An additional outcome, one that was not planned, has been the opportunity to determine the effectiveness of extensive utilization of scientific analyses for this archaeological site type.

In the Research Domain sections, above, data provided by special analyses were utilized in discussions regarding site formation and taphonomy, as well as settlement and subsistence. More specifically, these analyses provided data regarding soil susceptibility, radiocarbon dates, geomorphology, soil chemistry, dendrochronology, paleoethnobotany, starch grains, phytoliths, lipid residue, and FCR refit.

A soil susceptibility survey, that was more intensive than that done during Phase II investigations, was utilized to better define previously identified anomaly boundaries and to identify additional anomalies that may have been missed during Phase II investigations. Based on this survey, 7 new anomalies were added to the list of 27 previously identified. While one large previously identified anomaly was better defined as two anomalies situated side-by-side, overall, the more fine-grained soil susceptibility data did not create a better outcome for the investigation of site 33PK347. Two different geophysical surveys had been conducted on site 33PK347 during Phase II investigations. The surveys were well done and provided a large number of anomalies and possible activity areas to investigate (Pecora and Burks 2014). In the case of this upland, ephemeral lithic scatter, two geophysical surveys provided enough data to mitigate site 33PK347.

Radiocarbon dating is essential to providing temporal data for archaeological site interpretations. Relative dating of diagnostic artifacts is a useful tool. However, when few artifacts are recovered at ephemeral upland lithic scatter site types, relying solely on relative dating could be cause for temporal inaccuracies. Curation of old artifacts was likely practiced prehistorically, just as it is done in modern times. In the case of site 33PK347, AMS radiocarbon dating (versus traditional radiometric dating) proved essential, as little material is needed to obtain a date—and indeed, only small quantities of charred material in the cultural features identified were present.

Geomorphology, soil chemistry, and dendrochronology proved useful for interpretation of formation and taphonomy of this upland site, even though much of the data were negative. Site 33PK347 is an eroded upland site that has possibly not been disturbed by the modern plow; however, it has been disturbed by logging/clearing practices. This interpretation was suggested by Phase II investigators based on typical investigative techniques, including recording and interpreting soil profiles across site 33PK347, comparing those soil profiles to published soil surveys for the area, and conducting an extensive literature review (that included deeds, historical maps, and historical aerial photographs) (Pecora and Burks 2014). The Phase III investigations utilized special analyses to confirm the arguments made in the Phase II investigations. Results showed that this heavily eroded archaeological site, with a deflated and thin A horizon, was not a good candidate for agricultural crops, just as it is not a good candidate for archaeological interpretation of near-surface, multi-component cultural deposits that have collapsed into each other. What does this imply for other eroded ridgetop lithic scatters? On this eroded ridgetop, as on most, cultural features were shallow. If this location had been plowed, these features would have been destroyed. Would significant data regarding prehistoric lifeways in the area been lost if this had happened? In this case, no. Site 33PK347 continues to be interpreted as an ephemeral, upland lithic scatter with two cultural features of unknown utility. Known archaeological sites in the area that were more intensely occupied, are of similar ages, and have similar site characteristics may provide more significant data.

Paleoethnobotanical, starch grain, phytolith, and lipid analyses were conducted on feature fill in the hopes of providing data regarding FCR-filled pits that are commonly found in Ohio but whose function is much too often not determined. Paleoethnobotanical analysis was conducted during Phase II investigations (Leone 2014) that determined no plant foods were being processed in Features 1 or 2. Additional analyses found no new evidence regarding feature function. The lack of evidence could be a result of erosional factors or simply that no plant foods were being processed. Paleoethnobotanical (macrobotanical) analysis typically provides good evidence of feature function. In the absence of macrobotanical evidence, looking toward other forms of analysis, all of which revealed an absence of organic material, was necessary. During these investigations of site 33PK347, it became apparent that having an intact, or sealed, cultural feature is important, as erosional effects may have been a factor in the negative results obtained.

Refit analysis of FCR was undertaken to determine if features were cleaned out and the material either reused in a different area of site 33PK347 or dumped downslope. This determination, in turn, could have provided evidence of long- or short-term site occupancy. The analysis proved useful in determining that FCR from the features at site 33PK347 was not reused elsewhere. Furthermore, a lack of FCR concentrations on site 33PK347 side-slopes demonstrated that FCR was not being cleaned out of features and dumped downslope. Results were successful in answering the research questions.

In sum, for site 33PK347, an ephemeral, upland, lithic scatter characterized by two FCR-filled features, the extensive list of special analyses conducted proved generally effective in providing data to address research questions. These special analyses enhanced or confirmed site 33PK347 formation and occupation interpretations.

7.0 SUMMARY AND CONCLUSIONS

Gray & Pape, under contract with FBP, and acting on behalf of the DOE, has completed a Phase III archaeological data recovery at site 33PK347 on the PORTS reservation, Scioto Township, Pike County, Ohio. The DOE is the lead federal agency for this project.

The mitigation of adverse effects to site 33PK347 was conducted as part of the CERCLA process, which is being used for the environmental clean-up, including D&D and Waste Management at PORTS. Impacts to site 33PK347 occurred as a result of the selection of this specific location for siting of the OSWDF, for the deposition of demolition debris, as part of the D&D efforts.

The ROD for the Site-Wide Waste Disposition Evaluation Project at PORTS was concurred and finalized by the Ohio EPA in June 2015. The ROD identified site 33PK347 as a historic property where avoidance or minimization was not practicable.

Phase III data recovery fieldwork was completed at site 33PK347 prior to beginning construction of the OSWDF, fulfilling the first commitment of the five mitigation measures outlined in the ROD. Once finalized, this report will be submitted to the OHPO to fulfill the fourth commitment. To date, three of the five mitigation measures (1, 2, and 4) outlined in the ROD have been completed. Details of the mitigation measures are:

1. In accordance with the commitments in the ROD, fieldwork at site 33PK347 was completed in August 2015, fulfilling DOE's obligations to recover data from the site.
2. Coordination with federally recognized tribes and the OHPO on the data recovery effort. Communications and site visits took place prior to, during, and after the data recovery fieldwork.
3. The DOE is examining a variety of options for the curation of artifacts recovered from site 33PK347, and will ensure their curation at a facility meeting the requirements of 36 CFR 79.
4. This document serves as the technical report documenting the data recovery processes and results. Once finalized, DOE will provide the report to the OHPO.
5. The DOE will prepare a summary-level report intended for a general audience, based on the technical report, as an aspect of public outreach.

In accordance with the commitments in the ROD, the DOE has completed fieldwork at site 33PK347 and fulfilled its obligations to recover data from the site.

Site 33PK347 is a small (3,600 m²), multicomponent, prehistoric site located on an eroded ridgetop landform approximately 1,000 m north/northeast of Little Beaver Creek, in the northeast quadrant of the PORTS reservation. This report presented results from the Phase III data recovery, but also provided a comprehensive summary of results from all investigations done at site 33PK347, including the Phase I survey, Phase II testing, and Phase III data recovery. Site 33PK347 is characterized by a total of 4,809 prehistoric artifacts and two broad, shallow FCR-filled basin-shaped pits. The artifact assemblage consists mainly of FCR (96 percent), but also includes chipped stone debitage (4 percent) and chipped stone tools (less than 1 percent). In total, excavations at site 33PK347 have exposed 216.5 m² (6 percent) of the site's surface area. The strategic placement of 354 shovel test units and 128 excavation units across site 33PK347, as well as the use of geophysical survey and a multitude of special analyses, suggests that all significant cultural features have been identified and mitigated. Temporally diagnostic artifacts and AMS radiocarbon dates indicate occasional use of site 33PK347 over a span of approximately 7,500 years of prehistory, specifically during the Early Archaic, Late Archaic, Early Woodland, Late Woodland, and Late Prehistoric/Fort Ancient periods.

Site 33PK347 was identified as a significant archaeological site during Phase I and Phase II investigations, because it appeared that it had not been historically plowed. This possibly unplowed archaeological site was expected to provide data regarding complete cultural features and *in situ* evidence of intact activity areas. Results demonstrated, however, that site 33PK347 is located on a severely eroded landform that has left a thin, deflated A horizon. Erosion is naturally occurring on this ridgetop; however, it has been deforested, to an unknown extent, during historical times, thus advancing erosional forces. As a result, soils at site 33PK347 contain ephemeral archaeological evidence from prehistoric occupations spanning thousands of years that have eroded into one another and cannot be teased apart. A deflated and eroded A horizon implies that the archaeological deposits are no longer *in situ*. Therefore, despite the location of site 33PK347 in a possibly unplowed upland context, erosion has interfered with the ability to fully understand this upland remnant lithic scatter.

Site 33PK347 is located on an eroding ridgetop that appears to have been utilized occasionally over a span of 7,500 years for short-term occupations that left archaeological evidence of small-scale, lithic tool maintenance and repair, but no evidence of domestic activity. Furthermore, no definitive evidence exists that reveals what site 33PK347 was utilized for other than occasional tool maintenance. These types of archaeological sites are often interpreted as overnight hunting campsites that leave an ephemeral archaeological footprint. Occupations for longer periods of time should leave behind more evidence of thermal and domestic activity than was found at site 33PK347. Site 33PK347 is characterized by two large, shallow, FCR-filled, basin-shaped pits—a feature type that is found at other archaeological sites in the area. None of the investigative techniques undertaken during mitigation and analysis of site 33PK347 reveal the utility of these features. In sum, the adverse effects of the project to site 33PK347 have been mitigated. The data gathered reveal that site 33PK347 was likely a campsite that was visited occasionally for purposes that are unclear but, based on the small chipped stone lithic assemblage, may have included hunting.

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APPENDIX A

ARTIFACT INVENTORY

Prehistoric Artifact Inventory for Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

Unit	Fea. or Strat	Planum	Collect. Method	Category	DebitageClass	Tool Segment	Material Type	Heat	Point Type	Manufacture Method	Biface Type	Count
Blk 01-001	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unidentified Chert					1
Blk 01-001	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					2
Blk 01-001	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				33
Blk 01-001	I	2	TRW	Debitage	04 Biface thinning flake		Paoli					1
Blk 01-001	I	2	TRW	Fire Cracked Rock			Sandstone	Damaged				12
Blk 01-002	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Local Pebble Chert	Treated				1
Blk 01-002	I	1	TRW	Debitage	07 Flake Fragment		Paoli					1
Blk 01-002	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 01-002	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				20
Blk 01-003	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Paoli					1
Blk 01-003	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					3
Blk 01-003	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert	Damaged				1
Blk 01-003	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				29
Blk 01-003	I	2	TRW	Fire Cracked Rock			Sandstone	Damaged				6
Blk 01-004	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 01-004	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				14
Blk 01-004	I	2	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Upper Mercer					1
Blk 01-004	I	2	TRW	Debitage	04 Biface thinning flake		Unidentified Chert					2
Blk 01-004	I	2	TRW	Debitage	07 Flake Fragment		Paoli					1
Blk 01-004	I	2	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 02-005	I	1	TRW	Debitage	04 Biface thinning flake		Breathitt					1
Blk 02-005	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				7
Blk 02-006	I	1	TRW	Debitage	04 Biface thinning flake		Unidentified Chert					1
Blk 02-006	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 03-009	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				5
Blk 03-010	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Brassfield					1
Blk 03-010	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				2
Blk 03-011	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 03-012	I	1	TRW	Debitage	04 Biface thinning flake		Paoli					1
Blk 04-013	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 04-014	I	2	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unidentified Chert					1
Blk 04-015	I	2	TRW	Debitage	01 Initial Reduction Flake		Local Pebble Chert	Damaged				1
Blk 05-018	I	2	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Upper Mercer					1
Blk 07-037	Anomaly 12	1	TRW	Biface		Distal Frag	Upper Mercer	Damaged		Percussion, Pressure	Stage 4/ Formed	1
Blk 08-039	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				4
Blk 08-039	I	1	TRW	Projectile Point		Complete	Brush Creek		Dickson Cluster, Adena Stemmed	Percussion, Pressure		1
Blk 08-040	I	1	TRW	Debitage	08 Angular Shatter		Unidentified Chert					1
Blk 08-040	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 08-043	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unidentified Chert					1
Blk 08-043	I	1	TRW	Debitage	05 Biface finishing flake		Unidentified Chert					1
Blk 08-043	I	1	TRW	Debitage	08 Angular Shatter		Unidentified Chert	Treated				1
Blk 08-043	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				2
Blk 08-044	I	1	TRW	Core		Complete	Columbus					1

Prehistoric Artifact Inventory for Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

Unit	Fea. or Strat	Planum	Collect. Method	Category	DebitageClass	Tool Segment	Material Type	Heat	Point Type	Manufacture Method	Biface Type	Count
Blk 08-044	I	1	TRW	Debitage	01 Initial Reduction Flake		Local Pebble Chert					1
Blk 10-064	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Delaware					1
Blk 10-067	I	1	TRW	Projectile Point		Nearly Complete	Delaware		Dickson Cluster, Adena Stemmed	Percussion, Pressure		1
Blk 10-067	I	2	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 10-067	I	2	TRW	Debitage	07 Flake Fragment		Unidentified Chert	Damaged				1
Blk 11-071	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unidentified Chert					1
Blk 11-071	I	1	TRW	Debitage	07 Flake Fragment		Paoli	Damaged				1
Blk 11-071	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 11-071	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert	Treated				2
Blk 11-071	I	1	TRW	Debitage	08 Angular Shatter		Unidentified Chert	Damaged				1
Blk 11-071	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				15
Blk 11-071	I	2	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 11-072	I	1	TRW	Debitage	08 Angular Shatter		Unknown fossiliferous	Treated				2
Blk 11-072	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				15
Blk 11-075	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unidentified Chert					2
Blk 11-075	I	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unknown fossiliferous	Treated				1
Blk 11-075	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 11-075	I	1	TRW	Debitage	07 Flake Fragment		Unknown fossiliferous	Treated				1
Blk 11-075	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				12
Blk 11-075	I	2	TRW	Debitage	07 Flake Fragment		Unidentified Chert	Damaged				1
Blk 11-076	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				4
Blk 14-099	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 14-100	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 14-101	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 16-111	I	1	TRW	Debitage	07 Flake Fragment		Paoli					1
Blk 16-111	I	1	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 17-118	I	2	TRW	Debitage	07 Flake Fragment		Unidentified Chert					1
Blk 17-118	I	2	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 17-118	I	3	TRW	Debitage	07 Flake Fragment		Upper Mercer	Damaged				1
Blk 17-118	I	3	TRW	Fire Cracked Rock			Sandstone	Damaged				3
Blk 17-120	I	2	TRW	Fire Cracked Rock			Sandstone	Damaged				2
Blk 17-121	I	2	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 17-121	II	3	TRW	Fire Cracked Rock			Sandstone	Damaged				3
Blk 18-125	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				3
Blk 18-126	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				15
Blk 18-130	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				1
Blk 24-045	I	1	TRW	Fire Cracked Rock			Sandstone	Damaged				4
Fea 1-022	Feature 1	1	TRW	Debitage	05 Biface finishing flake		Columbus					1
Fea 1-022	Feature 1	1	TRW	Debitage	07 Flake Fragment		Unknown fossiliferous					1
Fea 1-022	Feature 1	1	TRW	Debitage	08 Angular Shatter		Unidentified Chert					1
Fea 1-022	Feature 1	1	TRW	Debitage	09 Microdebitage		Unidentified Chert	Treated				6
Fea 1-022	Feature 1	1	TRW	Debitage	09 Microdebitage		Unidentified Chert					4
Fea 1-022	Feature 1	1	TRW	Fire Cracked Rock			Sandstone	Damaged				90
Fea 1-022	Feature 1	1	TRW	Fire Cracked Rock			Sandstone	Damaged				92

Prehistoric Artifact Inventory for Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

Unit	Fea. or Strat	Planum	Collect. Method	Category	DebitageClass	Tool Segment	Material Type	Heat	Point Type	Manufacture Method	Biface Type	Count
Fea 1-023	Feature 1	1	TRW	Fire Cracked Rock			Sandstone	Damaged				56
Fea 2-019	Feature 2	1	TRW	Debitage	01 Initial Reduction Flake		Local Pebble Chert					1
Fea 2-019	Feature 2	1	TRW	Debitage	02 Flake Unspecified Reduction Sequence		Unidentified Chert	Damaged				1
Fea 2-019	Feature 2	1	TRW	Debitage	04 Biface thinning flake		Unidentified Chert					1
Fea 2-019	Feature 2	1	TRW	Debitage	05 Biface finishing flake		Unidentified Chert	Treated				1
Fea 2-019	Feature 2	1	TRW	Debitage	07 Flake Fragment		Upper Mercer	Damaged				1
Fea 2-019	Feature 2	1	TRW	Debitage	07 Flake Fragment		Upper Mercer					1
Fea 2-019	Feature 2	1	TRW	Debitage	09 Microdebitage		Unidentified Chert					2
Fea 2-019	Feature 2	1	TRW	Fire Cracked Rock			Sandstone	Damaged				11
Fea 2-019	Feature 2	1	TRW	Fire Cracked Rock			Sandstone	Damaged				419
ST A007	I	1	SCR 1/4	Biface		Frag	Unidentified Chert	Damaged		Percussion, Pressure	Indeterminate Stage	1
ST B003	I	1	SCR 1/4	Fire Cracked Rock			Sandstone	Damaged				1
ST F006	I	1	SCR 1/4	Fire Cracked Rock			Sandstone	Damaged				2
ST I007	I	1	SCR 1/4	Debitage	07 Flake Fragment		Unidentified Chert					1
ST J007	I	1	SCR 1/4	Debitage	02 Flake Unspecified Reduction Sequence		Local Pebble Chert	Treated				1

Site Ct: 971

APPENDIX B

OHPO REVISED SITE FORM

Ohio Historic Preservation Office
800 E. 17th Avenue.
Columbus, OH 43211
614/298-2000

3. Site No. 33- **PK0347**

OHIO ARCHAEOLOGICAL INVENTORY (Draft Form)

A. Identification

1. Type of Form: **Revised Form**
2. County: **Pike**
4. Site Name: **pending Revised Form by Karen Leone. 3/10/2016**
5. Project Number: **14-63201.001 PORTS Ph III**

B. Location

1. UTM Zone: **17** Easting: **328515** Northing: **4322607**

3. Township: **4N** Range: **21W** Section: **5** 1/4 Section: **NW** Not Applicable

Township Name: **Seal**

4. Quadrangle Name: **Waverly South** 5. Quadrangle Date: **1992** 6. Confident of Site Location: **Yes**

C. Ownership

1. Name: **U. S. Department of Energy-PORTS**
   Address: **3930 U. S. 23 South**
   City, State, Zip: **Piketon, OH 45661**
   Phone:

2. Tenant (if any):
   Address:
   City, State, Zip:
   Phone:

3. Ownership Status: **Federal Govt.**

D. Temporal Affiliations

1. Affiliations Present: **Prehistoric**

Prehistoric

2. Prehistoric Temporal Period(s) represented:

Unassigned Prehistoric   Paleoindian

Archaic:	Unassigned	X Early	Middle	X Late
Woodland:	Unassigned	X Early	Middle	X Late
	X Late Prehistoric	Protohistoric		Other:

3. Minimum Number of Prehistoric Temporal Periods Represented: **5**

4. Basis for Assignment of Prehistoric Temporal Period(s):

X Diagnostic Artifacts   Diagnostic Features   X Radiometric
Unrecorded   Other:

5 & 6. List Prehistoric Cultural Components Identified and describe how determined (list diagnostic artifacts and/or features and include type names).

- **4 Diagnostic material(s) recorded. See Continuation sheet for details.**

7 & 8. Specific Prehistoric Cultural Materials Observed or Collected (list diagnostic artifacts and/or features and include type names).

- **5985 Prehistoric cultural material(s) recorded. See Continuation sheet for details.**

Site No. 33- PK0347
Plotted:

Historic

9. Affiliation Present:

10. Historic Temporal Period(s) Represented:

Pre-1795	1796-1829	1830-1849
1850-1879	1880-1899	1900-1929
1930-1949	1950-1974	1975-2000
Historic	18th Century	19th Century
20th Century	Historic Aboriginal	21st Century

11. Minimum Number of Historic Temporal Periods Represented:

12. Basis for Assignment of Historic Temporal Period(s):

Diagnostic Artifacts	Diagnostic Architectural Remains	Diagnostic Features
Documentary Evidence	Oral Tradition	Other:

13. Describe how Historic Temporal Period(s) were determined (list any diagnostic architectural remains, diagnostic artifacts and/or features and include type names). When listing artifacts and/or features correlate to letters used for Temporal Periods in D.10

14 & 15. Functional Categories of Historic Materials Present at Site and Specific Cultural Materials Collected:

- **0 historic material(s) recorded. See Continuation sheet for details.**

General

16. Describe Prehistoric and/or Historic Cultural Materials observed but not collected. State reason(s) for not collecting.

All materials were collected.

17. Affiliated Ohio Historic Inventory Site Number and Name:

E. Physical Description

1. Archaeological Setting: **Open**

2. Prehistoric Site Type:

Habitation:	Camp	Village	Hamlet	X Unspecified Habitation
Extractive:	Quarry	Workshop		
Ceremonial:	Unspecified Mound		Earth Mound	Stone Mound
	Effigy Mound		Mound Group	Hilltop Enclosure
	Geometrical Earthwork		Cemetery	Isolated Burial(s)
	Petroglyph/Pictograph		Unknown	Other:

3. Historic Site Type:

Residential	Commercial	Social	Government
Religious	Educational	Mortuary	Recreation
Subsistence	Industrial	Health Care	Military
Transportation	Unknown	Other:	

4. State the basIs on which site type assignment(s) were made.

5. Site Condition: **Disturbed-Extent Unknown**

6. Dominant Agent(s) of Disturbance:

None Apparent	Agriculture	Water	Historic Construction
Transportation	Mining	Vandalism	Archaeological Excavation
X Unrecorded	Other:		

7. Nature of Disturbance/Destruction
logging or clearing is the agent of disturbance, based on the young age of the forest; however, there is no documentation of the clearing. Erosional forces have also disturbed original prehistoric contexts.

8. Current Dominant Land Use:
Mixed Forest

9. Land Use History:

10. Site Elevation: **229** Meters A.M.S.L.

11. Physiographic Setting of Site: **Unglaciated Plateau**

12. Glacial Geomorphology: **Not Applicable**

13. Regional Geomorphological Setting: **Hill or Ridge Top**

14. Local Environmental Setting: **Hill or Ridge Top**

15. Soils
Soil Association: **Shelocta-Latham**
Soil Series-Phase/Complex: **Coolville silt loam (CoC)**

16. Down Slope Direction: **N**

17. Slope Gradient (percent): **8** % Unrecorded:

18. Drainage System:
Major Drainage: **Ohio River**
Minor Drainage: **SCIOTO RIVER**

19. Closest Water Source Name **Unnamed tributary of Big Beaver Creek** Water Source Type: **Ephemeral Stream**

20. Horizontal Distance to Closest Water Source: **334** *(m from UTM point)*

21. Elevation Above Closest Water Source: **50** *(m A.M.S.L. from UTM point)*

F. Reporting Information

1. Investigation Type:

Reported	Examination of Collection	Surface Collection
X Auger/Soil Corer	X Shovel Test(s)	X Test Pit(s)
Deep Test(s)	PZ or Humus Removal	Test Trench(es)
X Aerial Photograph	X Mitigation/Block Excavation	Testing/Excav. (strategy unknown)

Chemical Analysis: **general soil chemical analysis**

Other: **GPS, dGPS**

Remote Sensing: **Magnetometer; Magnetic Susceptibility Meter**

2. Surface Collection Strategy:

X Not Applicable	Grab Sample	Diagnostics	Unrecorded
Controlled-Unknown	Controlled-Total	Controlled-Sample	Other

3. If surface collection strategy is Controlled-Total, Controlled-Sample, or Other, describe methodology and percentage.

4. Surface Visibility:

5. Describe surface conditions.

6. Site Area (square meters): sq. m **3600**

7. Basis for Site Area Estimate: **Other** Other: **GPS**

8. Confident of site boundaries? **YES**

9. Estimated Percentage of Site Excavated: **6** %

10. Name of Form Preparer: **Stephen Biehl**

11. Institution: **Gray & Pape, Inc.**

12. Date of Form: **12/02/2016**

13. Field Date: **08/20/2015**

14. Time Spent at Site:

15. Weather Conditions:

16. Name(s), Address(es), Phone Number(s) of Local Informants

17. Artifact Repository(ies): **Gray&Pape has all artifacts; pending DOE curation**

18. Name(s), Address(es), Phone Number(s), of Owners of Collections from Site (attach inventories of private collections).

21. National Register Status:

24. Special Status (select only one, as appropriate): **Other DOE property**

G. References - List Primary Documentary References

Primary Author	Secondary Author	Year	Title
Pecora, Albert M.		2012	PHASE I ARCHAEOLOGICAL SURVEY OF AREA 2 LOCATED WITHIN THE PORTSMOUTH GASEOUS DIFFUSION PLANT (PORTS), PIKE COUNTY, OHIO
Pecora, Albert M.	Jarrod Burks	2013	PHASE II ARCHAEOLOGICAL INVESTIGATIONS OF 33PK347, 33PK348, 33PK349, 33PK371, AND 33PK372 WITHIN THE PORTSMOUTH GASEOUS DIFFUSION PLANT (PORTS), PIKE COUNTY, OHIO
Karen L. Leone	Marcia Vehliing	2016	Results of the Phase III Data Recovery at Site 33PK347, Portsmouth Gaseous Diffusion Plant, Pike County, Ohio

23. Discuss the potential significance of the site.

Although the 33PK347 lithic assemblage is rather small, nearly all of the debris is from the very late stages in the primary reduction process and early stages of the secondary reduction process. The discussion of lithic technology and assemblage formation demonstrates that a sizeable number of bifacial tools could have been modified at 33PK347 without an appreciable amount of archaeologically visible debris. The 33PK347 assemblage is also unique compared to the other lithic assemblages in Survey Area 2 in the sense that it may represent the later stages of stone use. Site 33PK348, which is located to the northeast, produced a very different lithic assemblage, representing the earlier stages of the primary reduction process. Site 33PK347 is a potentially significant prehistoric archaeological site and should be considered for further evaluation.

The Phase III report states that Site 33PK347 is located on an eroding ridgetop that appears to have been utilized occasionally over a span of 7,500 years for short-term occupations that left archaeological evidence of small-scale lithic tool maintenance and repair, but no evidence of domestic activity. Furthermore, there is no definitive evidence that reveals what the site was utilized for other than occasional tool maintenance. These types of sites are often interpreted as overnight hunting campsites that leave an ephemeral archaeological footprint. Occupations for longer periods of time should leave behind more evidence of thermal and domestic activity that was found at the site. Site 33PK347 is characterized by two large shallow FCR-filled basin-shaped pits – a feature type that is found at other sites in the area. None of the investigative techniques undertaken during site mitigation and analysis reveal the utility of these features. In sum, the adverse effects of the project to Site 33PK347 has been mitigated. The data gathered reveal that Site 33PK347 was likely a campsite that was visited occasionally for purposes that are unclear but, based on the small chipped stone lithic assemblage, may have included hunting.

I. Description of Site

1. State physical description of the site and its setting, including dimensions, features (with Measurements), nature and location of artifacts and concentrations, extent, and location of disturbances, etc.

Site 33PK347 covers approximately 3,600 m^2 on a fairly broad ridgetop in the northeast quadrant of PORTS. The site is located approximately 1,000 m southwest of Little Beaver Creek, the nearest major stream. The current vegetation at the site is secondary growth hardwoods, though most of the trees appear to be less than 50 years old. The 1938/39 and 1951 aerial photographs show this portion of PORTS to be covered fully in trees, so it is possible that the site was timbered just before or after the land was purchased by the AEC in the 1950s. The presence of fairly intact archaeological features at or near the ground surface demonstrates that the site area may not have been cultivated. Site 33PK347 was originally documented during a Phase I archaeological survey that involved systematic shovel testing on a 15 meter grid. Each shovel test measured approximately 50 cm square and extended to no more than 30 cm below surface. All shovel test fill was screened through ¼-inch mesh screen. The Phase I survey effort recovered only 12 prehistoric artifacts from 10 shovel tests. The Phase I survey concluded that 33PK347 is a low density lithic scatter, but recommended additional work because the artifact assemblage represented a late stage lithic reduction trajectory that differed from the other lithic scatters recorded within this survey area.

The Phase II survey was initiated with the establishment of a work grid and a geophysical survey designed to identify sub-surface archaeological features such as hearths and earth ovens. The geophysical survey covered 3,394 m^2 of the site area. One-hundred-ninety-seven shovel tests were then excavated on a 5 meter grid for the purposes of procuring a representative artifact sample, to locate intrasite clusters of artifacts (perhaps representing discrete activity or refuse dumping areas), and to better define the site boundaries. Artifact concentrations identified in the shovel testing were investigated further with the excavation of 15 1x1 m units. Additional 1x1 m units (n=15.5) were placed over selected geophysical anomalies in an effort to determine if the anomalies were related to archaeological features. In total, the Phase II survey effort excavated 79.5 m^2 or 2.2% of the site area. The geophysical survey identified several other anomalies that were not investigated in this survey.

Gray & Pape, under contract with Fluor-BWXT, and acting on behalf of the DOE, has completed a Phase III archaeological data recovery at Site 33PK347 at PORTS, Scioto Township, Pike County, Ohio. The DOE is the lead federal agency for this project. The mitigation of adverse effects to Site 33PK347 was conducted as part of the Comprehensive Environmental Response, Compensation, and Liability Act process, which is being used for the environmental clean-up, including Decontamination and Decomminssioning and Waste Management at PORTS. Impacts to Site 33PK347 have occurred as a result of the selection of this specific location for siting of the On-Site Waste Disposal Facility, for the deposition of demolition debris, as part of the D&D efforts. The Final Record of Decision (ROD) for the Site-Wide Waste Disposition Evaluation Project at PORTS was concurred and finalized by the Ohio EPA in June 2015. The ROD identified Site 33PK347 as a historic property where avoidance or minimization was not practicable. In accordance with the commitments in the ROD, fieldwork at Site 33PK347 was conducted and data was recovered from the site.

The Phase III report presented results from the Phase III Data Recovery, but also provided a comprehensive summary of results from all investigations done at the site, including the Phase I survey, Phase II testing, and Phase III data recovery. The site is characterized by a total of 4,809 prehistoric artifacts and two broad, shallow FCR-filled basin-shaped pits. The artifact assemblage consists mainly of FCR (96%), but also includes chipped stone debitage (4%) and lithic tools (less than 1%). In total, excavations at the site have exposed 216.5 m^2 (6%) of the site's surface area. The strategic placement of 354 shovel test units and 128 excavation units across the site, as well as the use of geophysical survey and a multitude of special analyses, suggests that all significant cultural features have been identified and mitigated. Temporally diagnostic artifacts and AMS radiocarbon dates indicate occasional site use over a span of approximately 7,500 years of prehistory, specifically during the Early Archaic, Late Archaic, Early Woodland, Late Woodland, and Late Prehistoric/Fort Ancient periods.

Site 33PK347 was identified as a significant archaeological site, during Phase I and Phase II investigations, because it appeared to not have been historically plowed. This unplowed site was expected to provide data regarding complete cultural features and *in situ* evidence of intact activity areas. Results demonstrate, however, that the site is located on a severely eroded landform that has left a thin, deflated A horizon. Erosion is naturally occurring on this ridgetop; however, it has been deforested during historical times, thus advancing erosional forces. As a result, soils at the site contain ephemeral archaeological evidence from prehistoric occupations spanning thousands of years that have eroded into one another and cannot be teased apart. A deflated and eroded A horizon implies that the archaeological deposits are no longer *in situ*. Therefore, despite the site's location in an unplowed upland context, erosion has interfered with our ability to fully understand this upland remnant lithic scatter.

Site 33PK347 is located on an eroding ridgetop that appears to have been utilized occasionally over a span of 7,500 years for short-term occupations that left archaeological evidence of small-scale lithic tool maintenance and repair, but no evidence of domestic activity. Furthermore, there is no definitive evidence that reveals what the site was utilized for other than occasional tool maintenance. These types of sites are often interpreted as overnight hunting campsites that leave an ephemeral archaeological footprint. Occupations for longer periods of time should leave behind more evidence of thermal and domestic activity that was found at the site. Site 33PK347 is characterized by two large shallow FCR-filled basin-shaped pits – a feature type that is found at other sites in the area. None of the investigative techniques undertaken during site mitigation and analysis reveal the utility of these features. In sum, the adverse effects of the project to Site 33PK347 has been mitigated. The data gathered reveal that Site 33PK347 was likely a campsite that was visited occasionally for purposes that are unclear but, based on the small chipped stone lithic assemblage, may have included hunting.

2. Discuss the relationship between the site and other known sites in the area in terms of location, physical characteristics, size, etc.

SHPO Note: Site 33PK347is located in close proximity to two other archaeological sites, 33PK216 and 33PK215. Both 33PK216 and 33PK315 are of historic affiliation, and therefore suggest no relationship to 33PK347.

The 33PK347 assemblage is unique compared to the other lithic assemblages in the area in the sense that it may represent the later stages of stone use. Site 33PK348 produced a very different lithic assemblage, representing the earlier stages of the primary reduction process.

The Phase III report states that Site 33PK347 shows many similarities and some differences with the comparative sites described above. Similarities include FCR-filled features, a general littering of FCR across the sites, chert types, lack of evidence to identify feature function, and an upland topography. The differences show up in frequency/intensity and diversity of what is similar between the sites. Sites 33PK371 and 33PK372 are larger in area than the rest of the comparative sample; and because of this, there are higher frequencies and diversity of artifacts and features. These are the only sites in the area that show evidence of possible houses. Although the quantity and diversity of artifacts varies between sites, the frequencies are remarkably similar. All artifact assemblages are dominated (more than 90%) by FCR, but also have chipped stone debitage (6-8%) and lithic tools (less than 1%). Pottery, when present, is minimally represented (less than 1%). The features are all characterized by FCR clusters. Most features are described as FCR-filled basin/pits; few are described as midden, trash deposits, and houses. Lithic raw materials were obtained mainly from secondary river deposits, while small quantities were brought north from the Ohio River area. Temporal periods of occupation range from the Early Archaic through to the Late Prehistoric/Fort Ancient, with a noticeable absence during the Middle Woodland period. Most of the sites are multi-component. The distinguishing characteristics of all of these sites, that transcends time periods, is the utility of easily accessible sandstone bedrock for reasons that are unclear, and the surprisingly low frequency of wood charcoal and food remains within them.

D. 5 & 6 Diagnostic Artifact List

Diagnostic Artifact	*Cultural Component*	*Description*	*Count*
Brewerton Side Notched point	Side-Notch: Brewerto		1
Dickson Cluster, Adena Stemmed points	Adena Culture		2
Hamilton Incurvate Triangle point	Fort Ancient Traditi		1

D. 7 & 8 Preshistoric Artifact List

Material	*Category*	*Other*	*Count*
core (Ph III)	Lithics		1
angular shatter (Ph III)	Lithics		6
biface fragment (Ph III)	Lithics		2
Biface fragment (Phz II)	Lithics		1
biface thinning flake (Ph III)	Lithics		10
Brewerton SN point (Phz II)	Lithics		1
Core (Phz II)	Lithics		2
Decortication flake (Phz II)	Lithics		10
Early biface blank (Phz II)	Lithics		1
Early biface thinning flake (Phz I)	Lithics		2
Early biface thinning flake (Phz II)	Lithics		8
FCR (Ph III)	FCR		889
Fire cracked rock (Phz II)	FCR		3723
Fire-cracked rock (Phz I)	FCR		1
flake fragment (Ph III)	Lithics		31
Flake fragment (Phz II)	Lithics		20
flake, unspecified reduction sequence (Ph III)	Lithics		15
Hamilton Incurvate Triangle point (Phz II)	Lithics		1
initial reduction flake (Ph III)	Lithics		3
Interior flake (Phz II)	Lithics		11
Late biface thinning flake (Phz I)	Lithics		2
Late biface thinning flake (Phz II)	Lithics		32
Late pressure flake (Phz I)	Lithics		1
microdebitage (Ph III)	Lithics		12
Nodule blank (Phz II)	Lithics		1
nutshell from flots (Ph III)	Floral Remains		1
Pitted stone (Phz II)	Lithics		1
Preform tip (Phz I)	Lithics		1
Pressure flake (Phz I)	Lithics		4
Pressure flake (Phz II)	Lithics		2
projectile point:Dickson Cluster, Adena Stemmed (Ph III)	Lithics		2
Shatter (Phz II)	Lithics		12
wood from flots (Ph III)	Floral Remains		626
Wood-from flots (Phz II)	Floral Remains		550

D. 14 & 15 Historic Artifact List

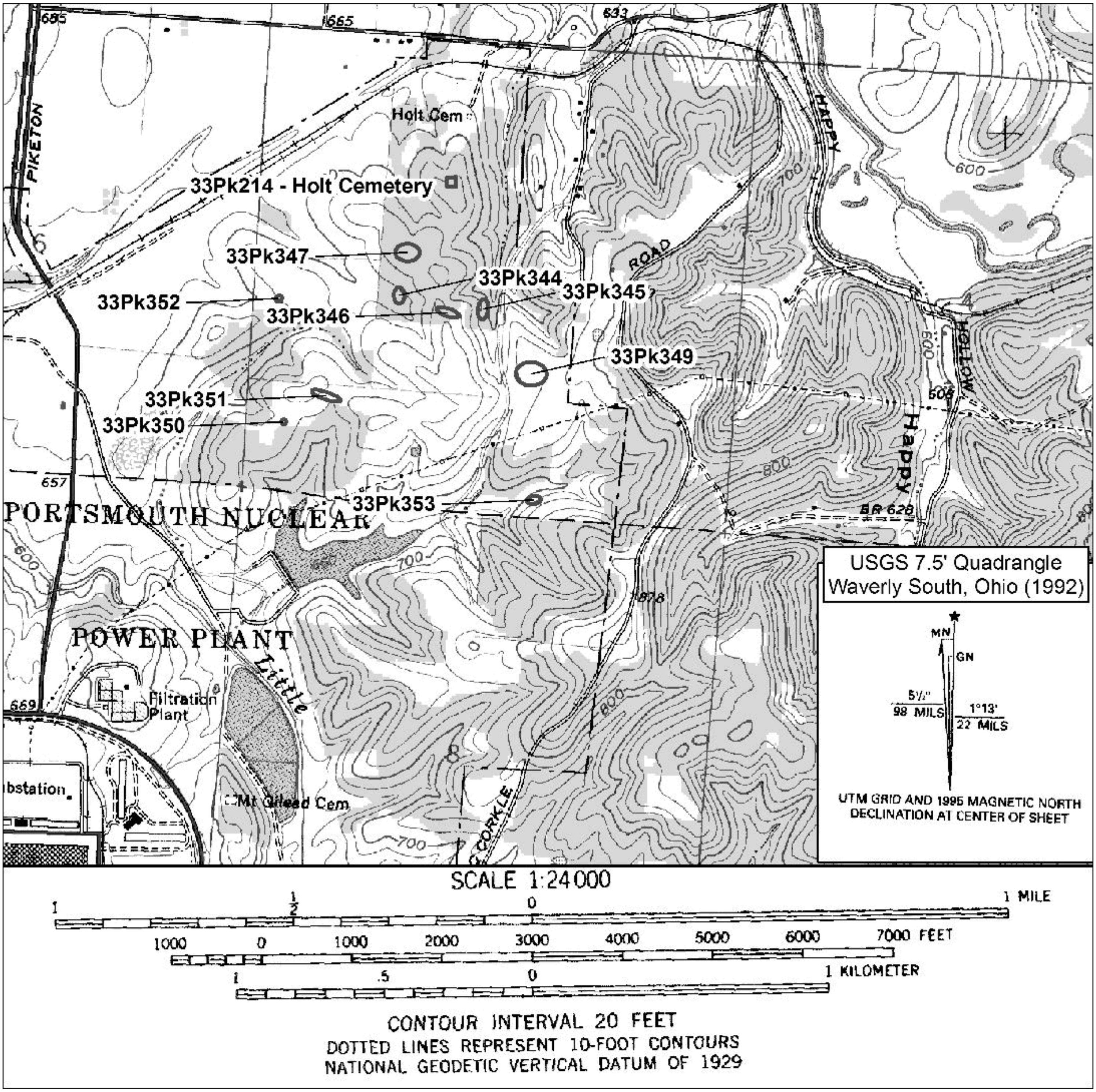
Material	*Category*	*Other*	*Count*
No Records	..	..	..

H. Radiometric Date List

Material Dated	*Date (uncorrected C14 years)*	Laboratory	*Sample #*
charred oak wood	1190 +/- 30 BP	Beta Analytic	421586
charred pine wood	3040 +/- 30BP	Beta Analytic	421584
charred walnut nutshell	3380 +/- 30 BP	Beta Analytic	421587
Charred wood	730 +/- 30 BP	Beta Analytic	328805
charred tree sap	7340 +/- 30 BP	Beta Analytic	421585

K. Sketch Map or Copy of Project Map of Site.

Include north arrow and scale of the appropriate U.S.G.S. quadrangle. Outline total area surveyed and include locations of all identified sites.



APPENDIX C

RADIOCARBON DATES REPORT

BETA

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

October 28, 2015

Ms. Karen Leone
Gray and Pape, Inc.
1318 Main Street
Cincinnati, OH 45202
USA

RE: Radiocarbon Dating Results For Samples 33PK347F1pin, 33PK347F1org, 33PK347F2oak, 33PK347F2wal

Dear Ms. Leone:

Enclosed are the radiocarbon dating results for four samples recently sent to us. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable. The Conventional Radiocarbon Ages have all been corrected for total fractionation effects and where applicable, calibration was performed using 2013 calibration databases (cited on the graph pages).

The web directory containing the table of results and PDF download also contains pictures, a cvs spreadsheet download option and a quality assurance report containing expected vs. measured values for 3-5 working standards analyzed simultaneously with your samples.

Reported results are accredited to ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 standards and all chemistry was performed here in our laboratories and counted in our own accelerators here in Miami. Since Beta is not a teaching laboratory, only graduates trained to strict protocols of the ISO/IEC 17025:2005 Testing Accreditation PJLA #59423 program participated in the analyses.

As always Conventional Radiocarbon Ages and sigmas are rounded to the nearest 10 years per the conventions of the 1977 International Radiocarbon Conference. When counting statistics produce sigmas lower than +/- 30 years, a conservative +/- 30 BP is cited for the result.

When interpreting the results, please consider any communications you may have had with us regarding the samples. As always, your inquiries are most welcome. If you have any questions or would like further details of the analyses, please do not hesitate to contact us.

The cost of the analysis was charged to the American Express card provided. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Ms. Karen Leone — Report Date: 10/28/2015

Gray and Pape, Inc. — Material Received: 10/19/2015

Sample Data	Measured Radiocarbon Age	d13C	Conventional Radiocarbon Age(*)
Beta - 421584	3040 +/- 30 BP	-27.8 o/oo	2990 +/- 30 BP

SAMPLE : 33PK347F1pin
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1365 to 1360 (Cal BP 3315 to 3310) and Cal BC 1290 to 1120 (Cal BP 3240 to 3070)

Sample Data	Measured Radiocarbon Age	d13C	Conventional Radiocarbon Age(*)
Beta - 421585	7340 +/- 30 BP	-26.4 o/oo	7320 +/- 30 BP

SAMPLE : 33PK347F1org
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 6235 to 6085 (Cal BP 8185 to 8035)

Sample Data	Measured Radiocarbon Age	d13C	Conventional Radiocarbon Age(*)
Beta - 421586	1190 +/- 30 BP	-25.7 o/oo	1180 +/- 30 BP

SAMPLE : 33PK347F2oak
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 770 to 900 (Cal BP 1180 to 1050) and Cal AD 925 to 945 (Cal BP 1025 to 1005)

Sample Data	Measured Radiocarbon Age	d13C	Conventional Radiocarbon Age(*)
Beta - 421587	3380 +/- 30 BP	-25.2 o/oo	3380 +/- 30 BP

SAMPLE : 33PK347F2wal
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal BC 1745 to 1615 (Cal BP 3695 to 3565)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -27.8 o/oo : lab. mult = 1)

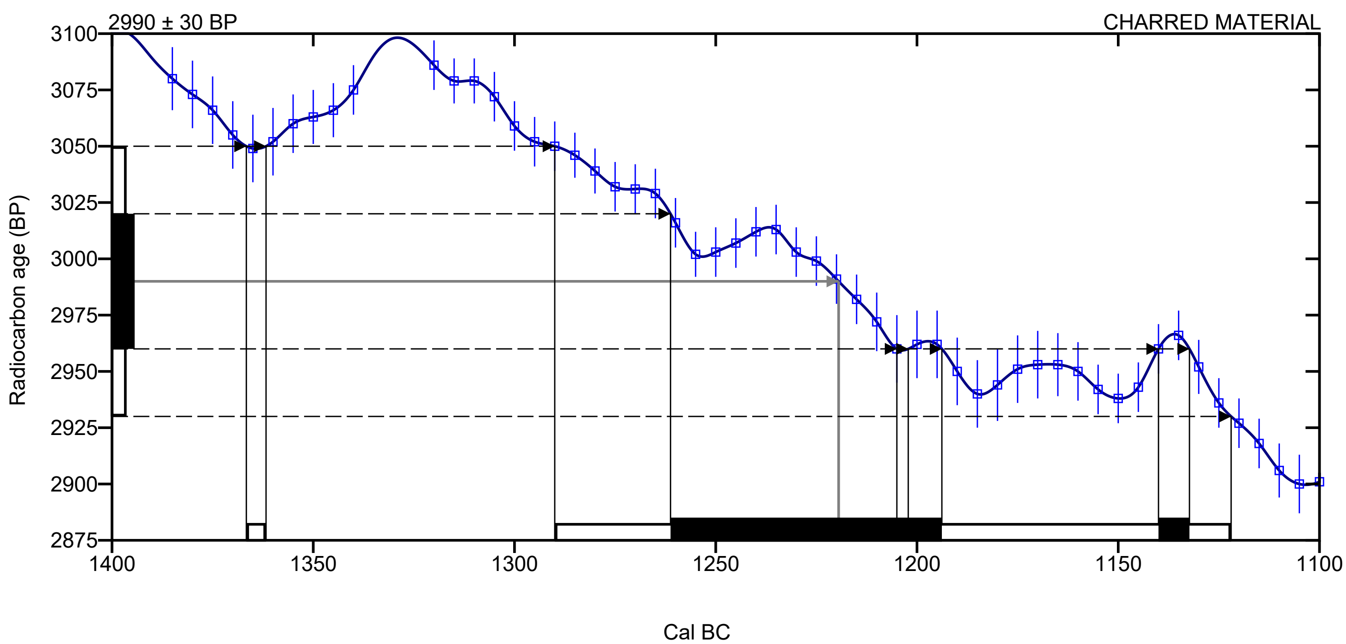
Laboratory number **Beta-421584 : 33PK347F1PIN**

Conventional radiocarbon age **2990 ± 30 BP**

Calibrated Result (95% Probability) **Cal BC 1365 to 1360 (Cal BP 3315 to 3310)**
Cal BC 1290 to 1120 (Cal BP 3240 to 3070)

Intercept of radiocarbon age with calibration curve Cal BC 1220 (Cal BP 3170)

Calibrated Result (68% Probability) Cal BC 1260 to 1195 (Cal BP 3210 to 3145)
Cal BC 1140 to 1130 (Cal BP 3090 to 3080)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to INTCAL13 database

Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887., 2013.

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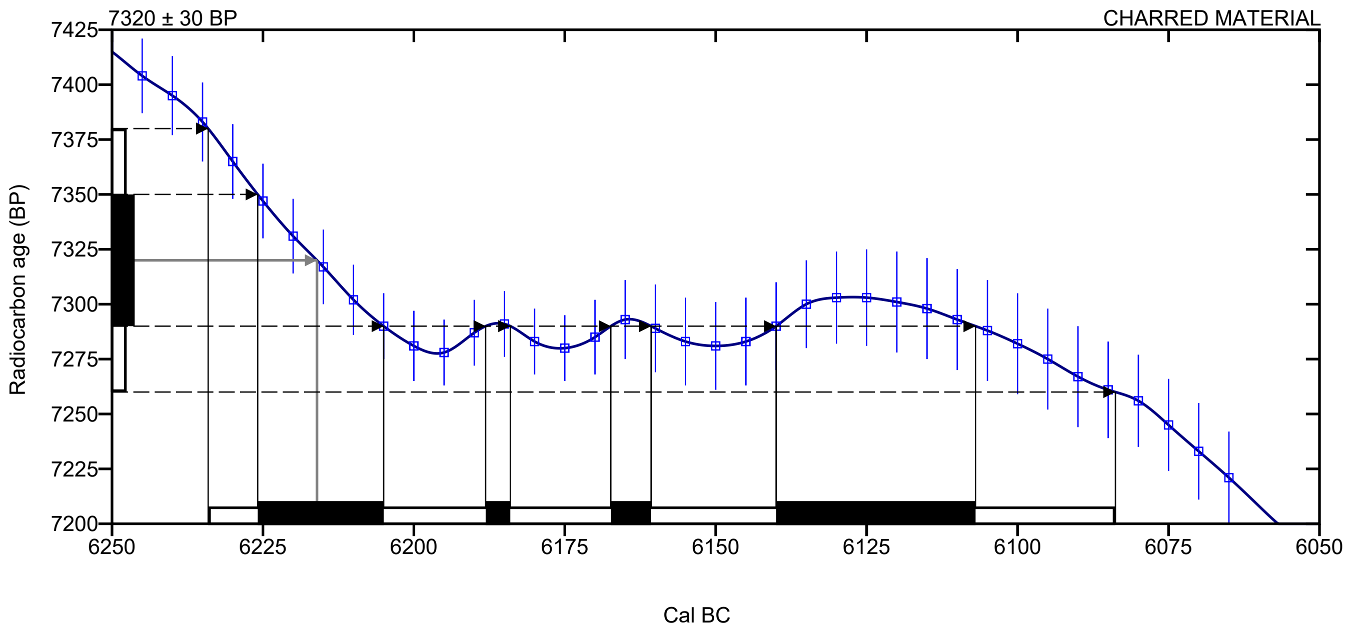
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -26.4 o/oo : lab. mult = 1)

Laboratory number	**Beta-421585 : 33PK347F1ORG**
Conventional radiocarbon age	**7320 ± 30 BP**
Calibrated Result (95% Probability)	**Cal BC 6235 to 6085 (Cal BP 8185 to 8035)**
Intercept of radiocarbon age with calibration curve	Cal BC 6215 (Cal BP 8165)
Calibrated Result (68% Probability)	Cal BC 6225 to 6205 (Cal BP 8175 to 8155) Cal BC 6190 to 6185 (Cal BP 8140 to 8135) Cal BC 6165 to 6160 (Cal BP 8115 to 8110) Cal BC 6140 to 6105 (Cal BP 8090 to 8055)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to INTCAL13 database

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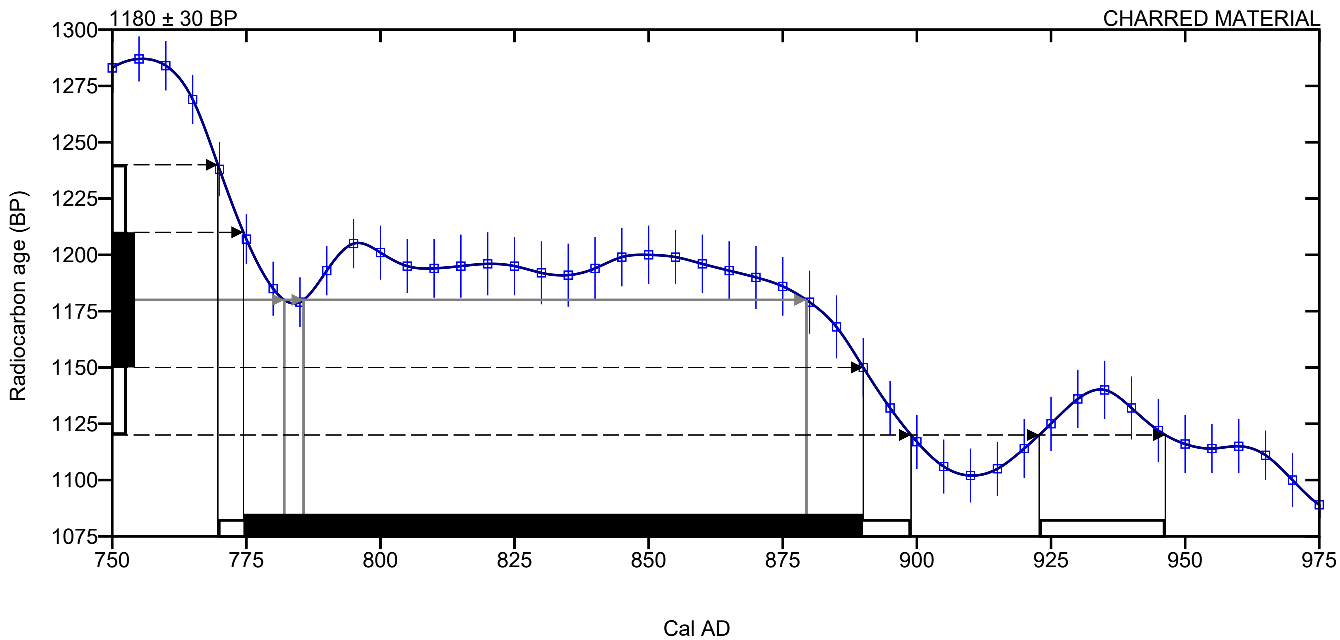
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -25.7 o/oo : lab. mult = 1)

Laboratory number	**Beta-421586 : 33PK347F2OAK**
Conventional radiocarbon age	**1180 ± 30 BP**
Calibrated Result (95% Probability)	**Cal AD 770 to 900 (Cal BP 1180 to 1050)** **Cal AD 925 to 945 (Cal BP 1025 to 1005)**
Intercept of radiocarbon age with calibration curve	Cal AD 780 (Cal BP 1170) Cal AD 785 (Cal BP 1165) Cal AD 880 (Cal BP 1070)
Calibrated Result (68% Probability)	Cal AD 775 to 890 (Cal BP 1175 to 1060)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

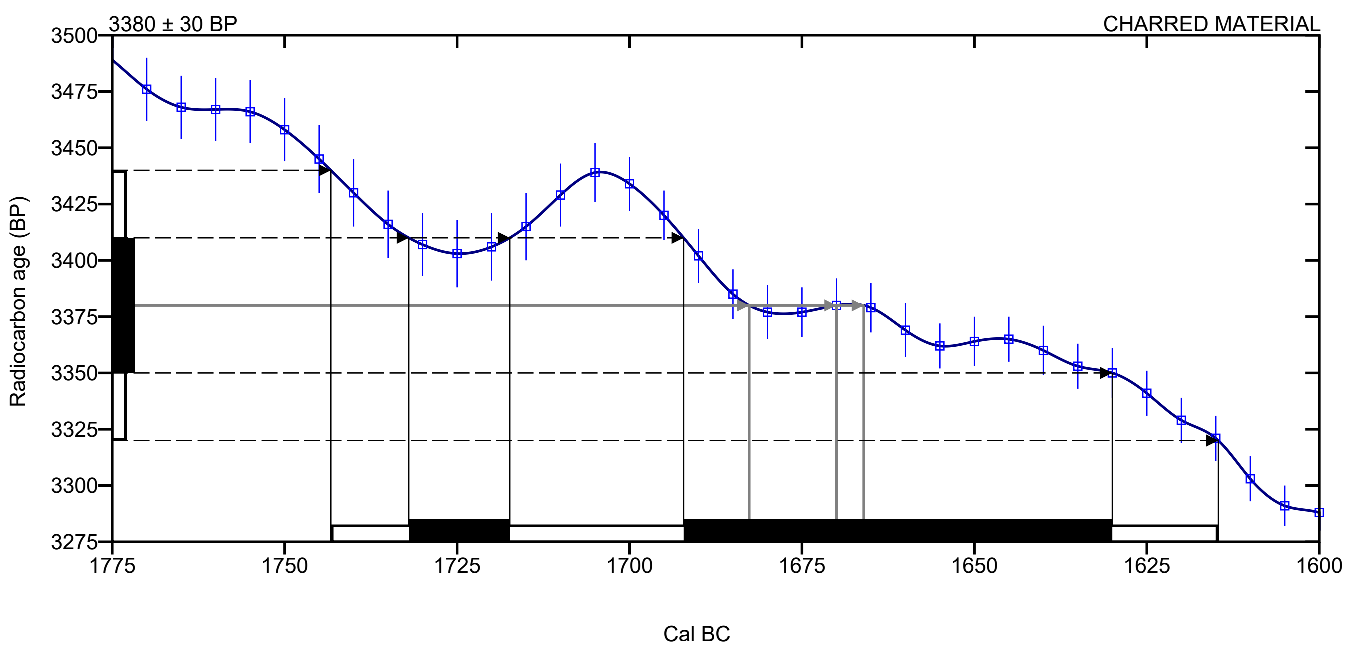
References to INTCAL13 database

Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887., 2013.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -25.2 o/oo : lab. mult = 1)

Laboratory number	**Beta-421587 : 33PK347F2WAL**
Conventional radiocarbon age	**3380 ± 30 BP**
Calibrated Result (95% Probability)	**Cal BC 1745 to 1615 (Cal BP 3695 to 3565)**
Intercept of radiocarbon age with calibration curve	Cal BC 1685 (Cal BP 3635) Cal BC 1670 (Cal BP 3620) Cal BC 1665 (Cal BP 3615)
Calibrated Result (68% Probability)	Cal BC 1730 to 1715 (Cal BP 3680 to 3665) Cal BC 1690 to 1630 (Cal BP 3640 to 3580)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to INTCAL13 database

Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887., 2013.

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APPENDIX D

GEOMORPHOLOGY AND GEOARCHAEOLOGY REPORT

PHASE III GEOMORPHOLOGICAL AND GEOARCHAEOLOGICAL INVESTIGATION OF SITE 33PK347, PORTSMOUTH GASEOUS DIFFUSION PLANT (PORTS), SCIOTO TOWNSHIP, PIKE COUNTY, OHIO

Prepared by:
Nathan C. Scholl, M.A., RPA

Gray & Pape, Inc.

1.0 PROJECT AREA DESCRIPTION

Gray & Pape, Inc., of Cincinnati, Ohio, under contract with FBP, and acting on behalf of the United States Department of Energy, has completed the Phase III archaeological data recovery at site 33PK347, Portsmouth Gaseous Diffusion Plant (PORTS), Scioto Township, Pike County, Ohio. Part of this data recovery included a geomorphological and geoarchaeological investigation.

Site 33PK347 is a multicomponent prehistoric site located on a relatively level ridgetop at an elevation of approximately 225 meters (m) above mean sea level, in the northeast quadrant of the PORTS facility, outside of Perimeter Road. The site is currently wooded in secondary growth hardwoods and covers an area of approximately 3,600 square meters (m^2). The majority of Pike County is drained by the Scioto River and its associated tributaries. Big Beaver Creek is the main tributary in the eastern part of the county and the closest active stream to the site. Pike County is located in the temperate region of North America, and the climate is typified by hot summers and cold winters (Hendershot 1990:2).

Site 33PK347 lies within the Shawnee-Mississippian Plateau of the Allegheny (Kanawha) Plateaus of the Appalachian Plateaus (Brockman 1998). The Shawnee-Mississippian Plateau is characterized by areas of high dissected plateaus of coarse and fine-grained rock sequences. Remnants of the lacustrine clay-filled Teays drainage system are extensive in lowlands and absent in the uplands (Brockman 1998). The eastern part of Pike County is characterized by broad ridges and abrupt, steep hills with streams in U-shaped valleys (Hendershot 1990:2–3).

The bedrock in the vicinity of site 33PK347 is comprised of sandstone and shale deposited in an inland sea during the late Devonian and Mississippian periods (Coogan 1996; Slucher et al. 2006). The near surface bedrock formations include Bedford shale, Berea sandstone, Sunbury shale, and Cuyahoga shale. Bedford shale consists of thinly bedded shale with thin interbeds and laminations of hard, gray, fine-grained sandstone and siltstone. Outcrops of Bedford shale are located in deeply incised streams and valleys on the PORTS reservation (DOE 2014:3–11). Berea sandstone consists of light gray, hard, thickly bedded, fine-grained sandstone with thin shale laminations. It is present beneath the industrial section of PORTS. Berea sandstone underlies Sunbury shale on the eastern side of PORTS, and underlies Minford and Gallia members on the western side. Sunbury shale is a competent, black, very carbonaceous shale. It underlies the unconsolidated Gallia of the Teays Formation on the eastern side of industrialized PORTS but is absent in the western half of the reservation. Sunbury shale underlies Cuyahoga shale outside of the Portsmouth River valley. The Cuyahoga shale consists of moderately hard, thinly laminated shale with numerous interbedded sandstone and siltstone laminations. It forms the hills that surround PORTS and is not present in the industrial section of PORTS (U.S. Department of Energy 2014:3–11).

2.0 METHODS

In conjunction with the archaeological investigation, a geomorphological study was performed on the landform that site 33PK347 is located on, as well as on other landforms and contexts across the PORTS area. This study involves descriptions of the soil and sediment profiles that compose these landforms. These profiles came from various sources, including the wall profiles of test units and hand driven soil core profiles.

Description of these profiles followed set standards in accordance with USDA (United States Department of Agriculture) terminology discussed in the *Soil Survey Manual* (Soil Survey Division Staff 1993). Such descriptions were done in the field or a lab setting while still in field-moistened condition and included: soil horizon, Munsell color, texture, mottling, soil structure, ped coatings, sedimentary structure and bedding characteristics, moisture content, boundary type, effervescence, and inclusions, such as organic material or artifacts. These descriptions were done in accordance to the observed master horizons (with suitable subdivisions), noting any possible lithologic discontinuities (Stafford 2004; Stafford and Creasman 2002).

While unit excavation provided information on the surface soil horizons on site, the soil coring was used to provide information on the underlying deposits to a depth of refusal, where bedrock or other rocky surface was encountered. Two soil core testing locations were selected, one adjacent to Feature 1 (Core 1) and one control sample (Core 2, away from the excavation) to compare on and off-site profiles. The information provided by the cores helped to better inform the landform's depositional history below the level of the archaeological excavations.

The information gleaned from the profiles was used to define the nature of the buried geological deposits, examine the depositional history of the landform, and compare the data to similar landforms within the region. This information provided context to the landform on which the site had developed over time, and how these taphonomic processes have shaped the archaeological record.

3.0 GEOMORPHOLOGICAL/ GEOARCHAEOLOGICAL RESULTS

Site 33PK347 is found on a somewhat broad (40–80 m wide) upland toe-ridge. The general landscape rises at a less than five percent slope to the east, towards a ridge-line summit. It is located approximately 50 m above the Big Beaver Creek stream channel, which can be found approximately 1,000 m to the northeast of the site. From the site, the landform continues to extend approximately 500 m to the west and narrows while descending 25 m to end in a much broader, lower upland surface, which may be part of a remnant glacial lake bed. The heads of two small southeast to northwest running erosional swales occur to the north and south of this toe-ridge landform, running to the broad lower upland surface to the west of the site. East of the site, is a much longer and deeper incised drainage that has its head just to the southwest (approximately 300 m) of the site, which runs north to empty into Big Beaver Creek. This drainage swale, which likely contains a seasonal or spring fed stream, is a prominent topographic feature on the landscape.

3.1 Site Soils and Stratigraphic Profile

The mapped soils of the site indicate that two soil map units are found within or near to the site boundaries, as described in Table 1 (Web Soil Survey 2015). Mapped soils for the site include Coolville silt loam and Rarden silt loam. These soils belong the Alfisol soil order classification, which in turn implies that a significant depth of time (numbering in the thousands of years) is required for the formation of these soil types.

Table 1. Mapped soils located within the project area					
Map Units	**Soil**	**% Slope**	**Description**	**Setting**	**Origins**
Coolville	Silt loam	8–15	Well drained	Summits and benches of hills	Eolian loess on bedrock residuum
Rarden	Silt loam	8–15	Moderately well drained	Shoulders and slopes of hilly interfluves	Bedrock residuum

Soil profiles across the site appear consistent, both within the site boundaries and within the known profiles of the upland areas of the PORTS reservation. This site contained a single basic soil profile observed across the entire site. The site surface is composed of a single Ap horizon (anthropogenically disturbed A horizon) followed by an E horizon (soil with the primary organic and mineral coating stripped away leaving the natural lighter color of quartz), then by a series of Bt horizons (well-developed soil horizons that have accumulated clay through its downward vertical movement), which likely extend down to the interface with bedrock. The typical site soil profile, as described in Tables 2 and 3, was seen as an Ap-E-Bt-Bt2-2Bt-2Bt2 sequence (Figures 1 and 2). This soil profile description most closely matches that of the description for the Coolville soil series.

Two distinct Stratigraphic Units (SU) were observed in these profiles (Figure 3). At the surface of the site is SU 1, a silty loam unit that appears to have formed in glacial loess deposited during, or more likely, after the Wisconsin glacial period. The second unit, SU 2, directly underlies SU 1, and is seen as a silty clay loam formed in the residuum of the shale and sandstone bedrocks present in the area. These units are characterized by the soils that comprise them, as seen in Tables 2 and 3; SU 1 consists of the AP-E- Bt-Bt2 horizons, while SU 2 consists of the 2Bt-2Bt2 horizons. No buried A horizon was identified at the interface between the two SUs, indicating that some period of erosion occurred at the site location just prior to the deposition of the SU 1 loess sediments.

Table 2. Profile Description of Core 1 (Feature 1) from Site 33PK347

Depth Below Surface (cm)	Landform Sediment Assemblage	Stratigraphic Unit	Soil Horizon	Description
0–6	Loess-Mantled Summits (ULMS)	Wisconsin Glacial loess (SU 1)	Ap	Dark grayish brown (10YR 4/3); silt loam; strong medium granular structure; friable; many very fine roots; clear lower boundary
6–14			E	Pale brown (10YR 6/3); silt loam; strong fine platy structure; firm clear lower boundary.
14–22			Bt	Brownish yellow (10YR 6/6); silt loam; strong medium angular blocky structure; firm; many fine distinct very pale brown (10YR 7/3) clay skins some on ped faces; clear lower boundary.
22–31			Bt2	Yellowish brown (10YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; clear lower boundary.
31–45		Residuum (SU 2)	2Bt	Strong brown (7.5YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; gradual lower boundary.
45–60			2Bt2	Strong brown (7.5YR 5/6); silty clay loam; strong medium subangular blocky structure; very firm; many prominent light yellowish brown (10YR 6/4) clay skins on ped faces; many coarse shale and few coarse sandstone gravels.

Table 3. Profile Description of Core 2 (control sample) from Site 33PK347

Depth Below Surface (cm)	Landform Sediment Assemblage	Stratigraphic Unit	Soil Horizon	Description
0–5	Loess-Mantled Summits (ULMS)	Wisconsin Glacial loess (SU 1)	Ap	Dark grayish brown (10YR 4/3); silt loam; strong medium granular structure; friable; many very fine roots; clear lower boundary
5–15			E	Pale brown (10YR 6/3); silt loam; strong fine platy structure; firm clear lower boundary.
15–23			Bt	Brownish yellow (10YR 6/6); silt loam; strong medium angular blocky structure; firm; many fine distinct very pale brown (10YR 7/3) clay skins some on ped faces; clear lower boundary.
23–30			Bt2	Yellowish brown (10YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; clear lower boundary.
30–60		Residuum (SU 2)	2Bt	Strong brown (7.5YR 5/6); silty clay loam; strong medium subangular blocky structure; firm; many faint fine strong brownish yellow (10YR 6/6) clay skins on ped faces; gradual lower boundary.

Figure 1. Profile of Core 1, exhibiting Ap-E-Bt soil horizon sequence.

Figure 2. East Wall profile of Block 19, exhibiting Ap-E-Bt-Bt2 soil horizon sequence.

Figure 3. Core 1 and 2 soil samples, exhibiting the SU 1 and SU 2 profile sequence.

4.0 GEOMORPHOLOGY DISCUSSION

Recent geoarchaeological models for the Midwest focus on the following questions:

- Can specific landscape units be used as good archaeological chrono-markers? And if so,
- Where and what type of prehistoric settlement can be expected to be found in the sediments contained within them?

The unit of landscape resolution most often judged as appropriate to study, when predictions concerning archaeological site location are to be made, is that of the fine scale landform (e.g., terraces, floodplains, and fans) (Bettis and Hajic 1995).

A geoarchaeological soil based prediction model was created after extensive archaeological and geomorphological studies of the alluvial landforms of the Des Moines River Valley and their associated soil orders. By identifying informal lithological units called Landform Sediment Assemblages (LSA) (defined as genetically and temporally related landforms and their associated soil deposits), it was concluded that certain alluvial landforms can be directly correlated with the soil order identified from these deposits (Bettis 1992). The weathering characteristics of the soils that make up these landforms, together with the radiocarbon dates obtained from samples derived from such LSA, showed that landforms of certain ages have similarly weathered soils. It was also noted a correlation exists between these age deposits and the soil orders of the landforms, which shows that they can be useful as proxy indicators as to the absolute age of the deposits contained within them. This landform soil model can be used to predict the age and location of sites that are likely to be found on certain landforms, and whether possibilities exist for such sites to be deeply buried.

The geomorphological analysis of the site investigated during this Phase III excavation employed the use of soils maps, aerial color and infrared photographs, observations of excavation profiles, and hand driven soil cores taken from the landform on which the site is located. Soils maps, as accessed on Web Soil Survey (2015), were used for their ability to provide base-line interpretation of the composition and depositional history of landforms. Field observations were used to ground truth the information obtained from the soils maps. Field descriptions included soil horizon, Munsell color, texture, mottling, soil structure, ped coatings, sedimentary structure and bedding characteristics, moisture content, boundary type, effervescence, and inclusions, such as organic material or artifacts. These descriptions were done in accordance with the observed master horizons (with suitable subdivisions), noting any possible lithologic discontinuities. Descriptions followed set standards in accordance with USDA terminology discussed in the *Soil Survey Manual* (Soil Survey Staff 1993).

The LSAs defined in this study were coded based on terminology used by Hajic (2000), which is an abbreviated form of that developed and used for archaeological modeling in Minnesota by Hudak and Hajic (1999, 2002). In turn, this Minnesota coding scheme is an extension of the original LSA concept developed for the Upper Mississippi Valley by Bettis et al. (1995, 1996). Codes such as these are intended to summarize geographic location information and to create LSA maps with symbols that carry as much detail as possible. Scholl (2012) applied this same model to an upland landscape similar in age, showing that it escaped glaciation during the last glacial ice advance. As such, the LSA terminology developed for that research can also be used for the current study.

The coding scheme used here recognizes two hierarchical geomorphic levels, the landform and the landscape. The basic map unit used here is considered a landform; yet it should be noted that, often, genetically and temporally related landforms can form landscapes. Landscapes recognized at PORTS include unglaciated uplands and floodplains. Most of the LSAs are composed of one or more stratigraphic units, for each of which a date range has been attempted to be ascribed. Basic stratigraphic units, and as such the LSA they comprise, as well as detailed descriptions of the soil horizons that make up each stratigraphic unit are described below.

4.1 The Upland Landscape

The upland landscape at and near site 33PK347 consists of up to three landform sediment assemblage map units. The map units are distinguished based mainly on differences in general hill-slope location and stratigraphy of associated upland sediments. Most of the local region consists of rolling uplands or uplands dissected by low order streams and erosional swales. This landscape has been dominated and formed through a combination of glacial events and by weathering and erosion of underlying bedrock. The broad surface to the north and west of the site may be indicative of an erosional step (erosion surfaces) in the landscape that, in turn, make it possible that two cycles of erosion and stream incision have occurred near the site. This may be due, in part, to the glacial Lake Bainbridge that once occupied the area around Big Beaver Creek. Residual material derived from bedrock weathering and erosion mantles the bedrock surface. This residuum may have been subject to (1) remobilization and resedimentation *during* erosional cycles, and (2) additional weathering *between* erosional cycles.

As the detailed surface geology of the PORTS area has yet to be mapped, the generalized map shows only that the region is dominated by Wisconsin age outwash and lacustrine sediments, as well as upland residuum and colluvium (Coogan 1996). The interpretation of this geomorphological study of site 33PK347 proposes that Wisconsin age loess (e.g., the Wisconsin Peoria Loess) blankets the surface of the landscape. While this deposit is not conclusively loess, this and other regional interpretations (Bettis et al. 2003), as well as the county soil survey (Web Soil Survey 2015), hold it as the most likely origin of the surficial deposits.

The loess deposits and the underlying residuum have also been subject to erosion and resedimentation as colluvium, sometimes incorporating coarser resistant rock fragments from eroded residuum. No Quaternary deposits are thought to be present in the upland surfaces of this study area.

The landform this site is found on would fall under the Upland Loess-Mantled Summit LSA (Table 4). The two small swales to the north and south of the site would be classified as Upland Depression and Drainage Heads (UDDH). And the base of the toe-ridge at the west end of the site would be classified as Upland Intermediate Shoulder Slopes and Side Slope. The seasonal drainage to the east likely contains elements of both UDDH and Upland Steep Shoulder Slopes and Side Slopes LSA.

Table 4. Description of LSA Observed at Site 33PK347 and Details of Stratigraphic Units.			
LSA	**Stratigraphic Unit**		**SU Description- Color/Texture/Bedding**
Loess-Mantled Summits (ULMS)	SU 1	Wisconsin Glacial loess	Dark grayish brown to yellowish brown/ silt loam - silty clay loam/ massive.
	SU 2	Residuum	Strong brown/ silty clay loam-clay loam with bedrock fragment inclusions/ massive

4.1.1 Upland Loess-Mantled Summits (ULMS)

This map unit consists of broad summits and shoulder slopes with slopes of less than five percent. Site 33PK347 is part of a broad but heavily dissected upland divide that serves as the drainage divide between the Big Beaver Creek and the Scioto River. A majority of the PORTS area appears to be made up of this LSA.

The ULMS LSA surface is underlain by two stratigraphic units, which consist of what appears to be a cap of silty late Wisconsin Peoria Loess (SU 1), while this is underlain by a silty clay loam bedrock residuum (SU 2). Stratigraphic Unit 1, the late Wisconsin loess, is approximately 30 cm in thickness. It is preserved on almost all upland landscape locations, but may be somewhat eroded, as the A horizon is observed to be only 5–6 cm in thickness. This loess has a silt loam texture that exhibits grayish brown to yellowish brown colors (10YR hues) and is too thin to be calcareous. The loess unit overlies the residuum that makes up SU 2. The residuum has a silty clay loam texture, with matrix-supported pebble to cobble sized rocks ranging from few to abundant. Colors appear to be predominately strong brown (7.5YR hues). The contact between the Wisconsin loess and the residuum is differentiated by the somewhat sudden increase in the clay particle size of SU 2. The maximum thickness of SU 2 is unknown as its base was not reached during this investigation; however, the Coolville soil profile description indicates that this soil can reach depths of 1.5 m below surface.

Out of these units, the late Wisconsin Peoria Loess is the youngest of the upland material. The Wisconsin depositional period is generally considered to have ended by about 10,500–10,000 B.C. (Willman and Frye 1970), before the verifiable age of the peopling of this part of Ohio. As such, cultural deposits from any period will be surface manifestations where the ULMS LSA is found or, at best, buried shallowly (< 0.25 m) by loess-derived erosion deposits.

4.1.2 Upland Depressions and Drainage Heads (UDDH)

Depressed areas between summits of the ULMS LSA that are not marked by the wetland symbol on topographic maps make up this LSA. These depressional areas are primarily seen here as the level or gently sloping areas at the heads of small first order or erosional drainages. These depressions may have resulted from differences in either the underlying topography, loess thickness, from past erosional patterns, or for reasons that cannot be discerned from surficial observations. No stratigraphic data was collected from any of the examples of these LSA near the site.

However, it is likely that the temporal relationships of the sediments of the ULMS and UDDH LSAs are similar. If any erosion occurred in the Holocene period, colluvial deposits within these depressions would be young enough to contain prehistoric cultural deposits at both its surface and buried within to nearly any depth. As the hydrologic regimes and controls of these upland depressions are as yet poorly understood, it is likely that past climatic episodes produced cooler and/or wetter environments resulting in these depressions having been wet for part of the year and dry the rest. Today they are primarily dry.

4.1.3 Upland Intermediate Shoulder Slopes and Side-slopes (UISS)

The UISS LSA consists of side-slopes and shoulder slopes occurring around the higher, broader parts of interfluves immediately downhill of the broader upland divides. The UISS LSA can be found in an intermediate position between ULMS and USSS LSA, but can also be intermediate of the ULMS and an interfluvial stream. No stratigraphic data was collected from any of the examples of these LSA near the site.

The UISS LSA is thought to be underlain mainly by colluvium and residuum; however, alluvium may also represent a contributing factor to the deposition of this LSA. They may include reworked and redeposited sediments of glacial origin and/or loess from both glacial periods, as seen in the ULMS LSA. If such glacial sediments were deposited *in situ* they may well have been eroded and reworked into younger deposits down-slope, as this LSA is mainly associated with valley margins. *In situ* artifacts may be found at the surface of this LSA. However, as the age of this landform is yet unknown, artifacts buried below the surface (approximately the top 30 cm of the landform) may be *in situ* or may have been redeposited from an original context located up-slope.

4.1.4 Upland Steep Shoulder Slopes and Side-slopes (USSS)

The USSS LSA are steep side-slopes or shoulder slopes that occur along the sides of deeply incised drainage valleys or toe ridges. This LSA is most abundant east of the site, along the Happy Hollow drainage. No stratigraphic data was collected from any of the examples of these LSA near the site.

Surficial bedrock could be observed in this LSA, if not overlain by thin layers of residuum and/or colluvium from higher on the landscape. Investigation would be needed to be able to give any age determination for these LSA. Due to the angle of the slope of these landforms, no cultural activities are likely to have occurred on this LSA, with the possible exception of lithic raw material extraction. Cultural deposits on the USSS LSA may or may not be *in situ*. *In situ* cultural deposits would be expected to be found primarily on the surface of the landform. However, if any cultural material was recovered on these slopes, consideration should be given as to whether or not they were transported downslope through hillslope erosion.

4.2 Floodplain Landscape

Floodplain landscape in the immediate area around Site 33PK347 is nearly nonexistent, consisting primarily of the Big Beaver Creek floodplain located to the north of the site. This stream and its floodplain were not investigated for the current project; observations are made primarily from the 1985 Waverly South, OH USGS 7.5-minute quadrangle map.

Big Beaver Creek is a second or third order stream, approximately 30 km in length. One discontinuous terrace appears present along its length. A well-developed (as much as 800 m in width) floodplain is present near the site, with many meander cut-offs evident. From its headwater to approximately 6 km upstream of site 33PK347, the creek is relatively straight and little incised into its larger floodplain. After this point, the stream incises and begins to meander within its floodplain. This meandering sinuosity continues up to the point the creek enters the Scioto River floodplain, where it becomes less sinuous. After it enters the Scioto River floodplain, it becomes Yazoo-like, first traveling south approximately 6.4 km along the eastern valley margin before crossing the floodplain to join the Scioto River another 3 km downstream.

In general, the LSA in alluvial settings can be distinguished on the basis of floodplain morphology, presence, continuity, thickness of associated sediments, and character of soils developed in the associated sediments. These characteristics are likely to shift with changes in the stream order and with an increase in the size of the drainage basin. The alluvium found in the floodplains of lower order upland streams of this region is likely derived mainly from eroded loess and till, from residuum-derived colluviums, and to a lesser extent from bedrock and its overlying residuum. In general, sediment particle size will increase downstream from the headwaters and originate from increasingly less local sources.

Hajic (2000) identifies three floodplain LSA for these types of low order steams. These three floodplain types are described below.

4.2.1 Type A Floodplain (FFA)

The Type A Floodplain is found to consist of narrow level areas to shallow swales. This floodplain type represents the generally undissected valley floors and incipient drainage-ways between broad upland summits. While floodplain deposits are likely Holocene in age, they may vary widely in age within that period. Depositional conditions in the FFA LSA suggest that the potential for buried prehistoric cultural deposits is low. Type A Floodplains were not examined in the field during this study.

4.2.2 Type B Floodplain (FFB)

The Type B Floodplain consists of narrow alluvial surfaces in low order valleys and the colluvial foot-slopes that lead to the floodplains. This includes channels incised into older deposits. It is a continuous to discontinuous floodplain remnant and is inset into upland LSAs. Type B Floodplains were not examined in the field during this study.

4.2.3 Type C Floodplain (FFC)

The Type C Floodplain consists of continuous level to slightly concave floodplains and their associated underlying alluvium. The FFC LSA occurs in valley segments that are wider than the two other floodplain LSAs and tend to be associated with lower reaches of large tributaries. The FFC LSA is subject to modern flooding and the upper sediments are likely historical in age. Yet, a possibility exists that underlying alluvium may be prehistoric in age, suggesting a low to moderate potential for buried cultural deposits in this LSA. Type C Floodplains were not examined in the field during this study. This LSA likely best represents the Big Beaver Creek floodplain to the north of site 33PK347.

5.0 SUMMARY AND CONCLUSIONS

Site 33PK347 is located in an upland setting approximately 1,000 m south of Big Beaver Creek, on a somewhat broad (40–80 m wide) upland toe ridge. The toe ridge landform was formed primarily through erosional processes that have been acting on the upland environment in this physiographic region. The landform is comprised of two stratigraphic units: SU 1 is a late Wisconsin-age loess deposit, while SU 2 is a residuum that has been forming in place since the bedrock it derives from first began to weather. No A horizon is associated with the residuum soils, indicating a period of erosion was experienced at the site location at some point prior to the deposition of the glacial-derived loess that make up SU 1. This loess was likely deposited in the late Wisconsin glacial period or in the early Holocene period and, as such, likely predates the period of human occupation in the region. No significant additional sediment has been deposited on the site since SU 1. Given the antiquity of these sediments and soils, any cultural deposits would have been deposited on essentially the modern surface of the landform. It is possible that some ground surface erosion has taken place that may have washed sediments onto the site from higher surfaces to the east; however, it is likely that any such erosional processes would have also removed sediments from the site, making any sediment loss, or gain, neutral. Such a process may have helped shallowly bury cultural deposits below the modern surface.

Surface erosion has likely occurred on site in the recent past. The denuding of the landscape in historical times for agricultural or logging purposes created a situation where upland sediments could easily erode due to the lack of a vegetation cover to hold them in place. This most certainly took place at site 33PK347 as the A horizon is much thinner (0–6 cm) than average thickness of 20 cm for a Coolville soil series A horizon. Tree ring cores taken from trees on site indicate an average age of 50 years for this new vegetation growth. Given these datasets, it appears that the A horizon at site 33PK347 may have been completely eroded after agricultural clearing of the landform occurred and has only just begun to form in the last 60 years or so. This incipient A horizon has formed from the addition of decayed organic material to the top of the E horizon. The E horizon itself (and the soil horizons below it) appear to be undisturbed by anthropogenic processes. Any artifacts found in the soils below the A horizon likely have been transported there through natural bioturbation. Due to the erosion of the A horizon, it may be that any artifact not from a feature context on site is not in its original context.

Based on geomorphological observations, the position of site 33PK347 on the landscape could likely be due to the presence of the seasonal drainage to the east. From this drainage, the site can be accessed relatively easily from Big Beaver Creek. Further reasoning for the choice of this landform for occupation likely relates to the resource(s) that may have been being collected on or near the site.

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APPENDIX E

SOIL CHEMISTRY REPORT

GRAY & PAPE
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CULTURAL RESOURCES CONSULTANTS

SOIL CHEMICAL ANALYSIS OF SITE 33PK347, PORTSMOUTH GASEOUS DIFFUSION PLANT (PORTS), SCIOTO TOWNSHIP, PIKE COUNTY, OHIO.

Prepared by:
Nathan C. Scholl, M.A., RPA

Gray & Pape, Inc.

1.0 INTRODUCTION AND METHODS

Soil chemistry analysis was utilized to provide information regarding taphonomy and cultural markers within activity areas at site 33PK347. Soil samples were taken from three locations within the site for purposes of better understanding the differences between the natural and cultural modification of site soils. During archaeological field investigations, three soil samples were taken from (1) Feature 1 fill, (2) Feature 2 fill, and (3) a control sample. The control sample was taken from a soil column in Block 11, a noncultural context. All samples were taken using a water-cleaned and dried trowel. Approximately 250 milliliters (ml) of soil was collected from each context at the same depth below surface (5–10 cm) and placed in zip-top polypropylene bags. The samples were submitted to Spectrum Analytic, Inc., for their S3 analysis, which includes quantification of soil pH, organic matter, cation exchange capacity (CEC), percent base saturation of cation elements, cation element ratios, available phosphorus, potassium, magnesium, calcium, sulfur, boron, copper, iron, manganese, and zinc. Results were sent to the author for archaeological interpretation.

2.0 RESULTS

Chemical analysis of the soils at site 33PK347 reveal general similarities; however, some differences in element concentrations between Feature 1 and Feature 2 were present. Results of the multi-element analysis of three soil samples (Feature 1, Feature 2, and control sample) by Spectrum Analytic, Inc., are presented in Table 1. Their S3 analysis contains a suite of measurements, some of which are agricultural in nature and do not pertain directly to this study. Results show that some element concentrations in Feature 1 and Feature 2 are higher than the baseline reading of the control sample. Element concentrations in the control sample reflect mean soil concentrations on the ridgetop where the site is located. Absolute soil concentrations are of little use when trying to interpret feature functions between sites because of differences in geology, hydrology, and climate. Therefore, it is relative patterns of enhancement across a single site that are based on control sample levels. While no statistical analyses were performed to mathematically prove the elemental relationships discussed, frequency differences thought to be significant to the site and its interpretation are presented.

Table 1. Results of the chemical analysis from the three samples taken from site 33PK347

Element	Feature 1	Feature 2	Control Sample
Soil pH	4.5	4.8	4.8
Buffer pH	6	6	6
Organic Matter	1.8%	1.0%	0.1%
CEC	12.9	13.5	12.9
K Saturation	0.9%	1.0%	0.8%
Mg Saturation	2.8%	3.6%	2.4%
Ca Saturation	3.4%	6.8%	3.9%
K/Mg Ratio	1.1	1	1.1
Ca/Mg Ratio	2.4	3.70	3.2

Table 1 (Cont'd). Results of the chemical analysis from the three samples taken from site 33PK347			
Element	**Feature 1**	**Feature 2**	**Control Sample**
Phosphorus (P)	3 ppm	32 ppm	2 ppm
Potassium (K)	54 ppm	64 ppm	46 ppm
Magnesium (Mg)	50 ppm	66 ppm	42 ppm
Calcium (Ca)	118 ppm	246 ppm	136 ppm
Sulfur (S)	11 ppm	10 ppm	12 ppm
Boron (B)	0.3 ppm	0.1 ppm	0.1 ppm
Copper (Cu)	0.2 ppm	0.6 ppm	0.4 ppm
Iron (Fe)	240 ppm	70 ppm	101 ppm
Manganese (Mn)	10 ppm	13 ppm	6 ppm
Zinc (Zn)	1.2 ppm	2.8 ppm	1.7 ppm

Soil pH is a measure of the soil acidity or alkalinity. The pH reading of most soils is within a range of 4.5–8.5, where 7.0 is neutral. Readings above 7.0 are alkaline and readings below 7.0 are acidic. Results of the chemical analysis show that the soils on the ridgetop where site 33PK347 is located are strongly acidic. These levels are likely a reflection of the parent materials at this locale that consist of acid, clayey shale, and siltstone. No significant differences in the soil pH between cultural (Feature 1 and Feature 2) and non-cultural (control sample) contexts were noted, further supporting the interpretation that acidic levels are due to parent materials rather than anthropogenic activity.

Buffer pH is a value that is generated in the laboratory; it is not an existing feature of the soil. Laboratories perform this test to develop lime application recommendations for agricultural purposes and is not relevant to this study.

Organic matter is the remains of organic material (plant and animal) within the soil. Research has shown that cultivated soils become depleted of organic matter due to increased soil aeration and the break-up of soil aggregates that expose organic matter to microbial attack (Holliday 2004). This depletion of organic matter could also occur when soils are subject to erosional forces that remove both existing soils with integrated organic matter, as well as any new surface organic matter before it can become incorporated into the soil. Table 1 shows that while all three samples contain relatively low amounts of organic matter, the control sample contains much less. This likely indicates that the surface of the landform has either been cultivated in the recent past or subject to erosional wasting. It also indicates that the two features contain significantly more organic matter than the natural soil, providing some evidence for their utility as anthropogenic features.

CEC (cation exchange capacity) is a calculated value that is an estimate of the soil's ability to attract, retain, and exchange cation elements. It is reported in milliequivalents per 100 grams (meq/100g) of soil. A common CEC range is 0–50. Higher CEC values (11-50) are associated with clayey soils and indicate that a soil has a greater capacity to hold nutrients. Lower CEC values (1–10) are associated with sandy soils that have a low capacity to hold nutrients. Samples from site 33PK347 (12.9–13.5) are indicative of clay soils, but are in the lower end of the range, suggesting less than optimal nutrient retention. Readings between the cultural and noncultural contexts are indistinguishable, demonstrating that soils within the features are from the ridgetop.

Potassium (K) saturation, magnesium (Mg) saturation, and calcium (Ca) saturation percentages provide information regarding the nutrient balance in soil. The three major nutrient cations in soil are K, Mg, and Ca. The ideal balance, for agricultural purposes, is 2–4 percent K, 10–20 percent Mg, and 50–70 percent Ca. Percentages from site 33PK347 show evidence of soils that are nutrient-poor: 0.8–1 percent K, 2.4–3.6 percent Mg, and 3.4–6.8 percent Ca. Readings between the cultural and noncultural contexts are indistinguishable, demonstrating that soils within the features are from the ridgetop.

While the K:Mg and Ca:Mg ratios are an important discussion in agricultural fertilization, they are not a factor in element (K, Mg, or Ca) availability. These frequencies are not relevant to this study.

Concentrations of phosphorus (P) levels in soil are one of the most widely recognized indicators of past human presence on the landscape, mainly as soil enhancement in agricultural areas and refuse disposal in habitation zones (Arrhenius 1963, Woods 1977). Phosphates represent organic waste deposited by humans, including fecal material, and they leave a strong and lasting chemical signature. The same is true for all other animal waste/dung. Phosphorus bonds to iron, aluminum, or calcium ions at the site of deposition and cannot be easily removed through natural processes; therefore, P accumulates in the precise place it was deposited. Table 1 shows that Feature 2 contains a much higher amount of P (32 parts per million[ppm]) than either Feature 1 (3 ppm) or the control sample (2 ppm), which show levels close to depletion. This chemical marker provides strong evidence that Feature 2 is anthropogenic and brings up the question of possible differences in feature function. Was Feature 2 utilized for plant or animal processing, but not Feature 1? Some researchers suggest that P is a less reliable indicator of human activity than originally thought, since elevated levels can also be caused by animal dung (Entwistle et al.1998, 2000). Based on the fact that multiple factors can increase phosphorus levels, postabandonment waste deposition by humans or animals cannot be ruled out and, therefore, P levels may not necessarily reflect primary feature function. The small sample size (just two features were identified at the site) does not allow for patterning in the data to help identify postabandonment outliers.

Potassium (K) is one of the three major nutrient cations in soil, along with Mg and Ca. Potassium does not form a structural part of any plant component or compound; however, it is required for various metabolic and physiological functions of plants. The leachate of wood ashes is a good source of potassium in nature and relevant to this archaeological discussion. Table 1 shows that levels in all three samples are similar (46–64 ppm). Low levels of K in FCR-filled pits suggests that the pits were either not thermal features, or the wood ash K has almost completely leached out of the soils over time.

Magnesium (Mg) is one of the three major nutrient cations in soil, along with K and Ca. Research shows that its connection to human activity is not yet well understood (Entwistle et al. 1998, 2000). Table 1 shows that levels in all three samples are similar (42–66 ppm), suggesting no difference between cultural and non–cultural contexts.

Calcium (Ca) is one of the three major nutrient cations in soil, along with K and Mg. The calcium level in Feature 2 (246 ppm) is nearly twice that of the other two samples (118 ppm in Feature 1 and 136 ppm in the control sample). This may indicate that a significant presence of decayed bone is locatedin this Feature. This lends further evidence to the domestic utility of Feature 2. High Ca concentrations can also be affected by limestone parent materials (Pollard and Heron 2008:119–128); however, it is shale and siltstone parent materials that are found on this ridgetop.

Most sources of the micronutrient sulfur (S) are in the soil's organic matter and, therefore, concentrated in the topsoil or plowzone. Sulfur frequencies were indistinguishable between samples (10–12 ppm) and these similarities correlate with the similarities in organic matter between the samples.

Boron (B) is a micronutrient that is found in the organic matter of soils. Boron is highly mobile and, therefore, can easily leach out of soils. Levels of B in the site 33PK347 samples are extremely low (0.1–0.3 ppm) and indicative of nutrient-depleted soils. Readings between the cultural and noncultural contexts are indistinguishable, and these similarities correlate with the similarities in organic matter between the samples.

Copper (Cu) is the most immobile micronutrient. Research shows that the connection of Cu to human activity is yet not well understood (Entwistle et al. 1998, 2000), though it has been linked to pigments in Mayan ceremonial activity areas (Parnell et al. 2002). Table 1 shows that the readings between the cultural and noncultural contexts at the site are indistinguishable.

Iron (Fe) in soil will naturally collect where oxidation occurs. This usually indicates that some process has disturbed the soil and allowed water and/or oxygen to better interact with the iron in the soil. An example of the concentration of iron may occur where roots have or are decaying and allow for air or water to better interact with soils buried below the surface. Iron will oxidize and collect adjacent to these disturbances creating iron concentrations (Vepraskas 1992). In archaeological contexts, this often takes the form of iron collecting around the outside of a thermal feature boundary, although it does not preclude the possibility of iron collecting within a feature. For site 33PK347, Feature 2, which has multiple lines of evidence supporting its function as an anthropogenic feature, has a low iron content (70 ppm), in comparison to Feature 1 (240 ppm) and the control sample (101 ppm). This may indicate that Feature 1 has been more exposed to natural processes, such as a decaying root systems, than Feature 2 and the control sample. Given the shallow nature of both features situated in a forested environment, this would not be unexpected.

Research shows that the connection of manganese (Mn) or zinc (Zn) to human activity is yet not well understood (Entwistle et al. 1998, 2000). Table 1 shows that the readings between the cultural and non-cultural contexts for both micronutrients (6–13 ppm for Mn and 1.2–2.8 ppm for Zn) are indistinguishable.

3.0 DISCUSSION AND CONCLUSIONS

Frequencies of soil elements can be explained both by geochemistry and by human activity. Subtle differences in elemental frequencies are difficult to interpret as the features sampled at site 33PK347 are few; however, significant differences of particular elements may provide insight into anthropogenic versus nonanthropogenic activity at the site.

Activities involving organic matter due to food preparation and consumption result in the production and deposition of elemental P (from organic food or human waste) and Ca (from faunal bone and shell) (Cook and Heizer 1962, 1965; Skinner 1986; Terry et al. 2000). Identifying concentrations of these chemical elements is one way to detect activity areas. Phosphorus levels are high in Feature 2 when compared to the other two samples; the levels in Feature 1 and the control sample appear to be almost depleted. This evidence suggests that Feature 2 is anthropogenic. Additionally, Feature 2 has an elevated Ca level, which adds to the evidence that it is a cultural feature that was utilized for domestic purposes.

Areas of thermal activity are characterized by high levels of K due to elemental deposits of wood ash/charcoal. No concentrations of K were identified in the samples analyzed. This is surprising, since Features 1 and 2 are FCR-filled pits, which suggests that they were thermal features from which wood ash should have left a K marker. It is possible that the K has leached out of the features over time.

No clear explanation for elevated levels of Fe in Feature 1 is apparent. The shallow nature of the feature and the root action of the forested environment provide the best explanation.

In sum, a basic multielement chemical analysis of three soil samples (Feature 1, Feature 2, and a control sample) from site 33PK347 provide some evidence for domestic activity in Feature 2, but not in Feature 1, based on elevated levels of P and Ca. Given that only two features characterize the site, not enough data to provide a pattern for site activity areas is available. Acidic soil pH corresponds to the acidic soils in the region, that come from acidic, clayey shale, and siltstone parent materials. Generally speaking, the ridgetop soils appear quite depleted of nutrients and organic matter. Low levels of nutrients, organic matter, and a low CEC may be caused by erosion.

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APPENDIX F

DENDROCHRONOLOGY REPORT

GRAY & PAPE
INC.
CULTURAL RESOURCES CONSULTANTS

DENDROCHRONOLOGY OF SAMPLES FROM SITE 33PK347

Prepared by:
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and
Marcia Vehling

Gray & Pape, Inc.

1.0 INTRODUCTION

The dendrochronological analysis of live tree samples within site 33PK347 and in the drainages to the north and to the south of the site provide four tree ring dates for this forested ridgetop location. After Phase II archaeological investigations, Pecora and Burks (2014) suggested that the site has never been plowed, but they did not rule out disturbance from logging. No detailed land-use information is available for this area before it was purchased by the AEC; the parcels were simply described as farm land. This dendrochronology study was conducted to try to determine if clear-cut logging had taken place on the ridgetop location of the site. This information is significant to site interpretations, since clear-cut logging could have disturbed the integrity of the shallow features identified at the site. This analysis was conducted by Karen Leone and Marcia Vehling of Gray & Pape.

2.0 METHODS

Dendrochronology was utilized to provide insight into the age of the forest surrounding the site, precipitation history, possible fire events, and any other growth stressors that may have taken place during its existence. During archaeological field investigations, four live tree cores were taken from (1) a median-sized oak (*Quercus* sp.) located within site boundaries, (2) a large oak located within site boundaries, (3) a large oak located in the drainage area north of the site, and (4) a large shagbark hickory (*Carya ovata*) located in the drainage area south of the site. Sample 1 was taken at a height of 96 centimeters (cm) above surface, Sample 2 was taken at a height of 115 cm above surface, Sample 3 was taken at a height of 111 cm above surface, and Sample 4 was taken at a height of 118 cm above surface. Cores were taken using a Haglöf® 3-Thread Increment Borer 30.5 cm in length, with core diameter of 4.3 mm. Core length included outer cambium and bark layer and went beyond the tree's central pith, thus ensuring growth ring history of the lifetime of the tree in one core. At the time samples were taken, no trees showing signs of scarring due to fire were identified within or in the drainage areas located north and south of the site.

In the laboratory, cores were sanded lightly, first with medium-course general purpose sandpaper and then with extra-fine wet/dry sandpaper. After sanding, the cores were coated with linseed oil. Sanding, then oiling, the cores allows for clearer visibility of growth rings. Growth rings were analyzed using low microscopic magnification (Leica® EZ4D 13X to 56X binocular microscope). Growth rings were counted and patterns in the ring-widths of each sample were compared to each other for environmental markers. Official records of precipitation kept by the National Oceanic and Atmospheric Administration (NOAA) were consulted for comparable environmental markers.

3.0 RESULTS

Analysis of a small sample of hardwood oak (*Quercus* sp.; n=3) and hickory (*Carya ovata;* n=1) tree cores within and around site 33PK347 provided a wide range of ages. The core samples were taken from live trees; therefore, tree ring data is complete from the center to the bark edge—showing early wood and late wood components of each growth ring from the time the tree sprouted through to August 2015. Tree ring dates from the four trees analyzed show ages of 29 years (1986) and 92 years (1923) within site boundaries, 38 years (1977) in the north drainage, and 128 years (1887) in the south drainage (Table 1). No fire scars were observed on the trees sampled nor on any surrounding trees; however, without cutting down the tree samples to see a complete cross-section of the growth rings, minor fire damage in any given year cannot be ruled out.

Table 1. Tree Ring Data from Site 33PK347, Phase III.

Sample	Provenience	Taxonomic Classification	Number of Rings	Calendar Years
1	On-Site median-sized 96 cm above surface	Oak (*Quercus* sp.)	29	1986–2015
2	On-Site largest tree 115 cm above surface	Oak (*Quercus* sp.)	92	1923–2015
3	Off Site North Drainage largest tree 111 cm above surface	Oak (*Quercus* sp.)	38	1977–2015
4	Off Site South Drainage largest tree 118 cm above surface	Shagbark Hickory (*Carya ovata*)	128	1887–2015

Sample 1 represented a median-sized tree within the site boundaries. This tree size was chosen intentionally, to demonstrate the average age of the forest on this ridgetop landform. Sample 1 came from an oak (*Quercus* sp.) and provided a tree ring date of 29 years. This sample represents a chronology dating from 1987–2015. The core was extracted 96 cm from the base of the tree (ground surface). Examination of the growth ring sizes over its lifespan exhibited short periods of growth stress and growth spurts. Annual growth was greatest in the first three years of life (8–10 mm ring widths) and slowest from 2011–2014 (1.4–2 mm ring widths). The size range of growth ring widths was 1.4–10 mm; the median width was 2.9 mm over the lifetime of the tree (Plate 1).

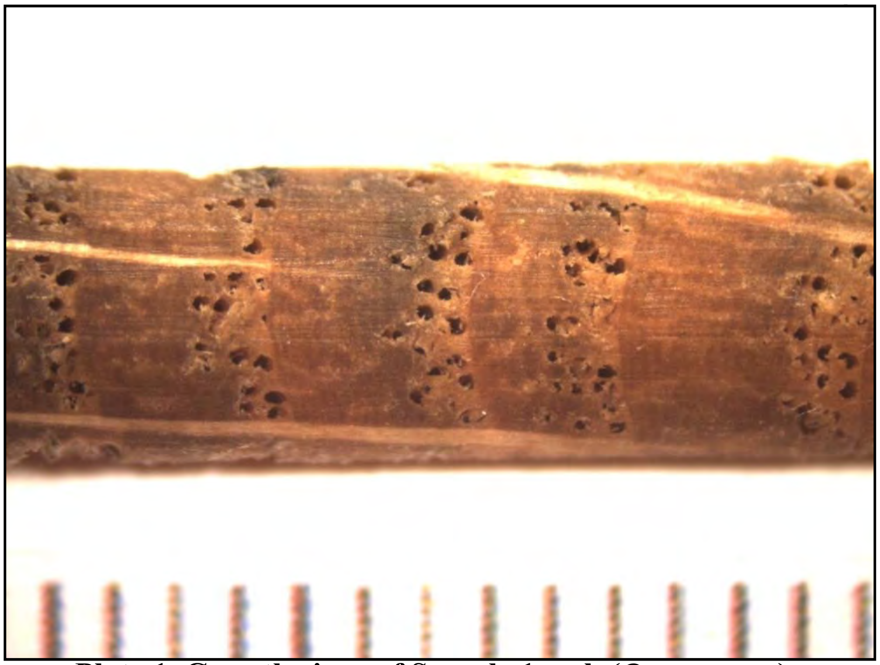

Plate 1. Growth rings of Sample 1, oak (*Quercus* sp.); millimeter (mm) scale across the bottom.

Sample 2 represented the oldest tree (based on its circumference) within site boundaries. The sample came from an oak and provided a tree ring date of 92 years. This sample represents a chronology dating from 1923–2015. The core was extracted 115 cm from the base of the tree (ground surface). Examination of the growth ring sizes over its lifespan exhibited periods of growth stress and growth spurts. Annual growth was highest from 1978–1980 (6–7.5 mm ring widths) and slowest from 1947–1972 (1 mm ring widths). The size range of growth ring widths was 1–7.5 mm; the median width was 1 mm over the lifetime of the tree (Plate 2).

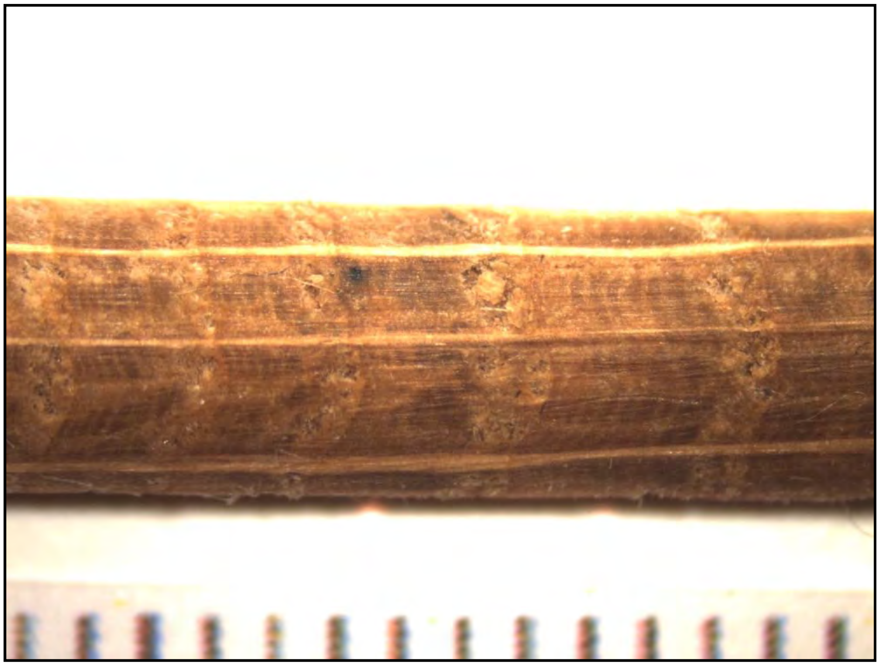

Plate 2. Growth rings of Sample 2, oak (*Quercus* sp.); mm scale across the bottom.

Sample 3 represented the oldest tree (based on its circumference) outside site boundaries, and in the north drainage. The sample came from an oak and provided a tree ring date of 38 years. This sample represents a chronology dating from 1977–2015. The core was extracted 111 cm from the base of the tree (ground surface). Examination of the growth ring sizes over its lifespan exhibited short periods of growth stress and growth spurts. Annual growth was highest from 1986–1995 (4–5 mm ring widths) and slowest from 2011–2014 (2–3 mm ring widths). The size range of growth ring widths was 2–5 mm; the median width was 3 mm over the lifetime of the tree (Plate 3).

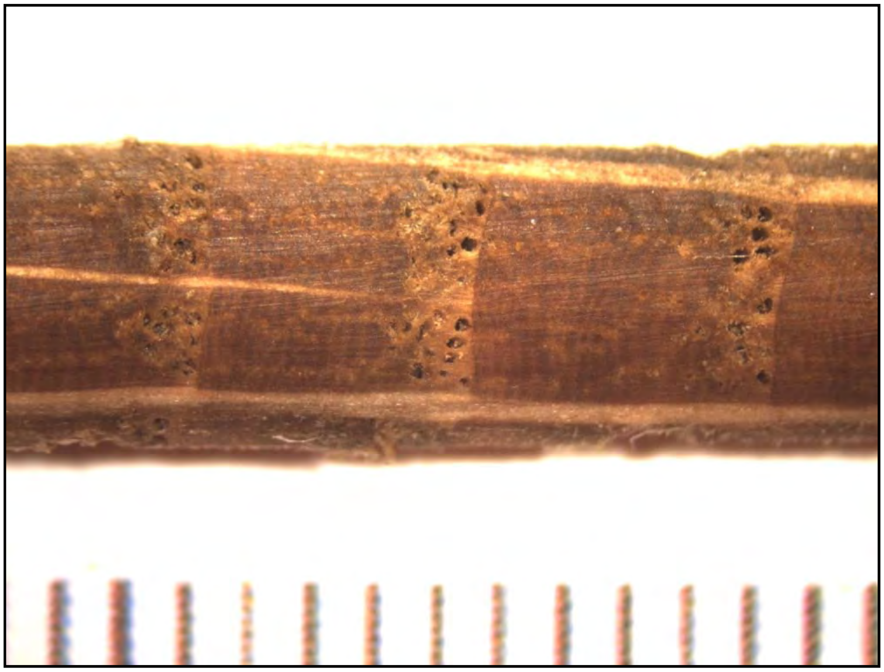

Plate 3. Growth rings of Sample 3, oak (*Quercus* sp.); mm scale across the bottom.

Sample 4 represented the oldest tree (based on its circumference) outside site boundaries and in the south drainage. The sample came from a shagbark hickory (*Carya ovata*) and provided a tree ring date of 128 years. This sample represents a chronology dating from 1887–2015. The core was extracted 118 cm from the base of the tree (ground surface). Examination of the growth ring sizes over its lifespan exhibited periods of growth stress and growth spurts. Annual growth was highest in the first two years of life (5 mm ring widths) and slowest from 1935–1964 (0.3 mm ring widths). The size range of growth ring widths was 0.3–5 mm; the median width was 1.2 mm over the lifetime of the tree (Plate 4).

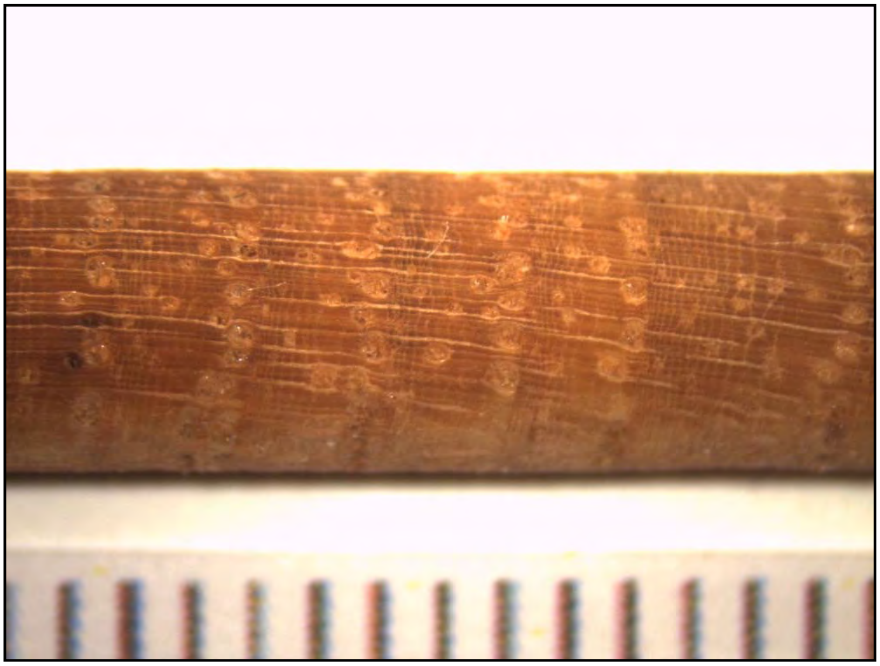

Plate 4. Growth rings of Sample 4, shagbark hickory (*Carya ovata*); mm scale across the bottom.

4.0 DISCUSSION

The sample size of the dendrochronology study at site 33PK347 is small, but provides some important information. Based on the age of the median-sized tree on-site (Sample 1), evidence supports a generally young age (29 years) of the forest on the ridgetop landform. The young age of the forest, however, does not necessarily imply clearcutting was taking place on this ridgetop. Given that it was possible to locate some older trees on-site (Sample 2; 92 years) and in the south drainage (Sample 4; 128 years), the evidence seems to contradict the possibility of clearcutting of the forest after 1887. However, high grading, or selective logging, which includes only the cutting of trees with the highest value while leaving those with lower value, cannot be ruled out.

Periods of slow growth in the trees sampled provided us with some patterning, which were compared to precipitation records for the area. Figure 1 illustrates the annual growth ring width for each sample analyzed. Growth stress from 2011–2014 was notable for all of the oaks: the on-site median oak (Sample 1), the north drainage oak (Sample 3), and, to a slightly lesser degree, for the large on-site oak (Sample 2). Sample 2 showed a slightly greater degree of growth stress from 1947–1972, before Sample 1 and Sample 3 existed. In contrast, the old hickory in the south drainage (Sample 4) did not show any growth stress from 2011–2014 but, rather, from 1935–1964. Annual climatological data from the NOAA for Piketon AEC Pump Station, Waverly, and Portsmouth, Ohio stations show monthly and annual precipitation totals as far back as 1898. There are no records for consecutive years with very low rainfall (NOAA 2015). Furthermore, droughts or severe dry spells occur about once a decade in Ohio, rather than for years at a time. Notable droughts have occurred in 1895, 1931, 1934, 1954, 1961, 1987, and 1999 (Ohio Memory 2014). No drought lasted for more than a single year; therefore, it can be concluded that the growth stress affecting the sampled trees was not caused by lack of water.

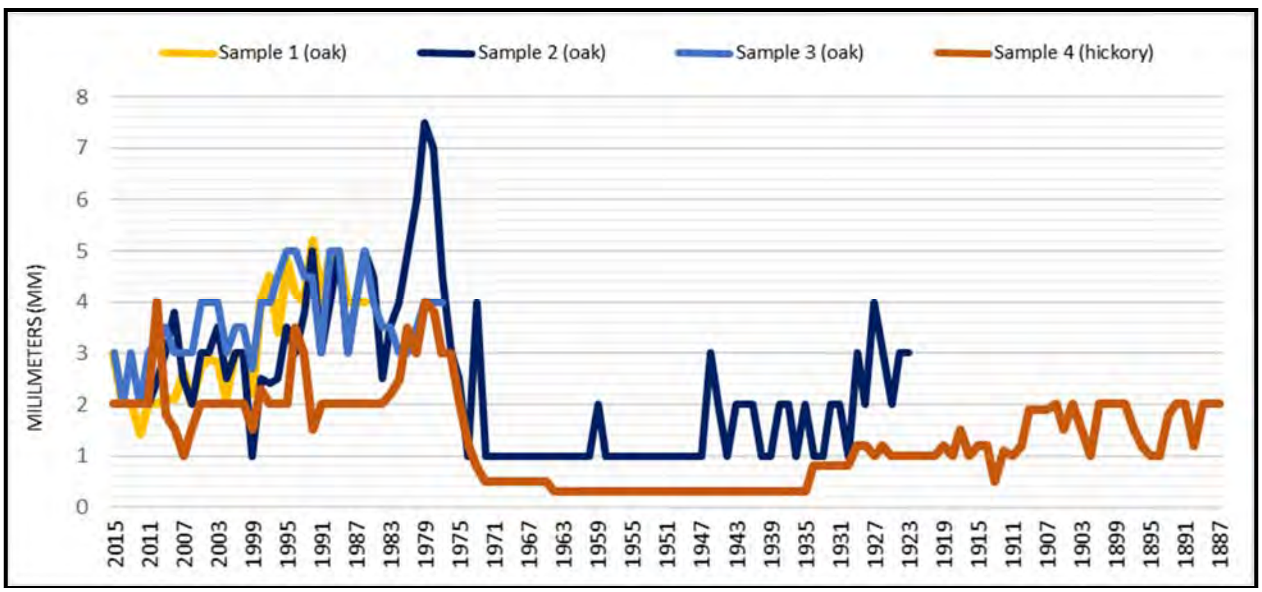

Figure 1. Annual growth ring widths of tree cores within and outside of Site 33PK347.

Other factors that can affect tree growth include pests and disease. Pest infestations and disease can affect areas for many years at a time and, therefore, are most likely the cause of the growth stress we see in the sampled trees. Periodic occurrences of decline and death of oaks over widespread areas have been recorded in Ohio since 1900 (Wargo et al. 1983). These outbreaks are caused by a complex interaction of environmental stresses and pests. Trees are weakened by environmental stresses, such as drought, excess rain, frosts, or pests. The weakened trees are then invaded by additional pests and diseases that cannot otherwise successfully attack healthy trees. Usually, the progression of decline is slow, occurring over many years. The European Gypsy Moth (*Lymantria dispar*), the common oak moth (*Phoberia atomaris*), the half-wing geometer (*Phigalia titea*), Scarlet Oak Sawfly (*Caliroa quercuscoccineae*), tent caterpillar (*Malacosoma americanum*), jumping oak gall (*Neuroterus* sp.), oak wilt (*Ceratocystis fagacearum*), *Armillaria* root rot, two-lined chestnut borers (*Agrilus bilineatus*), *Hypoxylon* canker, and *Phytophthora* can work singly or in multiples to defoliate and weaken oak trees in Ohio. The most recent outbreaks affecting oak forests in southern Ohio have taken place from 2010–2013 (2013 is the latest report available) and are attributed to a Gypsy Moth infestation following drought conditions in 2009 (ODNR 2013). These dates correspond to the stress growth dates reported in Samples 1, 2, and 3, from 2011–2014. The Gypsy Moth was first eradicated in Ohio in 1914 and over forty eradication projects in the state have taken place since then (ODNR 2015). No details could be found indicating where these infestations and eradications were located.

The growth ring data for the hickory show different patterning than for the oaks. Hickories are affected by at least 133 known fungi and other diseases. Most of the fungi are saprophytes (feeding on trees that are already dead) but a few can cause damage to foliage, produce cankers, or cause trunk/root rot (Hepting 1971:658). The hickory bark beetle (*Scolytus quadrispinosus*) is the most destructive of all insects or mites that might infect hickory trees. The hickory bark beetle kills infested trees, so this is not likely the cause of growth stress to our hickory sample. The twig girdler (*Oncideres cingulate*) and twig pruner (*Elaphidionoides villosus*), however, will severely prune trees (making them unattractive to loggers), but not kill them (Baker 1972:642). No reports of large-scale hickory blights or infestations in Ohio were found, but this may be due to growth habit. Hickories are consistently present in oak-hickory forest associations at a rate of 20–30 percent; however, they grow singly and not in solid stands where infestations and blights might spread more quickly and completely. Sample 4 shows growth stress from 1935–1964. This is not attributed to a three-decade-long drought; as a result, pests or diseases are the most likely explanation.

5.0 SUMMARY AND CONCLUSIONS

Four tree core samples were analyzed within and outside the boundaries of site 33PK347. Despite the small sample size, some important information was gathered. Although median tree size of the forest provides an age of about 29 years, the forest was not previously completely clear-cut. Much older tree ages of 92 and 128 years suggest that this landform may have been subjected to selective logging during historic times. Growth stress indicators in the annual growth rings of the samples are more indicative of pest and disease infestation and infections rather than drought conditions. Such indicators include (1) a one-time period of stress (2011–2014), affecting all oak samples, that corresponds to a recorded Gypsy Moth outbreak in the region, (2) growth stress periods are generally similar in the oaks, but different than the hickory, which likely indicates species-specific infestation and/or infection outbreaks, and (3) the growth stress periods indicated in the analyzed samples last longer than any droughts recorded in Ohio.

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APPENDIX G

PALEOETHNOBOTANY REPORT

GRAY & PAPE
INC.
CULTURAL RESOURCES CONSULTANTS

PALEOETHNOBOTANICAL ANALYSIS OF SAMPLES FROM SITE 33PK347, PIKE COUNTY, OHIO

Prepared by:
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Gray & Pape, Inc.

1.0 INTRODUCTION

This report describes the macrobotanical assemblage collected from two features during Phase III archaeological investigations at site 33PK347. A Phase II paleoethnobotanical analysis was completed on the same two features, by this author, in 2014 (Leone 2014). Those results, along with the current Phase III results, have been combined to provide a comprehensive discussion and summary of macrobotanical remains recovered from site 33PK347.

Based on one radiocarbon date and diagnostic artifacts from Phase II investigations, the site has been identified as multicomponent, having both Late Archaic and Late Prehistoric/Fort Ancient occupations (Pecora and Burks 2014). Research questions addressed in the study of this site include (1) what can the plant assemblage tell us about the prehistoric environment surrounding the site, (2) what subsistence information can be drawn from the contexts excavated, (3) what insight do the macrobotanical remains provide in regards to feature function and season of occupation, and (4) how do the results from this study compare to other contemporaneous sites in the region.

Results from the Phase III paleoethnobotanical analysis are similar to those reported for the Phase II investigation (Leone 2014), in that a small quantity of charred wood was the only plant material recovered from the features, with the exception of a single tiny nutshell fragment. Results provide evidence of a mixed-oak forested environment, but provide no evidence of subsistence practices, season of site occupation, or feature function. Evidence provided by the macrobotanical remains would suggest that the FCR-filled pits, identified as Feature 1 and Feature 2, were utilized for activities that did not include the processing of plant foods or plant materials.

In the sections below, laboratory methods are described and results from the Phase III sample analysis are presented. Subsequently, results from both the Phase II and Phase III analyses have been combined to provide a comprehensive discussion and summary of paleoethnobotanical data from Features 1 and 2 at site 33PK347.

2.0 LABORATORY METHODS

During archaeological investigations, a soil sample from Feature 1 and Feature 2 was collected for flotation-processing and paleoethnobotanical analysis.

The flotation processing technique requires little, if any, handling, which limits further fragmentation of the carbonized material. Although the flotation process produces heavy and light fractions for each sample; counts and weights of plant remains from heavy and light fractions are combined during analysis. Using low magnification (Leica® EZ4D 13X to 56X binocular microscope), all charred botanical remains larger than 1.4 millimeter (mm) in size were sorted by taxonomic category, such as wood and nuts. Charred remains smaller than 1.4 mm in size were scanned for seeds and fragile/underrepresented categories (Pearsall 2000). All categories were weighed (to an accuracy level of 0.001 grams [g]), counted, and identified to the lowest possible taxonomic level using standard references (Britton and Brown 1936; Core et al. 1976; Fernald 1950; Fritz 2009; Hoadley 1990; North Carolina State University 2004; Panshin and de Zeeuw

1970; USDA 2010), as well as an extensive comparative collection housed at the Gray & Pape laboratory.

With each flotation sample, an attempt was made to identify a representative selection of wood charcoal specimens; 20 pieces were randomly chosen and taxonomically identified. However, in samples with low counts or excessive fragmentation, every attempt was made to identify as many specimens as possible, up to 20 pieces. These details are noted in the Botanical Inventories below (Tables 1 and 4).

The carbonized plant material recovered through flotation is a small and inherently biased sample (due to differential conditions of deposition, preservation, and recovery) and, statistically speaking, can only represent a small part of the total spectrum of plant taxa used at a site (Pearsall 2000:66–76; Popper 1988). However, it is likely that the recovered plant remains represent those most used and burned as a result of spillage, intentional thermal activity, or general refuse burning.

3.0 RESULTS

Table 1 provides the detailed botanical inventory of samples analyzed from Feature 1 and Feature 2 during Phase III investigations, and Table 2 provides a summary of these results. The soil samples from these two features had a combined volume of 19 liters (L) and produced a total of 77 pieces (0.43 g) of charred plant remains, yielding a plant density of 4.05 specimens (n), or 0.02 g, per liter of sediment. Two plant categories were identified, including (1) wood and (2) nuts. No seeds were recovered from either feature.

Table 1. Botanical Inventory for Site 33PK347, Phase III

Provenience	**Feature 1 6-16 cm FS# 77**		**Feature 2 6-26 cm FS# 60**	
Soil Volume	9 L		10 L	
	Count (n)	**Weight (g)**	**Count (n)**	**Weight (g)**
Wood Total	**64**	**0.35**	**12**	**0.07**
Wood-Representative Sample	*20*		*12*	
hickory (Carya sp.)	*2*			
oak (Quercus sp.)	*17*		*12*	
pine (:Pinus sp.)	*1*			
Nut Total	**0**	**0**	**1**	**0.006**
black walnut (Juglans nigra)	-	-	1	0.006
Totals	**64**	**0.35**	**13**	**0.08**

Table 2. Botanical Summary for Site 33PK347, Phase III						
Plant Class	**Count (n)**	**Weight (g)**	**Density n / L**	**Density g / L**	**Percent of Plant Assemblage (%)**	**Context Ubiquity (n=2) (%)**
Wood Nuts	76 1	0.42 0.006	4.00 0.05	0.02 <.01	99 1	100 50
Total	**77**	**0.43**	**4.05**	**0.02**	**100**	
Number of Samples: 2		Number of Contexts: 2		Total Liters of Soil: 19		

3.1 Wood

The wood assemblage consists of 76 fragments, weighing 0.42 g, and it accounts for 99 percent of the plant assemblage, by count (Table 2). Wood density is 0.02 grams per liter of soil (g/L), or 4.00 specimens per liter of soil (n/L). Wood was present in both features (100 percent ubiquity).

Table 3 summarizes the three wood taxa identified, including oak (*Quercus* spp. n=29), hickory (*Carya* sp. n=2), and pine (*Pinus* sp. n=1). As described in the methods section above, a representative sample of 20 identifications were attempted from each of the samples except in the case of Feature 2, where wood totals were less than 20 specimens (Table 1).

Table 3. Wood Sample Summary from Site 33PK347, Phase III			
Wood Taxon	**Count**	**Percent of Wood Assemblage (%)**	**Context Ubiquity (n=2) (%)**
Oak Hickory Pine	29 2 1	91 6 3	100 50 50
Total	**32**	**100**	

The wood assemblage is dominated by oak, accounting for 91 percent of identified specimens, and present in both features (100 percent ubiquity) (Table 3). The remaining 9 percent of the assemblage consists of two pieces of hickory (6 percent) and 1 piece of pine (3 percent), recovered from Feature 1 (50 percent ubiquity). Feature 2 contained oak, exclusively. The higher frequency and ubiquity of oak may indicate a preference for this taxon as a fuel wood; however, in the midst of a mixed-oak forest, it likely means that this species was most abundant in close proximity to the site, as it is today.

3.2 Nuts

A single tiny (0.006 g) black walnut (*Juglans nigra*) nutshell fragment was recovered from Feature 2 (Table 1) and is likely an incidental inclusion.

4.0 DISCUSSION

Paleoethnobotanical analysis was completed on soil samples from Feature 1 and Feature 2 at site 33PK347 in an attempt to provide data that would help answer research questions associated with environmental reconstruction, subsistence, seasonality, and feature function. The results were compared to contemporaneous sites in the region for some insight into site type. Combined results from Phase II and Phase III paleoethnobotanical analyses are presented first, as a basis for the comprehensive discussion.

4.1 Combined Results of Phase II and Phase III Paleoethnobotanical Analyses

Table 4 provides a detailed botanical inventory of a total of six samples analyzed from Feature 1 and Feature 2 during Phase II and Phase III investigations, and Table 5 provides a summary of these results. The soil samples from these two features had a combined volume of 106 L and produced a total of 627 pieces (7.18 g) of charred plant remains, yielding a plant density of 5.91 n/L, or 0.07 g/L. Individually, Feature 1 had a plant density of 10.24 n/L (0.11 g/L), while Feature 2 had a plant density of 2.05 n/L (0.03 g/L). Two plant categories were identified, including (1) wood and (2) nuts; however, the nut assemblage is represented by a single tiny (0.006 g) nutshell fragment. No seeds were recovered.

Table 4. Botanical Inventory for Site 33PK347, Phase II and Phase III

Provenience	**Feature 1 6–16 cm**		**Feature 2 6–26 cm**	
Soil Volume	50 L		56 L	
	Count (n)	**Weight (g)**	**Count (n)**	**Weight (g)**
Wood Total	512	5.52	114	1.65
Wood-Representative Sample	60		52	
hickory (Carya sp.)	2		9	
oak (Quercus sp.)	56		33	
pine (Pinus sp.)	2			
unidentified			10	
Nut Total	0	0	1	0.006
black walnut (Juglans nigra)	-	-	1	0.006
Total	**512**	**5.52**	**115**	**1.66**

Table 5. Botanical Summary for Site 33PK347, Phase II and Phase III						
Plant Class	**Count (n)**	**Weight (g)**	**Density n / L**	**Density g / L**	**Percent of Plant Assemblage (%)**	**Context Ubiquity (n=2) (%)**
Wood	626	7.17	5.91	0.07	99.8	100
Nuts	1	0.006	<.01	<.01	0.2	50
Total	**627**	**7.18**	**5.91**	**0.07**	**100**	
Number of Samples: 6		Number of Contexts: 2			Total Liters of Soil: 106	

4.2 Environmental Reconstruction

Site 33PK347 is located on an upland ridgetop setting in Pike County, Ohio. It lies within the Mesophytic Forest region of the deciduous forests of North America, as described by Braun (1950, 1989), and, more specifically, within mixed-oak forest associations, as described by Gordon (1969). Mixed-oak forests include a number of oak species and are interspersed hickory and other secondary growth hardwoods. The wood species identified in the sample correspond with those that would have been available to the site inhabitants.

Table 6 summarizes the three identified wood taxa, including oak (*Quercus* spp. n=89), hickory (*Carya* sp. n=11), and pine (*Pinus* sp. n=2). As described in the methods section, a representative sample of 20 identifications was attempted from each of the samples, except when wood totals were less than 20 specimens. Of 112 attempted taxonomic classifications, 102 were successful and 10 could not be identified due to excessive fragmentation (Table 4).

Table 6. Wood Sample Summary from Site 33PK347, Phase II and Phase III			
Wood Taxon	**Count**	**Percent of Wood Assemblage (%)**	**Context Ubiquity (n=2) (%)**
Oak	89	79	100
Hickory	11	10	100
Pine	2	2	50
Unidentified	10	9	50
Total	**112**	**100**	

The wood assemblage is dominated by oak, accounting for 79 percent of identified specimens, and present in both features (100 percent ubiquity). Hickory accounts for 10 percent of the assemblage and was also recovered from both features. Pine accounts for 2 percent of the wood assemblage, represented by just two wood fragments recovered from Feature 1 (50 percent ubiquity). The remaining 9 percent of the assemblage consists of highly fragmented unidentified specimens from Feature 2. Oak and hickory were recovered from both Feature 1 and Feature 2, and are consistent with a mixed-oak forest environment that would have surrounded the site. The higher frequency of oak may indicate a preference for this taxon as a fuel wood; however, in the midst of a mixed-oak forest, it likely means that this species was most abundant in close proximity to the site, as it is today. Pine is an upland taxon that thrives on shallow, sandy soils that form over sandstone, such as can be found on ridge crests, rocky summits, and eroded slopes (Braun 1950). This type of environment exists in the general area of the site. Although the pine specimens were too small to make a species determination, they are most likely scrub pine (*Pinus virginiana*) or pitch pine (*P. rigida*); both species are native to southeastern Ohio (Braun 1989, Sears 1925). Yarnell (1964) found that pine was used ethnographically for medicinal and technological purposes (e.g., pitch was used as a sealant and wood for utensils/tools).

4.3 Subsistence, Seasonality, and Feature Function

Given that the botanical assemblage consisted almost solely of wood charcoal, no subsistence or seasonality data can be gleaned from it. No plant food remains were recovered and it is often from their season of ripening, as well as the ripening season of seed rain, that season of occupation is interpreted.

Furthermore, little can be said regarding feature function other than what the features were *not* used for on site. Based on the macrobotanical evidence, the shallow FCR-filled pits (Feature 1 and Feature 2) were not used for domestic purposes that might include plant food harvesting/processing or domestic plant food preparation in large quantities. Although the wood quantity recovered from Feature 1 is approximately 3.5 times (by weight) that of Feature 2, wood species diversity is similar enough to suggest that the two pits were likely used for the same purposes.

4.4 Comparative Analysis

Botanical assemblages from Late Archaic sites in Ohio are characterized by wood taxa that are consistent with local forest habitats (with an emphasis on hardwoods), an abundance of nutshell (dominated by hickory), and few wild fruit and weed seeds (Johannessen 1984; Simon 2006). It is during this period that evidence of intentional cultivation of native seed taxa appears. During the Woodland periods, frequency and diversity of wild and cultivated plant foods is highly variable, but densities increase over time as groups become more sedentary and begin to strategically utilize resources available to them (Wymer 1987, 1992). The Late Prehistoric/Fort Ancient period was a time of great change in prehistoric Native American subsistence practices. This change manifested as a rather dramatic shift from the Woodland period subsistence practices of growing native seed crops to a subsistence base dominated by Northern Flint maize-and-bean agriculture. Nuts, fleshy fruits, and sometimes native cultigens continue to be recovered from Late Prehistoric/Fort Ancient sites, but in low quantities (Bush 2008; Rossen, 1992a; Simon 2000).

Plant densities recovered from site 33PK347 have been compared to other Late Archaic and Late Prehistoric/Fort Ancient sites in the region in an effort to tease out information regarding site type (short-term or residential). Table 7 compares site type, landform, and plant density data for five Late Archaic and five Late Prehistoric/Fort Ancient sites in the region. Sites include upland and floodplain settings. The average volume of soil samples analyzed is 159 L per site, which is similar to site 33PK347 (106 L). The comparative data demonstrate that plant densities at site 33PK347 are extremely low. This is unusual, as the author has never analyzed samples from a Late Prehistoric/Fort Ancient site that is void of food remains. Wood densities of the comparative sites range from 0.18–1.71 g/L; wood density at site 33PK347 is 0.07 g/L. Nut densities of the comparative sites range from 0.10–34.20 n/L; nut density at site 33PK347 is less than 0.01 n/L. Seed/corn densities of the comparative sites range from 0.02–6.30 n/L; no seeds/corn were recovered from site 33PK347. Although wood, nut, and seed/corn densities are highly variable between sites, the data for site 33PK347 are too low to provide insight into site type.

Table 7. Plant Density Comparison of Site 33PK347 with Contemporaneous Sites in the Region

Site (volume floated)	Site Type	Landform	Wood Density g/L	Nut Density n/L	Seed/Corn Density n/L
Late Archaic Sites					
33AD121[a] Stuart Station (142 L)	seasonal	floodplain terrace	0.21	28.70	0.18*
33LE619[b] Davisson Farm (111 L)	residential base camp	floodplain terrace	0.29	10.70	0.10
33MS29[c] Yellowbush Creek Camp Site IV (87.5 L)	residential base camp	floodplain	1.71	5.40	3.70*
33Co874[d] (153 L)	short-term residential base camp	upland	0.18	0.10	0.03
33LI185[e] (203 L)	residential base camp	upland	0.23	2.40	0.02*
33PK347 (106 L)		upland	0.07	<0.01	-
Late Prehistoric/Fort Ancient Sites					
15Hr21[f] Florence Site Complex (24 L)	village	ridge crest	0.70	12.00	1.50*
15Hr22[f] Florence Site Complex (128 L)	village	ridge crest	1.20	34.20	6.20*
46OH65[g] Bryan Site (327 L)	village	upland	0.89	8.20	6.30*
15FR36A[h] Carpenter Farm (132 L)	residential	ridgetop	1.60	1.40	1.00*
33MY57[i] SunWatch (280 L)	village	floodplain	0.70	~8.00	1.64*

References: (a) Leone 2009a; (b) Williams 2002; (c) Ericksen 2009; (d) Ericksen 2005a; (e) Ericksen 2005b; (f) Rossen 1992b; (g) Leone 2009b; (h) Rossen 1992c; (i) Wagner 1987

*Seed/Corn assemblage includes cultigens.

5.0 SUMMARY AND CONCLUSIONS

Paleoethnobotanical analysis completed on six soil samples from site 33PK347, collected during Phase II and Phase III archaeological investigations, identified just two plant classes: wood and nuts; no seeds were recovered. The wood assemblage was dominated by oak, but hickory and pine were also represented. The wood assemblage is consistent with a mixed-oak forest environment. The fuel wood was likely gathered deadfall from the general site area; no evidence in the botanical assemblage was identified to suggest that any one species was targeted as a fuel choice. Two pieces of pine wood suggest that either (1) pine trees were growing on a nearby ridge crest, or (2) a utensil or tool made of pine was burned in Feature 1. Wood density is higher in Feature 2 than in Feature 1; however, the similarities of the wood assemblages and general characteristics of these shallow, FCR-filled pits suggest that they were utilized for the same purposes. The single tiny black walnut shell fragment recovered from Feature 2 is likely an incidental inclusion. Due to a complete lack of plant foods or incidental seed rain in the botanical assemblage, no subsistence, seasonality, or feature function information could be determined from the botanical remains.

Site 33PK347 is a multicomponent site that contained extremely low frequencies of wood charcoal, suggesting that this was not a locale used for plant food harvest/processing or large quantity food preparation. Wood accounts for 99.8 percent of the botanical assemblage. This fact, along with the concentration of FCR within shallow pit features indicates that thermal activity was a component of feature and site function, which may have focused on other logistical activities requiring short durations of stay.

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APPENDIX H

STARCH GRAIN AND PHYTOLITH REPORT

ARCHAEOBOTANICAL ANALYSIS OF THE 33PK347 SITE, PIKE COUNTY, OHIO

REPORT PREPARED FOR

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EXECUTIVE SUMMARY

This report presents the results of archaeobotanical analyses undertaken on samples from two features at 33PK347, a Middle Archaic to Late Prehistoric/Fort Ancient archaeological site located in Pike County, Ohio. Samples of fire-cracked rock (FCR) from each feature were analyzed for starch grain residues, and sediment samples from each feature were analyzed for phytoliths, to investigate feature function and identify possible plant foods or materials processed therein. In addition to these samples, a control sample of sediment from an on-site location outside the features was processed for phytoliths. Methods of extraction, processing, and analysis for each technique were based on standard protocols. Identifications were made using reference collections and published sources.

Starch extraction and analysis yielded no starch grains on the FCR. This may be due to a lack of starchy plant tissues being processed in the features, or the destruction of existing residues through heat and fire at the time of deposition or through taphonomic processes after deposition.

Phytolith analysis of the sediment samples did not yield evidence of economic crop species, but did provide information regarding local vegetation. The samples from both features, as well as the external control sample, were dominated by grass phytoliths, but also included significant amounts of tree and shrub phytoliths. Feature 1 and the control sample contained sedge phytoliths. There are some small differences between the two features that suggest possible differences in background vegetation during their formation, or differences in cultural behavior surrounding their use. Feature 1 had a higher frequency of grass phytoliths and a corresponding lower frequency of arboreal phytoliths than Feature 2. This higher frequency of grass phytoliths is mainly attributable to higher levels of Pooideae phytoliths. This suggests more Pooid grasses existed in the vicinity of Feature 1, or were intentionally introduced into the feature for unknown reasons. Although the features were created through burning activities, levels of burnt phytoliths are low; the highest level of burnt phytoliths was found in the control sample. When the phytolith assemblages of the feature samples are compared to the control sample, Feature 2 is more similar to the control sample in terms of morphotype frequencies, but Feature 1 is more similar to the control sample in terms of taxonomic diversity.

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1.0 INTRODUCTION

This report presents the results of archaeobotanical analysis on samples from 33PK347, an archaeological site near Piketon in Pike County, Ohio, USA, with evidence of cultural occupation during the Middle to Late Archaic and the Late Prehistoic/Fort Ancient periods. During excavations, two concentrations of FCR were encountered and identified as features. A sample of FCR from each feature was submitted for starch grain analysis, and a sediment sample from each feature was submitted for phytolith analysis, along with a control sediment sample from Block 11, Unit 17 (Table 1.1).

Table 1.1. Samples from 33PK347 submitted for archaeobotanical analysis.

Lab Code	Cat #	Sample Type	Analysis	Location	Unit	Feature	Level	Depth (cm BD)
GP-P010	FS0070	Sediment	Phytolith		22	1	I	0-20
GP-P011	FS0058	Sediment	Phytolith	SW 1/4	19	2	I	0-26
GP-P012	FS0104	Sediment	Phytolith	Block 11	17	control	I	0-20
GP-S013	FS0069	FCR and sediment	Starch		22	1	I	0-20
GP-S014	FS0057	FCR and sediment	Starch		19	2	I	0-26

Since the 1960s and the "flotation revolution" (Struever, 1968), macrobotanical analysis has been systematically employed throughout Eastern North America at archaeological sites to provide data on Native American plant use prior to European Contact (e.g. Asch and Asch, 1985; Crawford and Smith, 2003; Fritz, 1990; Gremillion, 1997; Scarry, 2003; Smith and Yarnell, 2009). More recently, microbotanical analyses, specifically starch grain and phytolith analyses, have begun to be implemented, contributing significant new insights into plant resource use, agricultural origins, and human-environment interactions (e.g. Hart et al., 2007; Hart et al., 2003; Messner, 2011; Messner and Dickau, 2005; Messner et al., 2008; Thompson et al., 2004). Within Ohio, a small number of geological phytolith studies have been done, focusing primarily on reconstructing vegetation history and prairie versus forest transitions (Boettcher and Kalisz, 1991; Kalisz and Boettcher, 1990; Wilding and Drees, 1971, 1973), but archaeological starch grain analyses have been limited or non-existent, and have so far remained unpublished.

2.0 METHODOLOGY

Methods employed during this investigation are based on standard protocols for each type of analysis, and are described in detail below.

2.2 STARCH GRAIN ANALYSIS METHODS

Starch grains are microscopic particles used by plants to store energy, usually for regrowth or germination. They are made up of alternating layers of amylose and amylopectin, which gives them a quasi-crystalline molecular structure that causes birefringence (the formation of an interference cross) under cross-polarized light when undamaged (Blanshard, 1987; Gott et al., 2006). Starch grains have been found to preserve for long periods of time on the surface of archaeological artifacts (stone, ceramic, organic) used in processing plant material, presumably in micro-crevices where they are protected from enzymatic degradation (Fullagar, 2006; Haslam, 2004; Loy et al., 1992). They have also been recovered from human dental calculus (e.g. Henry and Piperno, 2008; Piperno and Dillehay, 2008), and occasionally within soils (e.g. Barton and Matthews, 2006; Haslam, 2004). Their morphology can be diagnostic to the level of genus or species, permitting taxonomic identification of plants used and processed by people in the past (Dickau et al., 2007; Loy, 1994; Messner, 2011; Piperno and Holst, 1998; Reichert, 1913; Torrence and Barton, 2006).

STARCH ANALYSIS

Starch analysis methods were based on published protocols (Loy, 1994; Pearsall, 2000; Piperno et al., 2000; Torrence and Barton, 2006). From each sample provided, the largest fragment of FCR (Fig. 2.1) was selected and placed in a beaker using sterilized tongs. The FCR fragments were covered with distilled water and 2 ml of sodium hexametaphosphate ($[NaPO_3]_6$) was added to promote deflocculation of any existing clays. The artifacts were sonicated for 5 minutes and then gently brushed with a sterilized toothbrush to facilitate dispersal of adhering sediment. The FCR was then further sonicated for another 5 minutes. The resulting sediment was concentrated through centrifuge cycles of 2500 rpm for 5 minutes, and the water decanted from the pellet. Ten milliliters of sodium polytungstate ($Na_6[H_2W_{12}O_{40}]$) heavy liquid, prepared to a density of 1.75 g/cm^3, was added to the residue pellet, and the samples mixed thoroughly to float any existing starch grains. After centrifuging at 2500 rpm for 5 minutes, floating material was pipetted from the surface of the sample and deposited into a new, labeled, sterile centrifuge tube. The extracted material was rinsed several times with distilled water, and mounted in a 10% glycerin solution for microscope viewing. Slides were analyzed using a transmitted-light microscope equipped with polarization and digital imaging camera.

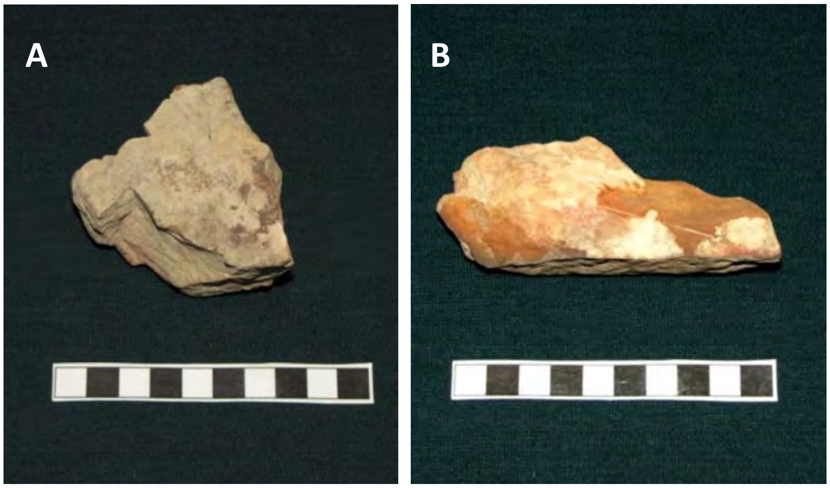

Figure 2.1. Fragments of FCR analyzed for starch grain residues. Photographs taken after sonication and extraction procedure. **A)** GP-S013 (Feature 1), **B)** GP-S014 (Feature 2). Scale bar: 10 cm.

CONTAMINATION CONTROLS

Modern starch is encountered during food preparation and can be transported by air, water, or on surfaces such as clothing and skin. It is used commercially and industrially in numerous consumer products, including cosmetics, adhesives, and powdered detergents. For this reason, modern contamination is a concern when analyzing ancient starch, and various lab protocols were implemented to mitigate and control this threat.

1) Food is prohibited in the lab. Modern reference plant material is prepared and stored off site.
2) All glassware and equipment was sterilized under pressure for 30 minutes, handled with sterilized tongs, and stored in sealed, sterilized, plastic bins until needed. All consumables, such as paper towel and chemicals, were tested for starch presence. Only distilled water was used throughout testing and analysis.
3) Three blank microscope slides were placed at various locations around the lab and left for 7 days prior to and during extraction to test for airborne starch contamination. Three drops of 10% glycerin solution were pipetted onto the slide at the end of the trial period, and covered with a coverslip. The slides were then examined for starch. All three slides, from the work bench, microscope table, and inside the fumehood, tested negative for starch.
4) The FCR samples were left sealed in bags until analysis. They were handled using only sterilized forceps or tongs during processing to prevent contamination. Samples were sealed or covered at all times when not being actively processed (e.g. beakers covered, centrifuge tubes capped, extract capped until pipetted onto a slide and then immediately covered with a coverslip).
5) A blank control sample was run alongside the two archaeological samples, undergoing all the same processes with the same equipment and same chemicals. This control sample tested negative for starch.

2.3 PHYTOLITH ANALYSIS METHODS

Phytoliths are bodies of biosilica, formed in the cells or cell walls of certain plants. These plants take up dissolved silica from ground water, and deposit it in certain tissues for structural support, physiological functions, or protection against herbivores and fungi (Sangster et al., 2001). The formation of phytoliths is under genetic control, and only occurs in certain plant taxa (Piperno, 2006). Phytolith systematics are complicated by the factors of multiplicity (more than one phytolith morphotype may be produced in the same species) and redundancy (similar morphotypes may be produced across different taxa) (Piperno, 2006; Rapp and Mulholland, 1992; Rovner, 1971). For this reason, taxonomic levels of identification vary considerably. However, concentrated work on major domesticates and economic species by many researchers has resulted in the identification of diagnostic morphotypes for these taxa, such as maize (*Zea mays*) cob rondels (e.g. Bozarth, 1993b; Pearsall et al., 2003; Piperno and Pearsall, 1993), squash (*Cucurbita* spp.) rind scalloped spheres (e.g. Bozarth, 1987; Piperno and Stothert, 2003), and wild rice (*Zizania* spp.) inflorescence indented (crescent) rondels (e.g. Hart et al., 2003; Thompson et al., 1994; Yost and Blinnikov, 2011). Because phytoliths are made of silica, they preserve well in most contexts. They may be recovered from artifact residues, dental calculus, terrestrial sediments where they have been deposited after the decay of plant material, or lake cores where they have been introduced from the surrounding vegetation.

Phytolith extraction from the sediment samples submitted for analysis from 33PK347 followed standard protocols (Piperno 2006). The bulk sediment samples were first pre-treated to remove clays through deflocculation, agitation, and gravity sedimentation. One hundred grams of sediment from each sample was mixed with 750 ml warm water and 5 ml sodium hexametaphosphate ($[NaPO_3]_6$) and placed on an orbital shaker for 8 hours. This solution was poured into beakers and water added to make one liter (Fig. 2.2). Clay particles were removed by repeated cycles of gravity sedimentation: silt and sand were allowed to settle out for one hour, water containing the clay fraction was decanted, and then water was added to make one liter and mixed with the remaining sediment to be left to settle for another hour. After eight cycles, when the water was nearly clear, samples underwent a final decanting and then 4 ml of sediment was placed in a labeled centrifuge tube. Twenty milliliters of 36% hydrochloric acid (HCl) was added to remove carbonates. As no reaction was observed, after 10 minutes samples were rinsed three times. Samples were then treated with 70% nitric acid (HNO_3) and placed in a hot water bath for four hours, to oxidize organic material. In the final 30 minutes, approximately 2 ml of potassium chlorate ($KClO_3$) was added by small amounts to complete the oxidation reaction. After four cycles of rinsing, 10 ml of sodium polytungstate ($Na_6[H_2W_{12}O_{40}]$) heavy liquid solution prepared to a density of 2.37 g/cm^3 was added to the pellet and mixed to float phytoliths from the sediment. Samples were centrifuged at 2500 rpm for 5 minutes and floating material pipetted into a new, labeled, clean centrifuge tube. Extracted material was rinsed four times and then dried using acetone. Extracted material was mixed with Permount® mounting medium and mounted on microscope slides. This mounting medium permits rotation and three-dimensional viewing of phytoliths which is important in identification.

A significant amount of mineral residue floated out during the first extraction of the samples and impeded visibility of phytoliths; therefore a second extraction was undertaken. The sediment and SPT remaining from the first extraction (approximately 5 ml) were remixed and centrifuged at 2500 rpm for 5 minutes. All of the remaining SPT was decanted into a new labeled centrifuge tube. Extracted material was rinsed four times and dried using acetone, and then mounted on microscope slides as described above.

Slides were scanned using a transmitted light microscope equipped with digital imaging. A minimum of 250 phytoliths were counted for statistical frequency of morphotypes (Piperno 2006), and then the rest of the sample was scanned for diagnostic phytoliths of economic species such as maize and squash, as well as any new morphotypes not seen during the statistical count. Identifications were made using comparative material and published sources (Blinnikov, 2005; Blinnikov et al., 2013; Bozarth, 1986, 1987, 1992, 1993a, 1993b; McNamee, 2013; Ollendorf, 1992; Piperno, 2006; Twiss et al., 1969; Yost and Blinnikov, 2011).

Figure 2.2. Phytolith samples undergoing gravity sedimentation to remove clay-sized particles.

3.0 RESULTS

3.1 STARCH RESIDUE RESULTS

No starch was recovered from the FCR fragments from the two features. This suggests that either no starchy plants were being processed in the features, or that starch residues did not preserve. Given that the concentration of FCR in the two features indicates burning activities, and the FCR was formed through exposure to high temperatures, there is a high probability that any starch residues that might have been present at the time of feature use were destroyed. Generally, starch grains begin to gelatinize and deteriorate in the presence of moisture at temperatures as low as 65°C, and most are destroyed when exposed to temperatures above 80°C for sustained periods of time (Biliaderis, 2009; Gott et al., 2006; Henry et al., 2009; Reichert, 1913). However, there is accumulating evidence that some starch grains are resistant to heat, and can survive baking in earth-ovens, dry roasting, or even on FCR from hearth features (e.g. Chandler-Ezell et al., 2006; Crowther, 2012; Cummings, 2006; Messner and Schindler, 2010; Thoms et al., 2014). Based on current evidence from the two samples from 33PK347, it is presently not possible to conclude whether the absence of starch residues represents evidence of absence, or taphonomic processes resulting in poor preservation.

3.2 PHYTOLITH RESULTS

Table 3.1 presents a summary of the phytolith morphotypes recovered from the two features sampled and their taxonomic associations. Figure 3.1 presents these results graphically as a frequency

Table 3.1. Summary of phytolith frequencies (percent) from 33PK347 site samples.

Morphotype	Taxonomic Association	Feature 1 (PG-P010)	Feature 2 (PG-P011)	Control (PG-P013)
Cross Body	Poaceae	2.9	2.5	2.4
Rectangular Short Cell	Poaceae, cf. Arundinoideae	0.0	8.4	4.7
Trapezoid/Rondel	Poaceae	14.7	14.6	14.2
Domed Rondel	Poaceae, *Bromus* sp.	0.4	0.0	0.2
Thin Long-Shafted Bilobate	Poaceae, *Aristida* sp.	0.0	0.9	0.2
Bilobate	Panicoideae	39.6	31.0	29.9
Scooped Bilobate	Ehrhartoideae	0.0	0.0	0.7
Polybate	Poaceae	1.2	1.5	1.3
Collapsed Saddle	Poaceae	0.4	1.5	0.9
Saddle	Chloridoideae	3.3	4.0	4.2
Sinuate Trapezoid	Pooideae	22.9	11.1	10.2
Large Conical Polygonal Body	Cyperaceae, cf. *Carex* sp.	0.4	0.0	1.1
Small Conical Body	Cyperaceae	2.4	0.0	0.2
Faceted Elongate	woody eudicot	0.0	0.0	0.4
Sclereid	woody eudicot	0.4	1.2	0.7
Granulate Globular	woody eudicot	3.3	4.3	4.0
Echinate Globular	Arecaceae	3.3	11.1	4.4
Dendritic Irregular Body	woody eudicot	0.4	0.3	0.2
Granulate Polygonal Epidermal	woody eudicot	0.4	1.2	10.2
Blocky Irregular Body	woody eudicot	2.0	4.3	3.8
Hair Cell		0.0	0.3	0.7
Armed Hair Cell	select plant families	0.0	0.0	0.2
Curved Spatulate		0.0	0.6	3.5
Unidentified		2.0	0.9	1.6

Notes: Phytolith frequencies calculated as a percent of total phytoliths counted per sample.

diagram, and Figure 3.2 summarizes these results comparing graminoids (grasses and sedges) versus woody eudicots (trees and shrubs). A more detailed table and frequency diagram of all morphotypes identified and counted is provided in Appendix A. Table 3.2 provides the frequencies of burnt phytoliths, expressed as a percent of the total counted phytoliths for each sample, as well as the frequency of sponge spicule fragments (another form of biosilica) observed in the samples.

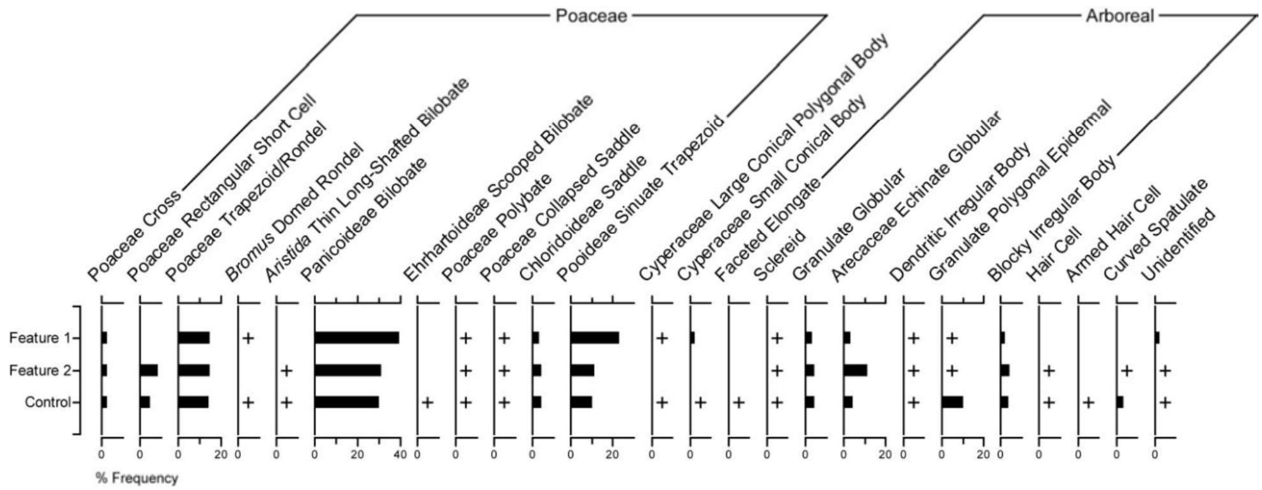

Figure 3.1. Diagram of phytolith frequencies by major morphotype groups. Frequencies calculated as a percent of total counted phytoliths. Frequencies <2% shown by a plus (+). Diagram produced in C2 (Juggins, 2010).

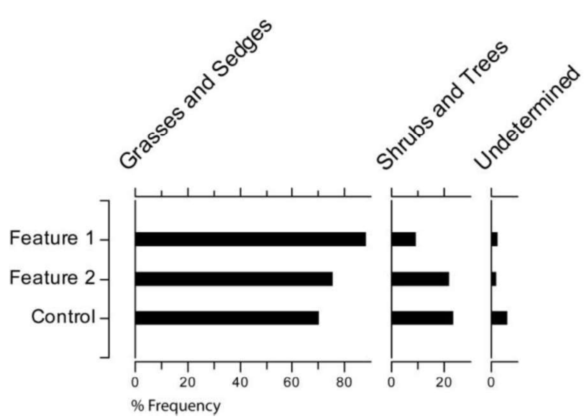

Figure 3.2. Diagram of phytolith frequencies of graminoids (grasses and sedges) compared to woody eudicots (shrubs and trees).

Table 3.2. Burnt phytolith and sponge spicule frequencies.

Sample	Total Phytoliths Counted	Burnt Phytolith Frequency (%)	Sponge Spicule Frequency (%)
GP-P010	245	2.9	1.6
GP-P011	323	7.4	3.1
GP-P012	451	8.6	1.8

No economic crop species were identified in any of the samples. The phytoliths documented represent vegetation from the environment. There are some small quantifiable differences between the features and the control sample, which will be discussed following a description of the assemblage of each sample.

SAMPLE GP-P010 (FEATURE 1)

The phytolith assemblage from the Feature 1 sediment sample was dominated by grass (Poaceae) short-cell phytoliths (88%), including cross bodies, trapezoid/rondels, bilobates, saddles, and sinuate trapezoids (Fig. 3.3). Trichomes (prickle cells), bulliforms, and elongate cells were noted, but not counted, as these are found broadly across herbaceous plant taxa and provide little specific taxonomic information. Among the grass short-cells, bilobate forms (Fig. 3.3A), associated with the Panicoideae subfamily (Twiss et al., 1969), were the most frequent (40%), followed by sinuate trapezoids (Fig. 3.3B) from the Pooideae subfamily (23%) (Brown, 1984). Cross body phytoliths (Fig. 3.3C) were observed (2.9%) but in numbers too low to permit discriminant function analysis, used to identify maize (Pearsall, 2000; Piperno, 1984, 1988, 2006). Several types of rondel morphotypes (Fig. 3.3D-G) were encountered (see Appendix A) including sloped and keeled rondels. A single domed rondel, consistent with those seen in *Bromus* sp. grasses, was recovered (Fig. 3.3H). No maize or wild rice rondels were identified despite specific scanning for them. Ongoing comparative work on the Poaceae in Eastern North America may eventually help distinguish more taxonomic associations among rondel forms (for example, see Hart and Matson, 2009). Several saddle form short-cells (Fig. 3.3I) from the Chloridoideae subfamily were documented (3%).

A large polygonal phytolith with a conical protuberance from the sedge family (Cyperaceae) was found in the sample (Fig. 3.3J-K). This morphotype is consistent with phytoliths seen in the achenes of *Carex* sp., however this genus level identification is tentative until more systematic comparative work can be undertaken on the Cyperaceae in Eastern North America. Cyperaceae was also represented by small conical bodies (Fig. 3.3L-M).

Several phytolith types representative of arboreal taxa were documented. These include a sclereid, a dendritic irregular body, granulate polygonal epidermal platelets, and blocky irregular bodies (Fig. 3.3N-P). Several granulate globular type phytoliths (3%, Fig. 3.3Q) were found in the sample. In the tropics, these are produced in numerous arboreal taxa, and are a good general indicator for woody eudicots (Piperno, 2006). However, this association has not been verified for Eastern North America. In other parts of North America, the morphotype has been documented in *Quercus* spp. (Blinnikov et al., 2013; McCune and Pellatt, 2013; McNamee, 2013), but more comparative work on woody taxa needs to be done before this morphotype can be confirmed as indicative of arboreal taxa in the eastern woodlands. Another type of globular phytolith,

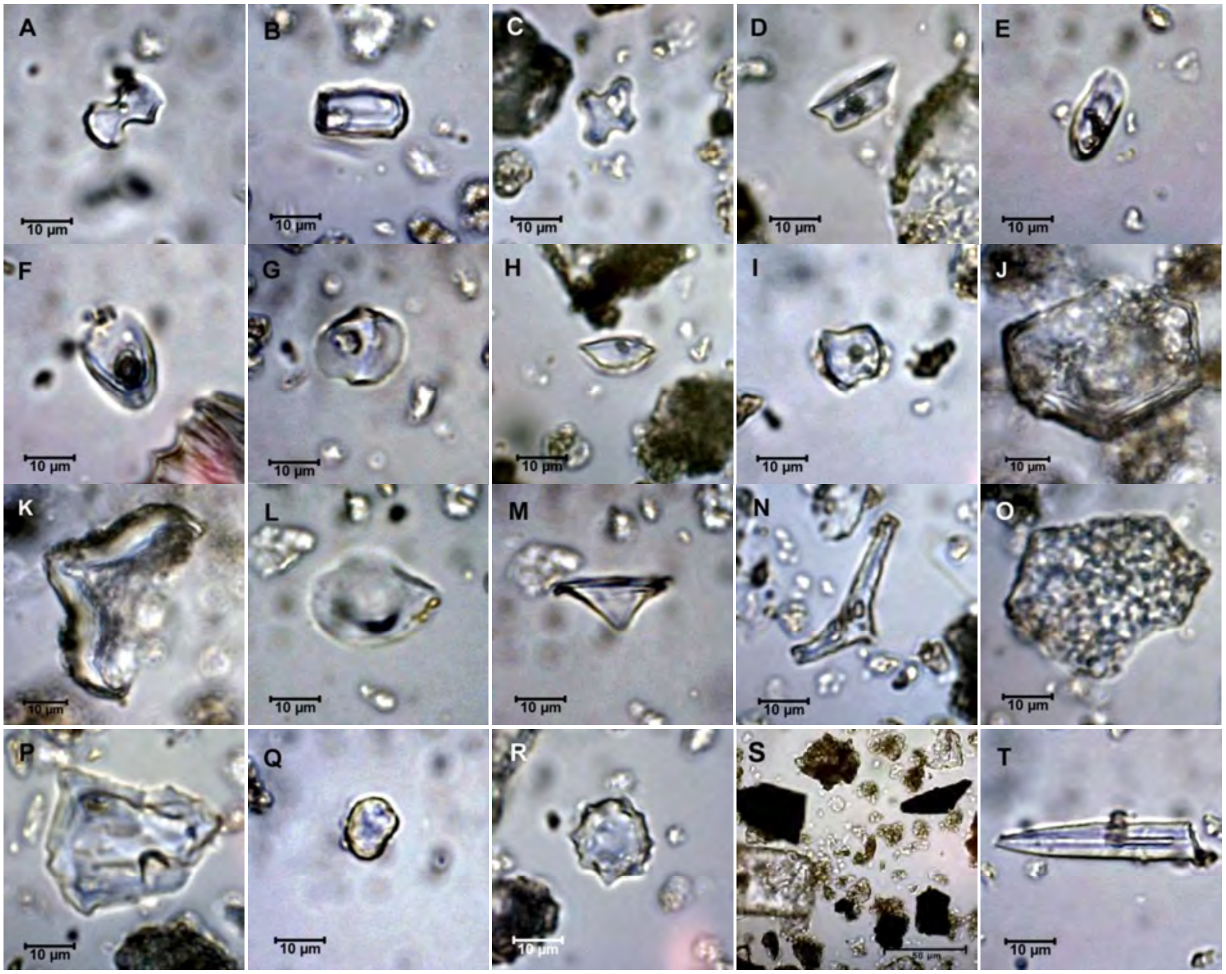

Figure 3.3. Selected phytolith morphotypes from GP-P010 (Feature 1). A-I) Grass phytoliths, J-M) sedge phytoliths, N-R) arboreal phytoliths, S-T) other material. **A)** Panicoideae bilobate, **B)** Pooideae sinuate trapezoid, **C)** Type 3/8 cross body **D)** Oval rondel, side view, **E)** Oval rondel, top view, **F)** Sloped rondel, top view, **G)** Keeled rondel, **H)** *Bromus* domed rondel, **I)** Chloridoideae saddle, **J)** Cyperaceae (cf. *Carex* sp.) achene large conical polygonal body, top view, **K)** Cyperaceae (cf. *Carex* sp.) achene large conical polygonal body, side view, **L)** Cyperaceae small conical body, top view, **M)** Cyperaceae small conical body, side view, **N)** Sclereid, **O)** Granulate polygonal epidermal platelet, **P)** Blocky irregular body, **Q)** Granulate globular, **R)** Arecaceae echinate globular, **S)** Broad field view of particulate charcoal (opaque blocky objects), **T)** Sponge spicule fragment. Scale bar: 10 µm except S, 50 µm.

an echinate globular (or 'spiny sphere', Fig. 3.3R) recovered in the sample (3%) is diagnostic of the palm family (Arecaceae); it has not been observed in any other plant family. The presence of this morphotype in temperate zone sediment samples from Ohio is unexpected; however, this morphotype has been encountered elsewhere in North American sediments. In her analysis of sediments from Nebraska, Strömberg (2004) argued that the presence of echinate globular phytoliths reflected phytolith inheritance (sensu Fredlund and

Tieszen, 1994), wherein phytoliths within a particular soil profile accumulate over a long period of time, and may represent ancient sediments deposited during periods of tropical climatic conditions, or the erosion and aeolian transportation of these sediments (e.g. loess deposits). Johnson and Bozarth (1996) also recovered echinate globular phytoliths at a site in Kansas, and suggest the possibility that they may derive from a temperate arboreal species that has yet to be identified.

In addition to these arboreal morphotypes, fragments of particulate charcoal (Fig. 3.3S) were observed in the sample from Feature 1, although it was not quantified during this study. Despite the presence of micro-charcoal, there were few burnt phytoliths observed. Only 3% of total counted phytoliths were burnt (Table 3.2). Sponge spicules were also observed in low numbers (Table 3.2, Figure 3.3T).

SAMPLE GP-P011 (FEATURE 2)

Like Feature 1, the phytolith assemblage from Feature 2 was dominated by grasses (76%), mostly represented by Panicoideae bilobates (31%, Fig. 3.4A) and trapezoid/rondels (15%, Fig. 3.4B). Pooideae sinuate trapezoids (Fig 3.4C) were also well represented (11%), but lower in frequency than Feature 1. Several Poaceae phytolith types were identified that were not seen in Feature 1, including: keeled rectangular bodies (Fig. 3.4D), rectangular short-cells, possibly from the Arundinoideae subfamily (Fig. 3.4E), and *Aristida* thin bilobates (Fig. 3.4F). Sloped and *Bromus*-type rondels were not observed in Feature 2, and Cyperaceae phytoliths were also absent.

Phytoliths from woody eudicots occurred at a higher frequency than Feature 1 (22%). Echinate globular (11%, Fig. 3.4L), granulate globular (4%, Fig. 3.4M), and blocky irregular bodies (4%, Fig. 3.4N) were the most prevalent. The remaining arboreal types were comprised of sclereids (Fig. 3.4O), dendritic irregular bodies, and granulate polygonal plates (Fig. 3.4P).

Several unidentified phytoliths were documented in the Feature 2 sample. Simple hair cells (Fig.3.4Q) are produced by several plant families, and additional comparative work with North American taxa may determine diagnostic morphotypes. The sample also contained numerous angled or curved rod-like structures with flattened or 'spatulate' ends (Fig. 3.4R). These structures may not be derived from plants, but may in fact be a type of spicule fragment or other form of non-vegetative biosilica. Charcoal was also present in the sample (Fig. 3.4S).

SAMPLE GP-P012 (CONTROL SAMPLE)

The control sample yielded many of the same phytolith types observed in the assemblages from the two features (Fig. 3.5). Grass phytoliths (Fig. 3.5A-G) again dominated the assemblage (70%), but woody eudicot species (Fig. 3.5K-M) were still well represented (24%). A few new phytolith types encountered in the control sample were a scooped bilobate associated with the Ehrhartoideae (Fig. 3.5D), a Poaceae tower rondel (Fig. 3.5E), a faceted elongate associated with woody eudicots (3.5K), and an armed hair cell (3.5N). The last morphotype is produced in a limited number of families in the tropics, such as Boraginaceae, Moraceae, and Urticaceae (Piperno 2006), and preliminary work by Bozarth (1992) has identified it in temperate members of the Fabaceae and Asteraceae. Armed hair cells have a high potential to be taxonomically informative with future work.

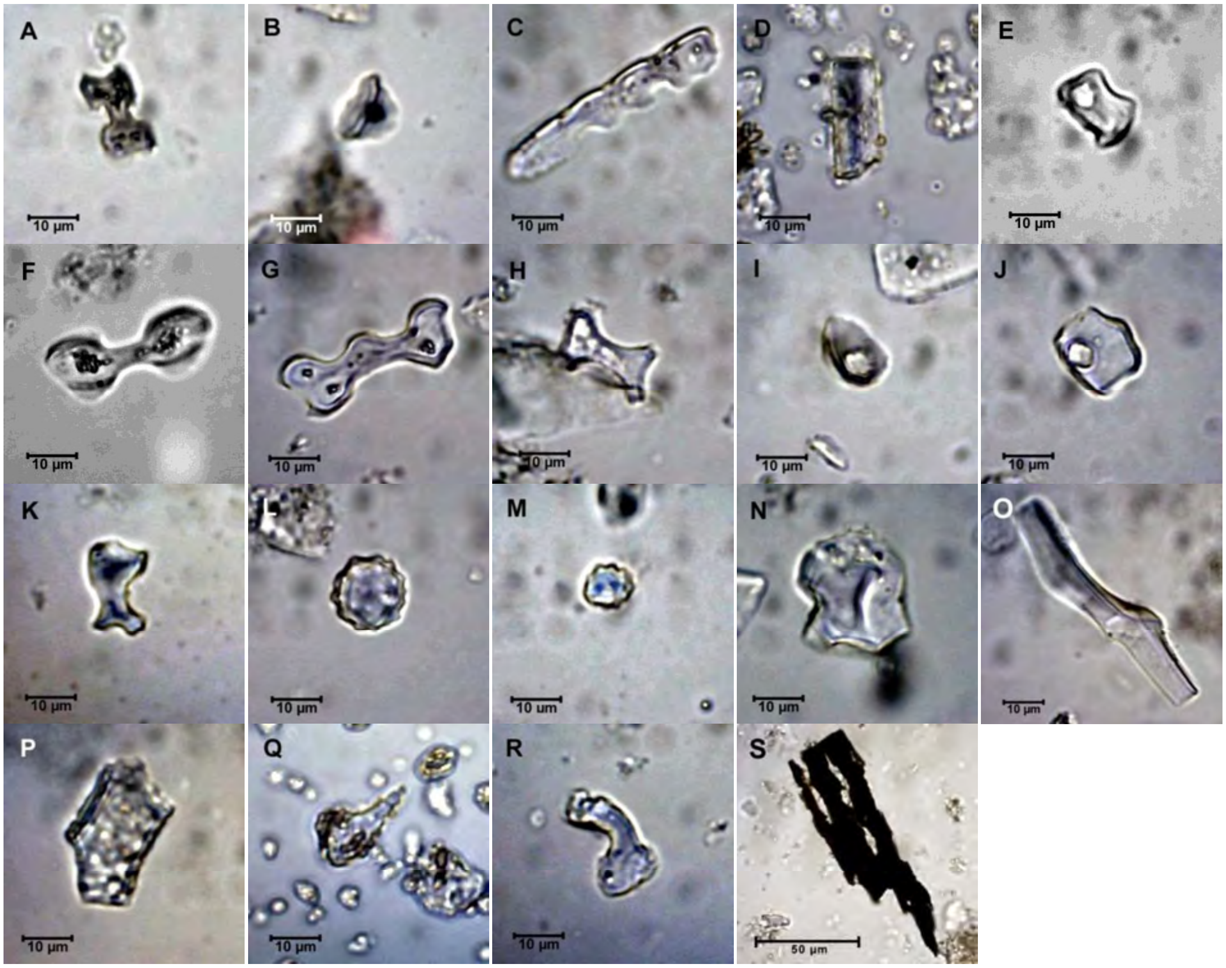

Figure 3.4. Selected phytolith morphotypes from GP-P011 (Feature 2). A-K) Grass phytoliths, L-P) woody eudicot phytoliths, Q-S) other material. **A)** Panicoideae bilobate (burnt), **B)** Rondel (burnt), **C)** Pooideae sinuate trapezoid, **D)** Keeled rectangular, **E)** Rectangular short cell, cf. Arundinoideae, **F)** *Aristida* thin bilobate, **G)** Polybate, **H)** Angular bilobate, **I)** Keeled rondel, **J)** Chloridoideae saddle, **K)** Collapsed saddle, **L)** Arecaceae echinate globular, **M)** Granulate globular, **N)** Blocky irregular body, **O)** Sclereid, **P)** Granulate polygonal plate, **Q)** Hair cell, **R)** Curved spatulate, **S)** Charcoal fragment. Scale bar: 10 µm, except H: 50 µm.

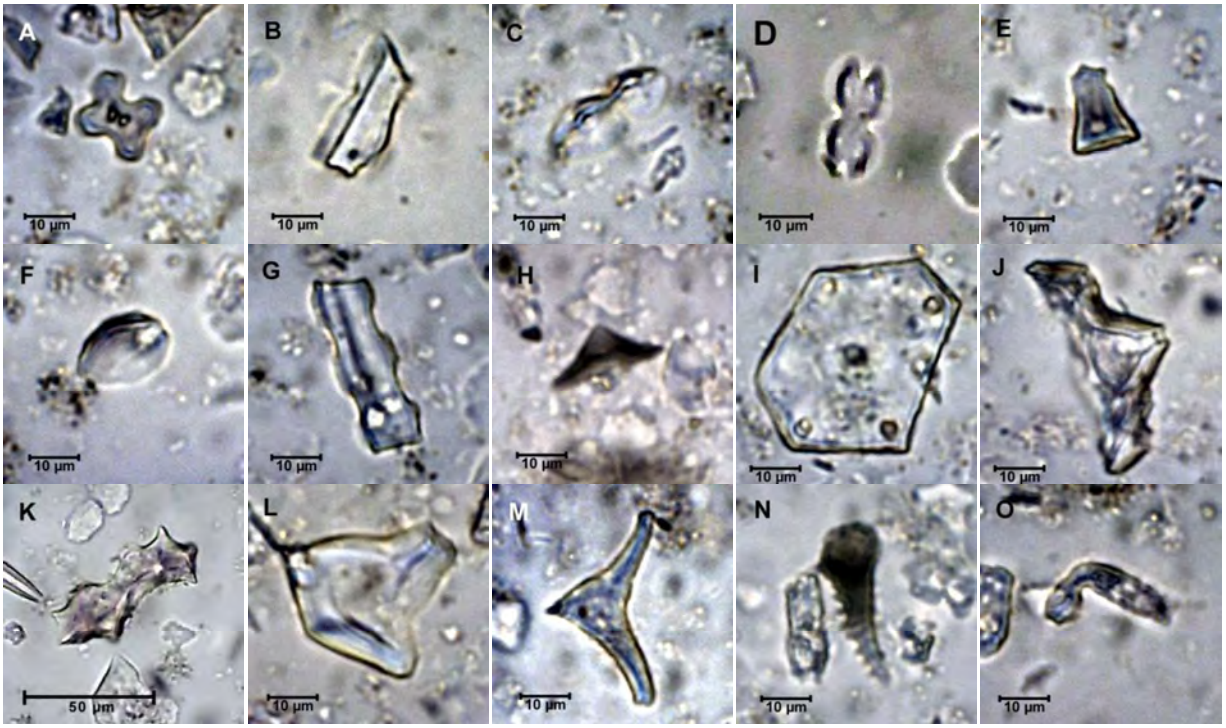

Figure 3.5. Selected phytolith morphotypes from GP-P012 (Control). A-G) Grass phytoliths, H-J) sedge phytoliths, K-M) woody eudicot phytoliths, N-O) other phytoliths and material. **A)** Type 1 cross body (burnt), **B)** Keeled rectangular, **C)** Keeled bilobate, **D)** Ehrhartoideae scooped bilobate, **E)** Tower rondel (burnt), **F)** Keeled rondel, **G)** Pooideae sinuate trapezoid, **H)** Cyperaceae small conical body, side view (burnt), **I)** Cyperaceae (cf. *Carex* sp.) achene large conical polygonal body, top view, **J)** Cyperaceae (cf. *Carex* sp.) achene large conical polygonal body, side view, **K)** Faceted elongate, **L)** Blocky irregular body, **M)** Sclereid, **N)** Armed hair cell (burnt), **O)** Curved spatulate. Scale bar: 10 µm, except K: 50 µm.

4.0 SAMPLE COMPARISON AND DISCUSSION

A comparative examination of the phytolith assemblages from the two feature samples and the control sample shows that in general, they are taxonomically similar, with only some small differences. The following observations can be made:

1) In terms of graminoids versus woody taxa frequencies, Feature 2 is more similar to the control sample than Feature 1 (see Fig. 3.2). Feature 1 had a higher frequency of grass phytoliths and a corresponding lower frequency of arboreal phytoliths than either Feature 2 or the Control sample. This higher frequency of grass phytoliths is mainly attributable to higher levels of Pooideae phytoliths, which suggests more Pooid grasses were growing (and dying) in the vicinity of Feature 1, or were being intentionally introduced into the feature for unknown reasons.
2) In terms of morphotype frequencies, Feature 2 is more similar to the control sample. However, in terms of taxonomic diversity, Feature 1 is more similar to the control sample. Both Feature 1 and the control sample contained phytoliths from *Bromus* sp. grass and from Cyperaceae, taxa that were

absent in Feature 2. On the other hand, Feature 1 and the control sample contained phytoliths from *Aristida* sp. grass, and several other specific grass morphotypes that have not yet been associated with a specific taxon. It should be noted that most of these phytolith types occur in very low frequencies, and their absence in a sample may simply reflect their rarity, rather than statistically significant patterns.

3) Based on the composition of the assemblages and the similarities to the control sample, it appears that the phytolith assemblage of each feature primarily represents background vegetation. The possible exception to this may be the intentional introduction of Pooideae species into Feature 1 as noted above. No economic crop species were identified in the features or the control sample.
4) Burnt phytolith frequencies were low in all three samples, which was somewhat surprising given the amount of micro-charcoal observed in the samples, and the concentrations of FCR in the features. Feature 2 and the control sample had the highest percentage of burnt phytoliths (7% and 9% respectively), whereas Feature 1 only had 3% burnt phytoliths. These frequencies suggest that generally, phytolith producing plants was not being intentionally burnt in the features in large quantities. Instead, the low frequencies likely reflect infrequent fire events within the general environment, such as the occasional forest or grass fire. Burnt particles and vegetation fragments from such fires, including phytoliths, can travel long distances once airborne from thermal updrafts.

The dominance of grass phytoliths in all three samples should not be interpreted to suggest that the surrounding environment of 33PK347 was open prairie grassland during human occupation, devoid of trees. Arboreal phytoliths are reasonably well represented within the samples. Most grasses are heavy silica producers and some of their phytoliths are often quite robust (resistant to dissolution and degradation), leading to potential over-representation in analysis. Kalisz and Boettcher's (1990) quantification of opaline silica in various soils across a prairie-transition-forest transect in Ohio showed that phytolith amounts in forest soils were much lower than other zones. In other words, arboreal species produced less volume of biosilica than grasses. Overall, the vegetation environment represented by the 33PK347 assemblages appears to be an open wooded area, with enough light penetration the forest canopy to permit growth of a variety of grasses and herbaceous plants. Low frequencies of wetland adapted taxa (e.g. Cyperaceae and Ehrhartoideae) suggest that the area was not inundated or situated in proximity to a wetland, which corresponds to the site's location on an upland ridge. The few phytoliths recovered from these taxa may represent occasional transport of plant parts or sediment (intentionally, or unintentionally, such as mud adhering to clothing or objects) into the site from wet lowland areas.

5.0 TAXA IDENTIFIED

This section briefly discusses each of the taxa identified and their ecological or economic significance.

ARECACEAE

In phytolith studies around the world, echinate globular phytoliths have only ever been found in the palm (Arecaceae) family. Species of this family are restricted to the tropics and subtropics, which makes the recovery of these phytolith morphotypes in sediments from site 33PK347 in Ohio unexpected and perplexing. However, as discussed previously, this phytolith type has been recovered in elsewhere in North America during phytolith assessments on sediments, where it has been presumed to represent either a residual phytolith signature of tropical vegetation from Tertiary or earlier geological periods (Strömberg, 2004), or a morphotype from a North American plant species that has not yet been identified (Johnson and Bozarth, 1996). Arecaceae phytoliths are very robust, and can be transported long distances in aeolian sediments, which may explain their presence in the light silty loam soils of the site.

CYPERACEAE

Most species of Cyperaceae prefer wetland habitats and are used as wetland indicators in paleoenvironmental reconstructions. Small conical phytoliths are diagnostic only to the family level, but large polygonal plates with conical protuberances are consistent with those produced in the genus *Carex*, the largest genus of Cyperaceae. Ethnohistoric and ethnographic data show that multiple species of *Carex* have been used by aboriginal groups across North America for dye, basketry, clothing, food, medicine, and other uses (Moerman, 1998), however, there is no specific reference of its use among aboriginal groups in the Ohio region.

POACEAE

Aristidoideae

Aristida sp.

Aristida is a large grass genus of the subfamily Aristidoideae, primarily found in warm and dry regions of the world.

Chloridoideae

Grasses in the Chloridoideae subfamily are better adapted to arid climates than either Panicoid or Pooid grasses, and are therefore considered an indicator of warm, dry conditions.

Panicoideae

The majority of members in the Panicoideae grass subfamily are adapted to warm and humid conditions in temperate and tropical regions of the world. Important economic members include maize (*Zea mays*) and big bluestem (*Andropogon gerardii*). However, no maize-specific phytoliths were observed in the 33PK347 samples.

Pooideae

The Pooid grasses are found mainly in temperate regions of the world, adapted to cool and dry (but not arid) conditions. The Pooideae includes several important economic species native to North America, including Canada wildrye (*Elymus canadensis*) and little barley (*Hordeum pusillum*). However, the phytoliths recovered during this study can only be distinguished to the subfamily level, with the exception of *Bromus*.

Bromus sp.

Bromus is a large genus of the Pooideae, found in temperate regions. In various parts of western North America, some species have been used by aboriginal groups for fiber, medicine, and food (Moerman, 1998), but there is no documentation of its use among aboriginal groups the Ohio region.

Ehrhartoideae

The Ehrhartoideae is the subfamily to which rice (*Oryza* sp.) and wild rice (*Zizania* sp.) belong, and many members are adapted to wet conditions. The phytoliths recovered from 33PK347 can only be classified generally to Ehrhartoideae. No diagnostic phytoliths from wild rice were observed.

6.0 SUMMARY AND CONCLUSIONS

Microbotanical analysis was undertaken on FCR and sediment samples from two features at the archaeological site 33PK347 in Pike County, Ohio. Starch analysis on FCR revealed that either no starchy plants were being processed in the features, or starch grains did not preserve, possibly due to exposure to high temperatures during feature formation. Phytolith analysis of sediments from the two features did not yield any evidence of economic plants, but it did show that the local vegetation around the site was an open forest with enough understory light to allow the growth of grasses. Comparison of the phytolith assemblages from the two features shows that they are quite similar, with the most notable difference a higher frequency of Pooideae grass phytoliths in Feature 1. This suggests that a higher number of individuals from this subfamily were growing near the feature, or were introduced into the feature in some way. The low frequency of burnt phytoliths in both features contrasts with the other artifactual evidence of burning activities, and reinforces the perspective that the phytolith assemblages represent background vegetation, rather than plants being processed or burned in the features.

In conclusion, while microbotanical analysis did not reveal any evidence of economic plant species being processed in the features, it did provide some useful information about surrounding palaeovegetation and feature formation processes. Future improvements in microbotanical reference collections for Eastern North America will improve resolution of palaeovegetation reconstruction, and refine interpretations of human-environment interactions.

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APPENDIX A

Table A.1. Detailed table of phytolith morphotypes observed in the 33PK347 samples.

Morphotype	Sample PG-P010 (Feature 1)	Sample PG-P011 (Feature 2)	Sample PG-P012 (Control)
Cross Type 1	1	0	4
Cross Type 3/8	4	1	2
Cross Type 5/6	1	3	2
Other Cross	1	4	3
Keeled Rectangular	0	4	14
Domed Rectangular	0	0	2
Concave Rectangular	0	23	5
Trapezoid/Rondel	32	46	56
Keeled Rondel	2	1	7
Sloped Rondel	2	0	0
Tower Rondel	0	0	1
Domed Rondel (*Bromus*)	1	0	1
Bilobate (Panicoideae)	92	96	128
Angular Bilobate	1	3	1
Thin Long-Shafted Bilobate (*Aristida*)	0	3	1
Square-Topped Trapezoidal Bilobate	0	1	2
Trilobate	3	0	0
Keeled Bilobate	1	0	4
Scooped Bilobate (Ehrhartoideae)	0	0	3
Polybate	2	4	5
Sinuate Keeled Polybate	1	1	1
Collapsed Saddle	1	5	4
Saddle (Chloridoideae)	8	13	19
Wavy Trapezoid (Pooideae)	56	36	46
Large Conical Polygonal Body (Cyperaceae achene)	1	0	5
Small Conical Body (Cyperaceae)	6	0	1
Faceted Elongate (woody eudicot)	0	0	2
Sclereid (woody eudicot)	1	4	3
Granulate Globular (woody eudicot)	8	14	18
Echinate Globular (Arecaceae)	8	36	20
Dendritic Irregular Body	1	1	1
Granulate Polygonal Epidermal (woody eudicot)	1	4	46
Blocky Irregular Body (woody eudicot)	5	14	17
Hair Cell	0	1	3
Armed Hair Cell	0	0	1
Curved Spatulate	0	2	16
Unidentified	5	3	7
Total	245	323	451

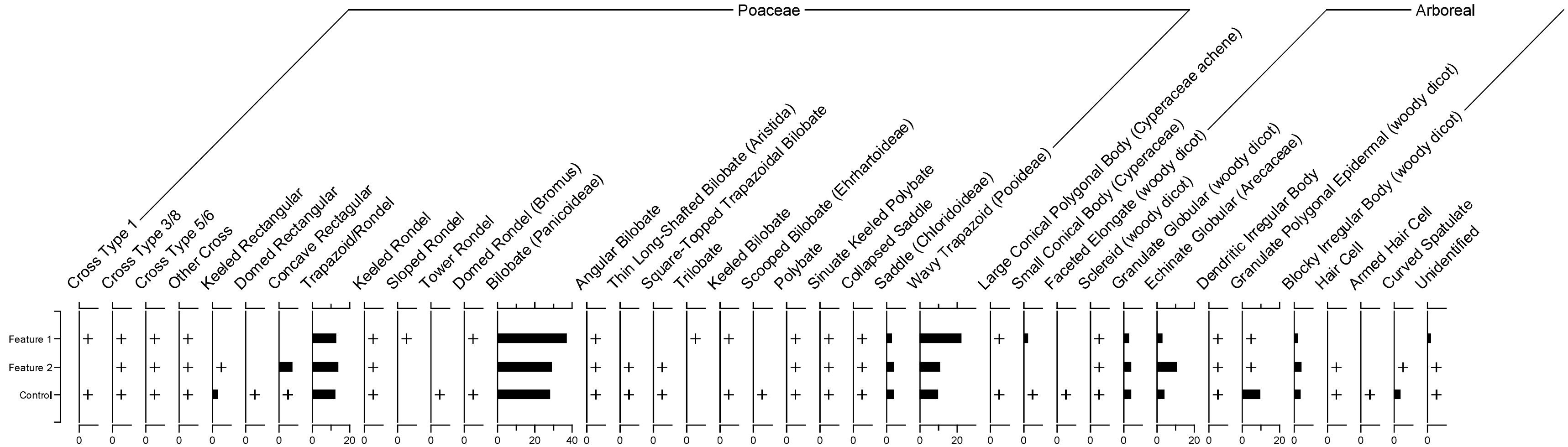

Figure A.1. Detailed diagram of phytolith frequencies by morphotypes. Frequencies calculated as a percent of total counted phytoliths. Frequencies <2% shown by a plus (+). Diagram produced in C2 (Juggins, 2010).

APPENDIX B

Micrographs of All Microbotanical Remains

Please see the CD-ROM for all raw digital images of microbotanical remains.

APPENDIX I

LIPID RESIDUE REPORT

Analysis of Three Soil Samples for Organic Residues by Gas Chromatography-Mass Spectrometry

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Sample preparation

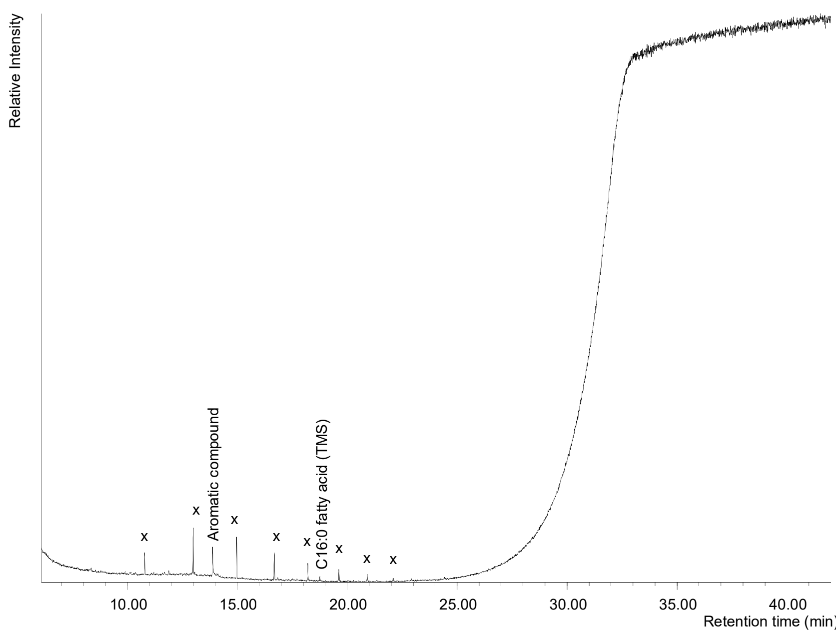
Three soil samples were sub-sampled for analysis: Control soil, Feature 1 soil and Feature 2 soil. For each soil a 4g sample was separately taken with a solvent cleaned metal spatula. The soils were extracted with ~4 ml DCM:MeOH (dichloromethane:methanol 2:1, v/v), with ultrasonication for 5 min. followed by centrifugation (5 min 2000 rpm, ~650 relative centrifugal force (g)). Excess BSTFA (*N,O*-bis(trimethylsilyl)trifluoroacetamide) with 1% TMCS (trimethylchlorosilane) was added to derivatise the sample which was heated at 70°C for one hour. Excess derivatising agent was removed under a stream of nitrogen. The samples were diluted in DCM for analysis by GC-MS. A method blank was prepared and analysed alongside the three soil samples.

Instrumental (GC-MS)

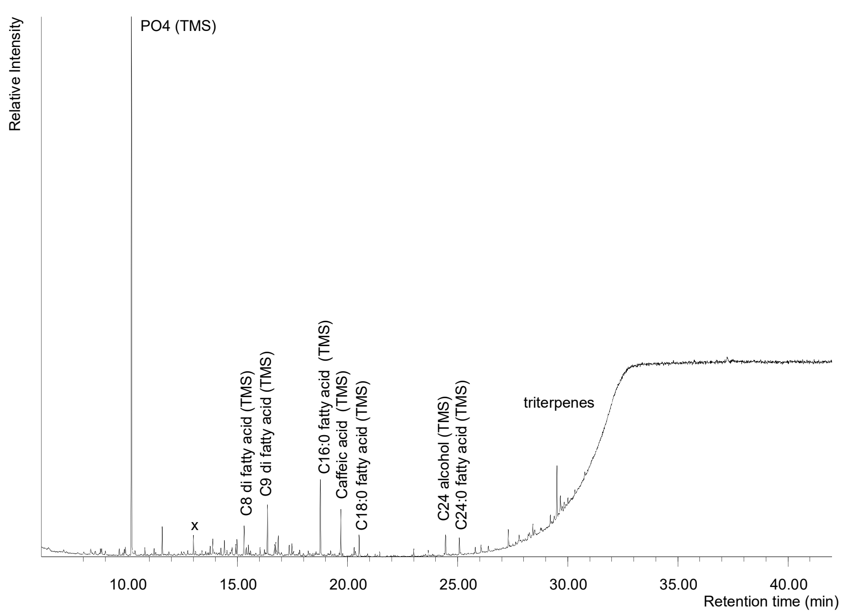
Analysis was carried out by combined gas chromatography-mass spectrometry (GC-MS) using an Agilent 7890A Series GC connected to an 5975C Inert XL mass selective detector. The splitless injector and interface were maintained at 300°C and 340°C respectively. Helium was the carrier gas at constant flow. The temperature of the oven was programmed from 50°C (2 min) to 350°C (10 min) at 10°C/min. The GC was fitted with a 30m X 0.25mm, 0.25µm film thickness HP-5MS 5% Phenyl Methyl Siloxane phase fused silica column (Agilent J&W). The column was directly inserted into the ion source where electron impact (EI) spectra were obtained at 70 eV with full scan from *m/z* 50 to 800.

Results and Summary
The results are presented as chromatograms of the BSTFA derivatized solvent extract. These show each separated component of the solvent extract as discrete peaks, the area under each peak being representative of the abundance.

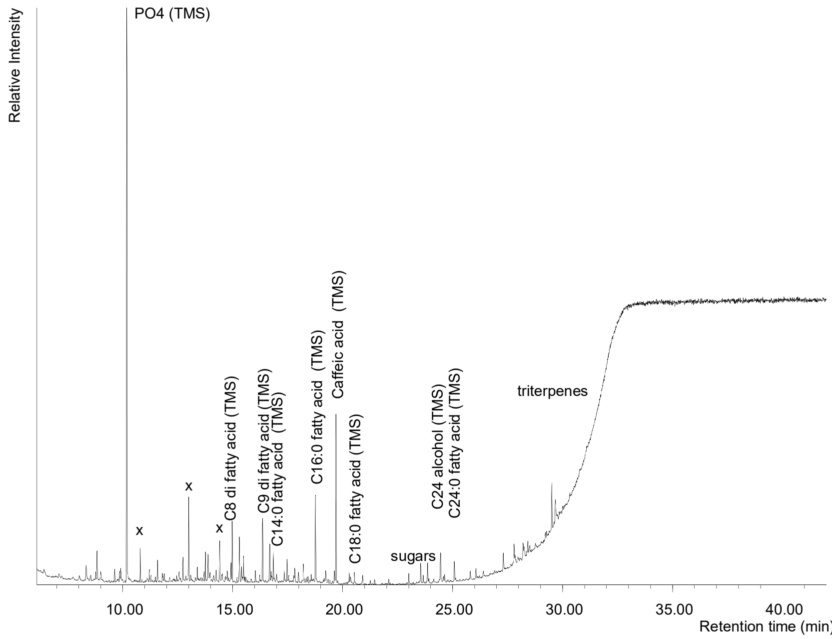
P = phthalate plasticiser
C = Fatty acid showing carbon number and the degree of unsaturation.
X = analytical artefact (polysiloxylanes)



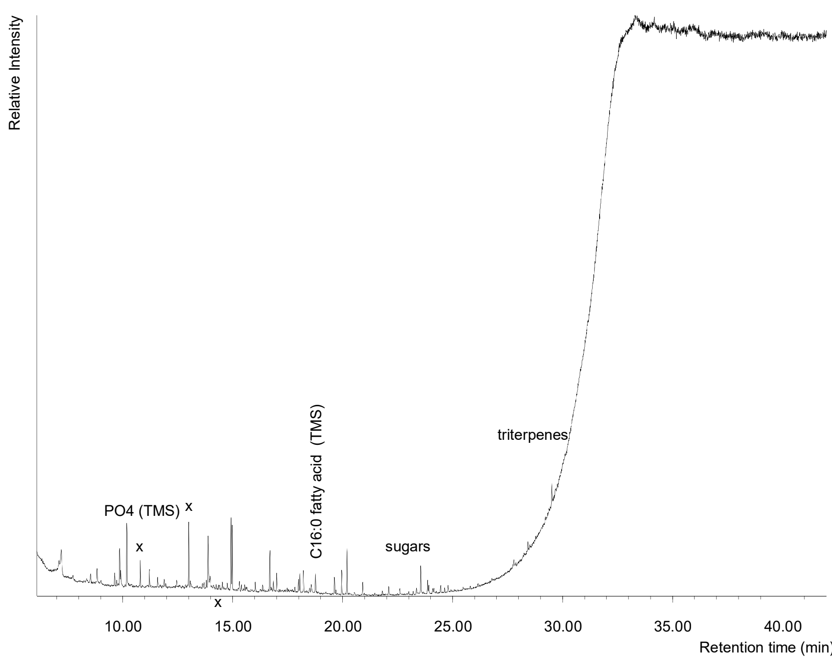
Method blank



Control soil



Feature 1 soil



Feature 2 soil

A method blank was prepared and analysed alongside the three soil samples. This sample contains known analytical artefacts (x, polysiloxylanes) originating from column degradation or vial septa, an unknown aromatic compound and trace levels of C16:0 fatty acid. These originate from sample preparation or during the analysis and can be excluded from further interpretation. The raised baseline from ~30 to 42 minutes is termed 'column bleed', this is a normal occurrence as part of analysis and is only revealed here as the vertical scale has been enlarged for these samples.

The three soils contain a similar range of lipid components, their abundances differ as do the type of lipids but the lipids which are present are typical of soils and are not diagnostic of a particular input to the soil. The abundances of these lipids is low. 4g of soil was extracted from each sample, much more soil was available, however if the lipid content was significant then it would have been present in these sub samples.

The identified lipids were;
Fatty acids. Generally, C14 to C16, with a C24 fatty acid. Some unsaturated fatty acids e.g. C18:1 and odd carbon numbered e.g. C15 were also present – these are typical in soils and are also ubiquitous contaminants as seen in the method blank. It is not possible to assign a particular input based on these. The fatty acids are not of high enough abundance for further analysis such as individual isotopic measurement.
Sugars and triterpenoids, these were not individually identified, but are typical plant constituents and would be expected in a soil – lipid biomarkers for more exotic materials (birch bark tar etc.) were looked for but not identified.
Caffeic acid was identified, but this is a component of lignin and as such would be expected as a common material in plants.
Other components (long chain alcohol, dicarboxylic acids) are also typical components of plants and are not diagnostic – especially at these low levels.

In conclusion, lipids were extracted from the soils at low levels and can most parsimoniously be assigned to plant material present in the samples.

APPENDIX J

FCR REFIT REPORT

GRAY & PAPE
INC.
CULTURAL RESOURCES CONSULTANTS

REFITTING OF FIRE-CRACKED ROCK FROM SITE 33PK347

Prepared by:
Melissa R. Lavender

Gray & Pape, Inc.

1.0 INTRODUCTION

Based on research questions outlined for Phase III archaeological excavations at Site 33PK347, the fire-cracked rock (FCR) collected during the Phase III investigations was evaluated for refitting alongside the FCR that was collected by Ohio Valley Archaeology, Inc. (OVAI), during the Phase II testing (Pecora and Burks 2014). Evaluating relationships between pieces of FCR recovered from both within and outside of feature contexts can provide insight into the potential cleaning, reuse, and disturbance of features. Melissa R. Lavender, of Gray & Pape, Inc., conducted the analysis.

2.0 METHODS

To begin the process of refitting, the FCR pieces recovered during Phase II testing were assigned Field Specimen (FS) numbers, ranging from 0501 to 0577, based on provenience. If two or more pieces of FCR came from the same provenience, they were given the same FS number. The FCR pieces recovered during Phase III investigations already had FS numbers that were assigned during the routine laboratory artifact analysis process; numbers ranged from 0002 to 0096.

With the exception of pieces deemed too small, too eroded/deteriorated, or otherwise unsuitable to be effectively refitted, each piece of FCR from the Phase II and Phase III investigations was labeled with its corresponding FS number using ink pen on a layer of archival adhesive. Of the 4,599 pieces of FCR that had been cataloged, a total of 2,082 pieces were labeled as suitable for refit analysis, including 1,487 pieces from Phase II investigations and 595 from Phase III investigations.

After labeling, the FCR was spread out on tables and roughly sorted according to similarities, taking into account variations in color, texture, and type/condition of any cortex present. The FCR specimens were examined, and sometimes placed into subgroups for comparison; for example, all specimens that exhibited obvious banding were set aside and considered as a subgroup. Specimens were rearranged as more details were observed, and were placed next to other pieces of similar material, which also had a similar shape and/or size to see if a match could be made. Matches, which can be two or more pieces, were assigned Refit Group numbers and recorded in a Refit Log.

3.0 RESULTS

Of the 2,082 pieces of FCR that were examined as part of this analysis, refits were found among 20 pieces. This amounts to approximately one percent of the specimens. The 20 pieces of FCR comprised eight Refit Groups; these details are summarized in Table 1. Four Refit Groups (1, 2, 6, and 7) consisted of two-piece refits, each from the same provenience (same FS numbers). The remaining four Refit Groups consisted of FCR pieces recovered from different proveniences (different FS numbers), which ranged from different levels to different locations. Refit Groups are discussed in more detail below.

Table 1. Fire Cracked Rock Refit Groups at Site 33PK347				
Refit Group	**FCR Field Specimen Numbers and Provenience**			
1	FS# 0015 Feature 2, Unit 19 628.5N 526E 0–26 centimeters (cm)m	FS# 0015 Feature 2, Unit 19 628.5N 526E 0–26 cm		
2	FS# 0096 Block 17, Unit 121 609N 510E 30–40 cm	FS# 0096 Block 17, Unit 121 609N 510E 30–40 cm		
3	FS# 0078 Feature 1, Unit 22 630N 512E Unknown Depth	FS# 0078 Feature 1, Unit 22 630N 512E Unknown Depth	FS# 0539 50x50cm Unit 630N 511E Unknown Depth	FS# 0078 Feature 1, Unit 22 630N 512E Unknown Depth
4	FS# 0015 Feature 2, Unit 19 628.5N 526E 0–26 cm	FS# 0574 Feature 2 16–26 cm	FS# 0574 Feature 2 16–26 cm	FS# 0060 Feature 2, Unit 19 628.5N 526E 0–26 cm
5	FS# 0540 Feature 1 630N 512E 0–8 cm	FS# 0545 Feature 1 631N 512E 0–12 cm		
6	FS# 0575 Feature 1 6–16cm	FS# 0575 Feature 1 6–16 cm		
7	FS# 0067 Feature 1, Unit 23 630N 512E 8–18 cm	FS# 0067 Feature 1, Unit 23 630N 512E 8–18 cm		
8	FS# 0541 Feature 1 630N 513E 0–10 cm	FS# 0575 Feature 1 6–16 cm		

Two pieces of FCR comprise Refit Group 1. Both pieces were recovered from Feature 2, Unit 19, 0–26 centimeters below datum (cmbd) (Figure 1).

Figure 1. Fire-cracked rock, Refit Group 1.

Two pieces of FCR comprise Refit Group 2. Both pieces were recovered from Unit 121, 30–-40 cmbd, in Stratum II (Figure 2).

Figure 2. Fire-cracked rock, Refit Group 2.

Four pieces of FCR comprise Refit Group 3. Three pieces were collected during Phase III investigations in Feature 1, Unit 22 (630N 512E). The fourth piece was collected during Phase II investigations in a 50- by 50-cm test unit (630N 511E) along the northern edge of the Feature. No depths were recorded for either of these two proveniences (Figure 3).

Figure 3. Fire-cracked rock, Refit Group 3.

Refit Group 4 also consists of four pieces of FCR. All four pieces were recovered from Feature 2. Two of the specimens were collected during Phase II investigations, at a depth of 0-26 cmbd, and two were collected during Phase III investigations, at a depth of 16-26 cmbd (Figure 4).

Figure 4. Fire-cracked rock Refit Group 4.

Two pieces of FCR comprise Refit Group 5. Both pieces were recovered from 1- by 1-m units within Feature 1 during Phase II testing. One piece was recovered from Unit 630N 512E, at a depth of 0–10 cmbd; the other was recovered from Unit 631N 512E, at a depth of 0-12 cmbd (Figure 5).

Figure 5. Fire-cracked rock, Refit Group 5.

Two pieces of FCR comprise Refit Group 6. Both pieces were recovered from Feature 1, at a depth of 6–16 cmbd, during Phase II testing (Figure 6).

Figure 6. Fire-cracked rock, Refit Group 6.

Two pieces of FCR comprise Refit Group 7. Both pieces were recovered from Feature 1, Unit 23, at a depth of 8–18 cmbd during Phase III investigations (Figure 7).

Figure 7. Fire-cracked rock, Refit Group 7.

Two pieces of FCR comprise Refit Group 8. Both pieces were recovered from Feature 1 during Phase II testing. One piece was recovered from Unit 630N 513E, at a depth of 0–10 cmbd; the other had no unit coordinates listed, but came from a depth of 6–16 cmbd (Figure 8).

Figure 8. Fire-cracked rock Refit Group 8.

4.0 DISCUSSION

Generally, refits are made by matching specimens that possess similar qualities. Using attributes like color, texture, porosity, size, and fracture patterns, related items can be brought together. However, in the case of FCR from Site 33PK347, the overall homogeneity of the FCR assemblage made refitting a difficult prospect and resulted in a low number of matches. Fine-grained tabular sandstone is abundant at the site, and appears to have been almost exclusively utilized in the activities which created the FCR. Fewer than a dozen pieces of non-sandstone FCR were observed. In fact, the local sandstone is so abundant, that after looking at the assemblage as a whole, it appears that much of what was collected during the Phase II testing, and some of what was collected during the Phase III investigations, may not be FCR after all, but rather naturally occurring broken stone. As some of the sandstone showed signs of erosion, it was difficult to ascertain whether or not it was truly cracked due to thermal activity. Up to 65 percent of the Phase II FCR assemblage and up to 25 percent of the Phase III FCR assemblage is unmodified raw material.

Overall, the refit results do not indicate any cleaning out of, or reuse of, FCR used in Feature 1 and Feature 2. Nor does it appear from this analysis that any significant disturbance of the FCR artifacts occurred from their initial placement. Of the eight refit matches that were made, all but one included refits that came from the same feature. The lone standout consisted of three pieces recovered from Feature 2 and one piece that was recovered from the unit along the northern edge of the Feature (Refit Group 3). When Feature 2 was initially described by Pecora and Burks (2014) during Phase II investigations, they noted that additional FCR was scattered around the edges of the feature concentration. The concentration of FCR within Feature 2 was not that much denser that the scatter around it, so it could be argued that the scatter was, itself, part of the feature. The one piece of FCR from "outside" Feature 2 could easily have been moved further away from the concentration through bioturbation, tree-fall, or a number of other slight disturbances.

5.0 SUMMARY AND CONCLUSIONS

All of the FCR collected during Phase II and Phase III investigations at Site 33PK347 was evaluated for refitting potential. Of the 4,599 pieces recovered, 2,082 were deemed possible candidates for refit; these were labeled and analyzed. Twenty pieces were found to have matches as eight Refit Groups. The matches were all found within the same feature or excavation unit context, with the exception of Refit Group 3, whose matches occurred in such close proximity to each other that they are likely from the same context.

6.0 REFERENCES

Pecora, Albert M., and Jarrod Burks
2014 *Phase II Archaeological Investigations of 33PK347, 33PK348, 33PK349, 33PK371, and 33PK372 Within the Portsmouth Gaseous Diffusion Plant (PORTS), Pike County, Ohio*. Ohio Valley Archaeology, Inc., Columbus, Ohio.