2. THE ROLE OF GEOPHYSICS AT HOPEWELL CULTURE NATIONAL HISTORICAL PARK

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Hopewell Culture National Historical Park is best known for its earthwork complexes built by the Hopewell during the Middle Woodland period. The park was originally established in 1923 to preserve the Mound City site after its use as a World War I training camp. In the past two decades, the park has added four additional earthworks—Hopeton Earthworks, Hopewell Mound Group, Seip Earthworks, and High Bank Works—and recently had its boundaries increased to include Spruce Hill. The recent growth in land located within the park has provided opportunities for archaeological research, most of which used some sort of geophysical technique.

Geophysical techniques measure physical properties of the surface and subsurface within a surveyed area. The differences in measurements, which can be very minute, result in higher or lower measurements from those of the surrounding area. These differences are called geophysical anomalies. These anomalies can be analyzed to determine if they are likely to be natural or cultural features. Additional analysis, partnered with existing archaeological knowledge and ground-truthing, may provide more detailed information about the type of feature detected. It should also be stated that no single geophysical technique will work on all archaeological projects because the physical property measured is dependent on the physical and/or cultural environment under study. However, the main advantage of using geophysical techniques in archaeology is the ability to quickly survey an area with little to no ground disturbance. This survey type preserves more of the archaeological record intact and saves time and money by pinpointing potential features to excavate. Disadvantages include the expense of the equipment and the high learning curve for field use and data interpretation.

The National Park Service has a strong interest in the archaeological use of geophysical techniques due to the potential to learn about site boundaries, feature types, and formation processes in a minimally destructive manner. And the Midwest Archeological Center of the National Park Service has conducted week-long training workshops about this topic for well over a decade. This article will review several case studies to examine the role of geophysics in cultural resource management at Hopewell Culture National Historical Park.

Hopewell Mound Group

Hopewell Mound Group *(Figure 1)* consists of two large enclosures, two smaller enclosures, several gateways, and numerous mounds inside and outside its once massive earthen walls. The“type-site” for Hopewellian earthworks has been well documented with early maps from the first quarter of the nineteenth century and with several archaeological reports, namely from Squier and Davis, Moorehead, and Shetrone.
In the summer of 2001, park staff worked with Ohio State University to conduct research concerning site use within the site’s earthen walls. The research used a combination of traditional and geophysical methods. A random sample of the interior space lead to the

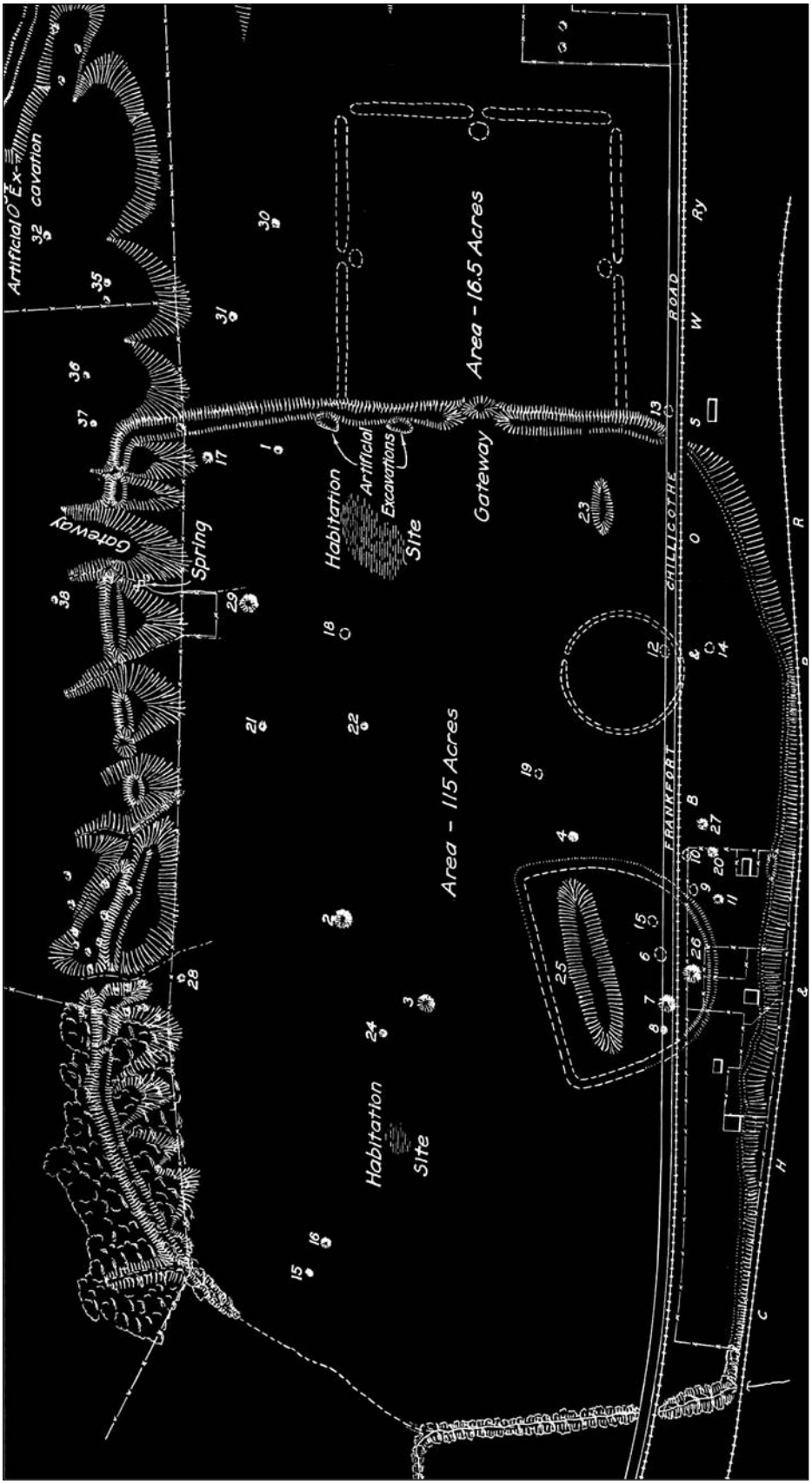

Artificial Excavation
Area - 16.5 Acres
Area - 115 Acres
Habitation Site
Artificial Excavations
Gateway
Spring
Gateway
Habitation Site
CHILLICOTHE ROAD
FRANKFORT
Ry

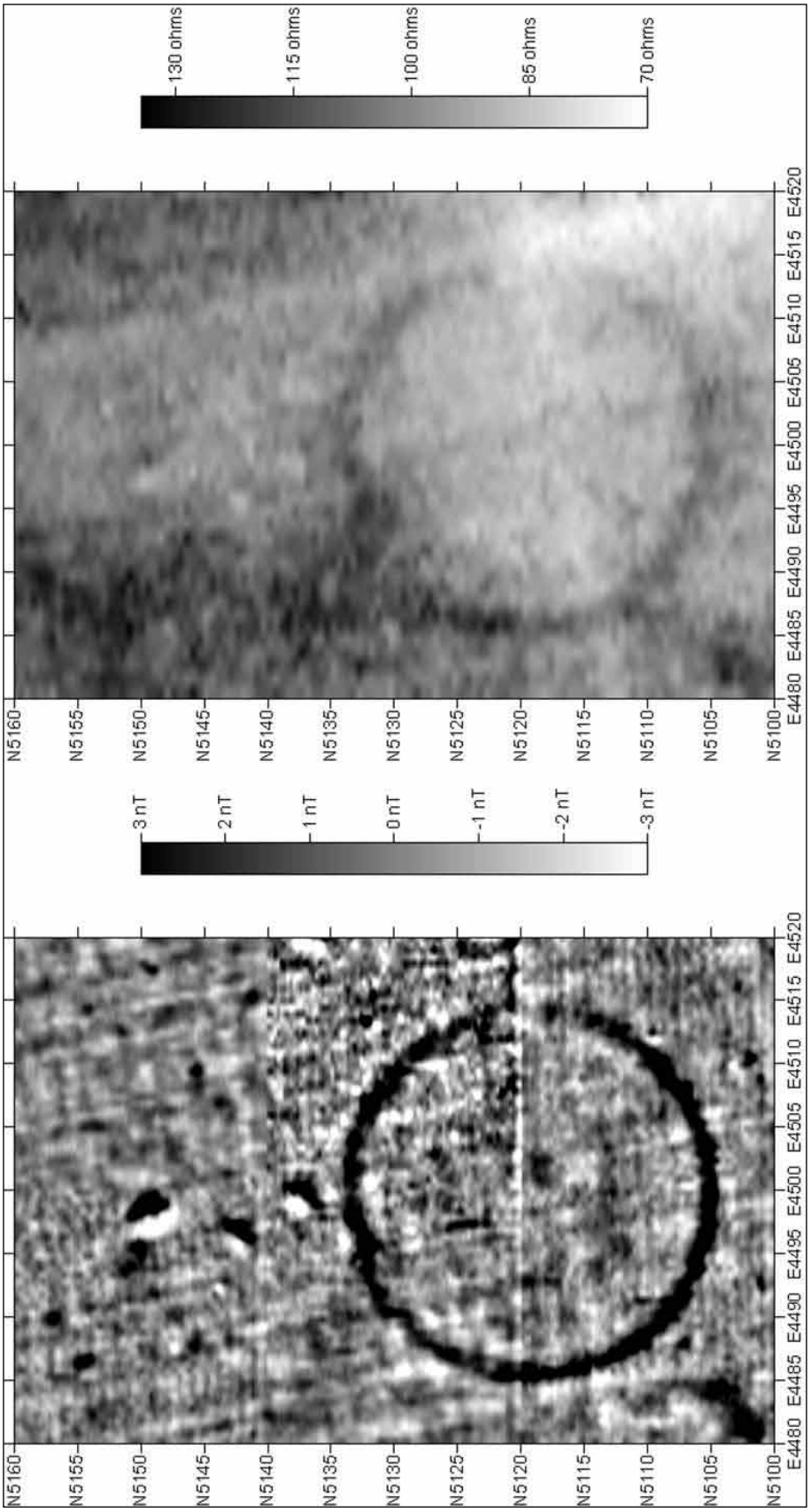
Figure 1

testing of an area located near the center of the main enclosure, away from any known mounds. In this area, systematic shovel testing was conducted resulting in the finding of one piece of lithic shatter from chipped stone tool manufacture and 22 pieces of cinder. No cultural features were found in the shovel test units. Magnetic and electrical resistance survey data was collected from the area and showed surprising results. *(Figure 2)* Both types of data revealed a circular anomaly measuring 30 meters in diameter and 1.5 meters in width with a gap facing east. Interestingly, the resistance data show the circular anomaly as an area of higher resistance with an interior area of lower resistance. To determine the nature of this anomaly, a 1 by 4 meter trench was excavated through the southern portion of the anomaly. A shallow ditch 2.5 meters wide and 20 centimeters below plowzone was found. The only artifact recovered was a piece of fire-cracked rock. No charcoal was recovered. While the age of the feature is still in question, it is clear that the circular feature may not have been found using traditional archaeological methods. This example underscores the benefit of continuous land coverage offered by geophysical techniques, as well as its utility to provide new knowledge about previously documented sites.

Also in the summer of 2001, an area near Moorehead's and Shetrone's west village or habitation site in the western portion of the earthwork was tested using traditional and geophysical techniques. This area definitely has a Middle Woodland occupation based on artifacts collected from shovel tests and an earlier surface collection conducted in the 1980s by Mark Seeman. Two anomalies, both having strong signatures in the magnetic and resistance data, were excavated and found to be prehistoric in nature. *(Figure 3)* This feature was a deep cooking pit filled with refuse. Bivalve shells atop a layer of charcoal were found at the lower depths, while assorted trash were in the upper layers. A quartz crystal bladelet found at 5 centimeters below plowzone indicate a Hopewell occupation. However, the base of a biface point recovered from the feature indicates a later occupation as does the charcoal recovered from 90 to 100 centimeters below plowzone which yielded a date of 1040±60 RCYBP (radiocarbon years before present), at about the time of the transition from the Late Woodland to Late Prehistoric periods. A nearby feature was also found to be a deep cooking pit with a layer of FCR and charcoal at its base. Animal bones, chert flakes, and a few pottery sherds were found. Although Hopewellian diagnostic artifacts were found in the plowzone, charcoal obtained from 75 to 80 centimeters below plowzone returned a date of 1090±60 RCYBP, again during the transition from the Late Woodland to Late Prehistoric periods. Although this area contains evidence of a Middle Woodland occupation, two cultural features, found with geophysics and subsequently excavated, contain settlement debris from a later occupation dating to the Late Woodland to Late Prehistoric periods. Therefore, areas around the western village proposed by Moorehead (1922) and Griffin (1996) have a much later significant occupation. The use of geophysics in this instance led to the purposeful excavation of cultural features to answer a question of site use.

Riverbank Site

Located just a couple hundred meters southeast of the Hopewell Mound Group is the Riverbank Site. The 4-acre site sits atop a terrace overlooking the North Fork Paint Creek. The site was extensively documented from 2003 to 2006 during a project to determine how to correct the northward migration of the creek onto park lands. Prior to


130 ohms
115 ohms
100 ohms
85 ohms
70 ohms
3 nT
2 nT
1 nT
0 nT
-1 nT
-2 nT
-3 nT
N5160
N5155
N5150
N5145
N5140
N5135
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N5125
N5120
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N5110
N5105
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E4480
E4485
E4490
E4495
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Figure 2

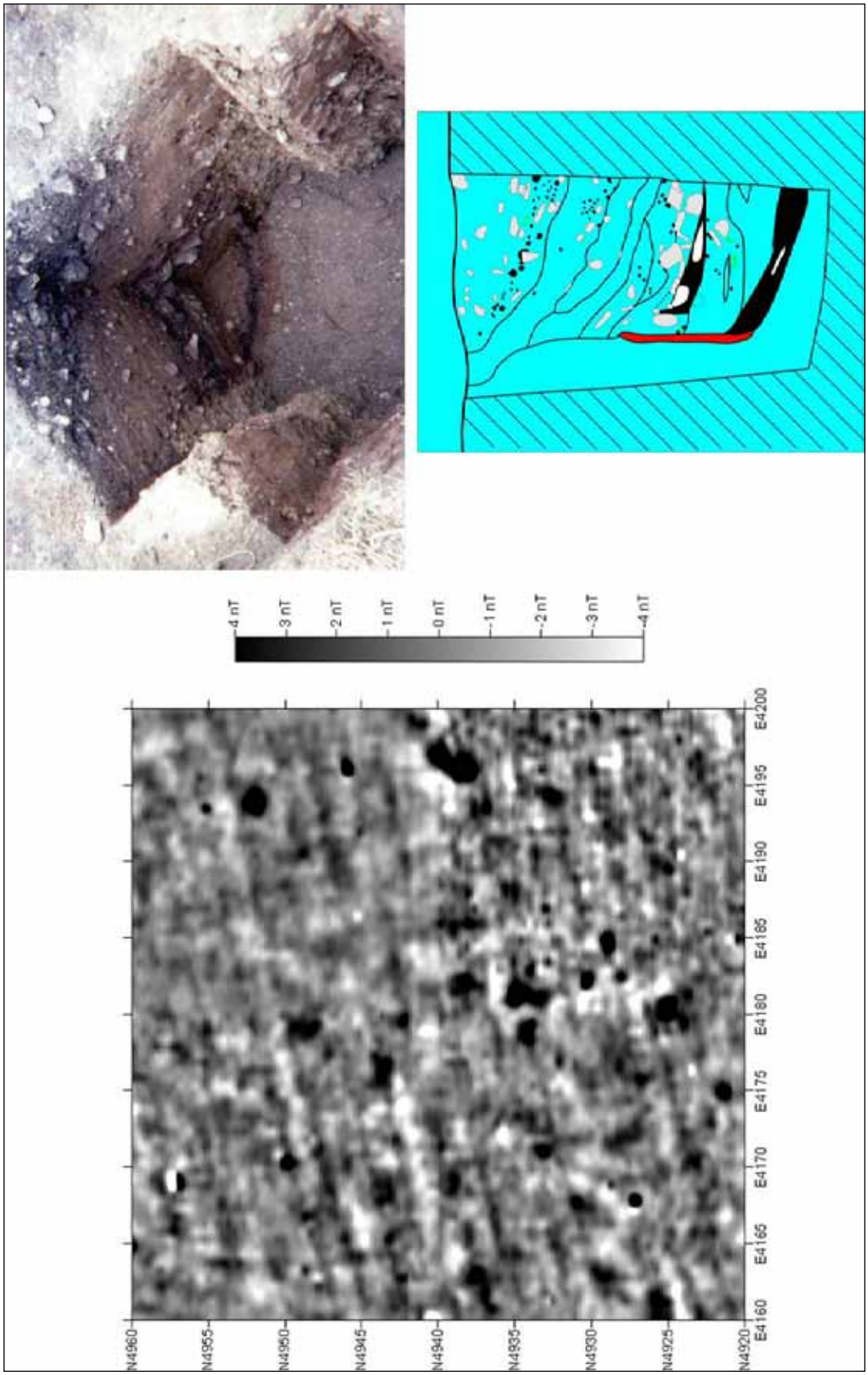
4 nT
3 nT
2 nT
1 nT
0 nT
-1 nT
-2 nT
-3 nT
-4 nT
N4960
N4955
N4950
N4945
N4940
N4935
N4930
N4925
N4920
E4160
E4165
E4170
E4175
E4180
E4185
E4190
E4195
E4200

Figure 3

2003, research in the general area found artifacts dating to the Archaic, Woodland, Late Prehistoric, and 19th and 20th century periods. A controlled surface survey recovered 357 artifacts in three distinct artifact clusters: an historic cluster resulting from modern dumping; an historic cluster associated with a structure, probably a 19th century farm building; and a prehistoric artifact cluster possible related to use of the nearly earthwork complex. Additional research was undertaken to determine the nature and extent of the site, including geophysical survey and feature excavation.

The geophysical survey, conducted by the Midwest Archeological Center, covered approximately 4 acres. The entire project area was surveyed using a fluxgate gradiometer and selected areas were tested with electrical resistance and conductivity meters. *(Figure 4)* Several distinct anomalies are apparent in the magnetic data. The long linear feature corresponds to high ground associated with glacial geologic formations. Several starburst patterns in the data represent lightning strikes and strong dipoles represent metal objects. A number of strong monopole anomalies are indicative of prehistoric features. Excavations in the summer of 2006 found numerous features that, based on the feature content and radiocarbon dates, date to the Middle Woodland period. Artifacts from the features, such as small pieces of mica and footed pottery vessels, are indicative of a Hopewellian presence, probably a short-term habitation site directly related to the use of the mounds.

Another interesting study in this area was the examination of how prescribed fire impacts the magnetic data of archeological sites. The Park Service has long used prescribed fire to manage vegetation and reduce fuel loads. Park staff was concerned about the impact of prescribed fire on magnetic data of sensitive archaeological sites such as earthworks. We were especially concerned about the continued use of fire on a cyclical basis. Previously we had tested a small area at Battelle Darby Metropark in Franklin County, Ohio that was burned regularly over a period of fifteen years. We found the magnetic data was useless due to the accumulation of carbon rich sediments throughout the first couple inches of soil. An extensive literature search provided no references relating to prescribed burns and magnetic survey. In autumn of 2008, park land containing the Riverbank site was selected for a prescribed burn since the area had been documented for archeological resources through traditional and geophysical methods. *(Figure 5)* The low-intensity fire was conducted and magnetic data collected. A comparison of data collected before and after the burn has initially confirmed that fire, even low intensity, does affect magnetic data over the short-term. For instance, the magnetic strength of one anomaly was intensified from about 16 nT to 21 nT a week after the prescribed burn. Although the difference appears to be minute, we rely on very subtle changes when interpreting geophysical data. More research on this topic is clearly needed and this case study highlights the application of geophysical data to more complicated resource management issues.

Just north of the Mound City earthworks is a 40-acre parcel of land covered by alfalfa and orchard grass. In 2006, park officials suggested the possibility of a new vegetation management regime to revert the old agricultural field to forest. Perhaps somewhat surprising, the area has experienced only limited archaeological research. Archaeologists from the Midwest Archeological Center conducted investigations on this parcel during the early 1980s under the direction of Mark Lynott. Archaeological

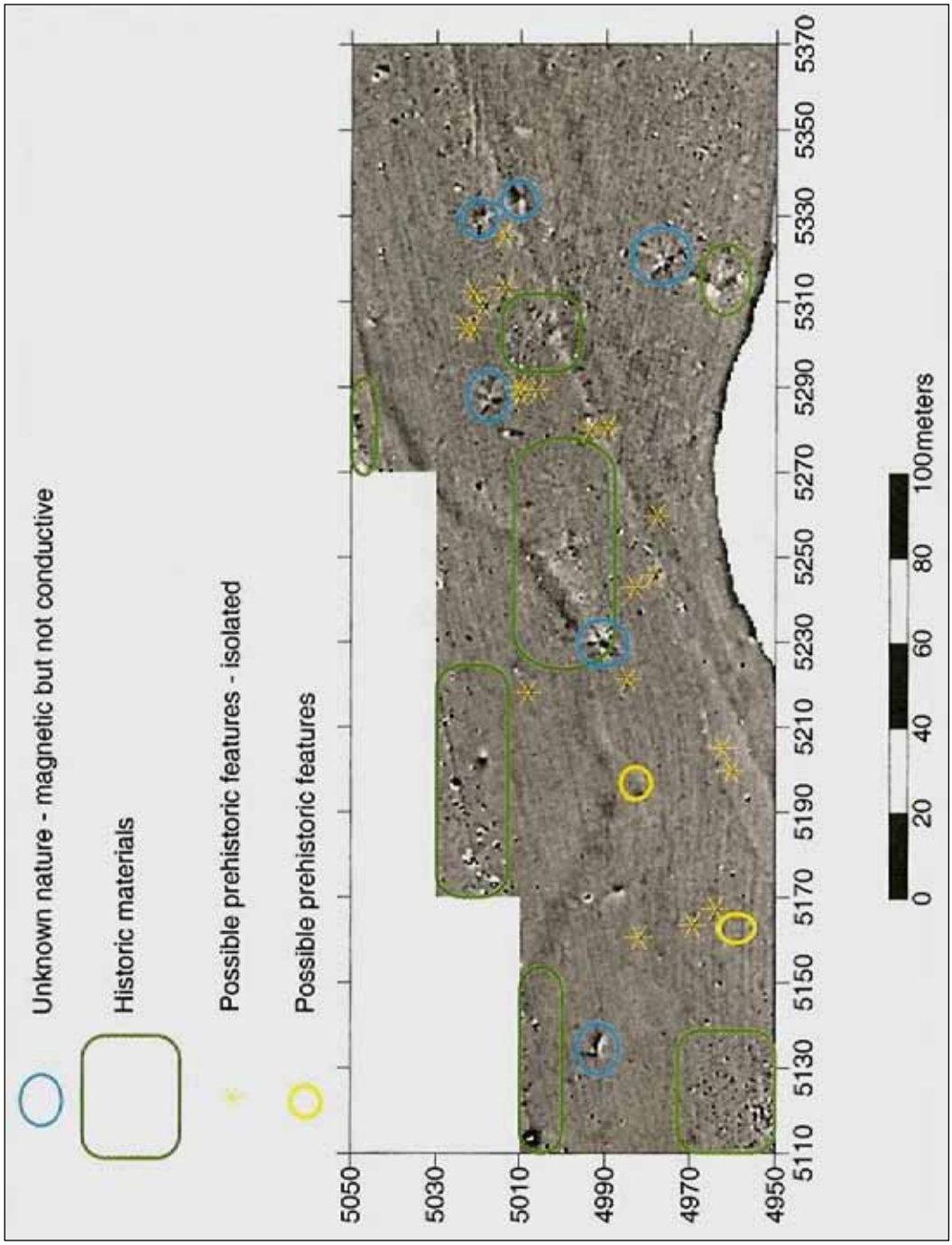
Unknown nature - magnetic but not conductive
Historic materials
Possible prehistoric features - isolated
Possible prehistoric features
5050
5030
5010
4990
4970
4950
5110
5130
5150
5170
5190
5210
5230
5250
5270
5290
5310
5330
5350
5370
0
20
40
60
80
100meters

Figure 4

Figure 5

investigation included controlled surface survey, shovel testing, and a limited number of test pits. Three historic scatters, including a prehistoric component on one of these scatters, and a Middle Woodland prehistoric site were located. The possibility of eventual reforestation spurred park archaeologists to return to the site in the summer of 2007 to re-examine the site and its relationship to Mound City Group.

To make the best use of the limited staffing and funds and to best supplement the previous traditional fieldwork, a methodology of geophysical data collection combined with subsequent anomaly testing was employed. A magnetic survey was conducted over the southern portion of the parcel using a Geoscan FM-256 fluxgate gradiometer. *(Figure 6)* The survey consisted of approximately one hundred 20 x 20-meter survey blocks. The research strategy employed a fine-grained data collection technique by placing transects at half meter intervals and takings readings at a rate of 8 readings per meter. Preliminary analysis of the magnetic data located dozens of magnetic anomalies that based on their characteristics are probable prehistoric features.

Coring was chosen as the methodology to ground-truth magnetic anomalies because it is minimally destructive and can be executed quickly and efficiently. Seventeen magnetic anomalies were chosen for coring on the basis of strength or magnitude, as well as the overall configuration of the anomaly. Anomalies were relocated on the ground using a Total Station. Eleven of the seventeen cores were found to contain prehistoric artifacts at depths below the plowzone. We suspected an area containing two linear anomalies and five, large aligned anomalies of being a prehistoric structure with associated pit features.

Park staff and volunteers returned to the site in the summers of 2008 and 2009 to conduct excavations. *(Figure 7)* With respect to the linear anomalies, an excavation of 6 square meters in the summer of 2008 revealed four post holes. The post holes of the structure are readily visible in the surrounding gravel. It is not yet known whether the gravel is anthropogenic or natural, although its presence may contribute to the visibility of the posts in the magnetic data as a result of the good contrast between it and the organic-rich post fill. In 2009 the plowzone was stripped across the structure area in a transect 2 meters wide by 25 meter long. Additional post holes were found. Possible interior features exist across the floor of the structure.

Excavations were also conducted on two of the five aligned anomalies. The northern-most anomaly is a large irregular pit feature containing pottery, chert debitage and bifaces, as well as mica and copper. The middle anomaly is a large, circular pit feature containing bifaces, biface fragments, and associated chert debitage. Neither pit has evidence of in situ burning and contained relatively little charcoal.

When taken as a whole, current research supports the initial survey findings indicating a Middle Woodland site at this location. The presence of bladelets, sub-ovate bifaces, and mica fragments, along with AMS dates on wood charcoal from the post holes and from a pit feature indicate a Middle Woodland occupation associated with the adjacent mounds and earthwork. Therefore, the utility of geophysics in this case was the ability to direct limited staff and financial resources in a way that provided a rich set of

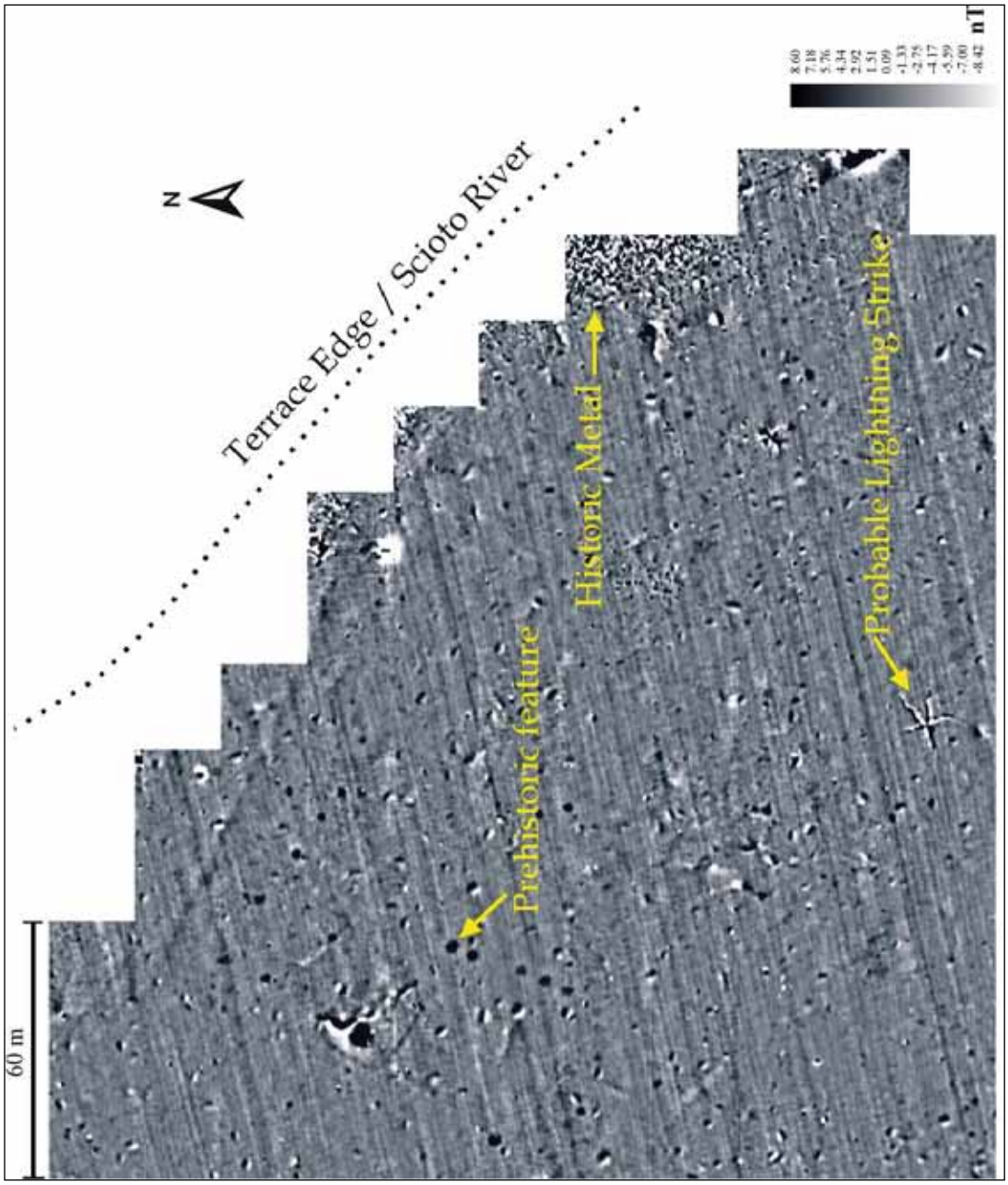
8.60
7.18
5.76
4.34
2.92
1.51
0.09
-1.33
-2.75
-4.17
-5.59
-7.00
-8.42
nT
N
Terrace Edge / Scioto River
Historic Metal
Probable Lightning Strike
Prehistoric feature
60 m

Figure 6

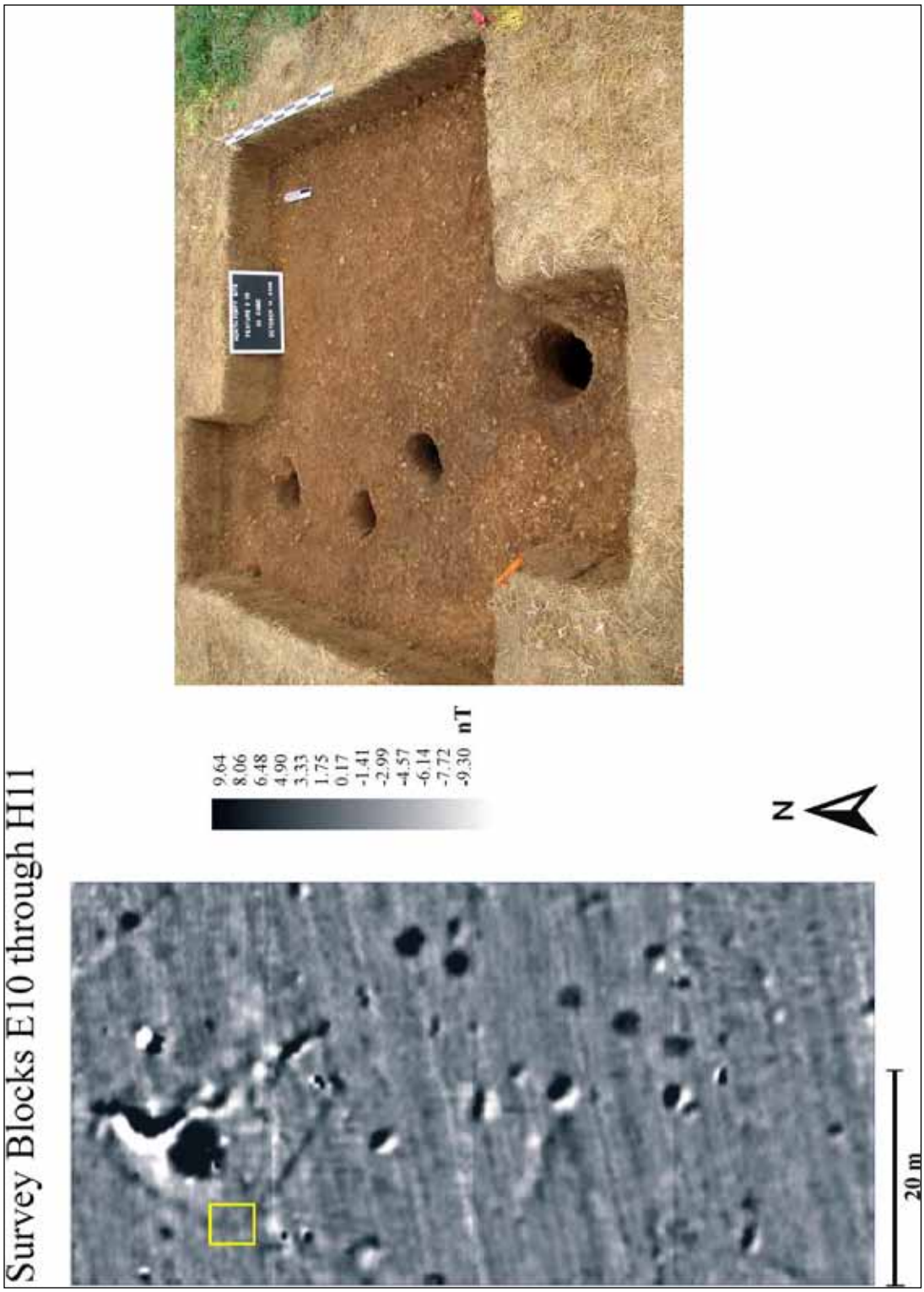
Survey Blocks E10 through H11
9.64
8.06
6.48
4.90
3.33
1.75
0.17
-1.41
-2.99
-4.57
-6.14
-7.72
-9.30
nT
N
20 m

Figure 7

data from which to draw conclusions; in this case, the information specifically related to use of space adjacent to a Hopewellian earthwork.

The last case study examines the location for the park's new museum collection facility. The new building, to be constructed in 2010 at the Mound City Group, will greatly improve storage conditions by providing a building with a stable environment, adequate space for the existing collection and anticipated growth, mitigate a radon gas problem in the existing facility, and provide handicapped accessibility. The 2,300 square-foot building is adjacent to the existing Resource Management building. The area of potential effect was not directly occupied by a Camp Sherman building and was used in the mid to late twentieth century as a garden and play area for park staff and their families residing on-site.

Systematic shovel tests were excavated within the area of potential effect. A total of nine artifacts were found: five historic artifacts dating to the 19th and 20th centuries and four prehistoric artifacts that were not temporally diagnostic. No cultural features were found. Due to the proximity to the Mound City earthworks and the historic use of the general vicinity, a magnetic survey was conducted to determine if any prehistoric or historic features were present.

(Figure 8) The magnetic data, collected with the FM-256, shows several interesting anomalies. A linear anomaly, although subtle, is clearly visible running east to west in the survey data. Its low magnitude or strength indicates a lack of metal and thus it appeared to be a narrow trench. Historic maps of Camp Sherman, a World War I training camp built over a vast stretch of land including Mound City, showed the area was used as a fire break. Current utility maps did not show any lines running in the direction of the anomaly. A conversation with park maintenance staff revealed the presence of an old geothermal injection well in that general direction. An outdated land-use map was found that showed the location of the well that lined up with the linear anomaly and a note that the line was a 2-inch PVC pipe placed in a narrow trench. Of interest here is that the location of non-metal utility lines can show up on magnetic data due slight magnetic variations resulting from the trench disturbance. Another curiosity in the magnetic data was the presence of two bipolar anomalies. We immediately recognized both as pieces of metal, which was confirmed after a maintenance staffer with 30 plus years at the park explained that those matched the locations of the two permanent anchors for volleyball net poles.

In this case, geophysical data provided a more complete picture of human activity within the area of potential effect and provided information on something that could have unnecessarily halted the project if inadvertently discovered during construction. In addition, it serves as a good reminder of the knowledge possessed by people who own, work at, or farm the land under survey. These people greatly aid the interpretation of geophysical data.

This article has reviewed several case studies from Hopewell Culture National Historical Park. The case studies have focused on the utility of geophysical techniques as an important addition to traditional archaeological fieldwork. Many times geophysics can either aid in locating archaeological resources or be used to re-examine documented

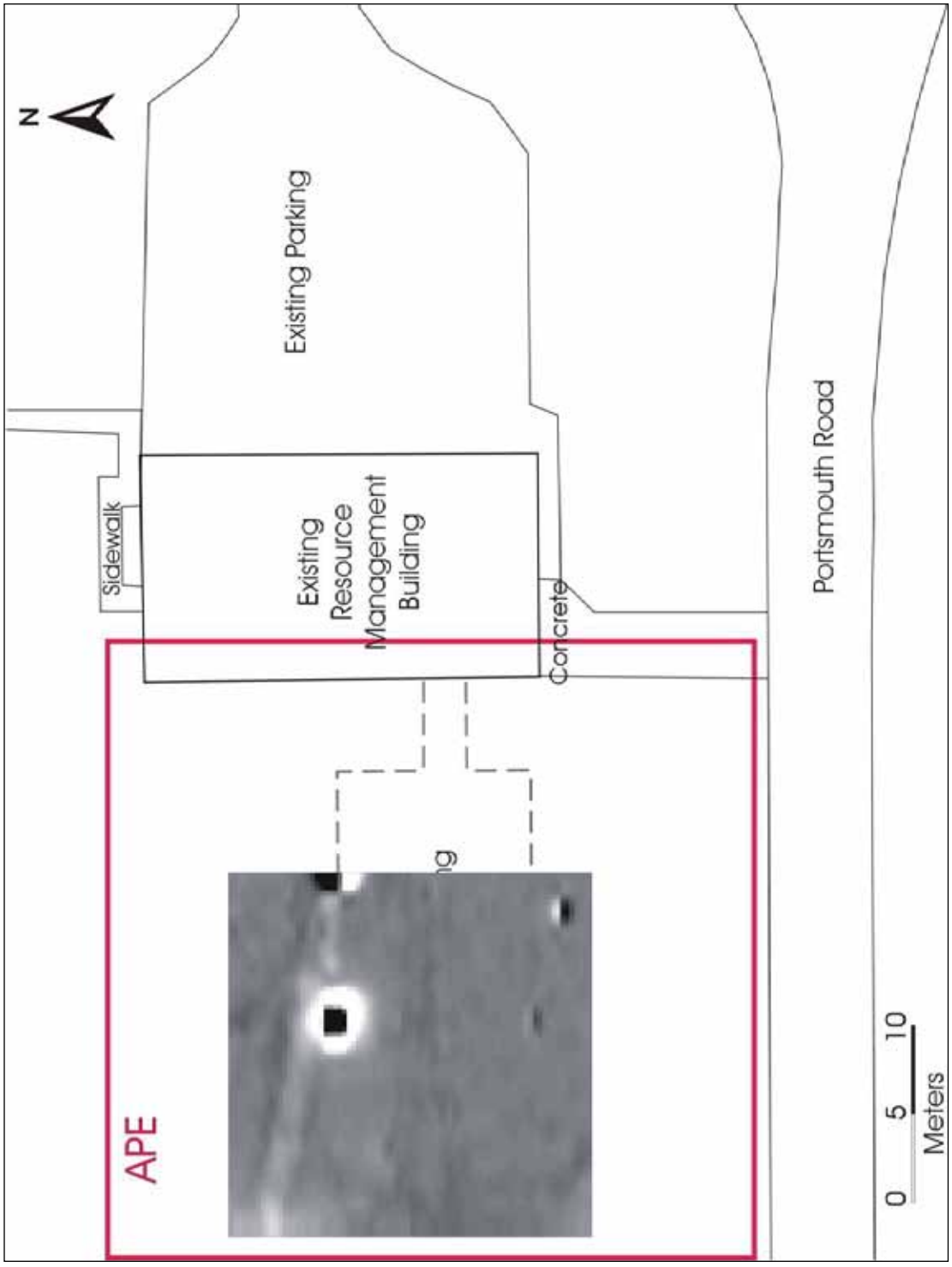
N
Existing Parking
Sidewalk
Existing Resource Management Building
Concrete
Portsmouth Road
APE
0 5 10
Meters

Figure 8

sites. Projects conducted on prehistoric and historic sites throughout Ohio and the Midwest support the utility of geophysical techniques in archaeological research, provided that geophysics is thoughtfully placed within the research design based on the local environment and knowledge of cultural resources. The obstacles faced with using geophysical techniques, namely equipment cost or rental and learning curve, are significantly outweighed by the benefits of continuous data coverage, the ability to pinpoint excavations to save time and money, to accurately map large-scale archeological features, and conservation of the resource by minimizing ground disturbance.