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Geophysical Study at Old Stone Fort State Archaeological Park, Manchester, Tennessee

Stephen Jay Yerka
University of Tennessee - Knoxville, syerka@utk.edu

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To the Graduate Council:

I am submitting herewith a thesis written by Stephen Jay Yerka entitled "Geophysical Study at Old Stone Fort State Archaeological Park, Manchester, Tennessee." I have examined the final electronic copy of this Thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Gerald F. Schroedl, Major Professor

We have read this Thesis and recommend its acceptance:

David G. Anderson, Boyce N. Driskell

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

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Vice Provost and Dean of the Graduate
School

(Original Signatures are on file with official student records.)

Geophysical Study at Old Stone Fort State Archaeological Park, Manchester, Tennessee

A Thesis Presented for
the Master of Arts
Degree
The University of Tennessee, Knoxville

Stephen Jay Yerka
December 2010

Dedication

This thesis is dedicated to my grandfathers Luciano A. Lama and Jay H. Yerka. Both men highly valued education, and always encouraged in me the desire to learn, to be curious, and invent my own ways for seeing the world.

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Funding for geophysical study at Old Stone Fort was provided by a grant from the Tennessee Historic Commission. Time and resource contributions were also provided by Old Stone Fort State Archaeological Park, The Cave Archaeology Research Team (CART), the Tennessee Division of Archaeology and the Department of Anthropology, University of Tennessee, Knoxville. The Archaeo-Imaging Lab, University of Arkansas consulted on this project, and also provided additional geophysical survey coverage. I would like to express my gratitude to these institutions for supporting this important research at one of Tennessee's most intriguing archaeological sites.

I would like to thank my family, especially my wife, Amy, and daughter, Maia, for their support throughout this process. Amy served as first reader, editor, and field technician during some of the coldest topographic survey. Amy also served as photographer and emotional support when needed. Maia helped with the topographic survey and excavation.

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Hayes helped out in more ways than I can list. Tommy Johnson provided backhoe support.

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Thanks to the Old Stone Fort Archaeological Society, Mark Norton, Manchester Historical Society, and the students of the Sewanee Environmental Institute Archaeological Field School.

I would also like to thank those that helped with the project, but I neglected to mention here, and apologize for my oversight. To atone for my short coming I will buy you a drink!

Lastly, all errors, omissions and mistakes contained within this document are entirely my own, and are in no way the responsibility of those individuals mentioned above.

Abstract

The Old Stone Fort State Archaeological Park covers over 800 acres within Manchester, Tennessee, and is owned and managed by the Tennessee Division of State Parks. The central archaeological site within the park boundary is The Old Stone Fort mounds that enclose about 50 acres on a plateau above the convergence of the Big Duck and the Little Duck Rivers. The hilltop enclosure dates to the Middle Woodland Period, and radiocarbon dates obtained at the site range from the first to the fifth century A. D. Because of its size and apparent complexity, previous investigations of the site have been quite limited in areal exposure. Many questions remain as to the overall structure of the site, including the relationship of built and natural features, the presence of any structures or other anthropogenic features, and the occurrence of presence of any domestic remains.

This research project utilizes detailed digital topographic survey, geographical information system (GIS) analysis, geophysical survey, limited re-excavation of previously investigated portions of the site, and manual coring to locate and characterize archaeological deposits within the enclosure and mounds. Magnetometer, resistance, electromagnetic susceptibility, conductivity, and ground penetrating radar techniques were used during the investigations. Geophysical data, using these instruments, were collected over the same area in many cases. All together 20,000 m^2 were examined during the project.

Results indicate potential archaeological features and deposits within the plateau interior. Analysis suggests the presence of several geophysical anomalies potentially associated with prehistoric use of the site, especially within the Eastern Gateway complex. One such anomaly, or complex of anomalies, represents a possible structure. Historic archaeological deposits are also indicated by the geophysical data. Excavations at the site were limited to minimize impact. In a re-excavated trench, a lens of black shale within the stone mound construction may indicate a building stage not previously observed at Old Stone Fort. A second excavation confirmed a ditch feature detected in the geophysical survey. Archaeological deposits located during the survey are interpreted as evidence of sustained use of the ceremonial site during the Middle Woodland Period by local corporate groups to maintain and intensify membership for individuals who were settled in nucleated villages throughout most of the year.

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Chapter 1

Introduction

The Old Stone Fort State Archaeological Park covers over 800 acres within Manchester, Tennessee, and is owned and managed by the Tennessee Division of State Parks (Figure 1). The central archaeological site within the park boundary is The Old Stone Fort (40CF1) Middle Woodland mounds that enclose about 50 acres on a plateau above the convergence of the Big Duck and the Little Duck Rivers (formerly Barren Fork and Bark's Camp Branch respectively).

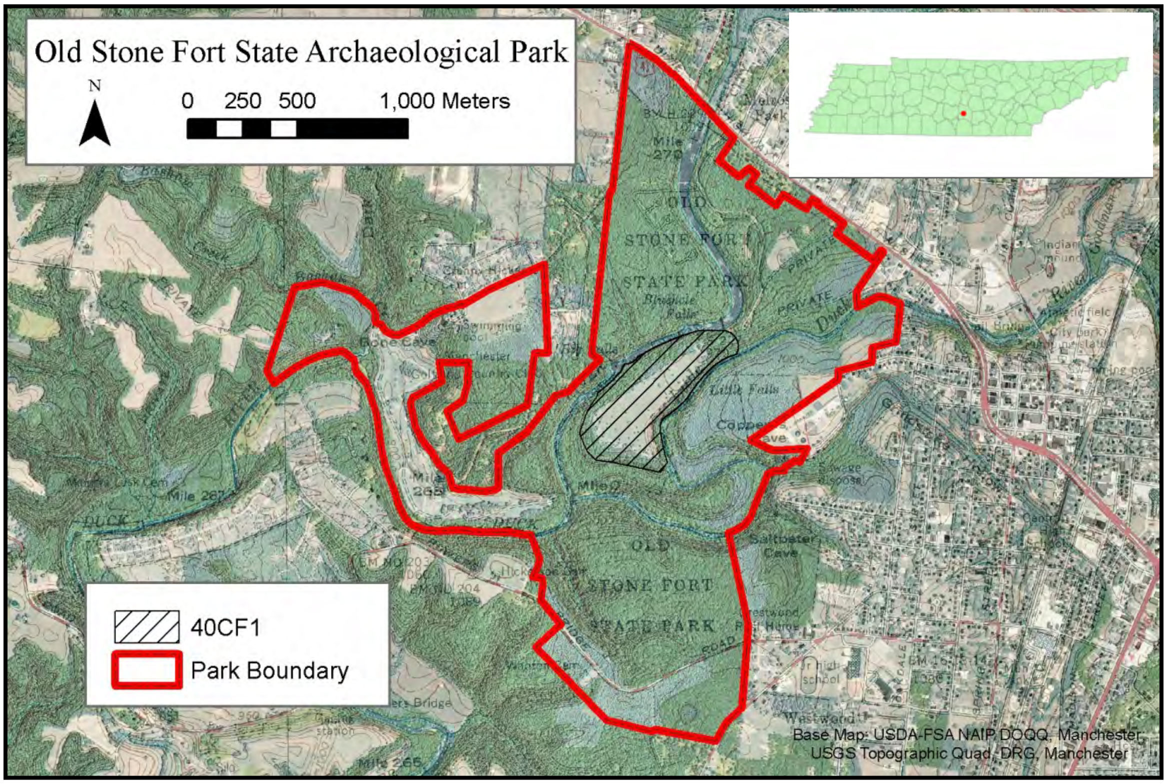


Figure 1. Old Stone Fort State Archaeological Park Boundary and 40CF1 Boundary

Old Stone Fort was a prehistoric, special use site associated with the Middle Woodland period in Middle Tennessee. Because of its size and apparent complexity as a built environment, previous investigations (Cox 1928, Faulkner 1968) of the site have been quite limited in areal exposure. Many questions remain as to the overall structure of the site, built versus natural features, presence of any structures or other anthropogenic features, and presence of any domestic remains. This study applies new techniques of near-surface geophysical survey, along with detailed mapping and some verification through excavation, to these questions. Through expeditious application of several geophysical survey techniques, and comparison of results, important new insights are reported about site structure and use.

Old Stone Fort was a corporate-ceremonial center used by local Woodland Period inhabitants of the Upper Duck and most likely Elk River Drainages. The mounds are mostly linear embankments consisting of loosely stacked limestone and shale slabs mixed with rubble and earthen fill that were constructed around the perimeter of the plateau. These mounds range approximately from one to two meters high, and five to ten or more meters wide.

Beginning at the northeast corner of the site, there are two conical mounds about eight meters apart, and extending southwest from each conical mound into the interior of the enclosure are two parallel earthworks, each one approximately 40 meters long (Figure 2). The more southerly earthwork was mostly destroyed by road construction in the 19th century (Faulkner 1968). The northern earthwork, instead of terminating, continues another 20 meters at an approximately 90 degree angle to the southeast. These embankments and the conical mounds comprise the Eastern Gateway complex (Figure 3). Similar earthworks run from each conical mound toward the peninsula rim until both terminate at limestone bluffs. These are the eastern Linear Embankments of the enclosure in Figure 3, and these mounds have suffered a limited amount of destruction through the site history previous to the Park's ownership. On the southeastern promontory of the peninsula and forming the westernmost edge of the site is an embankment earthwork over 550 meters long that stretches from one river bluff to the other. This is the western Linear Embankment.

The Old Stone Fort State Archaeological Park was selected for this study for several reasons. It is the only site of its kind preserved by the state of Tennessee, and one of only a few hilltop enclosure sites that are preserved by state or federal agencies in North America. Archaeological investigations in 1968 recorded no prehistoric archaeological features within the enclosure making this a premier site for testing the usefulness of geophysical techniques. Geophysical survey, limited excavation, micro-topographic survey and geoarchaeological analysis have provided a wealth of new information contributing to the interpretation of this important historic property. The recent investigations discovered multiple prehistoric archaeological features within the enclosure, new ways to detect buried remnant mound components with geophysical instrumentation and evidence of mound staging with different stone material.

Figure 2. Eastern Gateway Conical Mounds Facing Southwest (240 deg.)

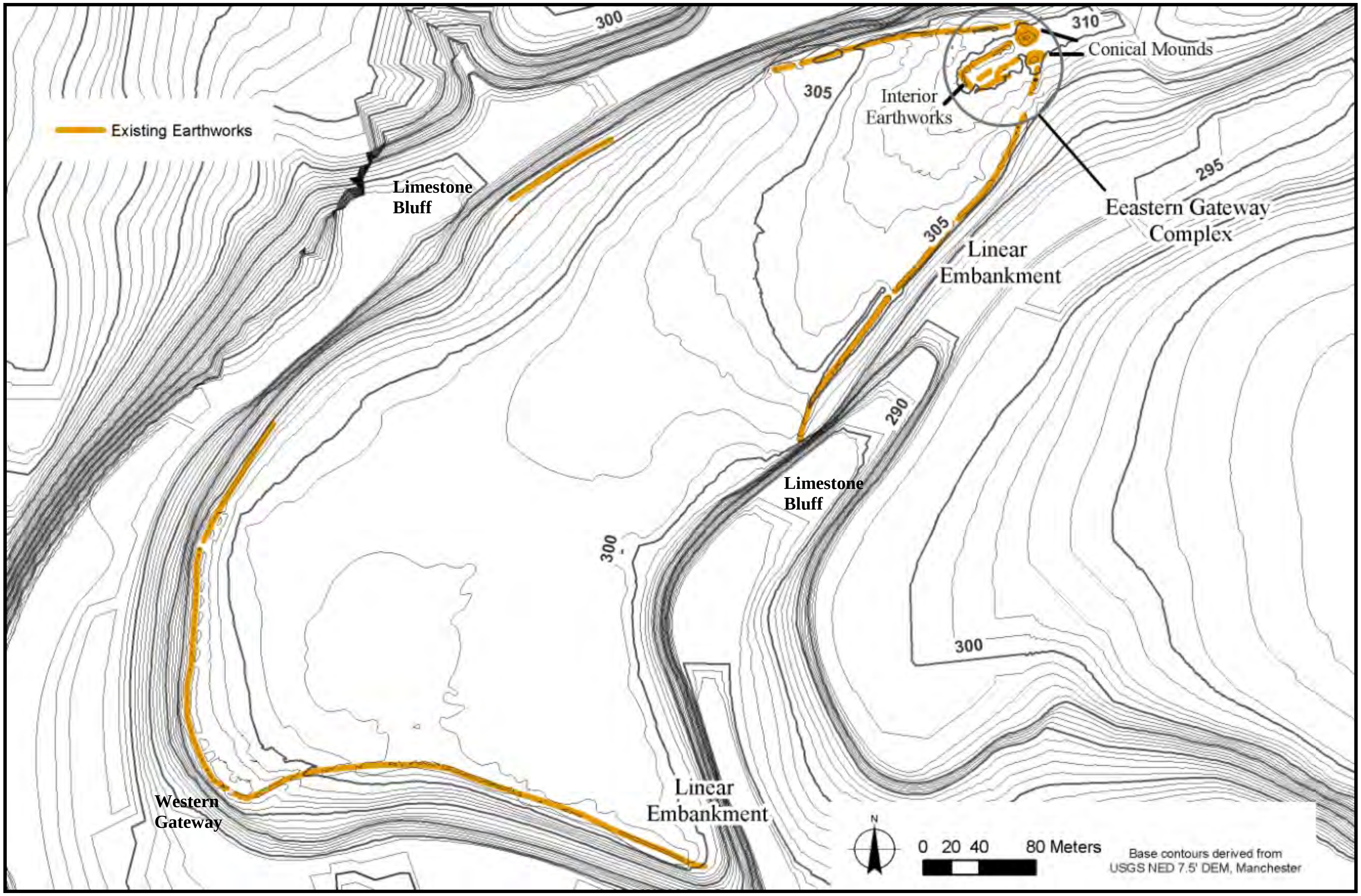


Figure 3. Old Stone Fort Earthen Embankments

From August 2006 through October 2007 the University of Tennessee Department of Anthropology conducted an archaeological survey at Old Stone Fort State Archaeological Park. The last archaeological investigation at Old Stone Fort prior to this was performed by the University of Tennessee in the late 1960's (Faulkner 1968), and cultural affiliation and date ranges were established. Several aspects of the engineering of the stone embankments were also discovered. These investigations were, however, performed before the wide spread application of geophysics in North American archaeology, and therefore the site became a prime candidate for this type of non-invasive methodology. Old Stone Fort is often grouped into a class of sites referred to as Vacant Ceremonial Centers (Prufer 1964), and geophysical survey is used in this project to assess the likelihood that substantial domestic deposits are located within the site. Additionally geophysics is used in this project to determine if these methods can identify aspects of the internal mound structure non-invasively. The results of these surveys also provide location data on sensitive archaeological deposits, potential issues of erosion, and visual interpretive tools that should inform park management and interpretive services. The goals of the current research design therefore are to assess the performance of geophysical survey at the site, identify cultural remains and features, help develop management plans for the site, and further public education efforts. The fieldwork was conducted under Tennessee Division of Archaeology (TDOA) Permit No. 000587.

Field methodologies included detailed digital topographic survey, geographical information system (GIS) analysis, geophysical survey, limited re-excavation of previously investigated portions of the site, and manual coring.

Digital topographic survey resulted in the collection of over 10,000 points with real geographical and vertical positions. All geophysical survey locations and excavations were recorded with a digital laser transit (Topcon TS and Trimble 5600). The manual coring probes were recorded with GPS units with sub-meter accuracy (Trimble Pro XRS and GeoXH). All geographical data were processed using ESRI's ArcGIS software package. GIS data are managed as separate raster datasets for images, individual shapefiles, and ESRI personal geodatabase files. The final GIS product integrates with the ESRI software packages that are used by Tennessee State Parks, and specifically Old Stone Fort State Archaeological Park. Modern features such as park access roads and trails were included in the mapping effort.

Geophysical survey was accomplished over several sections of the site. Results indicate potential archaeological features and deposits within the plateau interior. Analysis suggests the presence of several geophysical anomalies potentially associated with prehistoric use of the site. Historic archaeological deposits are also indicated by the geophysical data. One such anomaly, or complex of anomalies, represents a possible structure. Several different geophysical techniques were used during the investigations. Magnetometer, resistance, electromagnetic susceptibility, conductivity, and ground penetrating radar data were collected over the same area in many cases.

The excavations at the site were limited to three areas. The first excavation in the easternmost portion of the site re-excavated a trench that was first dug by P. E. Cox in 1921. The resulting profile revealed a feature not reported in earlier investigations. A lens of black Chattanooga shale and vertical stacking of the same material within the stone mound construction may indicate a building stage not previously observed at Old Stone Fort. The second excavation consisted of a single 1.5 m by 6 m trench to expose an irregular anomaly that was confirmed as a ditch feature. The small portion of the feature that was exposed yielded no diagnostic artifacts. The third excavation area was placed in the western portion of the site. The test unit was placed into a small mound of earth previously tested by P. E. Cox. None of the artifacts contained within the fill were diagnostic, no clear evidence of mound fill was indicated, and preliminary analysis indicates that the feature is likely a natural occurrence. Geoarchaeological samples were taken from this fill for particle analysis to aid in determining the nature of the fill. None of the excavations conducted recovered charcoal for dating.

Geoarchaeological samples were taken from excavations, and field profiles were described. Excavations provided information about the soil stratigraphy of the plateau between the Duck Rivers, and control samples were obtained from nearby cut-banks and with a bucket auger. The soil within the Old Stone Fort site consists of a thin organic horizon and shallow to non-existent plow zone followed by a deposit of loess. The thickness of the loess varies greatly throughout the site, being thickest under the stone mounds. This may be the result of historic modification and erosion on the site. Below the loess is a truncated clay horizon that formed in place from the parent limestone that lies beneath it. Field analysis indicates that beneath the stone mounds there is no detectable organic horizon associated with the loess which is indicative of surface preparation prior to mound construction.

In summary, new technology and methodologies developed since the last archaeological investigations at Old Stone Fort in the 1960s have revealed previously undiscovered archaeological deposits, differences in mound structure, and evidence of mound staging. Additionally, magnetic gradient survey was found to be a successful method for detecting the edge effects generated by the magnetic field of the mound fill at the site therefore allowing detection of buried mound deposits elsewhere on the site. A digital real-world topographic model of the site was created, and this model can be used to assess potential erosion and determine azimuth alignment. By overlaying the geophysical and topographic data, corrections for elevation can be performed, and micro-topographic modeling adds a layer of detail to interpreting geophysical anomalies and responses. Geoarchaeological analysis revealed a shale lens in the Entrance Complex mound profile that is detectable with ground penetrating radar, a loess deposit of unknown origin that is severely eroded within the enclosure, but thick under the mounds, and a sub-mound profile that does not have a detectable A horizon, which may indicate that the surface was prepared prior to mound construction.

Chapter 2

Prehistoric Earthen Enclosures and the Middle Woodland Record of The Upper Duck and Elk Rivers

The Middle Woodland period (ca. 200 B.C. to 400 A.D.) archaeological record in the Eastern Woodlands is marked by an *increase* in artifacts and earthen constructions associated with ceremonialism and long distance trade, and an increase in the amount of native cultigens and “pseudo-cultigens” recovered from archaeological assemblages as compared to the Late Archaic and Early Woodland record (Anderson and Mainfort 2002, Griffin 1967, and Smith, et al. 1992). The use of flood plain horticulture and domesticated plants like sunflower and sumpweed are well documented (for an overview see Smith 1987 and Steponaitis 1986). Middle Woodland period earthen constructions are still visible throughout the Eastern Woodlands, although many have been altered or destroyed by encroaching development. Early observers such as Squier and Davis chronicled a great number of these earthen constructions in *Ancient Monuments of the Mississippi Valley* (Squier and Davis 1998), along with Cyrus Thomas’s *Report on the Mound Explorations of the Bureau of Ethnology* (Thomas 1894).

Old Stone Fort is not a site that can be appreciated fully without understanding the environment and settlement context of which it was a part. The hill-top mound enclosure is a specialized site, differing from the typical Middle Woodland settlement in the Upper Duck and Elk Rivers, and there is a unique archaeological record within a small radius around Old Stone Fort that can provide clues to how this site was used by local people.

Middle Woodland Enclosures

There are two categories of earthen construction that occur almost ubiquitously throughout the Middle Woodland period archaeological record of the Eastern Woodlands: burial mounds and earthen enclosures. There are a great number of enclosures throughout the Eastern Woodlands. Webb (Webb 1941:161-166) lists 101 “sacred enclosures” that occur in and around Kentucky alone (cited Fenton and Jefferies 1991:52). In the edited volume *Ancient Earthen Enclosures* (Mainfort and Sullivan 1998) eight of the eleven collected essays deal with Middle Woodland period earthen enclosures. Clearly the earthen enclosure in some form or another found use within many Middle Woodland communities throughout the Eastern Woodlands.

A concise definition put forth by Riordan states that an enclosure is an “…open space that has been physically bounded for some purpose, at least in part by architectural elements” (Riordan 1998:73). Use of the term in this paper relates to a general category of monumental prehistoric earthen enclosures that are found throughout the Eastern Woodlands. The greatest concentration of these enclosures occurs in southern Ohio (Mainfort and Sullivan 1998).

There is a long history of enclosure construction in prehistoric eastern North America, but perhaps because of the density and complexity of the Middle Woodland structures, most earthen enclosure site interpretations relate to the Hopewell Interaction

Sphere. Large mound centers and various forms of iconography that occur throughout the Middle Woodland Period in the Eastern Woodlands are generally considered part of an extensive interregional network called the Hopewell Interaction Sphere—a network whose core is thought to be located in the Ohio River Valley (Caldwell and Hall 1964, Dancey and Pacheco 1997).

In the course of this paper the terms Hopewell Interaction Sphere or just Hopewell are used to refer to the specific archaeological record of the Ohio Valley River Region and Lower Illinois River Valley, and those artifacts of clear core Hopewell origin that occur at other sites throughout the eastern Woodlands.

Earthen enclosures share many common features, and can be grouped into many different categories. Riordan lists five distinguishing characteristics of earthen hilltop enclosures.

1. Hilltop enclosures had begun to be built early in the Middle Woodland period, by the first century A.D., and remained in use at least into the third century A.D."
2. Earth, stone and wood were the principal construction materials used at these sites.
3. Hilltop enclosures are typically built in two or more stages, in possible response to changing symbolic and/or functional requirements.
4. Hilltop enclosures were loci for activities that complemented, but were distinct from, those carried out at the mortuary/ ceremonial earthwork and mound sites on the river terraces. The original impetus to their construction and their lasting use was the dedication of spaces wherein corporate secular and/or religious activities could be properly conducted.
5. Some hilltop enclosures were employed for military purposes during their histories.

(Riordan 1996:243)

Riordan’s point number five is too vague however, and its conditions are met by the preceding point. Perhaps a more appropriate proposition for Riordan’s fifth point would be that hilltop enclosures have evidence for multi-purpose use over their histories. Old Stone Fort would then exhibit all five characteristics.

Site Structure and Function

In *Ancient Monuments of the Mississippi Valley*, Squier and Davis (Squier and Davis 1998) identify three categories of enclosure function: settlements, forts and sacred places. To this day these categories stand as the most common distinction between site function used in the archaeological literature. Although not mutually exclusive, these categories allow for generalized modeling of what is expected from the archaeological record at these sites. Enclosures used for settlement should contain a substantial deposit of domestic related artifacts. Military enclosures could also contain a substantial amount of domestic related deposits, but should also contain features and artifacts related to defensive architecture or conflict. Sacred places become difficult to predict in any specific way, but the site could be expected to contain specialized deposits or features that contrast to typical domestic and military contexts, such as burials, iconography and unique deposits. This concept is referred to as a corporate-ceremonial center (DeBoer and Blitz 1991,Greber 1997,Smith 1989,Mainfort, et al. 1998). Whether or not sites are sacred, they have a wide range of possible site uses: corporate ritual activity, cultural/material exchange, burial, and combinations of the above. The majority of earthen enclosures in prehistoric Eastern North America are of this last type—monumental constructions without clear evidence of domestic or military use alone.

Although debates centered on the particular uses of individual sites continue, the three categories of enclosure types provide the context for discussions of site function. The majority of earthen embankments do not contain much evidence of serving defensive purposes, and therefore without strong material correlates it is difficult to assign use of an enclosure to a primarily military purpose. Isolation provides some defensive advantage, but isolation also plays a key role in ritual and ceremony.

A model proposed by Knight (1986) concerning the organization of iconography, or *sacra*, among Middle Mississippian sites may provide an avenue to explore differences noted among Middle Woodland sites and the Hopewell phenomenon. Knight proposes that the Middle Mississippian iconography and mound construction, previously included under the name "Southern Cult," was really several separate—though related—groups of *sacra* expressing differing social themes. Although his article is about a more "complex" system of organization and the purpose is to identify co-related cults, I suggest that employing his concept of "iconic families" (1986: 676) can help to tease out the differences noted within Middle Woodland assemblages and corporate centers. Most interesting is the distinction Knight makes between the iconic families of "public works" and those of the political sphere. "Public works" are the platform mounds, which Knight relates to an "icon representative of the earth," and a communal rite of purification and intensification (1986: 678). I suggest that the seeds of these iconic families take root in the Middle Woodland period. In this way we can begin to discuss the functions of

Middle Woodland sites that reach beyond interpretations of political structure, and allow us to evaluate what other types of roles these sites might have played.

Byers (1998) considers mound sites icons themselves. There is an observable historical context and similarity in form among many of the enclosure sites, but his *interpretive* argument suffers from speculative logic in terms of the universality that it proposes. Icons exist only as a level of abstraction and through time. The ideas that mound constructions function as “warrants” for beliefs and behaviors can serve as an appropriate method for comparing and understanding different enclosure sites. If these monumental constructions are treated as iconic, then as Byers points out as well, we can expect to see competing variations between people and through time, and common threads and real differences should be apparent throughout the archaeological record.

Byers’ argument departs from this sound basis for speculation when he asserts his interpretation of symbolism presented by the icon, and presupposes that there is some universal reality to his perceived motifs. Without contextual knowledge, interpretation of the symbols an icon represents is an exercise in speculation. To ground analysis or model building through this interpretation becomes also speculation. So although Byers’ *sacred earth* interpretation is weak, treating enclosure sites as iconic provides archaeologists the language to describe the apparent cultural overlap, “rule guided” construction, and change over time by comparing and contrasting similar sites and the local assemblages.

In the last decade the term corporate-ceremonial center or corporate center has been increasingly used to interpret the possible function of the earthen enclosures. A corporate group, in the anthropological sense, refers to “a social group whose members act as a legal individual in terms of collective rights to property, a common group name, collective responsibility, and so on" (Keesing 1975:148). On this level the earthen enclosure functions as a communal space that intensifies an individual’s experience of membership to a particular corporate group.

The operation of the corporate-ceremonial center as it applies to current studies of earthen enclosures developed out of ethnographic study of the Chachi in Ecuador (DeBoer and Blitz 1991). Chachi live in “single houses dispersed along the high banks of the Cayapas River and its major tributaries” (1991:54), and periodically utilize ceremonial centers that lie vacant when not being used for some corporate activity. This settlement pattern is comparable to the settlement patterns of most Middle Woodland domestic sites in the Eastern Woodlands, and is similar to Prufer’s (Prufer 1964) Vacant Ceremonial Center-Dispersed Agricultural Hamlet model. DeBoer and Blitz remark that the Chachi ceremonial center is “calendar, court, church, and necropolis all wrapped up in one” (1991:61-62).

Through ethnographic analogy to the proposed notion of the corporate center, Greber asserts that in the Paint Creek Valley of Ohio Middle Woodland Period “a single social group claimed the two geometric enclosures as its corporate cultural expression” (Greber 1997:219). She also attributes change in architecture at these sites as an indicator of shifts in corporate structure (1997:216-217).

It is Bruce Smith’s assessment of the subsistence patterns and the shift towards agriculture that provides the ground work for the appearance of the corporate descent groups during the Woodland Period (Smith 1987, Smith et al. 1992). He asserts that major economic shifts occurred based on available proteins. Good crop land becomes an important aspect of landscape utilization, and therefore corporate groups form to establish control of disparate resource areas (Smith 1989). There is strong evidence that supports the idea that through the Middle to Late Woodland there is an increase in the use of domesticated plants, followed eventually by the use of maize (*Zea mays*), as the main focus of subsistence strategy during the Mississippian period (Cobb 1985, Crites 1978).

How is it possible to distinguish function and use at these corporate-ceremonial centers? Mainfort and Sullivan (1998:8) recount seven site uses included in the analysis of English Neolithic enclosures (Drewett 1977:222). There are burial, cult or ritual, meeting, trading, settlement, defense and “cattle enclosures” the last of which is in-applicable in North America. Weinberger adds to this list use for horticulture, and provides examples of material correlates for each type of site use (Weinberger 2006:6). Similarly, Neusius and colleagues established a list of expected archaeological correlates to distinguish between village and specialized mortuary use (Neusius, et al. 1998: 205-207). Clay provides a list of traits that he interprets as indicating a gathering place for multiple cultural groups rather than a single dispersed group at the Adena earthworks (Clay 1998). By breaking the abstract concept of site function into categories of human action, we can look to the archaeological assemblages to distinguish the specific functions sites like these performed for the corporate groups that built and maintained them. By modeling expectations for the archaeological record at these sites we can create a research design that addresses specific questions of site use in a more meaningful way.

Recent approaches have looked at non-mound space at mound sites to help interpret site use and function. Weinberger (2006) presents a review of recent investigations into non-mound activity at enclosure sites, and many have revealed deposits within the enclosed spaces. Riordan suggests exploration of chronologies and internal features at enclosure sites will shed light on the particular ceremonies that take place within (1996:254). In contrast, Faulkner points to enclosure walls themselves as the area of highest potential on the subject (1996:11).

Middle Woodland of the Upper Duck and Elk Rivers

This next section reviews settlement and subsistence of the Eastern Highland rim Middle Woodland period, and how these contexts relate to the Old Stone Fort.

The use of flood plain horticulture and the domestication of plants like sunflower and sumpweed had increased importance to Middle Woodland groups. The distribution of cultigens and domesticated plants in archaeological assemblages are partially the result of local species abundance, and the length of the growing season leading to different adaptations related to pre-maize agriculture (Gremillion 2002), but as an overall trend Middle Woodland period sites are expected to contain evidence of domesticated plant production. O'Brien and Lyman (2000) suggest that co-evolutionary relationships between humans and plants are mediated by population growth or dispersal during the Middle Woodland. This indicates a high level of dependence on plant foods during this time.

Large mound centers and varied forms of iconography that occur throughout the Eastern Woodlands are generally considered part of an extensive interregional network called the Hopewell Interaction Sphere. The Southeastern participation in the exchange of exotic goods has been associated with regional corporate groups that, through reciprocity on the local level, facilitated the movement of vast quantities of exotic materials over great distances (Goad 1979). Items were passed from Florida to west of the Mississippi River, and parts north. Sea shells, sharks teeth, mica, copper, obsidian and other siliceous stones, and even bear and wolf teeth were items that were exchanged over very long distances. A large percentage of these items were funneled into the Ohio River Valley likely into the possession of powerful individuals and families. The Hopewell Interaction Sphere, or Hopewell phenomenon, has in recent years come under scrutiny as a meaningful category to discuss the archaeological record outside of the "core" Hopewell area within the Southern Ohio River and Scioto Valley River drainages (Anderson and Mainfort 2002, Carr and Case 2005, and Seeman 1992). Specialized artifacts, especially those associated with Hopewell burials, are believed to be related to the appearance of power relations among elite males similar to a Big Man system, as the precedent for the system hypothesized for later Middle Mississippian groups (Smith 1987). As noted by Anderson and Mainfort (2002: 10-11), however, most Middle Woodland sites away from the Ohio River Valley core have relatively uncomplicated burial ceremonialism. In the Upper Duck River Valley very few elaborate burials have been uncovered, and the extent of burial elaboration at sites like Banks V and Jernigan are in the form of shaft and chamber graves with associated pottery (Faulkner and

McCollough 1976, 1978). The Middle Woodland archaeological record of the area is quite different from the “classic” Hopewell of Ohio, and most Middle Woodland sites contain no classic Hopewell artifacts.

The construction of the Normandy Dam on the Upper Duck included extensive archaeology of Woodland period sites (Faulkner and McCollough 1973; Faulkner 2002). Most striking looking over the assemblage data, was the lack of Hopewell related exotic materials—or much at all in the way of exotic materials throughout the Upper and Middle Duck River Valley. This is surprising since the Old Stone Fort earthworks at the headwaters of the Duck appears to be very similar to classic Ohio Hopewell hilltop mound enclosures like Fort Ancient and Fort Hill in the Little Miami River Valley where exotic material is more common especially within burial contexts. (Connolly 1998, Mainfort and Sullivan 1998).

Mark Seemen (1996) notes a similar difference between mound sites and the iconographic portable Hopewell items at sites only 170 km from the Hopewell “core”. The iconographic artifacts associated with Hopewell ceremonialism and burial practices are *not* present on many sites with mound construction such as the classic Hopewell mound groups at the Anderson and New Castle sites in Indiana (1996: 307).

Evidence of art or ceremonialism in Middle Woodland domestic sites in the Upper Duck comes only in the form of faceted hematite from the nearby Cumberland Plateau Escarpment (Faulkner and McCollough 1973). Presumably the hematite was used in pigmentation. In general the differentiation is inconsistent with a stratified society, and most likely the individuals with special burial treatment in the Upper Duck were not hereditary leaders. Evidence from the Upper Duck and Elk River valleys presents site plans with relatively similar structures and similar associated features, with no specialized activity areas identified (Faulkner and McCollough 1978). This evidence leads to the conclusion that there was probably a great deal of variation in social structure of the Middle Woodland period throughout the Eastern Woodlands. Many similarities *can* be found in subsistence practices and many some similarities can be found among the mound building practices throughout the Eastern Woodlands during the Middle Woodland period.

Throughout the Upper and Middle Duck, and for the most part the Elk River Valley, there are very similar assemblages and site structure. For instance, at the McFarland site (which is less than a river mile downstream from Old Stone Fort) at least five tension poled structures were excavated (Kline, et al. 1982). Each structure is similar in shape and size, and each consists of an oval to circular post hole pattern with diameters ranging from around six to seven meters, central posts, at least one deep cylindrical “storage” pit, a shallow basin shaped “processing” area, and fire cracked limestone filled “earth ovens.” Despite the variation, the similarity in artifactual content and distribution of associated features led the investigators to describe the households as “autonomous units” (1982: 46). No specialized activity areas were identified in any of the structures. A cob of *Zea mays* was found in Structure 2; it was found in a shallow basin (Feature 88).

A similar feature distribution is described at Aenon Creek along the Middle Duck River Valley (Bentz 1995). Although only one structure was identified, the Middle

Woodland component feature distribution fits closely with the “autonomous unit” households described at McFarland. Other sites throughout the Duck and Elk River Valleys through Middle Tennessee display similar site structure (Faulkner and McCollough 1977, 1978,and Bentz 1986).

Although no burials were found at the McFarland site, secondarily deposited cremated remains are found throughout the Elk and Duck River drainages. At the Ewel III site in the Upper Duck a small cemetery was uncovered (DuVall 1977). No distinction in status was observed among the analyzed remains. The exception is the Yearwood site (Butler 1979). This site produced burials with accompanying artifacts associated with the Copena and Hopewell trade network. Most conspicuous are the few blades made from Flint Ridge chert that is found in the Ohio River Valley. This site stands as an anomaly, and is described by Butler as a short-term, intensively occupied site where site structure and assemblage data contrasts sharply with other sites in the drainage. The Elk River drains into the Tennessee River in present-day Alabama where Copena burial mounds and sites abound (Walthall 1980). Butler suggests that the Yearwood site, if for a brief time, may have worked as a regional accumulation for items working their way through the trade networks that existed between southern groups and the northern Hopewell. The Yearwood assemblage is considered here to represent a unique historical context within the assemblage, and may indicate a single occurrence through the direction of an individual or individuals. This is an agent driven interpretation of the Yearwood assemblage, but is not a difficult proposition to entertain considering the brief occupation, singular artifact assemblage, and its anomalous appearance within Middle Tennessee.

Part of the work on the McFarland project in Manchester, Tennessee was designed to find a transitional continuity of McFarland to Owl Hollow Middle Woodland ceramic cultures (Kline, et al. 1982). No such cultural continuity was found leading the researchers to suggest the latter as an intrusive culture. This intrusive culture, or perhaps closely circumscribed territories within the Middle Tennessee area, could account for some of the disparities in the archaeological record.

Recent summaries of Hopewell archaeology have distinguished similar differences between the Lower Wabash-Ohio and Lower Illinois River Valleys that have less strict and elaborate burial practices compared to the Scioto Valley region (Ruby et al. 2005). Researchers used means in temperature and rainfall to determine the relative abundance and variety of species available to local human populations. The conclusion drawn from this research was that in the Scioto Valley areas with abundant resources were more circumscribed, linear and smaller, but in the Lower Wabash-Ohio and Lower Illinois River Valleys resources were more evenly distributed. Therefore territorialism is seen as driving mound construction in these areas. Elaborate burials in highly visible areas, and the construction events served to legitimate lineages' claims to certain resource abundant areas. Where the resources were more varied and abundant, like in the Lower Illinois, less elaborate burial practices and vacant ceremonial centers are more common. This latter situation seems to be in line with the archaeological evidence from Middle Tennessee. The Upper Duck in particular can be considered a very diversified and abundant resource area. The Duck River cuts through several physiographic regions providing a variety of resources (Figure 4). Secondly, it is likely that during the Middle Woodland this area of Tennessee was the boundary between the Mixed Mesophytic and Western Forest regions (Braun 2001). Many diverse plant remains have been recovered from Middle Woodland contexts throughout the Upper Duck. At the McFarland site, hickory nutshell is the most dominant of all plant remains and there is still a substantial amount of *Chenopodium*, *Polygonum* and *Phalaris*, as well as Sunflower and *Curcubita pepo*. The ceramic assemblages in the Upper and Middle Duck and Elk River are dominated mainly by Wright check-stamped. This pottery type is found as well on Copena sites, and in fact Faulkner and McCullough remark that “Woodland affiliations continue to be dominated by southerly influence,” and the “Hopewell influences are so sparse as to be virtually negligible” (1973: 223). The exception of course appears to be the Yearwood site which has more frequently plain ceramics and sand tempered sherds that are more similar to pottery found on the sites of Tunacunnhee (Jefferies 1976) or Georgia and Walling in Alabama (Walthall 1980).

Figure 4. Falls on the Big Duck River Adjacent to Old Stone Fort.

Although the Middle Tennessee sites have produced a fair amount of cultigens, assemblage data from sites like McFarland produced suites of lithic tools that are dominated by bifacial cutting implements. This may indicate a greater reliance on hunting and gathering by the people of the Upper and Middle Duck and Elk Rivers (Kline et al. 1982). Selection may have favored the aggregation of nucleated grouping verses dispersal in managing the risk of localized short falls in economies relying more and more on cultigens and domesticates (Dancey et al. 1997). This could easily be the situation in the Middle Woodland period around the Old Stone Fort where groups that were mostly dispersed were undergoing a process of settling in due to increased reliance on agriculture. Corporate groups may have formed to regulate control over access to resources. Under these conditions it is possible that sites like Old Stone Fort would materialize as groups gathered to intensify cultural bonds to establish and reinforce rules of resource access, as the population settled into the river terraces.

The Old Stone Fort, and surrounding contemporary archaeological sites, conform to aspects of other regional archaeological assemblages like the river valleys in Ohio, but also display a unique local cultural context. Ultimately, when considered in context, Old Stone Fort can be interpreted in functional terms as a site of cultural intensification. This premise allows researchers to build expectations for material correlates at the site, and provides an avenue to avoid defining ceremonial simply by what it is not.

Chapter 3

Research Design Methods

Research Goals and Organization

This research was undertaken in order to apply new technological and methodological techniques to the study of Old Stone Fort. When previous archaeological survey was performed at Old Stone Fort, many of the technologies available at present were not in widespread use in North American archaeology.

For instance, a survey map of Old Stone Fort was created during the 1968 investigations. While this provided the first precise map of the enclosure, it lacks the detail achievable with modern digital transits. Additionally, the advances in Geographic Information Systems (GIS) over the last several decades allow the creation of digital three-dimensional models that can be implemented on common desktop platforms. These digital models can be used for visual display as well as automated statistical modeling. A highly detailed topographic survey was deemed necessary also to confidently interpret geophysical data collected at the site in real world space.

Since Old Stone Fort appears on the National Register of Historic Places, and is owned by the State of Tennessee, and managed by the Department of Environment and Conservation it is a protected site, and therefore any archaeological study should be as minimally destructive as possible. Geophysical techniques allow for the coverage of large areas at the site without disturbing the ground, and are appropriate for sites like Old Stone Fort.

The primary research goal addressed here is whether or not there are undiscovered prehistoric archaeological deposits within the Old Stone Fort, and can the most advanced geophysical techniques facilitate their discovery with minimal ground disturbance. Old Stone Fort is considered to be a vacant ceremonial center, but detection of substantial domestic deposits could shed doubt on this hypothesis. Detecting additional archaeological deposits could greatly improve understanding of the function of the site itself. To that end a survey including geophysical techniques, global positioning satellite systems, total station survey, geoarchaeological analysis, high resolution photography, and limited excavation was initiated in 2006 at Old Stone Fort with a grant provided by the Tennessee Historic Commission.

Recent geophysical investigations have been successfully conducted at enclosure sites in Ohio (Lynott and Weymouth 2002, McKee 2005, Romain 2005, Weinberger 2006). These projects have identified previously unknown intact archaeological remains, even after long histories of site degradation from agricultural and developmental activities.

Geophysical survey is here considered the group of investigative techniques that measure physical properties of the earth in order to locate and characterize buried targets. Because of the heterogeneous nature of any archaeological site, there is no exclusive method of geophysical survey that can be used in all situations with consistent results above all other methods. Certainly there are a few techniques that archaeologists have settled on as being advantageous for most situations, but no single technique is always used over another unless constrained by availability. Therefore an additional goal of the research was to apply as many geophysical survey techniques as could be obtained over the course of the project to assess under what conditions particular methods performed best. Since each geophysical survey technique records a different geophysical response, be it magnetic field or galvanic induction, comparison of the differing techniques' responses to the same target areas was built into the research design. Surveying the same area with multiple instruments increase the likelihood of characterizing anomalies and understanding the qualities of the site matrix (Kvamme 2003).

Another aspect of field study related to geophysical survey is the digital topographic survey of the entire enclosure. Accurate modeling of the site provides an interpretive tool as well as a guide for future management of the site. High-density topographic survey was performed on all geophysical survey areas to help correlate topographic variation with responses from the geophysical surveys. Topographic features, even minor ones, can affect the response of the geophysical instruments, and so it is critical to map the site carefully for this type of comparative study.

Recent studies at ceremonial sites throughout the Eastern Woodlands have revealed that use of enclosures have varied through time and function. The research design at Old Stone Fort State Archaeological Park is directed at obtaining evidence for what these particular uses may have been. The study included a survey of a sample of the site to identify cultural features, assess the proficiency of differing geophysical methods at the site, and through re-opening previously excavated test units on the site, examine the deposits for correlative features in the geophysics. Furthermore by re-examining previously excavated trenches, geomorphological descriptions of the mound fill and surrounding soils, and also digital photographs could be collected for analysis.

Previous Investigations

The first written accounts related to the Old Stone Fort come from correspondence or publications of antiquarians. The earliest accounts provide interesting observations regarding the site's appearance and interpretation during the early post-European contact period. It is especially fortunate that Old Stone Fort was mapped by several early historical observers. Weems compares eleven such maps of the site drawn in the 19th century, including two that were published within the first quarter of that century (Weems 1995). Weems shows that several of the maps perpetuate errors in observation, but also that consistencies between maps can provide evidence for the age of a particular site features.

Some early observers recorded their opinions on the nature and use of the site by prehistoric people. James Mitchell (Mitchell 1810) estimated that Old Stone Fort was at least 1,000 years old, and that it was not likely a defensive fortification (cited in Weems 1995:112). Alexander Kocsis reports that there are "no kitchen-refuse-heaps, no weapons, tools, utensils in bone, stone, metal, or pottery, and no traces whatever of its being once inhabited…" (cited in Weems 1995:113). These early observations about the sites antiquity and lack of evidence for domestic occupation are at odds with the general opinion held during the 19th century that enclosures were the last fortifications of the mythic Moundbuilders. Obviously some of the historic observers saw the Old Stone Fort as a defensive structure, hence the “Fort” in its name.

State Archaeologist P.E. Cox (Cox 1929) led an investigation of the mounds and enclosed area in the early 20th century, and in 1966 Faulkner (1968) conducted further work at the site. His work prior to its establishment as a state park provided many key discoveries about the site (Faulkner 1968). Most importantly radiocarbon dates were obtained from the mound fill as well as from a burned feature in a ditch that spans the entrance way dating the site to the Middle to Late – Middle Woodland period. These dates range from cal A.D. 80 to cal A.D. 550 (Faulkner 1996: 8). A sequence of construction over the span of the dates was proposed: a ditch was excavated first, followed by construction of the perimeter embankments (and presumably the conical mounds); the final addition was the parallel cul-de-sac embankments.

Another key observation was the discovery of construction stages in the perimeter embankments. In excavation trenches through the mounds, alternating uses of stone slabs and rubble/earth fill were exposed. Profiles of the excavations show an interior embankment of “undressed limestone and shale, capped with clay” (Faulkner 1968: Fig. 2.2).

The Old Stone Fort has no evidence of long term domestic occupation identified within the enclosure. In the 1968 investigations, narrow mechanical trenches were placed throughout the enclosure, and no midden or signs of occupation were discovered (personal communication Faulkner 2007). These investigations placed the Old Stone Fort firmly into that category of Middle Woodland vacant ceremonial center.

Despite the previous research at the site not much is known about the interior or the construction stages of the mound fill. The current research project was designed to address to two major questions: Are there cultural deposits or features within the enclosure interior and mound fill that are detectable with geophysical instrumentation or digital imagery?

Geophysical Research Methods

Archaeological deposits are an appropriate target for near-surface geophysical survey, because they represent—similar to fissures in rock or inconsistencies in concrete—an intrusion into a relatively homogenous matrix. Anthropogenic deposits are typically created at a scale smaller than natural depositional or soil developing processes, and have the potential to stand in strong contrast to the natural background in geophysical survey data of an appropriate scale. In practice, however, there are factors that can limit the apparent contrast between the target archaeological deposit and the natural background. This is often referred to as the signal to noise ratio (Bevan 1998). Depending on the geophysical technique selected, the chemical composition of the matrix can affect the contrast in the signal to noise ratio. Ground penetrating radar wave reflections are hindered by the increasing saline in the soils (Conyers 2004). Soils with heavy iron content, or contamination, create a highly magnetic background that can obscure the presence of archaeological deposits in magnetic gradient data (Somers 2002a). Buried electrical lines can interrupt the current measurement in soil resistivity (Clark 2000).

Old Stone Fort State Archaeological Park was a natural choice for non-invasive geophysical investigation: the site has seen little large-scale systematic survey, and archaeological deposits are not expected to be deeply buried. The site is protected, and on the National Register of Historic Places, and therefore excavation and ground disturbance should be minimized.

Geo-Magnetic Survey

Geo-magnetic survey, as used in this paper, refers to the survey of the magnetic properties of the earth. To this end a sensor of some type is employed to measure the amount of magnetic flux in a sample area against the earth's magnetic field. The magnetic field at any given point on the earth's surface is a vector sum of the earth's ambient magnetic field, and the magnetic field effects of the sediments, soils and deposits at that location (Breiner 1973:5-6). The earth's magnetic field strength is approximately 30,000 to 60,000 nanotelsa (nT), while typical prehistoric features generate a magnetic flux between 0.5 nT to 50 nT (Somers 2002a:10-11).

In reality there are many complex systems that affect the intensity of the magnetic field at any location on the surface of the earth at any given time. Solar wind, particles and electric currents from the sun, distort the lines of magnetic flux throughout the daylight hours in an unpredictable way (Aspinall, et al. 2008; Bevan 1998; Breiner 1973). This diurnal variation must be accounted for since the variation can be much greater than the field effects of any target anomalies. Generally speaking the influence from the diurnal change in the intensity of the earth's magnetic field can be reduced or eradicated by use of a second stationary magnetometer to record that change and later subtract that from the survey data, or the operator of the magnetometer can re-balance the instrument to the ambient magnetic field of the moment. In this survey the latter correction was performed.

A magnetometer is an instrument designed to measure the magnitude of the total magnetic field at a given sample point, but since most deposits of archaeological interest are located near the surface, a gradiometer is most often used for archaeological survey. A gradiometer measures a gradient of the total field by measuring the difference between simultaneous readings between two magnetometer sensors that are arranged either horizontally or vertically. By separating the two magnetometer sensors in a vertical array magnetic field influence from deeper ferrous deposits are in effect subtracted from the data set, and what is left represents more closely the near-surface magnetic variation (Somers 2002a: 14). All gradiometers are magnetometers, but not all magnetometers are gradiometers. For most archaeological survey researchers are interested in measuring the local magnetic variation in the top meter or two of the subsurface, and so the gradiometer is the instrument of choice for archaeological deposits.

There are several types of available magnetometers: fluxgate, electron spin-resonance, optically pumped cesium vapor, optically pumped potassium, cryogenic superconducting quantum interference device (SQUID), and proton free-precession magnetometers (Aspinall et al. 2008). All have differing levels of sensitivity on the order of tenths to hundredths of a nanotesla, so all are sufficient to detect typical archaeological features. The core concept for the functioning of each device is the same: a sensor of some type is charged with electrical current creating a magnetic field, and that field is influenced by the local magnetic intensity of the total field (in the fluxgate sensor it is the measurement of the vector in line with the sensor cores axis). The intensity that varies over a site, when time is taken out of the equation, is the total field variation at those survey points regardless of the instrument being used.

The difference between the instruments is the material/mechanics that serve as the sensing device. A fluxgate magnetometer has a voltage measurement that determines the amount of flux measured by the sensing elements, while the proton magnetometer measures the amount of energy needed to bring spinning protons to a stop, but either way they both measure the intensity of the total field (Aspinall et al. 2008; Breiner 1973).

Local variations in magnetic flux create anomalies in survey data. These anomalies are generated by remnant and latent (or induced) magnetic fields of objects or deposits within the sample area. Remnant, or permanent, magnetization occurs when the domains in a magnetite crystal align parallel to each other. Heat, or more specifically the Curie temperature, and then cooling, is the usual condition under which magnetic domains realign from random orientation in a material. Be it molten rock, a hearth or pottery, when the material is heated past the Curie temperature (565 to 675°C) all magnetic domains are unfrozen and magnetically susceptible, and when they cool, they align to the ambient magnetic field at the moment of cooling (Breiner 1973: 7-9;Somers 2002a: 14-15).

Latent, or induced, magnetic fields are a function of a material’s magnetic susceptibility. Somers (2002a) likens this to the way porosity effects water flowing through a material. When susceptibility is great the magnetic field is amplified, and when it is a low value the magnetic field is attenuated. A homogeneous substance has a constant magnetic susceptibility relative to the presence of iron oxide crystal structures within it. When cultural activities displace, remove, or add deposits to a relatively homogeneous subsurface, anomalies related to the differences in susceptibility are present in the survey.

Archaeological features and artifacts can affect the local magnetic field severely or very weakly. Objects and features heated past the Curie temperature that have remnant fields often produce intense anomalies. These include items like ceramics/pottery, forged items, prepared surfaces, hearths, cooking features, and even heated sedimentary rocks like chert. Features such as root cellars, pit features, burials, structure floors, and post patterns will change the magnetic susceptibility often enough to become apparent magnetic anomalies.

Archaeological geo-magnetic survey data are subject to near-field effects. Complexities arise in the survey data due to the close proximity of the target anomalies as well as influence from near-surface bedrock, modern buried metal objects, to name a few. The result is a noisier dataset as compared to a total magnetic field "usual mineral exploration survey." (Breiner 1973: 47) In order to account for this complexity, and prevent spatial aliasing, the sampling method must be of a high enough density to accurately characterize small sized targets intended for detection in the research design. (ASTM International 2003: 1)

A potential problem that exemplifies the importance of clearly stating the smallest target size and sources of alias in magnetometer survey is the tendency to assume that no cultural resources are present in an area when a magnetic survey shows no anomalies. Cultural resource management decisions based on the potentially faulty assumption that there are no cultural deposits because none is indicated in a magnetic survey can lead to serious loss of resources. This warning should be taken seriously, and emphasizes that a multi-instrument survey is the preferred and most appropriate method for geophysical survey.

In order to select appropriate sampling methods, a researcher must propose a clear research design that specifies the scope of the survey. If the detection of small archaeological features is critical to the survey, then an appropriate sampling distance must be maintained throughout the survey. In this paper "resolution" is used to describe the spatial resolution of the sampling strategy employed for geophysical survey. Time constraints often play a role in influencing the selected resolution of a geophysical survey, but research design must receive the most weight in the decision making process. In the end some compromise must be reached between resolution and desired coverage. Since the Old Stone Fort enclosure covers over 50 acres, a sampling strategy was developed to allow for high-resolution geophysical survey over a stratified sample of the area.

All gradiometer survey data at Old Stone Fort were collected in sample units of 0.5 m by 0.125 m. This was accomplished by staking out grid squares of 20 m by 20 m (or larger/smaller factors of ten), and then systematically surveying transects on a north-south axis. The survey was performed north-south to minimize the distortion from sensor orientation to which a fluxgate magnetometer is susceptible (Somers 2002a). Two types of fluxgate gradiometers were used during the survey, a Geoscan Research FM36, and a Bartington Instruments B601. These instruments are carried by an operator above the surface of the ground. Readings are recorded along transects at specific time intervals, and it is therefore necessary to maintain a constant rate of survey throughout the investigation. When a grid square is staked out, guiding ropes are placed along the east-west axis at the north and south end of the grid. Using ropes or flags, the surveyor walks a north-south transect while the gradiometer records eight readings per meter, then she will shift over half a meter and walk another north-south transect. This is done until samples have been recorded throughout the survey grid square, and the process continues in this manner on to the next grid square.

The 0.5 meter by 0.125 meter sample size was chosen as a compromise between resolution and time, as well as research design. Any potential cultural targets that are less than half a meter in their greatest diameter (like post holes) are as a result not expected to be individually detected, but rather as a pattern in the survey from multiple post holes. A smaller sample size generally doubles the amount of time required to collect the data since the instrument must be carried over each reading location, and there is not sufficient evidence that magnetic survey resolution of .25 m readings per meter provides an advantage to detecting anomalies any more efficiently than 0.5 m samples.

The magnetic survey data is then transferred to a personal computer for processing and visual rendering. After processing the data, it is georeferenced to the actual representative space in mapping software.

Galvanic Soil Resistivity Survey

Soil resistivity survey is a galvanic method of geophysical survey. Electrodes, typically made of steel, are inserted into the surface of the ground at known intervals, electric fields are then created when regulated current is applied to one of the electrodes, another electrode then measures the induced voltage of the resulting electrical fields. The resistance method of geophysical survey relies on differences of water and salts, or more specifically, the character of free charge carriers available in the matrix (Somers 2002b, Gaffney and Gater 2003:26-27).

For the archaeologist, resistance data can be meaningful in that deposits alter the electrical resistance of the matrix. Stone typically resists passing electrical current and water facilitates it. Buried rock features, pits and ditches that alter the way water is held in the soil are targets that can be revealed through systematic resistivity surveys. Porosity of the soil relates to how water is held in the matrix, and is therefore also expected to affect resistance survey.

When an electrode is placed in the ground, and voltage is applied, a current is created proportional to voltage applied. If the resulting voltage is measured at some distance away from the current electrode then the resistance of the intervening material can be measured (Gaffney and Gater 2003:28). This relationship is often expressed as the equation R=V/I, where R = resistance, V = the change in voltage over a distance, and I = current. The units of measurement are ohms. As voltage is injected into the ground through a single electrode, eddy currents pass through the soil. Another electrode at a known distance measures the current. To put it simply, if a rock is in the path of the electrical field, the voltage from the altered current will be reduced as a result of this high resistance feature. Conversely, if the probes are placed on either side of puddled water in the soil, then the current will have a comparatively greater strength. In order to perform a consistent survey that can detect minimal differences in resistance, a four electrode array is used to remove the effect of contact resistance (Gaffney and Gater 2003:28). During the resistance survey the goal is to measure the resistance of the soil or intrusive archaeological feature below the surface, but another component of the resistance survey is a voltage drop that occurs when an electrode contacts the surface of the ground. This voltage drop generally has no relation to the deposits that an archaeologist is interested in. In addition many archaeological deposits are minimal in contrast compared to the background resistance and can be obscured by the contact resistance. A second pair of electrodes is used to effectively remove this bias from the survey. Two electrodes induce currents into the soil (these are referred to as the current probes), and two electrodes measure the resulting voltage (referred to as potential probes). As a rule the letters A and B are used to represent the current probes, while the letters M and N are used to represent the potential probes. In a twin probe array the four electrodes are split into two pairs of current and potential probes (A-M, N-B), one pair is fixed to a mobile frame and is traversed across the survey area, and the second pair is set at a distance away. Through this method the contact resistance is accounted for and removed from the resistance measurement (Gaffney and Gater 2003; Pozdnyakov and Pozdnyakova 2002; Somers 2002b). Averaging induced voltage measurements increases the precision of the resistance survey, and increases the likelihood of detecting features of weak resistance and a minimum contrast.

Depth of resistance survey, heuristically, is roughly equal to the distance between the current and potential electrode, although Gaffney and Gater claim that a "0.5 m Twin-Probe is likely to respond to features of a maximum depth of about 0.75 m" (2003:32). The reason this holds true is mostly a result of the way electrical fields propagate through a soil.

Resistivity data were collected at Old Stone Fort in a manner similar to the gradiometer data, with the exception of the resolution on the Y axis. This was done for two reasons: first because, the time constraints and desired resolution as discussed above, and second, because it is critical when comparing data produced by different techniques that the sampling units are comparable. Geoscan’s RM15 and MPX15 expansion were used to collect the resistance data. Data were all collected in what is called here a cubic survey, 0.5 m by 0.5 m sample units gathered by a 0.5 m twin array. Grid squares were staked out (or had been previously for magnetic survey), and the operator proceeded to collect data in a north-south transect inserting the electrodes into the surface ever half meter, and when finished the operator would shift the transect one half meter laterally. The data were then transferred to a personal computer for processing, and like the geo-magnetic data, were all georeferenced in the mapping software.

Electromagnetic (EM) Conduction Survey

EM survey is performed with two electromagnetic coils. The first coil creates eddy currents in the soil, the resulting secondary magnetic field is sensed by the receiver coil, and the result is a measurement of how well the material conducts electrical current (Bevan 1983:51). The strength of the secondary magnetic field is an average of the material around the receiver. Where galvanic resistivity survey is a point to point reading method that has been averaged, the conduction coil electromagnetic method is truly a reading of the average conductivity over the space that affects the receiver coil. So even though conductivity is mathematically the reciprocal of resistivity, the method of survey creates two categorically differing data sets. Electromagnetic pulses oscillate to allow the secondary magnetic field to generate. This field is created as the eddy current created by the coil is released and the conductors revert to their previous state (Bevan 1983). EM survey is best suited for identifying walls, ditches, compacted surfaces, and other archaeological features that affect how water is held in the deposits.

Electromagnetic survey is suitable for this investigation because it is noninvasive. The instrument does not need to contact the earth. Old Stone Fort is void of modern sources of major electromagnetic noise (like high tension power lines) at the area of the investigation, which is required for electromagnetic survey to detect subtle archaeological features. For areas near the stone mounds, and where possible stone pavements occur, conductivity often fares better than galvanic resistivity since the reading is not dependent on available water at the surface.

EM survey data were collected similarly to the gradiometer data in 0.5 m by 0.125 m sample units. Grid squares were staked out (or had been previously for magnetic survey), and the operator proceeded to collect data in a north-south transect carrying the instrument just off the surface of the ground. When finished with a single transect, the operator shifts the transect one half meter laterally. The data were then transferred to another computer for processing, and like the geo-magnetic data, were all georeferenced in the mapping software. The instrument used for EM survey was the Geonics EM38 which is capable of collecting both conduction and susceptibility readings.

Ground Penetrating Radar (GPR) Survey

GPR is an active method of geophysical survey that propagates high-frequency radar pulses into the subsurface and receives the resulting reflections and refractions of those waves (Clark 2000; Conyers 2004). Two antennae are used to produce and record these signals: a transmitter and a receiver. The transmitter antenna propagates the radar pulses into the ground, and the receiver records the amount of time that it takes for the energy to return to the surface. The return times are recorded in nanoseconds, or billionths of a second (Conyers 2004: 11). This process takes place at every survey point, and the instrument is generally pulled along the surface. Similar to the techniques discussed above, the GPR gathers many sample stations per transect which is decided by the surveyor. At each survey location many waves are pulsed and received, and the results are stacked into what is called a *trace*. Each trace can be thought of as the vertical behavior of radar waves at that survey point. Radar waves propagate as a cone emitted from the transmitter, and so there are components that are not completely vertical in the survey data. When these traces are put into line in the order they are collected, a radar profile is generated. The main advantage that GPR data have over other techniques is directly related to the consistent sample of multiple depths from the surface. When GPR is collected over a grid unit in a systematic way, the result is a three-dimensional rendering of the subsurface (or more appropriately a representation of how the subsurface affects radar energy).

When a radar wave passes into the ground some of the energy is dispersed and some is reflected. The way that a matrix treats radar waves depends on the conductivity and magnetic permeability (2004; Conyers 2004). Clay soils disperse and attenuate radar energy. This is because of the salts in the soil, and salts are highly conductive, and therefore the radar energy does not generate measurable reflections. The combined attributes of conductivity and magnetic permeability is called the *Relative dialectric permittivity* or *dialectic constant*. This measurement describes the ability of a material to accept and transmit electromagnetic energy from an applied field (2003). Conyers states that, in order for a measurable radar reflection to occur, there must be a sufficient electromagnetic contrast between two interfaces (2004:45). In other words, the goal is to detect an archaeological feature using GPR, then it must have a dialectric constant that contrasts sufficiently from the surrounding soil. A cut limestone block in soil creates very strong reflections while a pit filled with the same soil from which it was dug may not be of sufficient difference to cause a reflection. Even when a pit is dug into the ground and refilled immediately, there are still many variables that can affect the dialectric constant of that feature: the compaction and porosity of such a deposit differs as compared to the surrounding matrix, water tends to puddle at the interfaces of a pit feature, and most deep pits will cross-cut natural stratigraphy, thereby mixing the soil or turning it upside down. Following this reasoning, GPR has the potential to detect a multitude of differing archaeological features.

Radar energy is hindered by saline components in the subsurface (2004; Conyers 2004). Clayey soils typically have a high salinity, and therefore strongly reflect radar waves. This can be both an advantage and disadvantage to the archaeologist working in areas where clay is a dominant particle. Disadvantageous because it limits the archaeologist's ability to penetrate very deeply into the matrix, but advantageous if some intrusion has disturbed the substrate or interrupted it. An example is where a clayey soil was intruded by a pit feature that was subsequently refilled with organic sediments; this feature will affect radar waves differently than the surrounding clay matrix, and although the bottom of the feature may be too deep to detect with the radar waves, the disturbance in the stratigraphy will be apparent.

Ground penetrating radar, or for that matter any geophysical wave technology, is very complex since in propagation waves interact with each other and reflections and refractions produced by anything other than the target can occur. Although GPR surveyors are very careful to keep the radar antenna in contact with the ground, there is always the possibility of noise being introduced by air waves. It is this complexity that often intimidates archaeologists, even those that are comfortable with other types of geophysical survey (Conyers 2004). Specialized software has been developed to provide the most common of statistical techniques that render GPR data interpretable, and more and more systems are becoming available that can be used with a minimal amount of technical training. Conyers makes an interesting point that often only the truly successful geophysical surveys are published, leading others to believe "…that one or the other method is the greatest thing in archaeology since the invention of radio-carbon dating" (Conyers 2004: 7).

Due to mechanical malfunctions with the antenna, GPR survey was limited at Old Stone Fort through the course of this project. Several linear radar profiles were recorded at specific areas of the site, rather than systematically collecting three-dimensional survey grids. Profiles were placed over an intact section of mound to determine if internal structure could be interpreted. Radar profiles that were placed across survey grids with both resistance and magnetometer survey yielded complimentary but differing responses.

Processing Geophysical Data

Processing geophysical data is not truly standardized, but several processing steps are usually applied to most 2D data sets, and the ArcheoSurveyor2 ® software provides several of these statistical processes on demand. RADAN ® is the software that was used for processing the GPR data, and several canned statistical processes allow the GPR data to be manipulated in a consistent manner.

All of the gradiometer data collected in the surveys were collected on a time based traverse. The instrument operator must move at a consistent pace along the line. Both the Geoscan and the Bartington instruments produce an audible beep at set intervals along the traverse to keep pace. Most magnetic survey data will have to be adjusted to differences in actual collection time for a reading versus the audible beep produced by the instrument. De-staggering is a process by which survey collection points are moved either back or forward on the grid cells to adjust for the reading lag, which is compounded when a “zig-zag” collection pattern is employed.

Most large magnetic data sets also require some adjustment of each traverse’s survey mean. Fluctuations in the ambient magnetic field, as well as slight internal changes in the instrument, or orientation, bias the collected data over time. Generally however, gradiometer data is collected over short traverses that do not contain any major variation in the sample mean. The process called De-striping zeros the mean or median of each traverse depending on which method is selected. This process removes the striping that occurs as the orientation of the gradiometer changes.

Clipping, as it is used in geophysical data processing, is used to restrict the data range with a filter, and is used to enhance visual display and detection of anomalies. In other words, if a magnetic survey dataset has a range of values with a mean of zero, and one starndard deviation is 10 nT, then a clipping filter set to one standard deviation will convert all readings above 10 nT and below -10nT to 10 nT or -10 nT. Visually this stretches the gradation scale’s histogram across a compressed dataset rendering small contrast anomalies visually detectable.

In some circumstances a researcher may wish to remove readings within a certain range. In the case of prehistoric survey, most gradiometer readings above 100 nT are the result of some type of contamination. In this case the researcher may wish to remove these readings from the dataset rather than use clipping. Several methods exist for this, but this researcher prefers to replace the readings with cells with no value. Optionally one could replace the readings with zero, survey mean, or the traverse mean, but these options introduce estimated readings into the dataset and could cause difficulty in interpretation as further transformations are applied to the data. The less the data is transformed the less likely miscalculations will affect the final analysis.

Other spatial filters that are commonly applied are high-pass and low-pass filters. These are box-car statistical processes that are available within the Archeosurveyor ® program, and they allow a researcher to emphasize or reduce the impact of readings in the high and low ranges. A high-pass filter will cut out anomalies which cover many cells within a low range; conversely a low-pass filter reduces the impact of isolated high-contrast anomalies in the data set. A low-pass filter can be used for example to reduce the impact of scattered high-contrast anomalies associated with surface metal.

Contours are used to visually emphasize spatial distribution of a range of readings. Anomalies in a magnetic dataset appear as elevation anomalies in a contour map. Contours are lines drawn that fit to the spatial distribution of a class of readings.

Processing wave technology data like GPR requires background removal. As wave reflection data are collected, horizontal banding is generated in the data that represent system noise. The Finite Impulse Response (FIR) filter is used to remove the background noise and remove the banding. The filter is a spatial filter that compares each reading in the sample to other readings within the space determined by a user selected coefficient, and reduces spatial alias.

GPR data can also be enhanced for visual display through gain enhancement. Gain is a post-input signal boost. As GPR waves travel through the soil and become attenuated, adding gain to the return signal will enhance the appearance of any responses in the profile.

The last stage in processing involves importing the data into Geographic Information System (GIS), and referencing them to real-world coordinates. Placing geophysical data into the real coordinates allows for comparison of multiple data sets and assessment of context, ground cover, and so on. All 2D data were exported from ArcheoSurveyor ® as raster grid data and imported into ESRI's ArcGIS software. In the GIS software the data can be displayed or transformed into surfaces and fit to other layers. The color scheme can be manipulated, as well as the display histograms.

Detailed Digital Laser Transit and Global Positioning System (GPS) Survey

Digital topographic survey resulted in the collection of over 10,000 points with real geographical and vertical positions (Figure 5). All geophysical survey locations and excavations were recorded with a digital laser transit (Topcon TS and Trimble 5600). The geoarcheological probes were recorded with GPS units with sub-meter accuracy (Trimble Pro XRS and GeoXH). All geographical data were processed using ESRI's ArcGIS software package. GIS data are managed as separate raster datasets for images, individual shapefiles, and ESRI personal geodatabase files. The final GIS product will integrate with the ESRI software packages that are used by Tennessee State Parks, and specifically Old Stone Fort State Archaeological Park.

The topographic mapping project at 40CF1 was initiated for several reasons. The most pressing issue was the lack of a highly detailed topographic survey of the enclosure and surrounding embankments, apart from the entrance complex that was surveyed during the 1966 investigations.

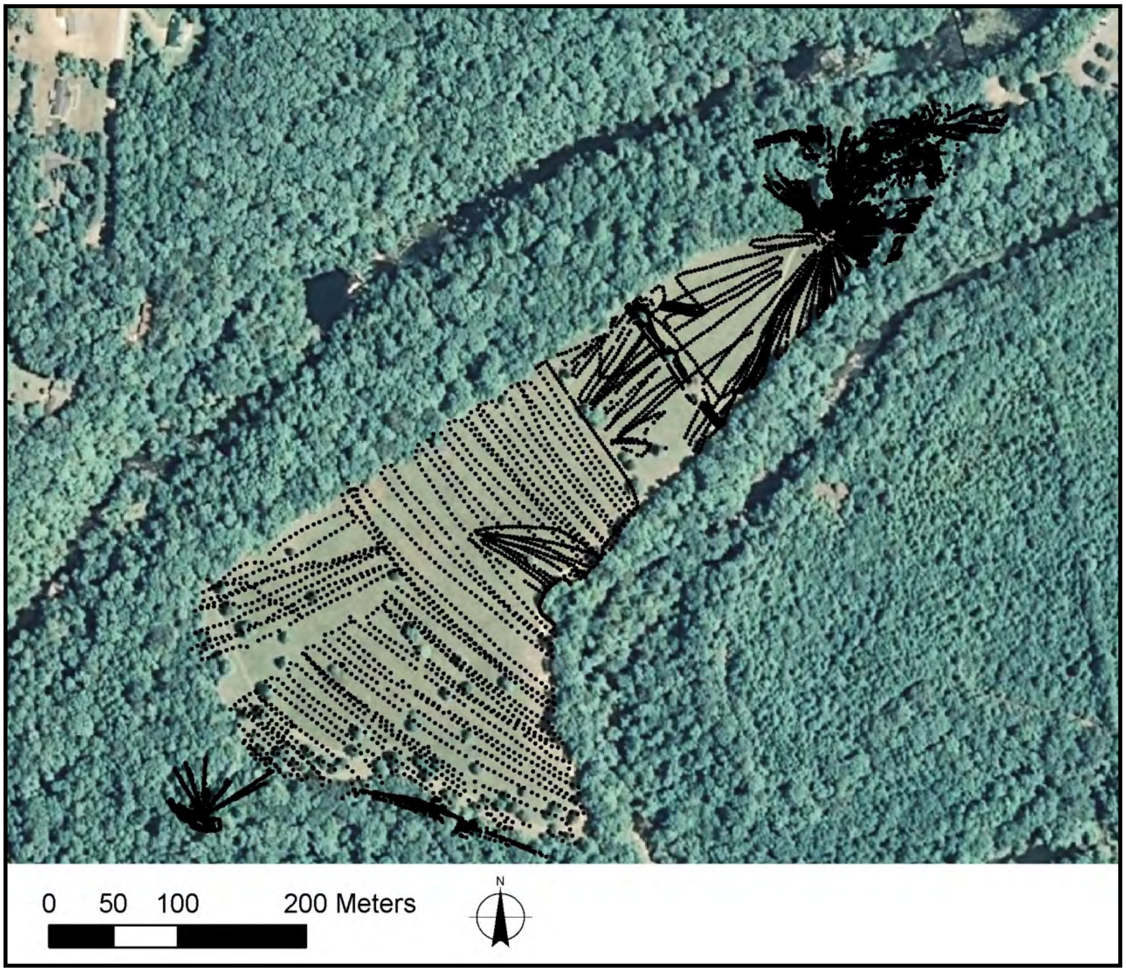


Figure 5. Laser Transit Topographic Survey Coverage.

Secondly, detailed topographic survey allows the comparison of geophysical survey results to small topographic features that are not represented on smaller scale maps of the site. Most importantly though the survey delivers a highly detailed digital data set as part of the geographic information system that encompasses the entire Old Stone Fort State Archaeological Park boundary. This is the first time that large-scale digital survey data have become available for the study of the Old Stone Fort. The data that accompanies this report can be imported or linked into GIS software for future research and researchers.

Certainly one of the limiting factors in creating a large scale topographic survey at a site like Old Stone Fort is the distance that is covered by the contiguous mound embankments. The land surrounded by the mounds has a perimeter of 2000 meters, and covers an area of nearly 20 hectares, and it is all surrounded by a ring of substantial secondary growth (with trees as large as two meters in diameter) and steep cliffs, inhibiting access for laser transit survey, and attenuating the accuracy of GPS survey. GPS receiver systems can be affected by anomalies created from mulitpath reception, and the large trees along the perimeter of the peninsula tend to induce such interference. Old Stone Fort is not unique in the problems it presents to the surveyor; when considering nearly any site that fits into the category of hilltop enclosure, a similar set of hindrances present themselves. Modern features such as park access roads and trails were included in the mapping effort.

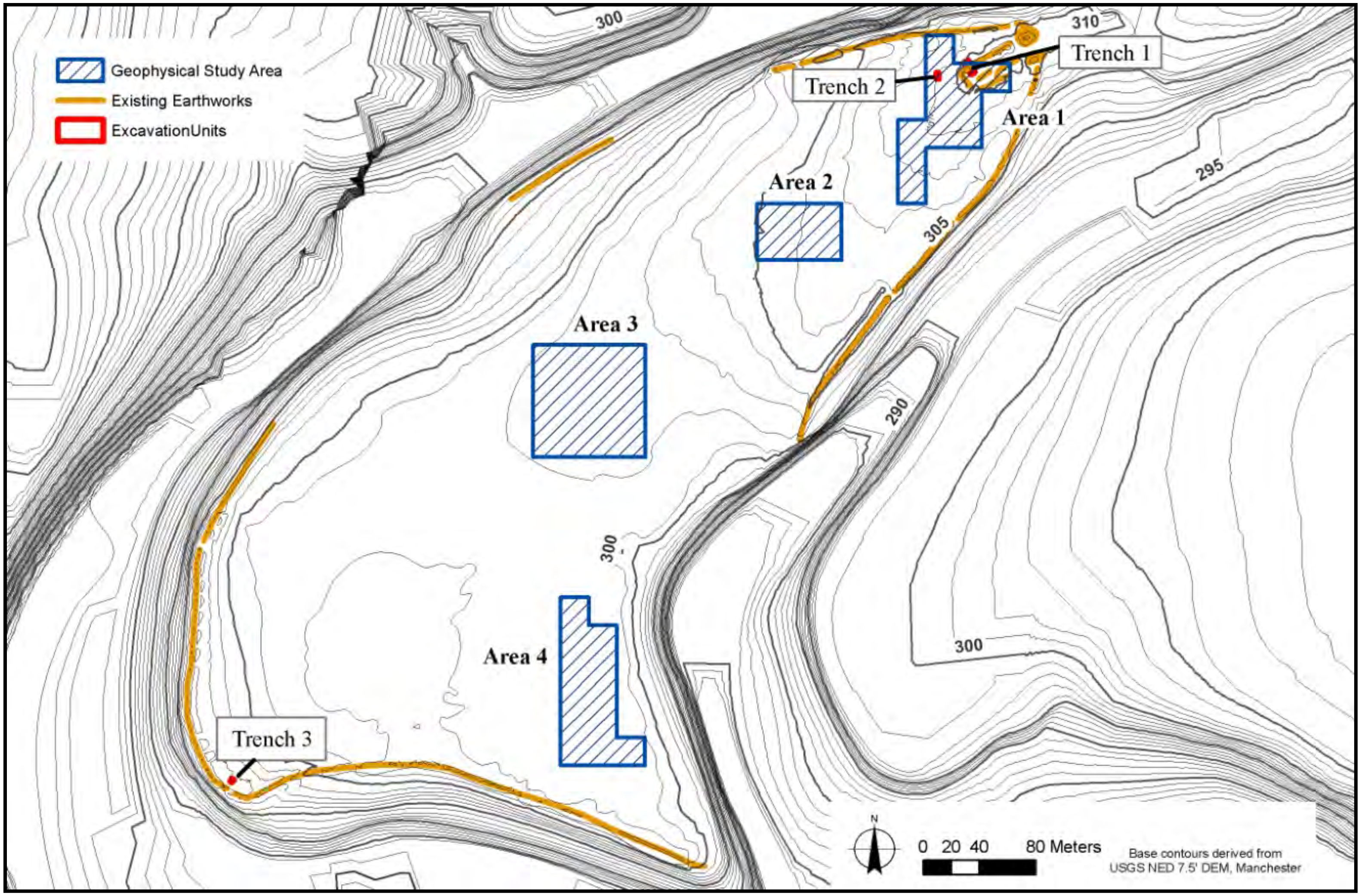
Excavation

Excavation was limited to three areas. Trench 1 exposed a profile previously excavated within the Eastern Gateway complex. This trench coincided with Faulkner’s (1968: 46) Trench 11, which he reports as a re-excavation of a trench dug by P. E. Cox in 1928.

(Figure 6) The majority of the excavation here was cleaning out old backfill with a backhoe. Prior to excavation, topographic data was collected over the site of the trench impression that remained. The original excavation trench, either through settling/crushing or perhaps not strict effort to contain all the backfill, had left an open gap in the mound that was a little lower than half the height of the surrounding mounds. This modern disturbance had become somewhat of a nuisance to park interpretive personnel, as visitors to the site would often use the mound cut to go off trail, walk across an intact-but-eroding portion of mound, and find that what they thought was the sound of waterfalls is actually a nine-foot, historic dam.

The limit of previous excavation efforts was easy to define, because the fill was much different than the intact mound. The intact mound fill contained large slabs of Chattanooga Shale, while the back-fill from the previous excavation trench rarely had a piece of shale larger than 5 cm in diameter. The shale in the mound fill has become brittle and fragile through weathering, and any amount of force that is applied to these slabs once they are exposed crushes them to small pieces. The northwest quadrant of the trench was excavated well below the mound into the clay residuum.

Trench 2 consisted of a single 1.5 m by 4 m excavation to expos a very large irregular anomaly that was correctly characterized as a ditch feature from the geomagnetic survey. The trench was placed purposefully on an edge of the anomaly where it appeared to be obliterated by the previously mentioned roadway. The trench was mechanically excavated and the feature was exposed in profile. The trench was excavated well into the sterile clay residuum.



Base contours derived from USGS NED 7.5' DEM, Manchester

Figure 6. Areas of Investigation

Trench 3 was placed in the western portion of the site. The test unit was placed into a small mound of earth previously tested by P. E. Cox (1928). There is not much in the field notes other than a sketch drawing of the mound and embankment with the words "no sign" written. This test trench was excavated by hand and sifted through ¼ inch screen. The area investigated by Cox was apparent when the organic debris was removed from the feature. Settling after the test trench was backfilled had preserved the rough shape of his test unit. After cleaning the profiles of the old excavation, the test unit was expanded to reach the perceived center of the feature. The unit was excavated to sterile residuum, and soil samples were taken from this fill for particle analysis to aid in determining the nature of the deposit.

Although it was hoped material for carbon dating would be gathered, none of the exposed contexts provide definitive dates for a particular event. Charcoal was encountered in the stone mound fill in Trench 1, but none *in situ*, which was the goal.

Geoarchaeological Analysis

Understanding of *Mississippian* mounds has been radically altered by recent applications of geoarchaeology (Sherwood 2005, 2006), but no Middle Woodland mounds have received this type of analysis. During this investigation a trench from previous archaeological study was re-excavated to expose a profile of a large embankment composed almost completely of stone, and excavated in the residuum to expose the total vertical profile. Study of the profile has provided new interpretations of mound staging and preparation of the pre-mound surface.

Soil samples were taken from excavations, and field profiles were described. The previously mentioned excavations provided windows into the soil stratigraphy of the plateau between the Duck Rivers, and control samples were obtained from nearby cut-banks and with a bucket auger. Aside from the few bucket auger control samples, soil descriptions were derived from the exposed excavations.

Geoarchaeological analysis is now considered a necessary component of any excavation program, but at the time of the previous excavations at Old Stone Fort, soil scientists were people that archaeologists mailed their samples to. The opportunity to have a geoarchaeological analysis of the mounds and sediments beneath them is unprecedented at this site. The soil within the Old Stone Fort site consists of a thin organic horizon and shallow to non-existent plow zone followed by a deposit of loess. Below the loess is a truncated clay horizon that formed in place from the parent limestone that lies beneath it. All collected samples for geoarchaeological analysis were taken directly from profiles, and carefully mapped with the total station. The samples were all 5 cm thick and around 10 cm wide and deep, and were taken at 5 cm intervals up the total height of the profile. Samples were collected from Trenches 1 and 3, and were used to describe the stratigraphy at these locations.

The application of geoarchaeology at Old Stone Fort informed not only on the depositional environment, and nature of the deposits, but also informed the interpretation of the geophysical data both on mound and non-mound space.

Chapter 4

Results

Within the Old Stone Fort Enclosure, four areas were investigated using geophysical techniques and three using limited excavation. Use of a detailed digital GIS model, a multi-instrument geophysical investigation, limited excavation, and geoarchaeology have led to new insights into the archaeological record at Old Stone Fort State Archaeological Park. New cultural features have been discovered, and mounds have been characterized with several different geophysical instruments. Limestone mound features can be confidently characterized by both gradiometry and EM conductivity/ magnetic susceptibility survey. GPR survey can be used to successfully interpret internal mound structure without excavation. A ditch feature was identified in gradiometer survey and was verified through limited excavation. No ditch has ever been recorded within the Old Stone Fort enclosure, although they are common in other Middle Woodland enclosures (Connolly 1996).

Archaeological features were discovered in each survey area, sometimes quite differently depending on technique. For example, the ditch feature that was detected in Area 1as a strongly contrasting anomaly in the magnetic gradient survey appears only as a weak anomaly with a diffuse boundary in the EM survey. The ditch is most likely associated with the prehistoric use and construction of the enclosure, but no diagnostic or carbonized remains were obtained for positive association. Geophysical techniques were successful in collecting substantial responses over mound features and even more minor topographic features, as well as those not visible on the surface. Several features were discovered, particularly in the area of the Eastern Gateway that deserve further study. Complex sets of anomalies within and surrounding the Eastern Gateway indicate a varied and changing history of use at this portion of the site. The discovery of mound staging, apparently different than was recorded during previous investigations at the other areas of the site, supports the idea that the Eastern Gateway had been modified over its history through repeated use.

Geophysical techniques are shown in this survey to be well suited for detecting the buried remnants of the stone and earth mounds. The detailed topographic survey allows for interpretation of minor topographic features that appear in the geophysical data as anomalies. The results are expected to be useful for the management of the park and for interpretive purposes. The high level of accuracy and precision of the survey of the mounds also provides the necessary base map to perform any number of azimuth calculations—intra and inter-site—for determining possible celestial alignments at the site. Although not under the purview of this research project, complicated alignment calculations such as the Summer Solstice alignment described by Pearsall and Malone (1991) in the Eastern Gateway complex can be created rapidly from the survey data in a digital environment.

In order to survey the site systematically, a 20 m by 20 m arbitrary grid generated in the GIS software was created, aligned with magnetic north (Figure 7). This grid was imported into the total station data collector, and stakes were placed at grid corners within the selected survey areas at the site. The grid coordinates were written in sharpie on each of the stakes. The site covers around 20 hectares, and almost a third of that area is covered in heavy tree growth. Although this does not prevent geophysical survey, it limits coverage, introduces anomalies not associated with anthropogenic deposits, and increases the time required to survey. Additionally, identifying features and patterns in geophysical survey data is more successful when contiguous survey units are used rather than separated random blocks. Since a goal of this project was to assess the efficacy of geophysical techniques at the site, study areas were selected that lie outside of the tree line, except for Area 1 which is on the edge of the tree line.

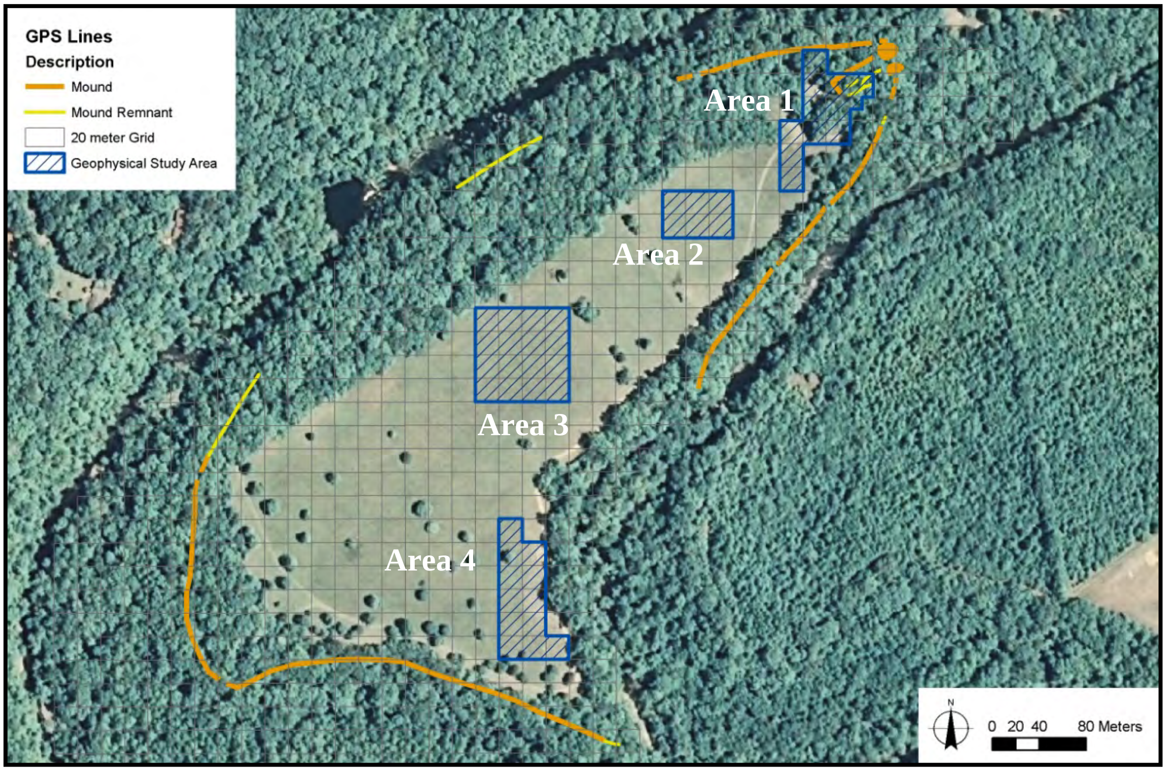


Figure 7. Old Stone Fort State Archaeological Park with Geophysical Study Areas

The opportunistically selected study are spread over the open portion of the site, and are intended to represent a baseline from which inferences can be made about the character of the record for the entire site. Area 1 covers 4600 m^2, and is made up of eleven 20 m by 20 m squares, plus two 10 m by 10 m squares. Area 2 covers 2400 m^2, and is made up of six 20 m by 20 m squares. Area 3 covers 6400 m^2, and is made up of sixteen 20 m by 20 m squares. Area 4 covers 4800 m^2, and is made up of twelve 20 m by 20 m squares (Figure 8).

Each study area represents a unique context within the site. Area 1 includes mounds and an area open just within the enclosure, Area 2 is in a flat grassy area just before sloping to the southwest. Mound embankments are within 40 meters to the east and 80 meters to the west. Area 3 is about the geographical center of the site, and furthest away from the prehistoric embankments. Area 4 was placed within 25 meters of the nearest embankment, and near one of the cliffs.

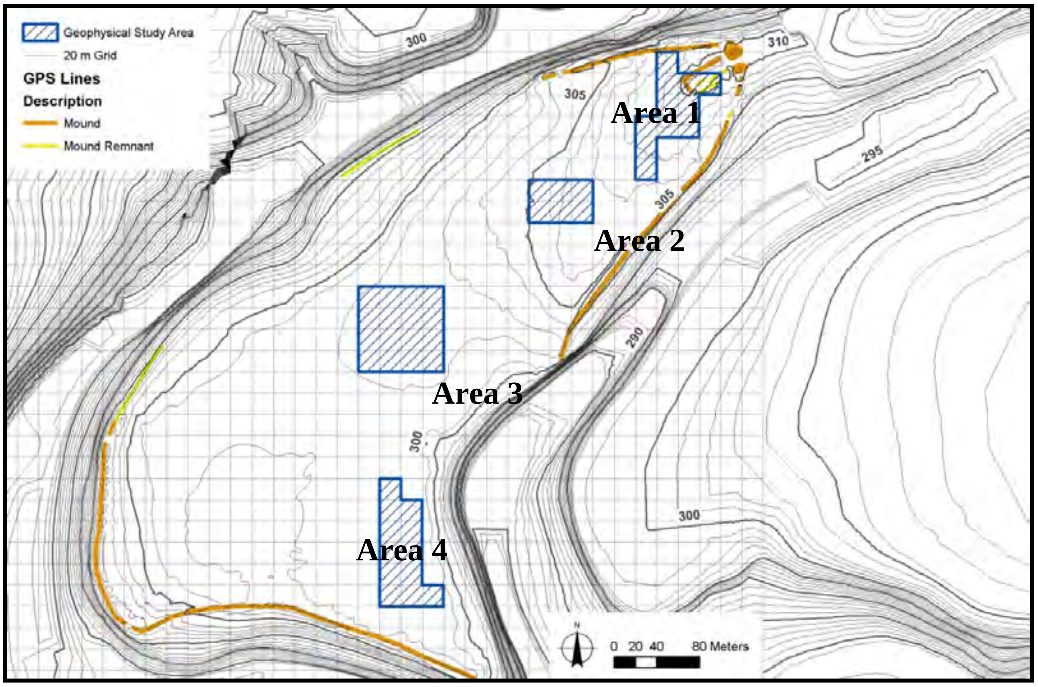


Figure 8. 1 Meter Elevation Contour Map, Mound Locations and 20 m arbitrary grid.

Geographic Information System and Database

A Geographic Information System (GIS) has been developed to manage all of the mapping data generated for this project. This includes all topographic mapping, as well as geophysical survey data and their locations, and photographs that were taken and geo-referenced. Geo-referencing is a process that places a map into real or arbitrary space for visual rendering and overlays (Clarke, et al. 2002; Wheatley and Gillings 2002). All spatial data were managed using ArcGIS ®, and all surface analysis algorithms, unless specifically stated otherwise, were used "as is" in the ESRI software. The final digital GIS DBMS will be provided to the Old Stone Fort State Archaeological Park and the appropriate offices of the Deartment of Environment Conservation.

Several layers combine to make the basic units of the Old Stone Fort State Archaeological Park GIS. Aerial imagery, or NAIP (Digital Orthophoto Quarter Quad) DOQQ, was obtained from USDA-FSA Aerial Photography Field Office; the latest version used in all figures was downloaded in December 2009. This raster layer provides a visual representation of the site and surrounding area as it is at present, and is used for thematic mapping purposes.

Elevation data for the project was obtained through several sources. Wheatley and Gillings (2002) list six analytical methods that rely on appropriately scaled elevation data: terrain visualization, cost-distance analysis, predictive modeling, analysis of visibility, erosion and flooding simulation and virtual reality interpretive programs (2002: 107). The topography of the dissected uplands is one of the primary visual aspects of Old

Stone Fort. The 10 meter Digital Elevation Model (DEM) created by the USGS National Elevation Dataset is used as a base layer for the elevation model. Since the resolution from the DEM is too coarse to accurately describe the landform, and total coverage with the laser transit survey was unobtainable, the model of the site and drainage area is the result of a combination of several layers. Contour lines from the 1967 investigations were georeferenced and modified with spot data, and added to increase the coverage of the model. Figure 9 displays the result of georeferenced topographic contour map relative to the GPS mound survey and location of study areas (Faulkner 1968:4-5).

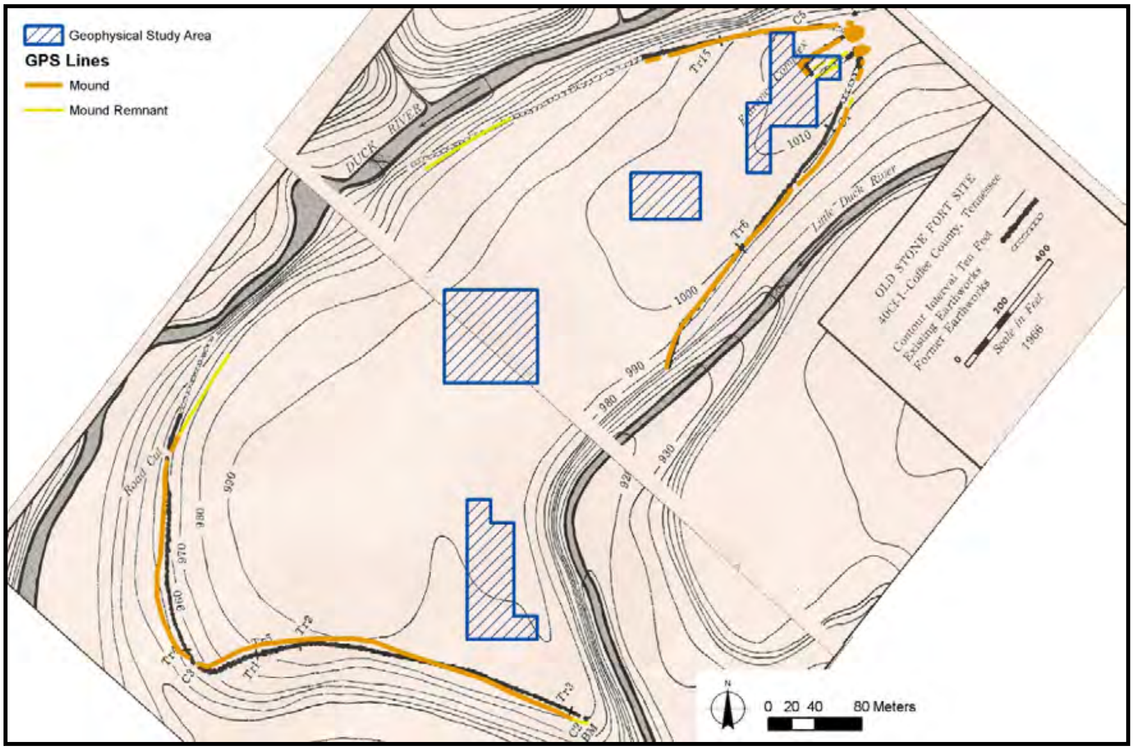


Figure 9. Topographic Map of Old Stone Fort, Faulkner 1968 (Figure2).

The contours from the Faulkner figure were scanned and modified where transit survey data were available. The GPS survey did not produce elevation data sufficient for modeling the site, and so in areas were transit survey data were not available, mound heights and positions were interpolated using the adjacent mound spot heights and comparing the GPS survey.

Figure 10 displays the 10 meter DEM, the modified Faulkner contours and interpolated spot heights that were used to develop the basic structure of the elevation model for Old Stone Fort.   When the above layers are added to the topographic spot heights from the laser transit survey it is possible to produce a three dimensional model of the site and plateau (Figure 11).

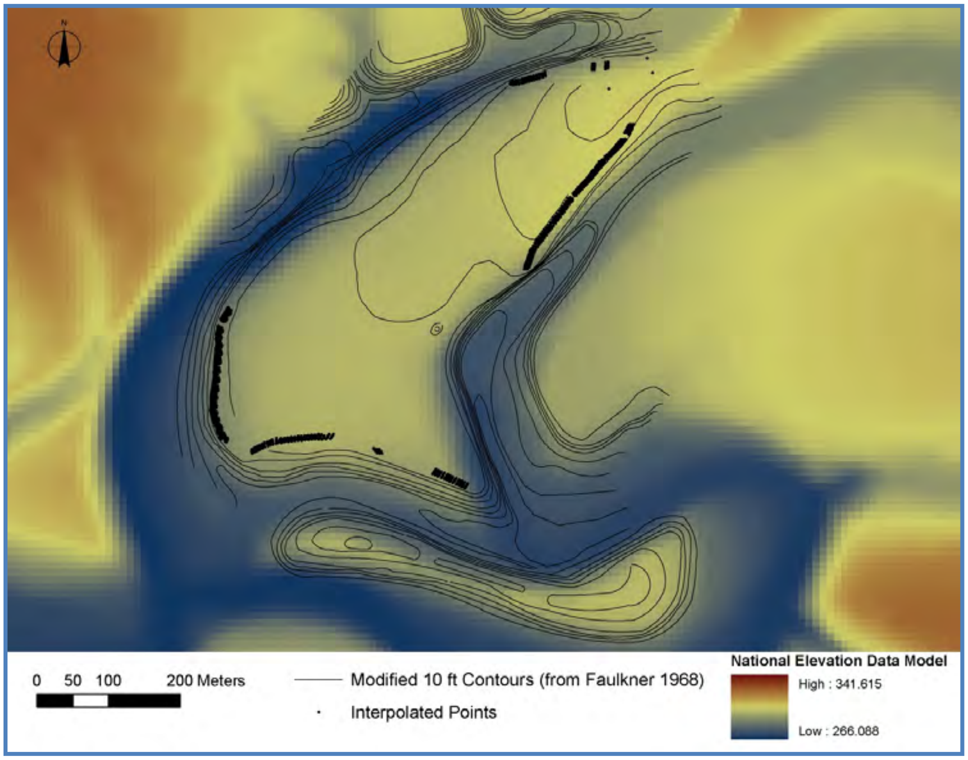


Figure 10. Layers Added to the Elevation Model For Old Stone Fort.

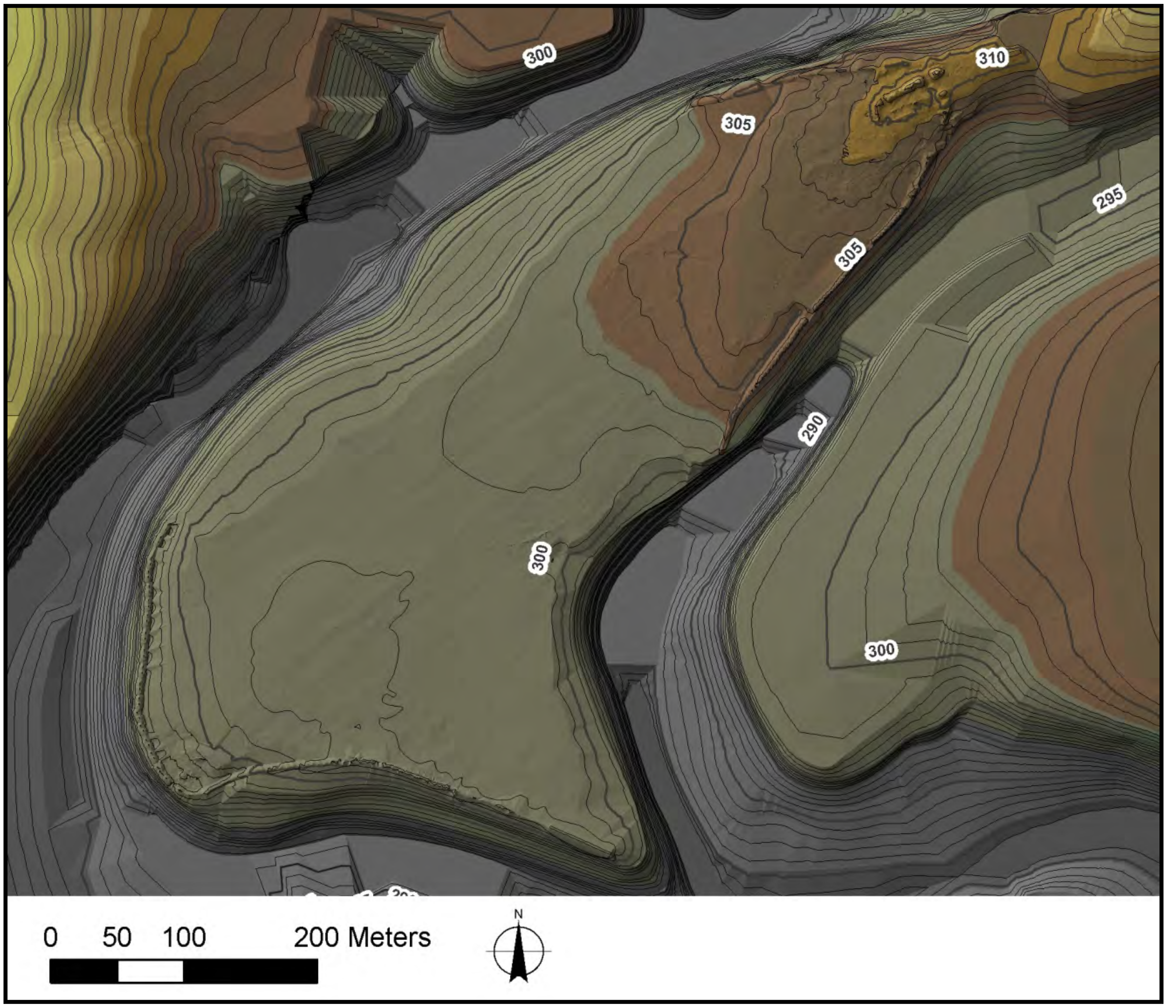


Figure 11. Triangulated Irregular Network (TIN) created from combined elevation sets. (Contours 1 meter)

Figure 12 is a close-up plan view of the Eastern Gateway complex rotated to a 240º azimuth. This rotation is roughly the azimuth upon which the summer Solstice sunrise and the winter Solstice sunset occurs, and provides a birds-eye view of the entrance complex as it appears at present, excluding the trees. This part of the total station survey included over 1000 recorded coordinates with elevations.

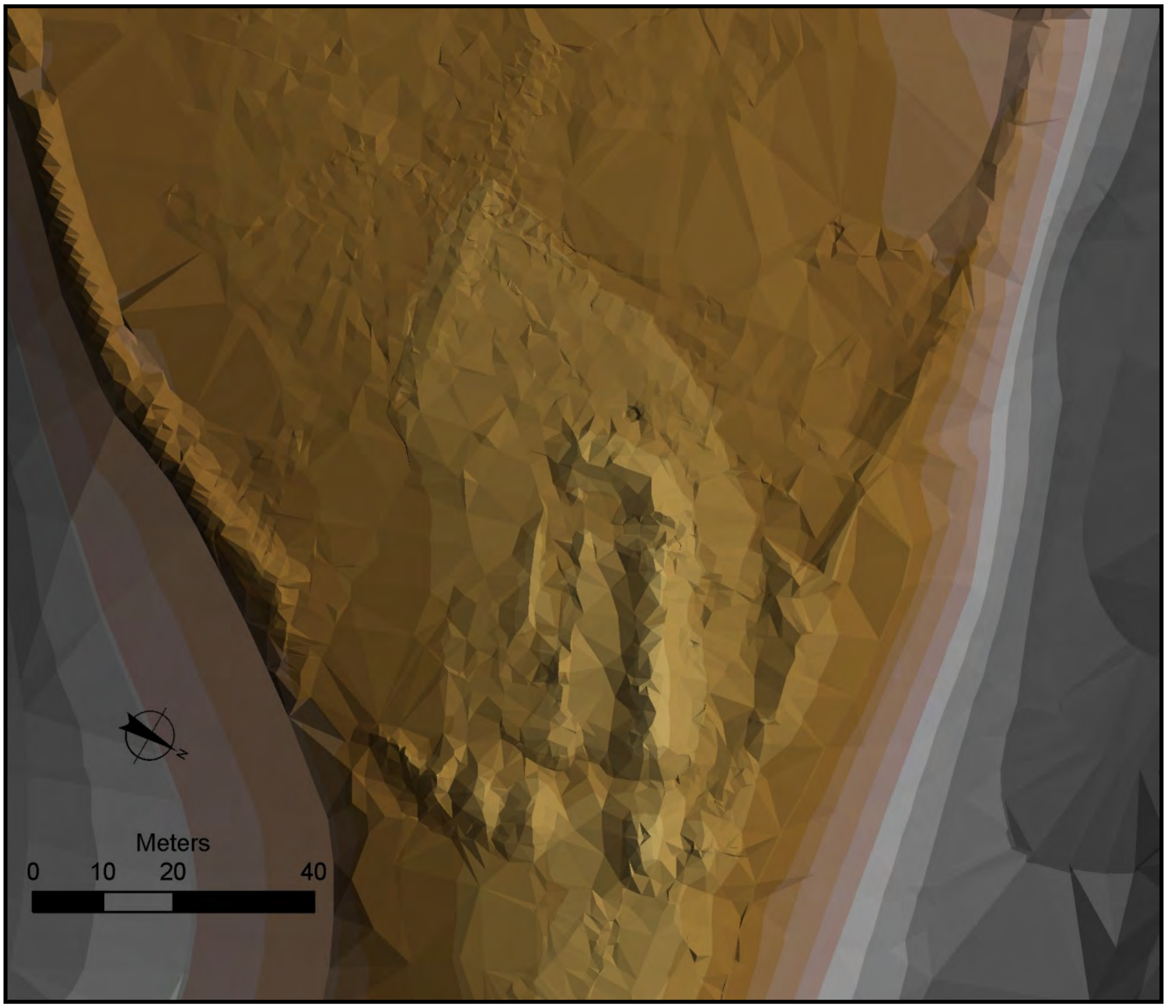


Figure 12. Eastern Gateway Complex Plan View Rotated 240 º.

Geophysical techniques used at the site included geo-magnetic survey, ground penetrating radar (GPR), soil resistivity, and electromagnetic conduction. Below in Figure 13 is presented a schema by which geophysical anomalies can be described in the same terms that are used to describe archaeological deposits and soil boundaries. The data presented in Figure 13 represent gradiometer data, but this concept is applicable to most forms of geophysical survey data when it is viewed from plan view or profile.

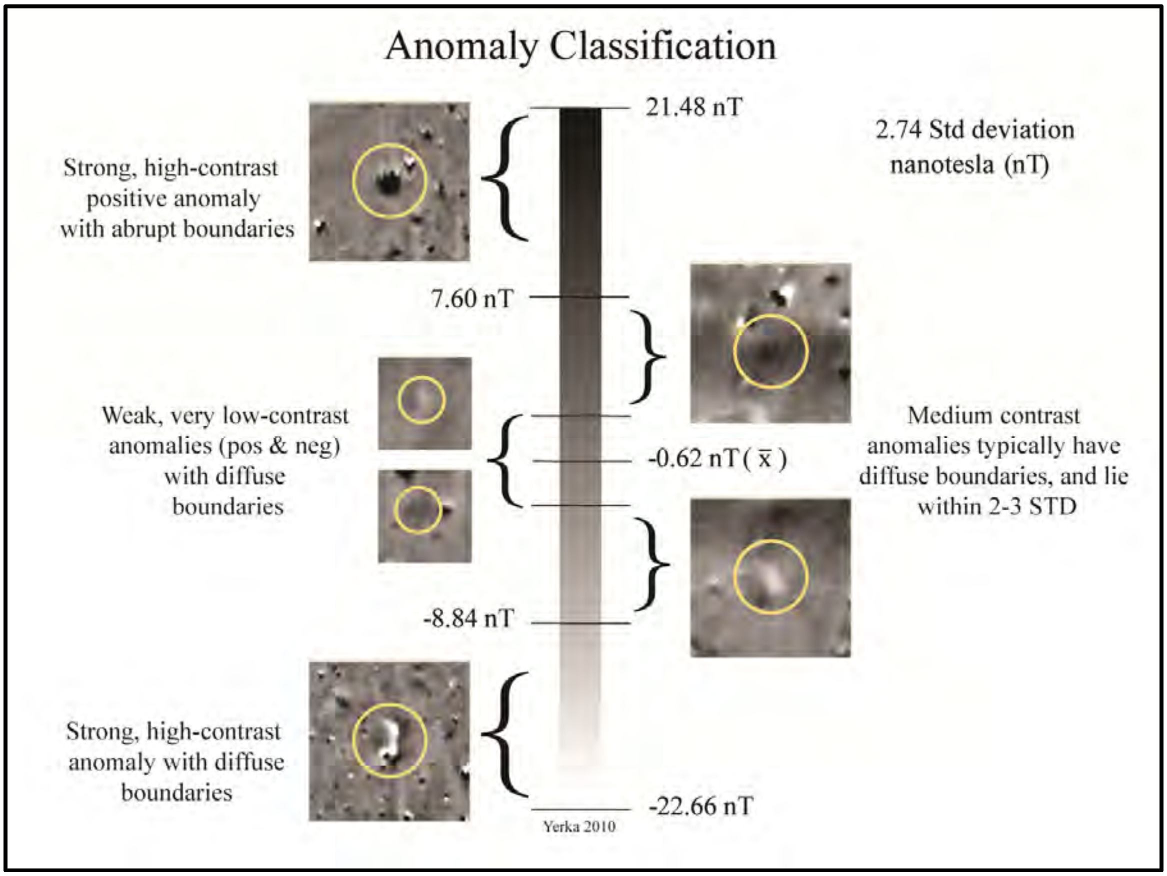


Figure 13. Concepts and terminology used to describe anomalies in the text.

The criteria for distinguishing the anomalies are based upon the mean and range of the dataset. In other words, it is a survey-relative method of distinguishing anomalies. Low contrast, or weak, anomalies are close to the mean and “background” of the survey data. High-contrast, or strong, anomalies depart from the mean in a substantial way. Boundaries are diffuse to abrupt, depending on the rate of change in surrounding cells.

Area 1

Area 1 was placed west and south of the Eastern Gateway complex. Portions of the area are covered by mound embankment, large trees, and open area. One feature of potential interest here is a low-lying linear mound feature that has never been confidently associated with the prehistoric mound construction at the site (Figure 14). It was hoped that geophysics could aid in comparing this feature to the known embankments.

In all, the Bartington 601, Geonics EM36B, GSSI SIR3000, and Geoscan FM36 and RM15, were employed in Area 1 for survey. Features detected include

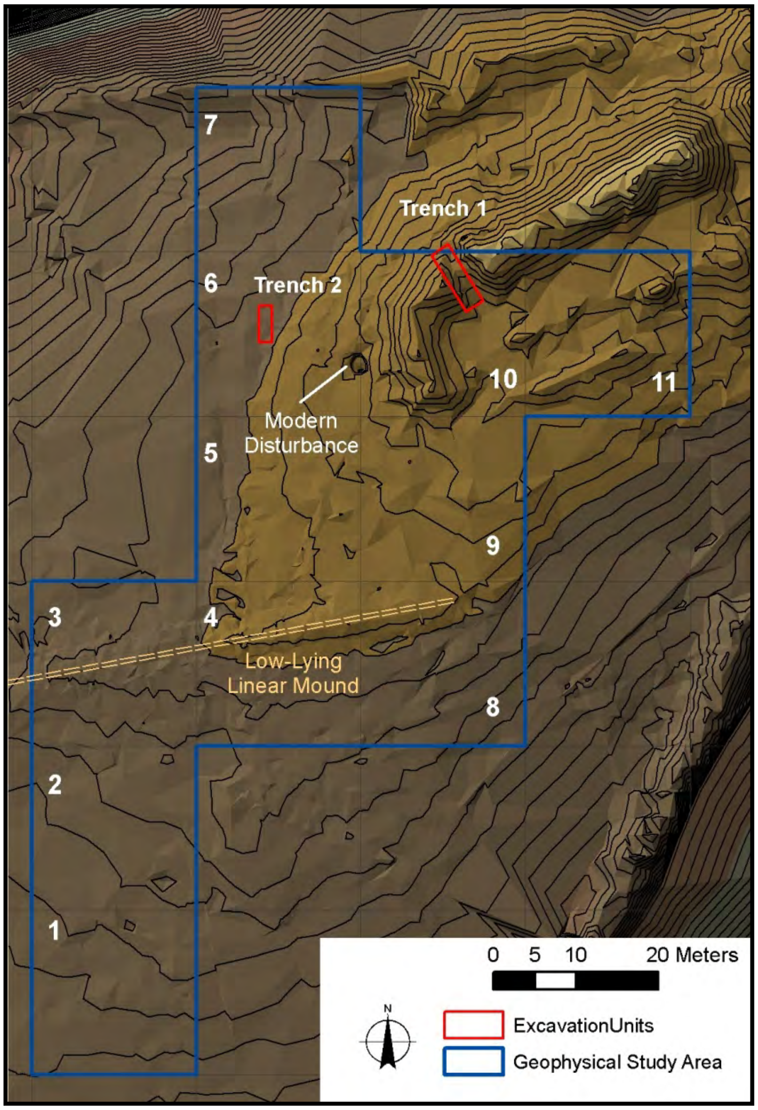


Figure 14. Area 1 Showing Topographic Features and Geophysical Survey Units

embankments, ditches, probable prehistoric pit features and other landscape modification, as well as historic and modern disturbance.

Area 1 Gradiometery Results

The soil stratigraphy on the peninsula creates a somewhat unique situation for magnetic survey. Eroded loess sediments which generally create only a weak magnetic background and “quiet” survey data sits on top of a magnetite rich clay subsoil. The result is that features that intrude into the clay subsoil and are subsequently slowly filled with eroded loess or organic matter can create very strong edge effects at the boundary of the feature. On the other hand low magnetic density features that may be intact in the upper part of the loess deposit may be obscured by the background density of the clay subsoil, which in some cases may only be 10 cm thick.

Figure 15 presents the results of the FM36 Survey within Area 1 in grayscale. This survey area is the heavily covered with trees, and in the interest in collecting consistent data, the 20 m blocks with the fewest trees were selected for this instrument survey. To minimize the impact of trees in the dataset all transects were collected in parallel fashion.

Figure 16 shows the results from the FM36 as selected contours. The contours allow isolation of anomalies at certain levels of density using ArcGIS’s 3D Analyst contour algorithms. This simplifies comparison between anomalies. Although as Bevan (1998) points out, the human eye can detect subtle patterning that even the most sophisticated algorithms can dismiss, using the contour analysis is an objective way to highlight strong anomalies and patterns.

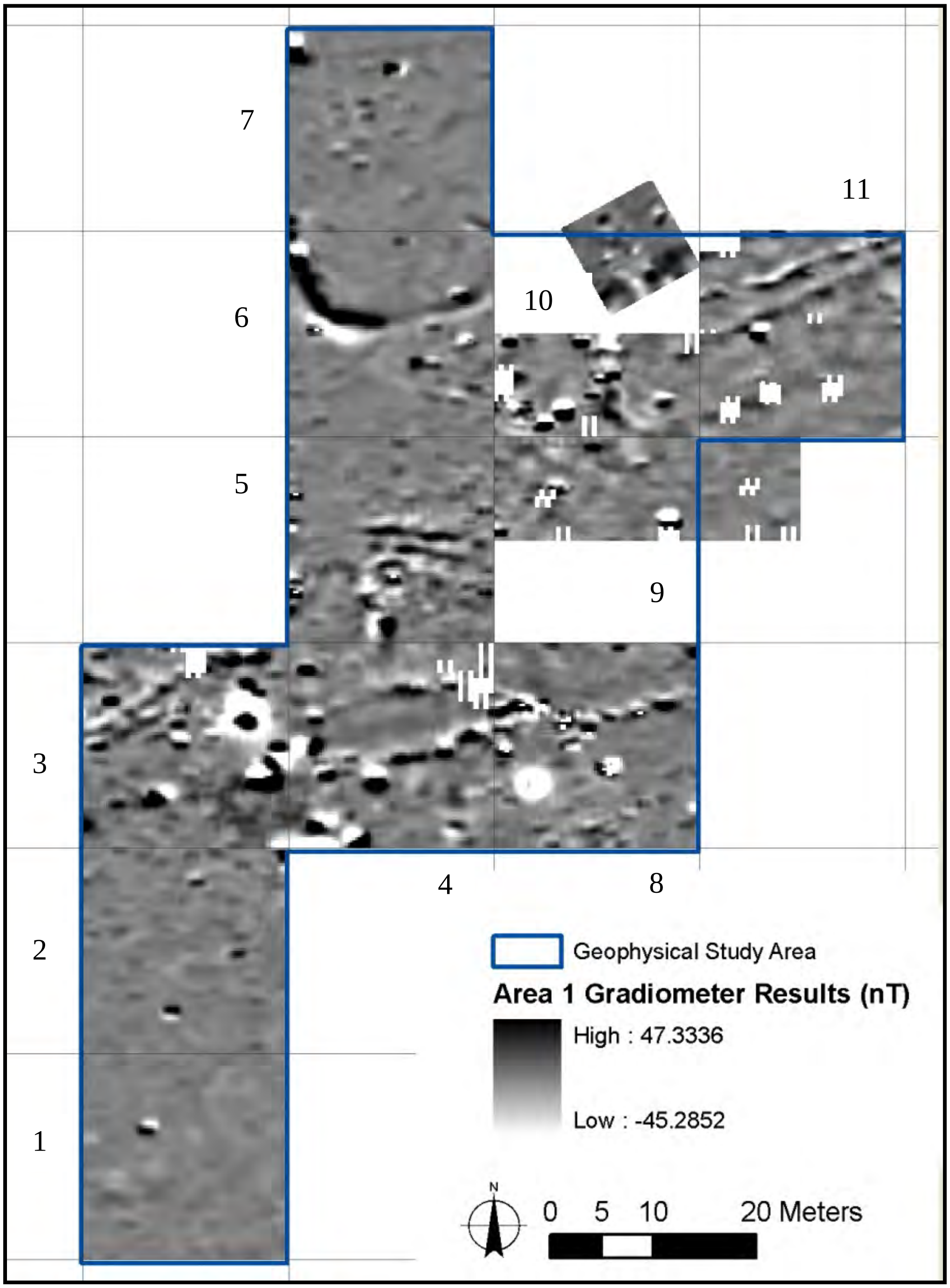


Figure 15. Area 1 FM36 Results as grayscale

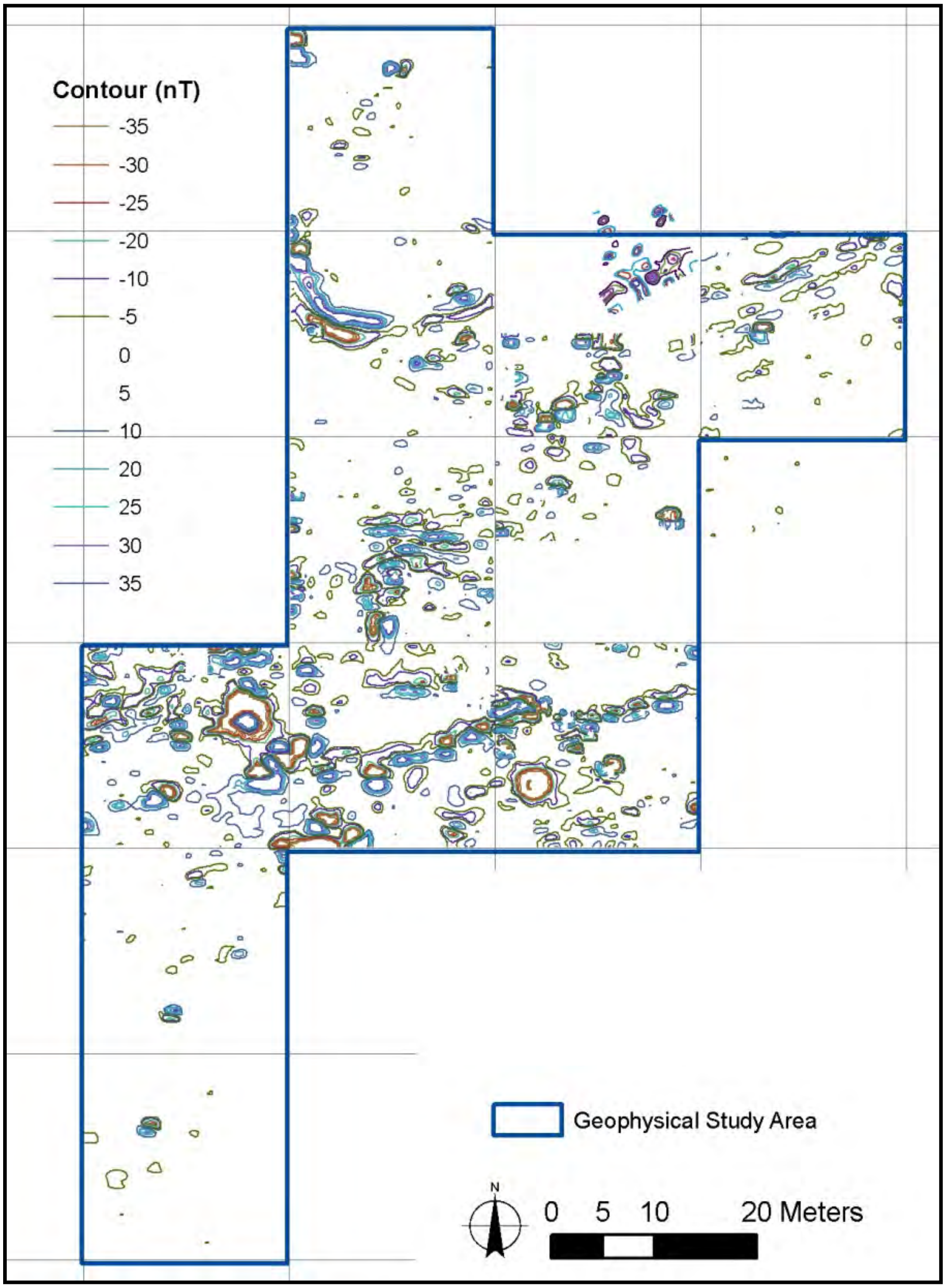


Figure 16. Area 1 FM36 Results: Contours

Contour maps are also a very familiar way to communicate a z-value, especially to archaeologists. The data for this survey were zeroed to the median traverse, smoothed with a 3 by 3 uniform low-pass filter, and clipped at three standard deviations. Several large complicated anomalies with strong boundaries and high contrast readings were identified in this survey, and are discussed below starting in the southwest corner of the survey grid.

Figure 17 shows the complete gradiometer results for Area 1 with selected contours, and the TIN model to show how the anomalies relate to the topographic features in the area. Several linear features correlate to the edge of embankments that were recorded in the high-density topographic survey and are indicated in Figure 17. The low-lying embankment that crosses Grids 3, 4 and 8 on an east-west axis has never been described in any of the early historic accounts, but is familiar to those that have spent time at the site. Shale can be seen on the surface of this feature, and shale does not occur naturally at this elevation. There are no cases of raised roadbeds anywhere on the site. The magnetic response from the edge of this mound feature is similar to the edges of other prehistoric embankments in Area 1, and this linear anomaly may represent a prehistoric mound feature.

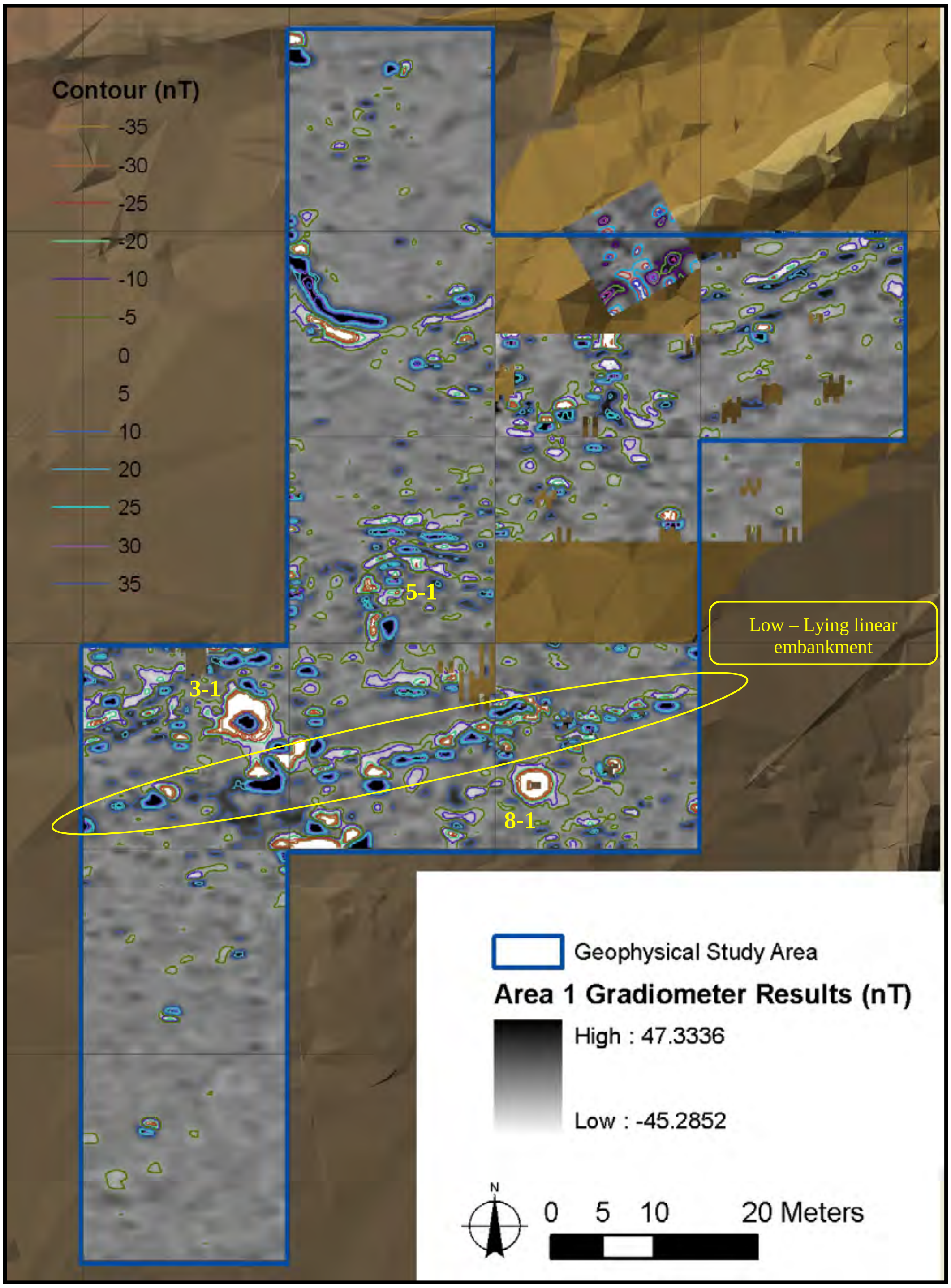


Figure 17. Area 1 Gradiometer Results, Selected Contours and the TIN.

The northern edge of the embankment has several large trees that obscure the linear anomaly associated with the possible mound feature. The largest trees were omitted from collection and can be seen as missing data in the grayscale magnetic data. Two large bull's-eye anomalies, identified on Figure 17 as 3-1 and 8-1, with strong boundaries are located on either side of the linear anomaly. These anomalies may represent modern or historic features of ferromagnetic materials, but the broad structure of the contours may indicate prehistoric features.

Grid 5 contains a series of anomalies described as 5-1 on Figure 17. Of note is a classic horizontal dipole field response as described in Breiner (1973:27). A close-up of Grid 5 appears in Figures 18 and 19. In these figures Anomaly 5-1 is separated into two parts A and B. Anomaly 5-1 is interpreted as a complex of anomalies created by a single context. AS discussed below, two very distinctive magnetic signatures can be examined to inform an interpretation of the anomaly complex. Anomaly 5-1A represents a horizontal remnant magnetic field. To the north of this anomaly are two "dipole" linear anomalies 5-1B. Because of this area's proximity to the Eastern Gateway Complex there is a high likelihood that this anomaly is associated with the prehistoric use of the site. Anomaly group 5-1 was selected for testing with other geophysical techniques that are discussed further in this section, and analysis of these data concludes that there is a high probability for this to be a prehistoric feature.

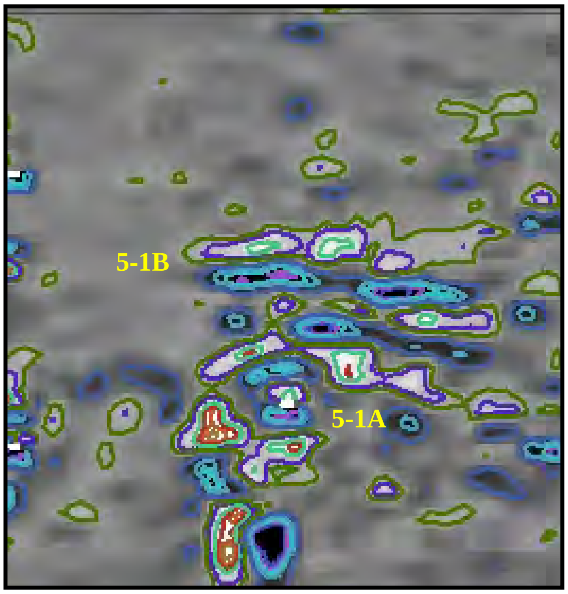


Figure 18. Close up of Grid 5 Gradiometer Results with Contours.

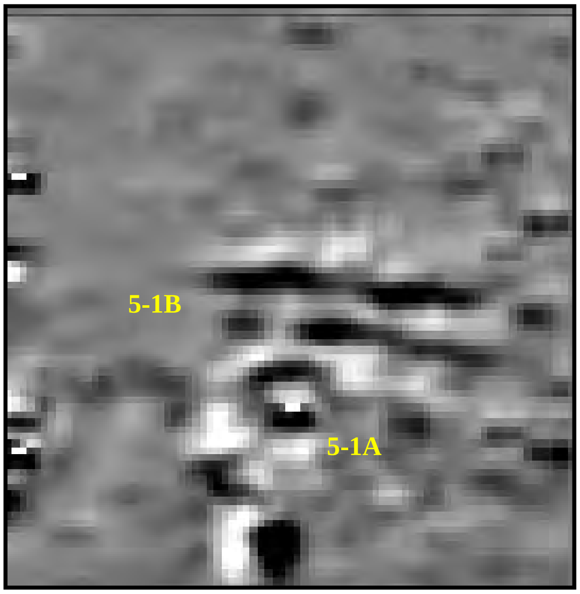


Figure 19. Close-up of Grid 5 Gradiometer Results.

North of this feature and also crossed by a buried gravel road is an anomaly that represents a ditch feature. In Figure 20, Anomaly 6-1is “dipole” curvilinear anomaly with strong boundaries. The variance in magnetic density over this feature is due to its intrusion into the clay subsoil. The clay subsoil presents a strong magnetic background. When this ditch was exposed and filled slowly by the eroding loess sediment an edge effect was created that can be detected as the clay “dips” further from the gradiometer sensor, and then “rises” again on the other side of the ditch on the traverse. This prominent anomaly was the only anomaly selected for ground-truthing from the geophysical survey because no ditch features had been identified within the enclosure during previous investigations. Ditch’s are common features in Middle Woodland enclosure sites, and factor into the interpretations of landscape use. A 1.5 m by 2.5 m test trench was placed on the edge of this anomaly, and it was confirmed to be a ditch feature. No diagnostic material was recovered here, but similar magnetic anomalies on the site can now be confidently associated with ditch features. At about the center of the curvilinear ditch is a single magnetic anomaly (6-1A) that is possibly a prehistoric feature associated with the ditch.

To the north of the ditch are several anomalies that are most likely historic in origin. At the north edge of grid 7 is a low-contrast linear anomaly this represents the near-field effects that occur at the edge of the prehistoric embankments found here. The northeastern section of Area 1 was surveyed in 10 meter by 10 meter grids since the large trees and heavy undergrowth made it difficult to perform consistent survey in long, straight transects.

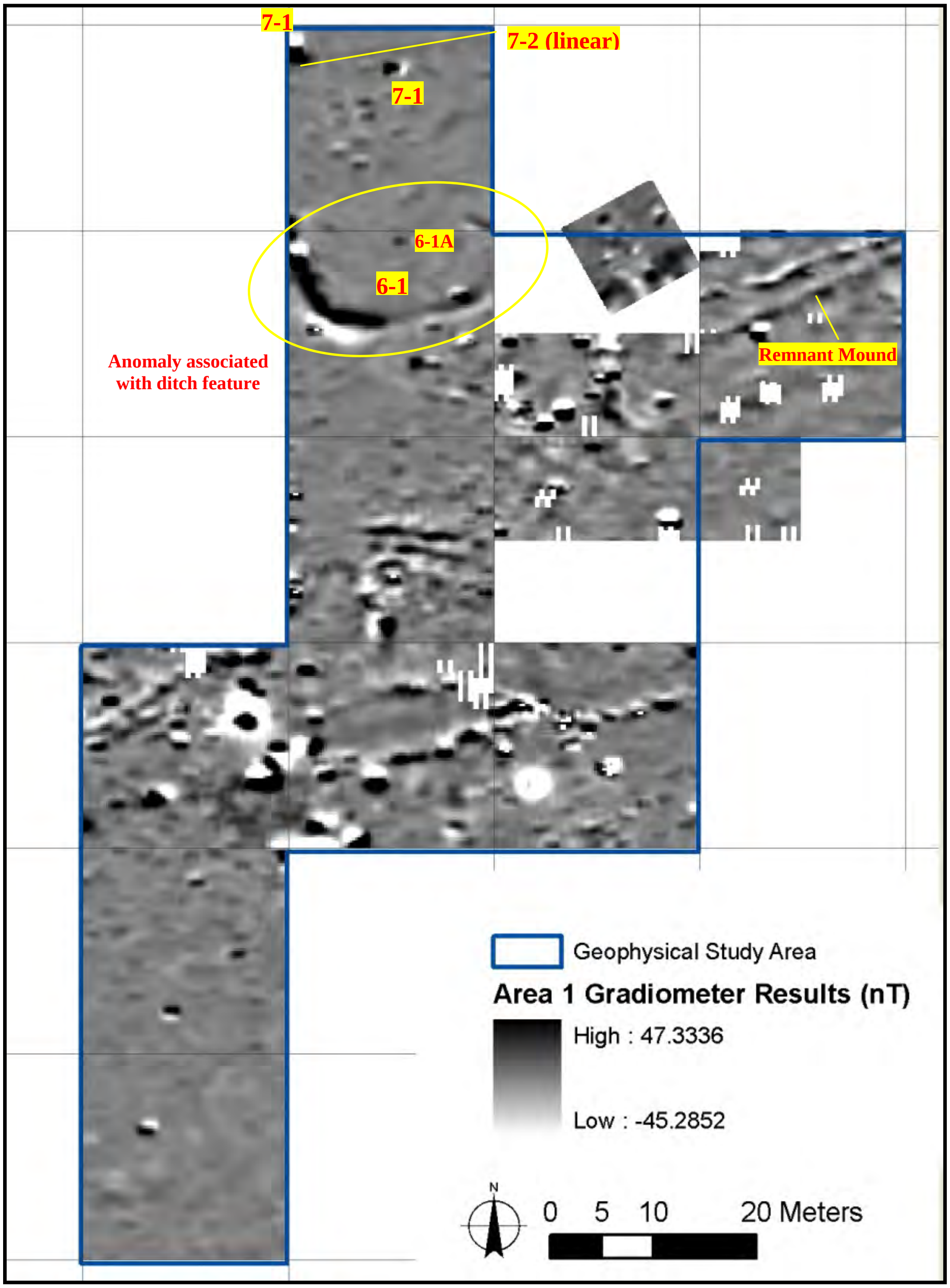


Figure 20. Gradiometer results from Area 1 with Select Anomalies Highlighted.

These data were processed separately, but with the same processing procedures. In the northeast corner of the survey area several strong responses from the edge of the remnant embankment and the intact portions of mound that were surveyed are apparent (Figure 20). The off-axis grid in the northern part of this area covers Trench 1.

Figure 21 displays the results of the gradiometer survey draped onto a psudeo-3D representation of the TIN to emphasize the flux created by the edges of the mound embankments. For comparison Figure 22 displays the results of the gradiometer survey as elevation values in oblique view. Here the edge effects from the mounds appear as raised areas and the ditch feature appears to sink. Notice the similarities between the responses from the entrance complex mounds and the low-lying linear mound in the foreground. This indicates that the targets creating the anomalous readings are of the same character, and therefore similar in structure.

Another anomaly that requires attention is the linear anomaly 11-1, north of the mound remnant in Figure 23. This anomaly is similar to the response from the edge of the mound embankments, but no topographic feature is associated with it.

It does not lie on the same azimuth as the parallel embankments. This represents a buried feature in the entrance complex, and is possibly evidence of an earlier stage of the Eastern Gateway Complex. Faulkner (2002:200-203) reports that this area of the site was modified prehistorically: a ditch was created and conical mounds constructed and then later the parallel mounds were constructed requiring modification of the ditch feature. It is likely that this anomaly is another indication of the changing use during the prehistoric construction in this portion of the site.

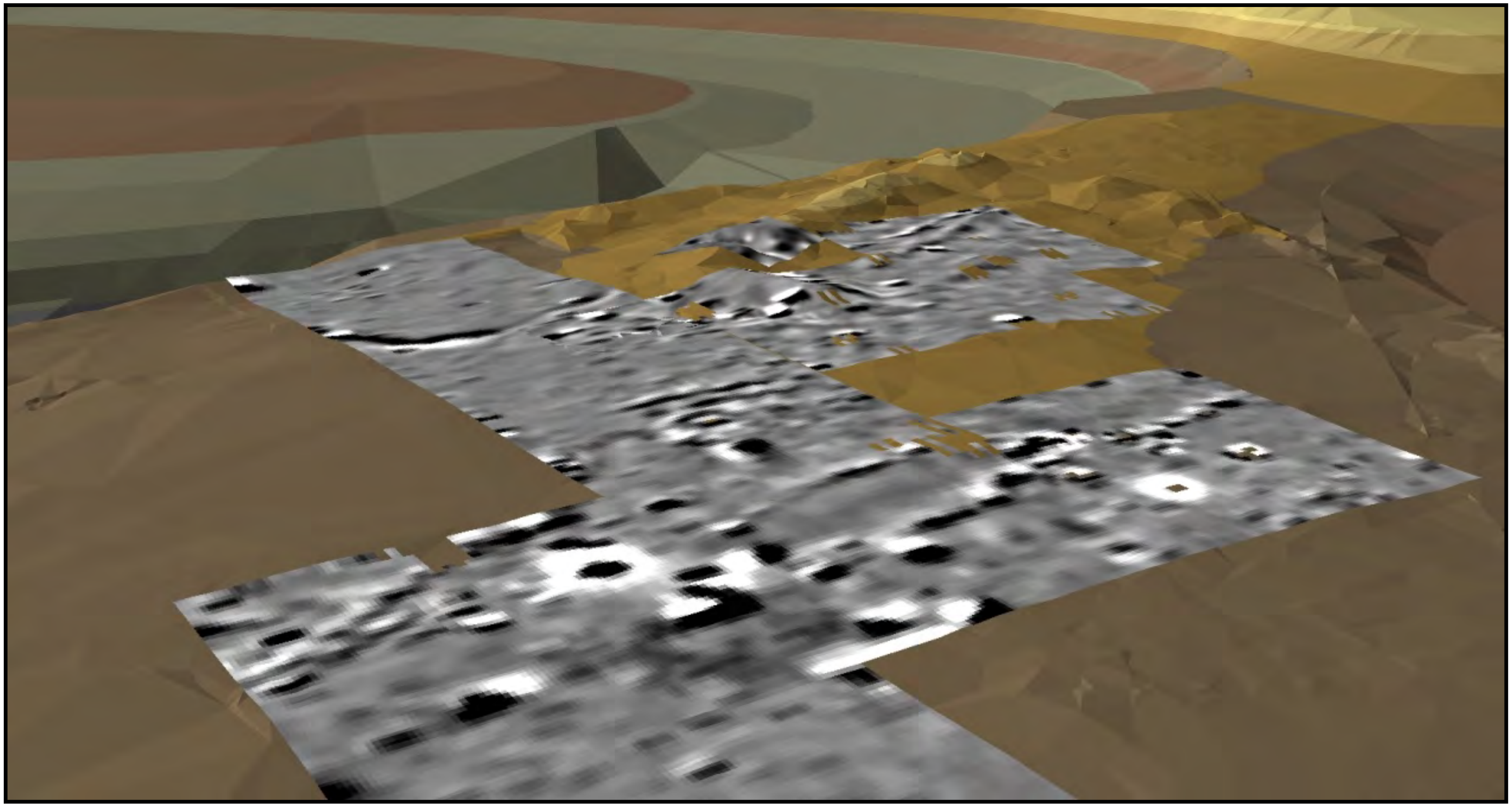


Figure 21. Oblique View Facing Northeast of Area 1 Gradiometer Results Fit to Elevation Model.

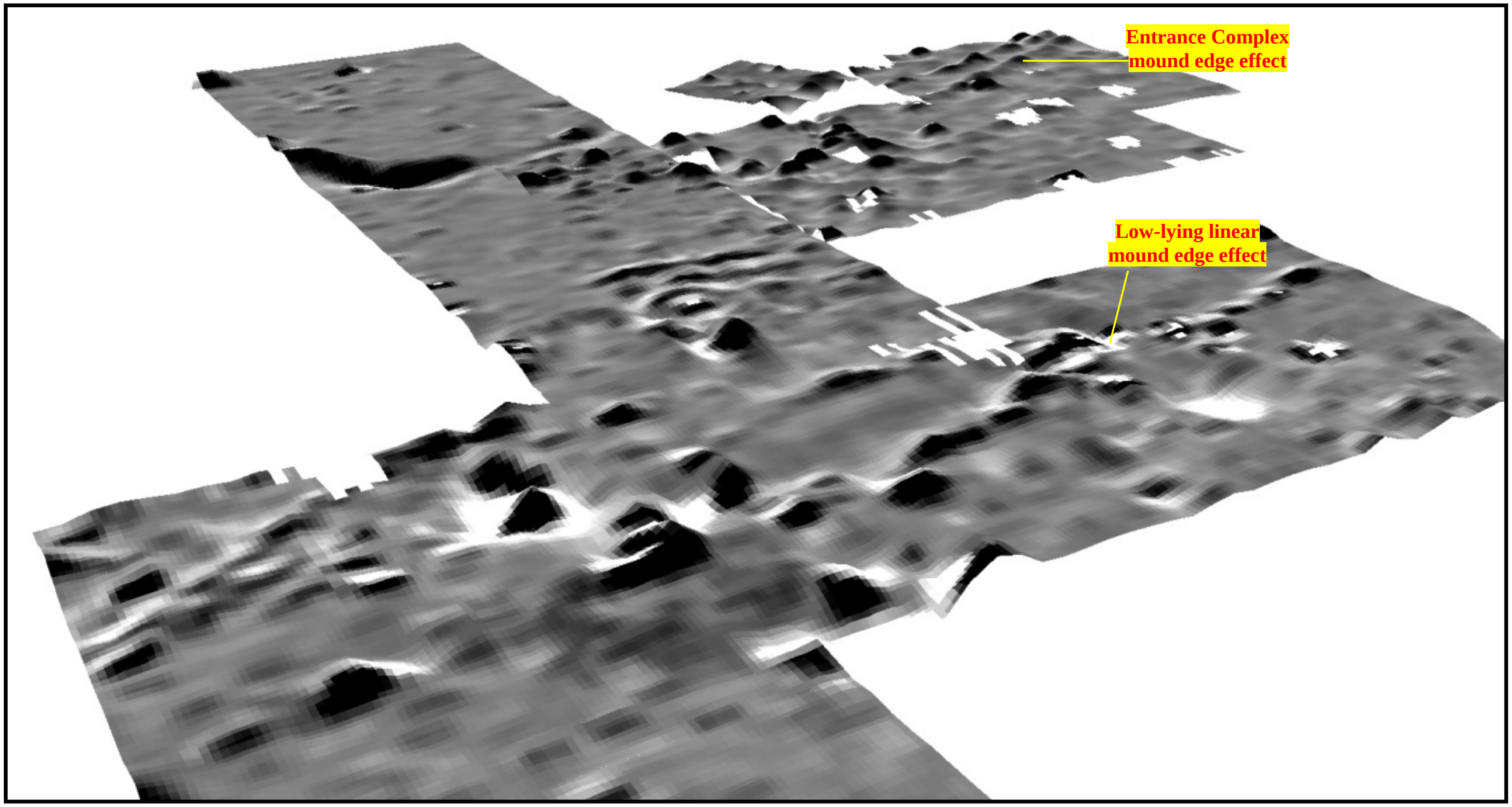


Figure 22. Oblique View Facing Northeast of Area 1 Gradiometer Results as Elevation Model.

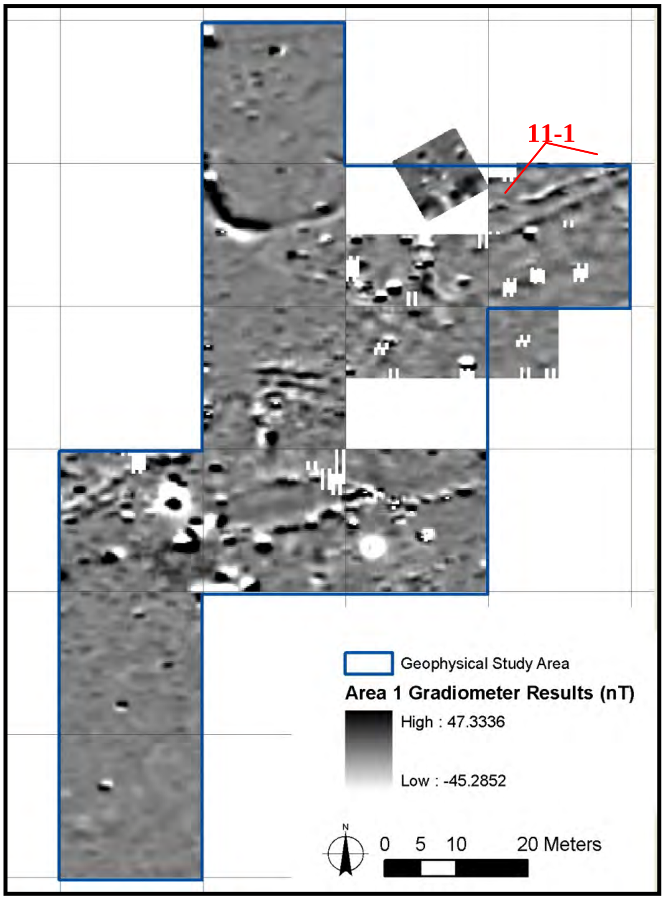


Figure 23. Gradiometer results from Area 1 with anomaly 11-1 highlighted

The two survey grids in the southwest portion of Area 1 contain few high contrast anomalies with strong boundaries. When these two grids are compared to the rest of the data set they are rather “quiet” survey units. Figure 24 shows an enhanced view of this survey section that has been clipped at 10 nT to -10nT, which allows the medium contrast anomalies to stand out. The figure shows a semicircular pattern (anomaly 2-1) of small round anomalies spaced about 1.5 meters apart in an arc that spans roughly 7 meters in diameter.

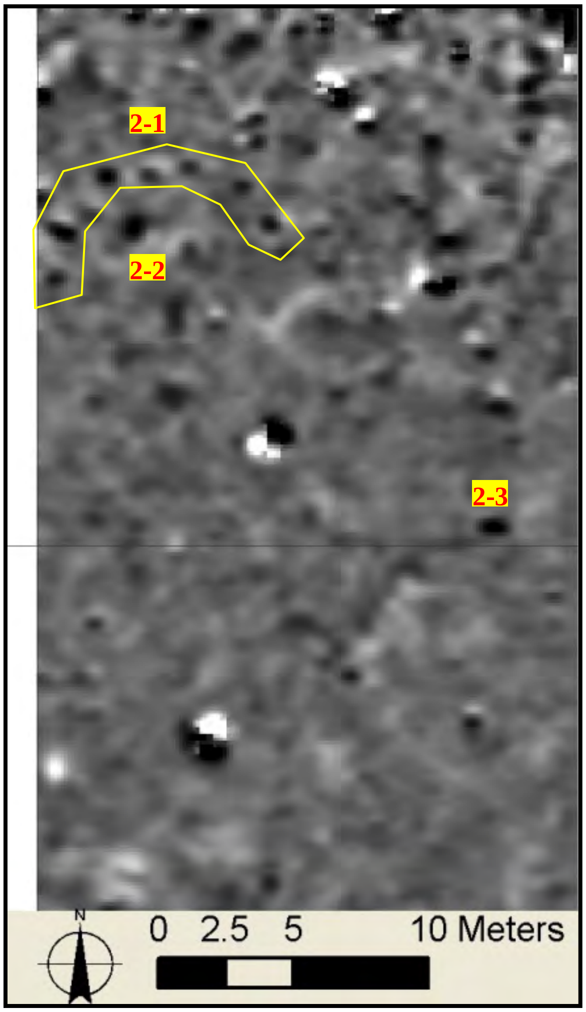


Figure 24. Area 1 Close-up of Grids 1 and 2

Within the arc are several weak to medium magnetic responses. One positive anomaly, greater than a meter in diameter (Figure 24, anomaly 2-2), is consistent with the character of a subsurface pit feature. These anomalies together could represent a prehistoric structure. Inspired by the recent work of Palmyra Moore (Moore 2009), this researcher geo-referenced a plan map from the McFarland excavation, a Middle Woodland archaeological site less than a mile from Old Stone Fort that contained several circular structures (Kline, et al. 1982). These structures have a 7 meter diameter, and at the

McFarland site are interpreted as special purpose structures. The only processing used to reference the image was to bring it to the appropriate scale for the map project and then line up one structure with the anomaly pattern. In other words the plan map was simply fit to the pattern and not stretched or re-scaled. As shown in Figure 25 both the original scale for the figure and the scale from the GIS are similar and the pattern of posts and features line well, and this lends credence to the analysis of this anomaly pattern as a archaeological deposit.

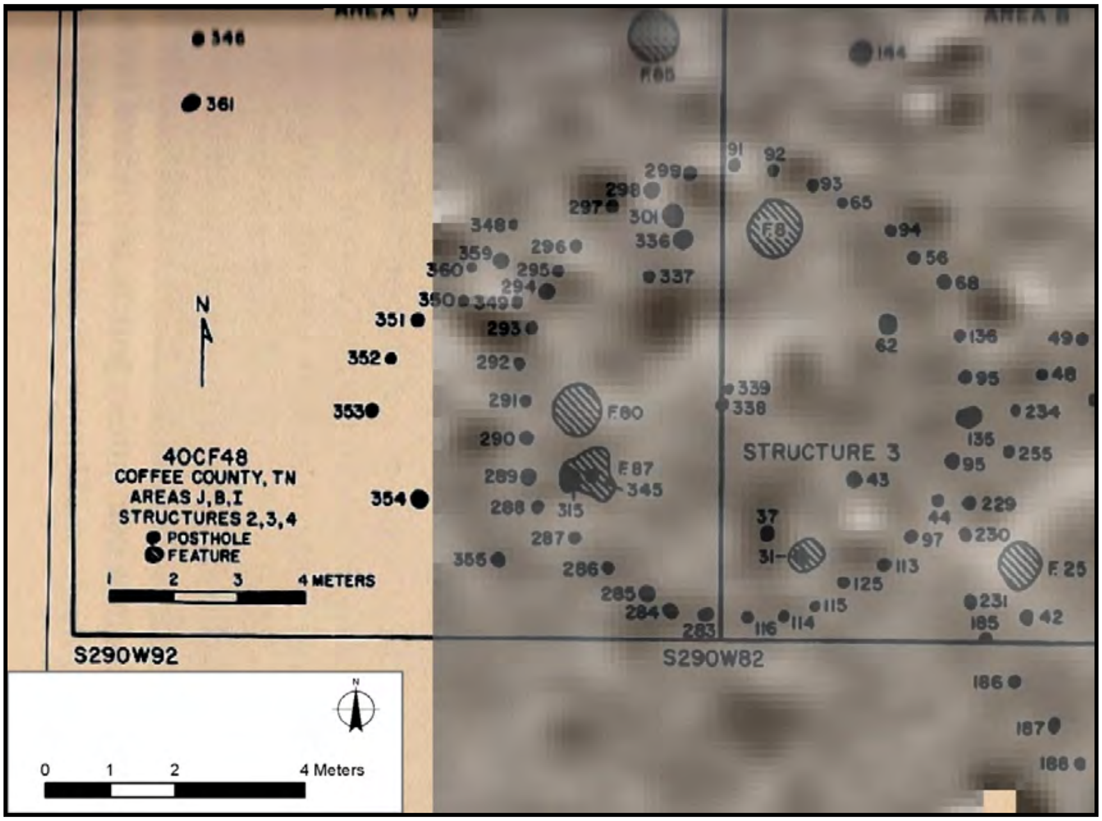


Figure 25. Structure 2 From McFarland Site Georeferenced to Possible Structure Pattern in Grid 2 of Area 1 (figure adapted from Kline et al 1982)

Figure 26 displays the McFarland structure post pattern below selected contours from the FM36 gradiometer survey. These contours represent the absolute value of the gradiometer survey ranging from 4 to 15 nT. The fact that each anomaly is within this small range strengthens the interpretation that they represent similar deposits, and further more there is a strong correlation between the incidence of features from the plan view map, and the highlighted anomalies. In some cases a single anomaly spans more than one post, and thus both posts are considered to correlate spatially with the posts from the McFarland structure. While these data do not allow for the indisputable claim that this anomaly pattern represents a structure, nevertheless, there is a strong correlation between the Old Stone Fort pattern and the McFarland structure pattern.

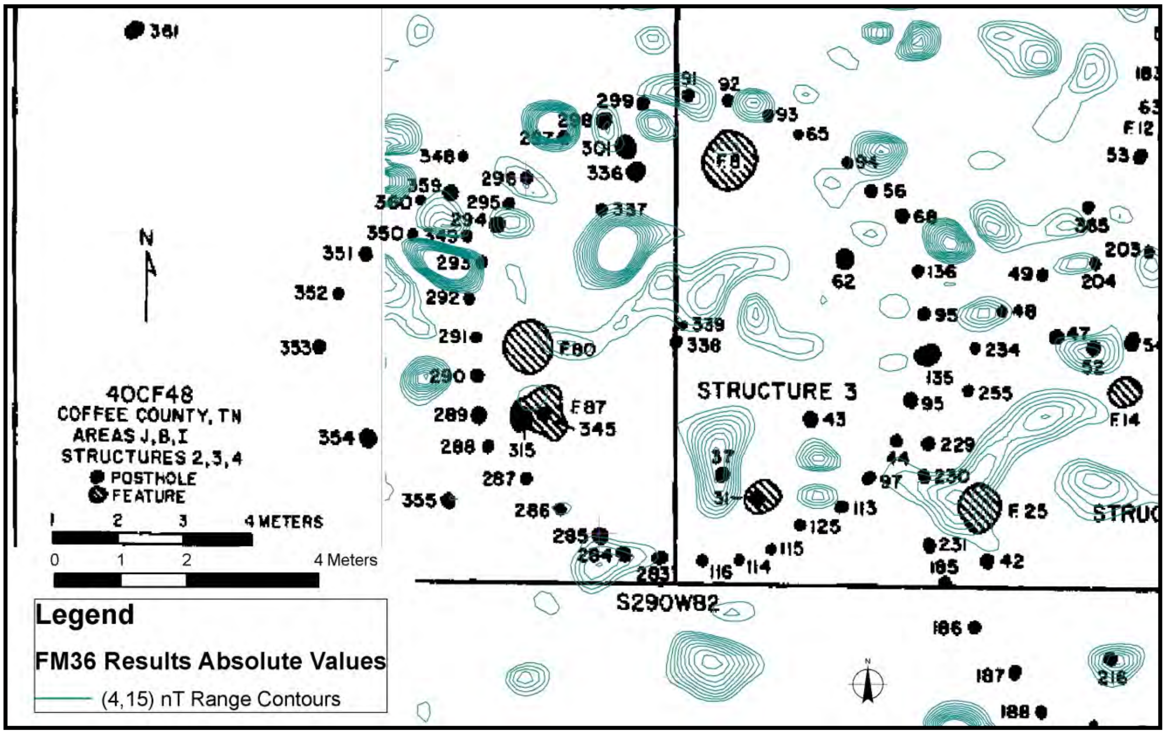


Figure 26. McFarland Structure 2 with Contours of Gradiometer Data (Contours are Absolute Values)

One other element in the survey is considered to represent a pit feature, and it is located in the southeast corner labeled 2-3 in Figure 24. The two “dipole” anomalies are greater than a meter in diameter and are very likely cultural features, but the steep slopes observed in the contours suggest a more recent and near surface origin of the target. There remains a small probability that these anomalies are prehistoric in origin, considering the remnant field responses from both face a similar direction and may indicate heating *in situ*. This southwestern portion of the survey contains the least variation in readings in Area 1.

Area 1 Conductivity and Magnetic Susceptibility

A Geonics EM38B was used to record both in-phase and quad-phase induced EM data. This instrument was provided for use by the Archeo-Imaging Lab. The data were minimally processed (cleaned, clipped and smoothed) for visual analysis (Kvammee 2006 personal communication). Figure 27 shows the results of the two EM surveys next to the gradiometer survey covering the same area.

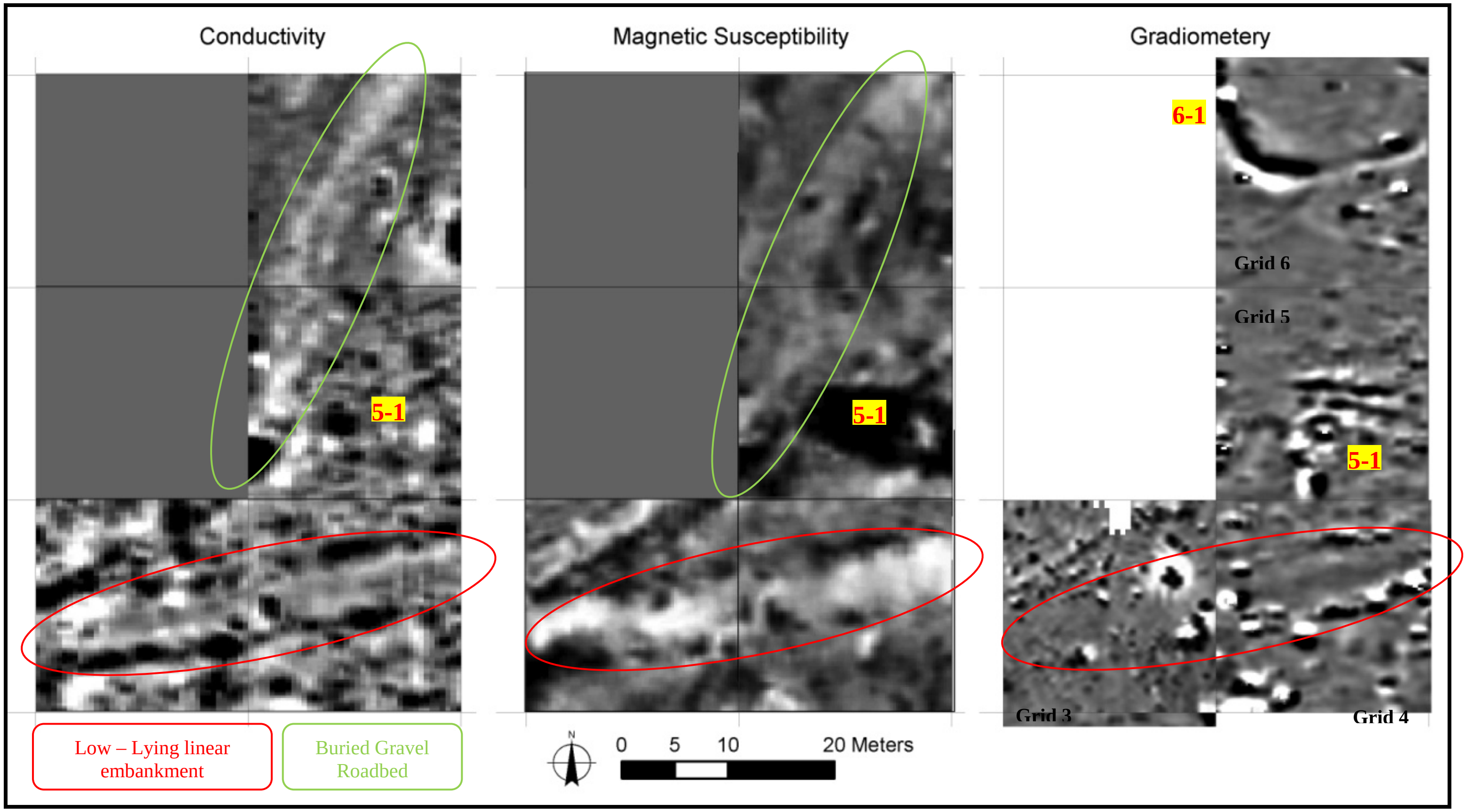


Figure 27. Area 1 EM Survey Results with Gradiometer Results for Comparison.

In the southern grids the edge of the low-lying linear mound is quite visible in each dataset. In both the magnetic susceptibility and the conductivity datasets, there is an anomaly that trends in a northeast direction. This linear feature lines up with the gradiometery data in Grid 3, but does not correlate well in Grids 5 and 6, except where there is a break in Anomaly 6-1. This EM signature is created by a remnant of a buried gravel drive. This anomaly crosses over the ditch feature in the magnetic data where it appears segmented in gradiometer results. The ditch does not appear in the EM survey data, and the road does not appear in the magnetic data. The low mound appears in all three data sets. This indicates that the composition of the three different features varies greatly, and therefore the low-lying mound represents a different type of feature than the roadway. The gravel comprising the road covering is the most likely source for the low conductivity and magnetic susceptibility results. Therefore, limestone features on the site will also have low conductivity and magnetic susceptibility at the site. This is an important inference, since it may be used to identify mound features at the site without excavation.

The center grid contains the horizontal, dipole Anomaly 5-1. This complex of anomalies responds differently to each geophysical instrument. The magnetic susceptibility shows a large, strong contrast anomaly with abrupt boundaries covering the entire area that correlates to the magnetic anomaly complex, and the conductivity shows strong contrast, circular anomalies in both positive and negative ranges. Figures 28 and 29 display the results of the EM surveys and a two-grid resistance survey over the same location with the gradiometer results contours overlain. The resistance results over Anomaly 5-1 indicates a stone layer just under the turf. Since the area is covered with stone it could be that the complicated magentic signature is related to the stone piled near the surface causing near-field effects. Metal objects are not likley the source of the Anomaly 5-1 since the conductivity does not indicate the presence of metal there. In other words low conductivity is likley to mean there is no substantial amount of conductive material there.

Analysis of this complex of anomalies concludes that it is prehistoric in origin. This is most likely a prepared stone surface made of the same material that was used to build the mounds, and this area may represent a staging area for mound building. The Anomaly 5-1 represents a high resistance anomaly, with low magnetic susceptibility, several conductivity anomalies, and complicated gradiometer responses. This response is far from typical, and a perusing of the literature comes up empty for comparative samples. More research is required here to increase the probability of appropriate characterization.

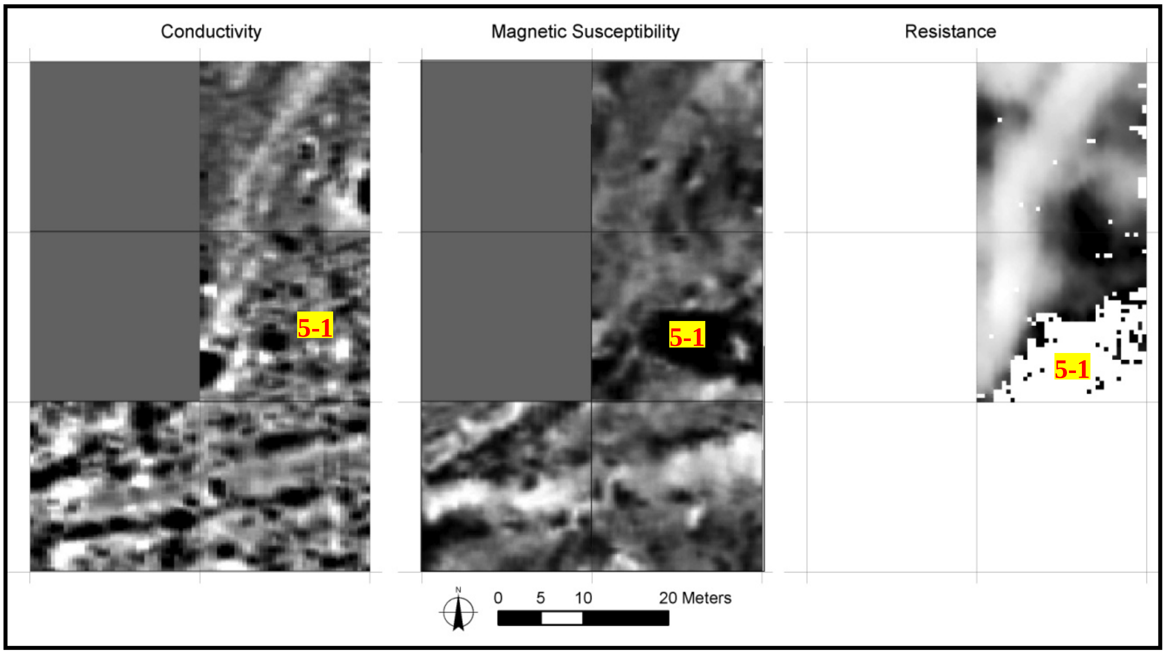


Figure 28. Area 1 EM Survey and Resistivity Results

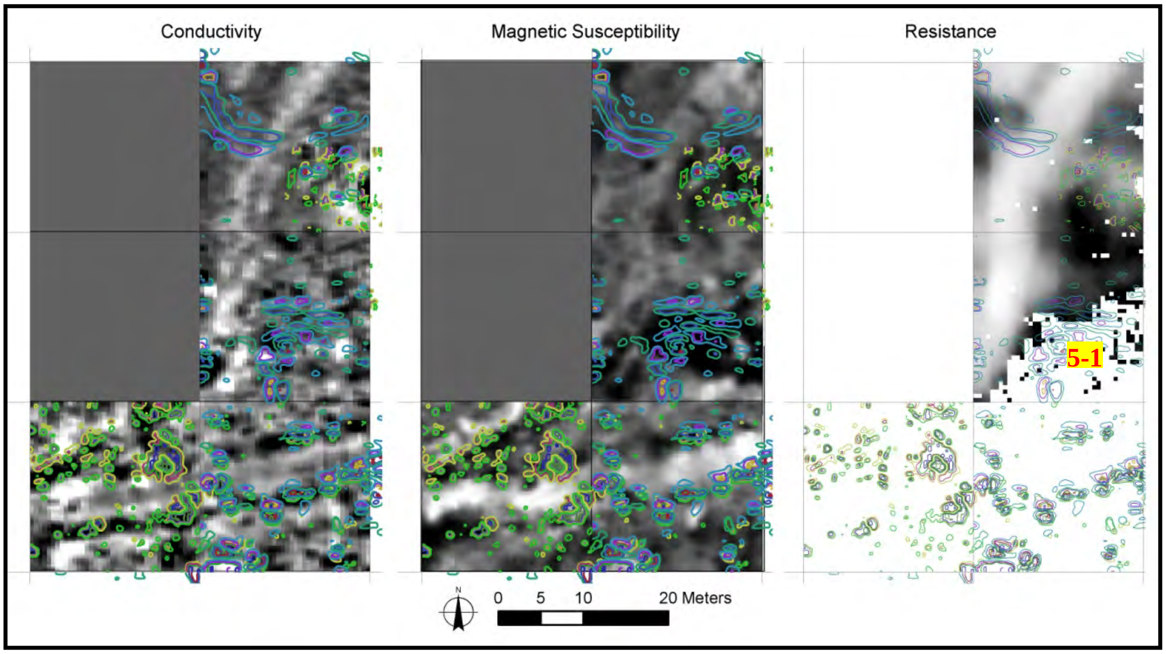


Figure 29. Area 1 EM Survey and Resistivity Results with Gradiometer Contours Overlain.

Area 1 GPR Survey Results

During the fieldwork portion of this project the SIR3000 GPR system that was used to collect the grid survey units for this area experienced technical malfunctions that resulted in a loss of data. Two mechanical issues were discovered: The odometer wheel failed as did several pins in the antenna connection. Four GPR profiles were collected with the GSSI SIR3000 with 400MHz antenna (Figure 30), at 60 scans per meter, stacked 4 times. Gain settings and other specifics are presented in the appendix.

The minimally processed GPR profiles are shown in Figures 31 and 32. These files have had the background noise removed using a Finite Impulse Response (FIR) Filter, and the display gain has been enhanced. Locations of the mound features are indicated on the profiles.

The GPR traces vary greatly between mound and non-mound surface. Several subsurface layers are present in profiles three and four, and correlate to a construction stage that is observed in the mound profile. These data were collected at a range of 50 nS with the surface occurring at about 6.5 nS.. In Profile 3 a highly reflective surface is observed in the mound at 25 nS, and at around 30 nS in Profile 4. This surface is the result of reflections from the flat faces of shale slabs observed in the

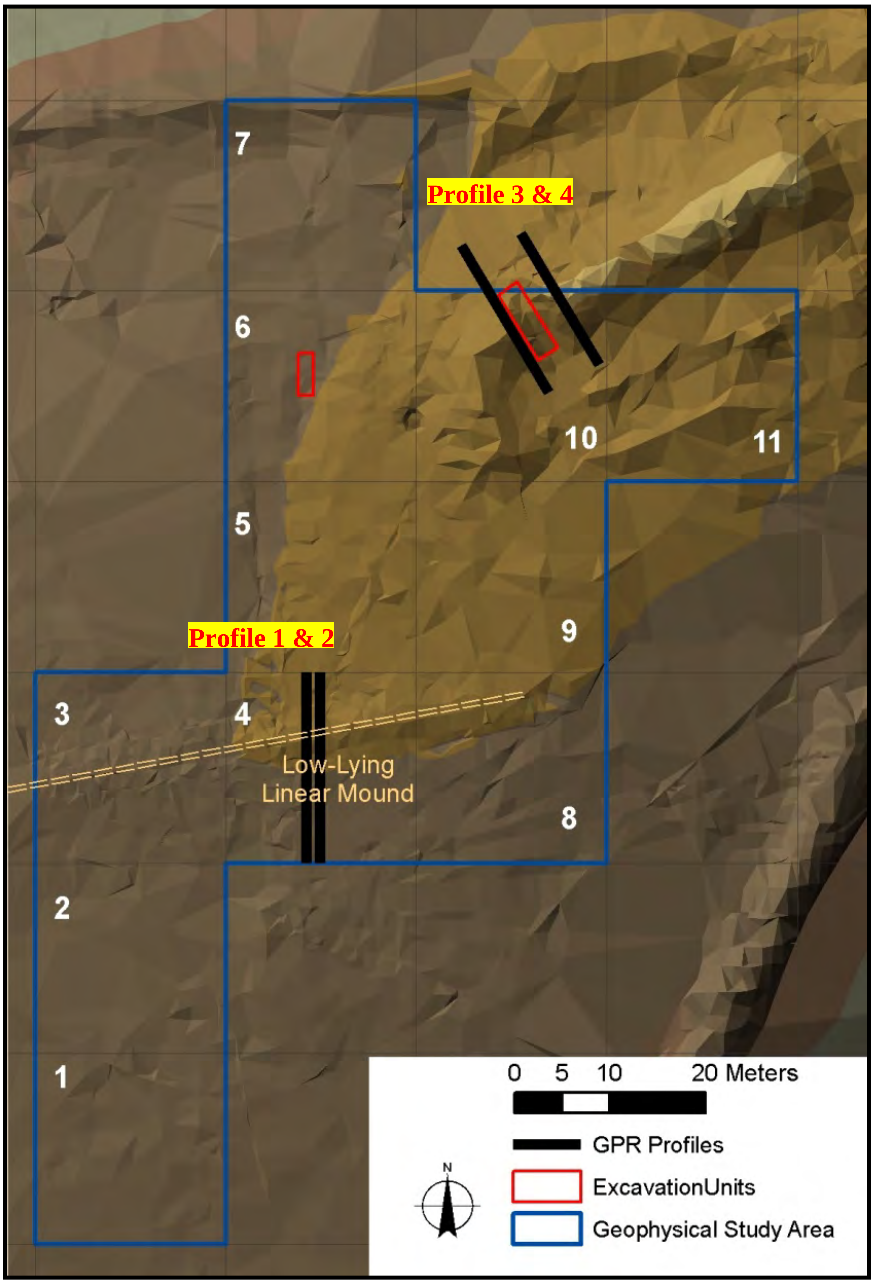


Figure 30. Area 1 Location of GPR Profiles

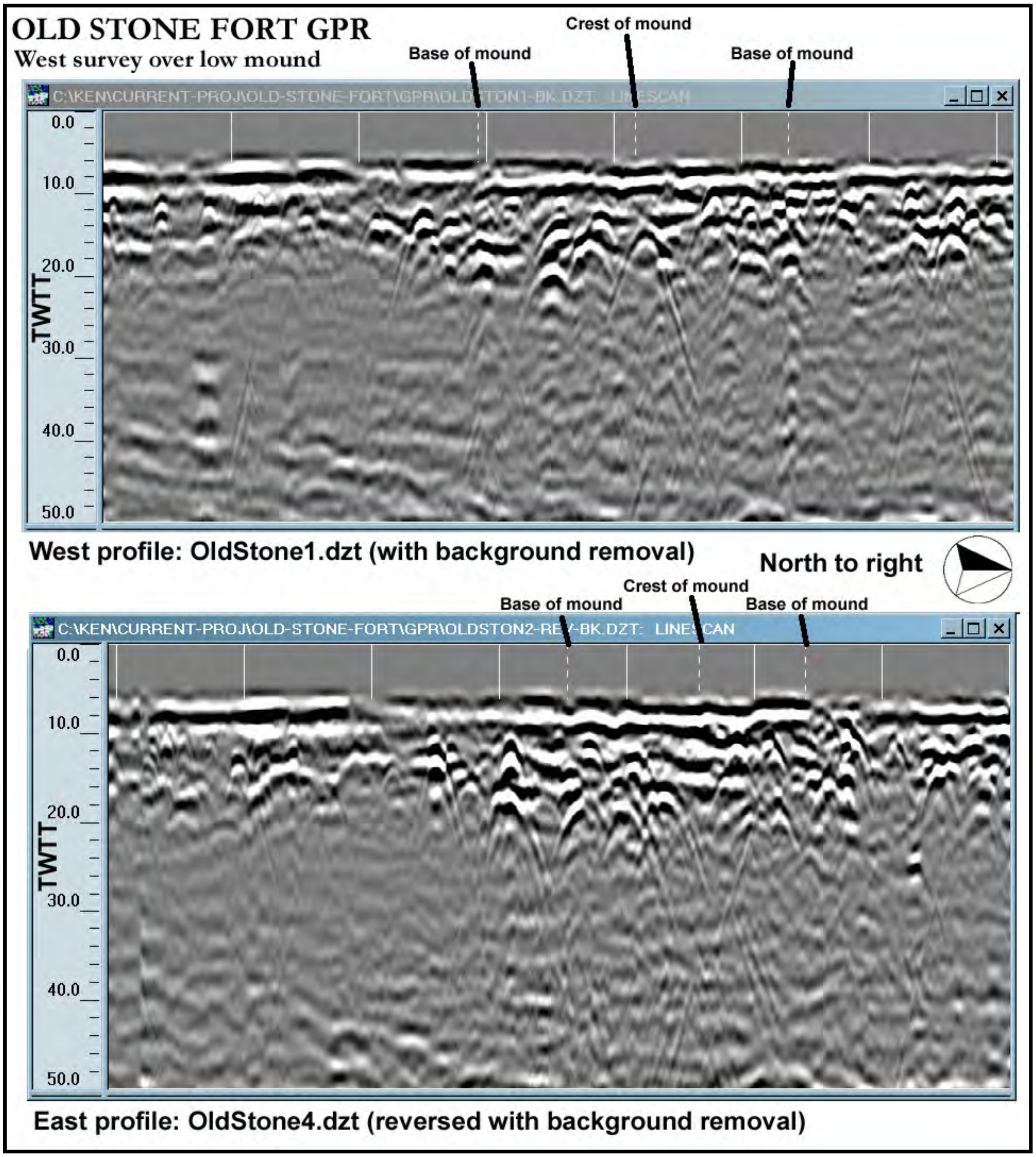


Figure 31. Area 1 GPR Profiles 1 and 2.

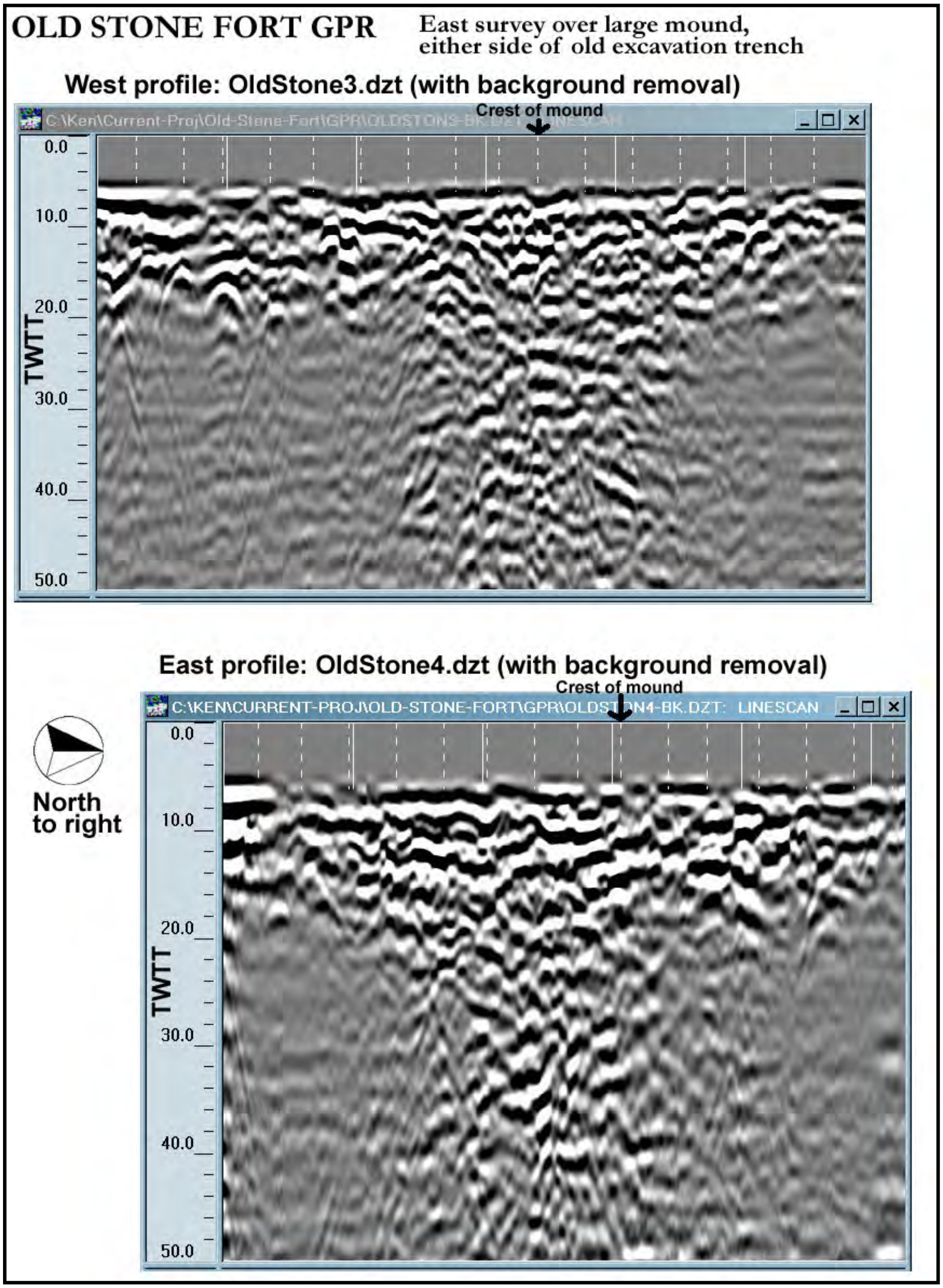


Figure 32. Area 1 GPR Profiles 3 and 4.

excavated profile. The radar profiles corroborate the interpretation that this mound was built in stages consistently through this embankment. This is a trait that Old Stone Fort shares in common with nearly all hilltop enclosures—staging in earthwork? construction.

Also noteworthy in the GPR results is the overall signal penetration. The two profiles collected in the open area of the enclosure show a stratigraphic unit that is not as thick as the unit in profiles three and four, which are on the mound area of the gateway complex. Loess sediment that is much thicker under the mound than it is in the open area is the most likely source of the GPR response. Also, the GPR response is quickly attenuated as the loess stratigraphic unit is cleared and the clay subsoil is encountered.

Area 1 Excavation Results

Two excavations were performed in Area 1. Trench 1 was placed into the stone embankment of the Eastern Gateway Complex within previously excavated trenches, and Trench 2 was placed adjacent to a geophysical anomaly for ground-truthing purposes (Figure 33). Both of these test trenches were excavated mechanically.

Trench 1

Trench 1 is located in Area 1 where a trench has been excavated twice previously (Cox 1929, Faulkner 1968). The location of the trench and the impression from the previous excavations can be seen in Figure 34. An uncalibrated radiocarbon date of A.D.

430, recorded in the previous UT excavations, came from this portion of the mound (Faulkner 1968:24).

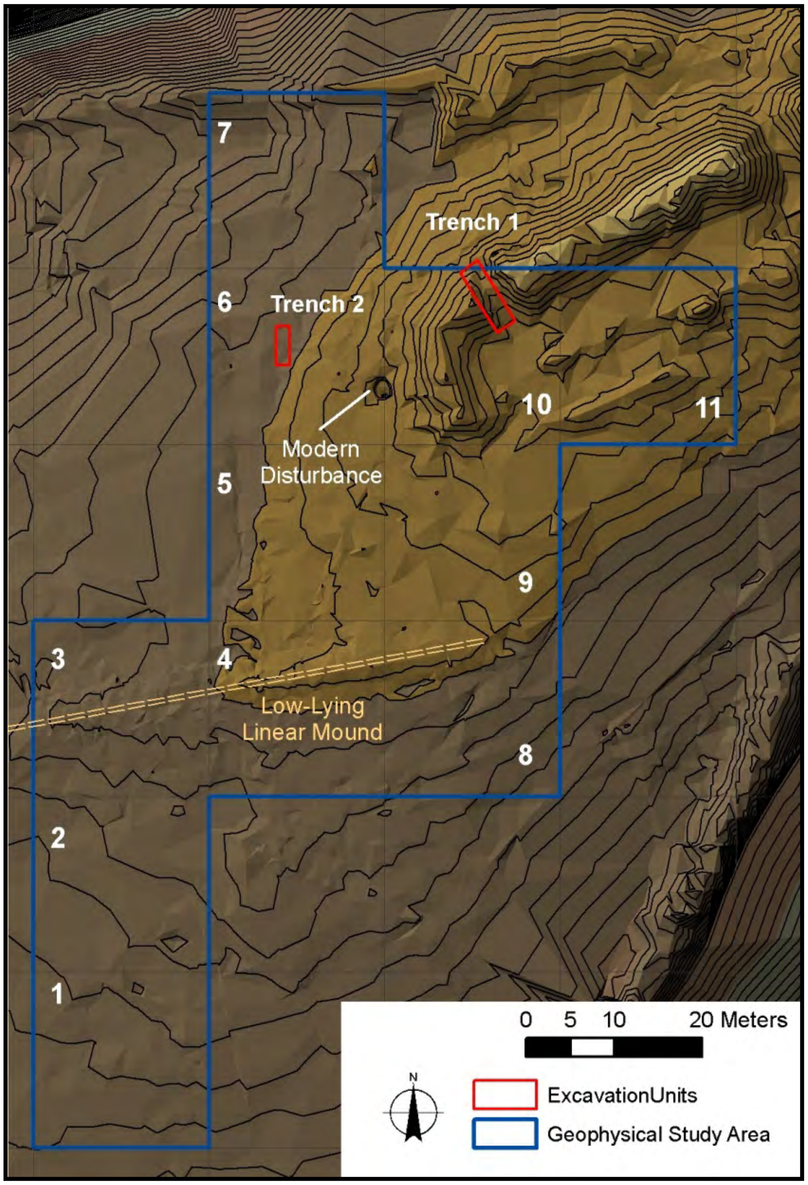


Figure 33. Location of Excavation Trenches 1 and 2

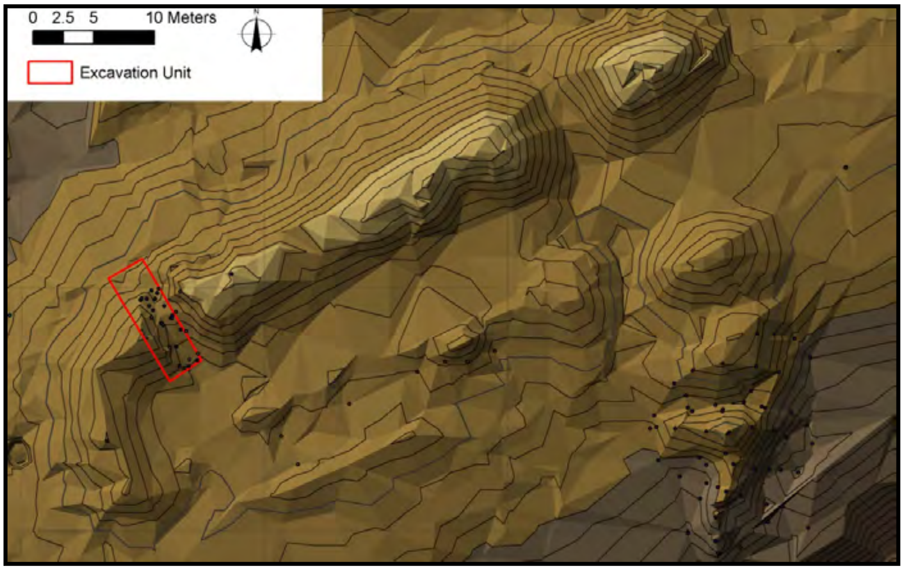


Figure 34. Location of OSFAP Trench 1.

The backfill from the previous excavations was removed in order to reexamine the stone mound profile, and to compare the stratigraphy with the geophysical data. The trench was never completely backfilled from the previous excavations, and settling further lowered the height of the mound (Figure 35). Trench 1 was 10 meters long by 3 meters wide, but the only portion of undisturbed mound that was excavated was less than a meter wide. The excavations exposed the surface just below the loess sediment and a small test pit was excavated to the cherty residuum to gain access for geoarcheaological analysis. In re-excavation the difference between the backfill of the old excavation and the intact portion of mound was obvious. Within the backfill, any shale slabs were crushed into small pieces (<5 cm). As the excavation began to expose the intact mound profile, large intact slabs of shale that

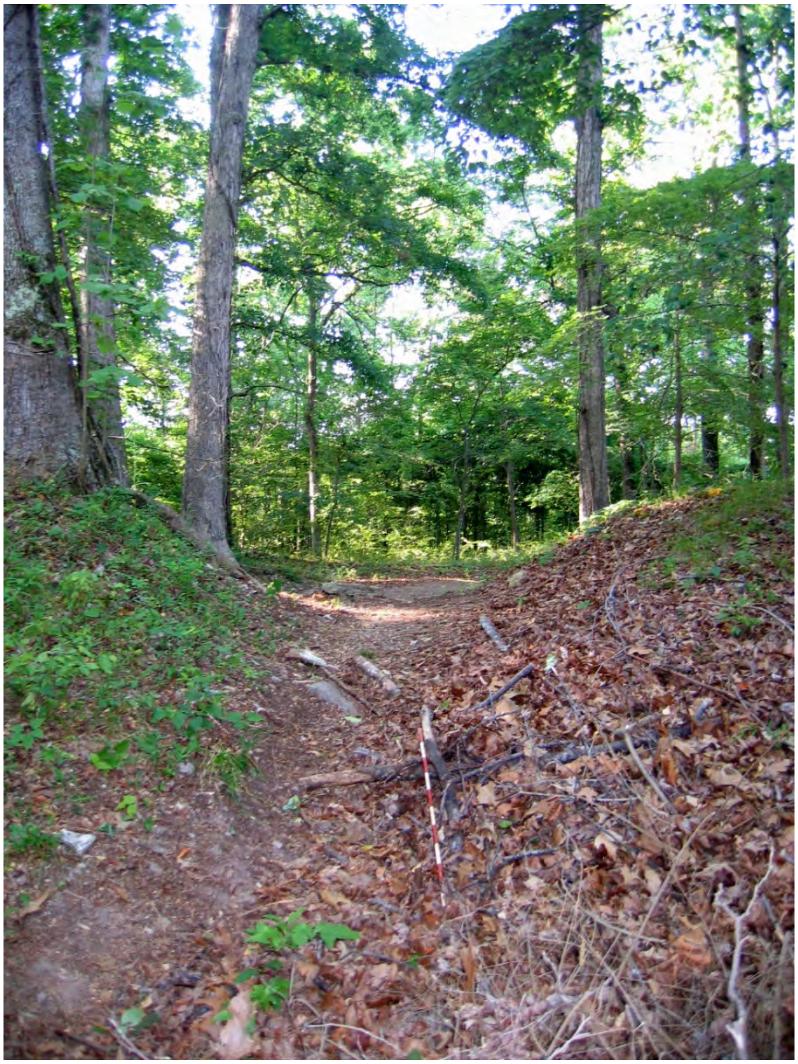


Figure 35. Photograph of Trench 1 Prior to Re-Excavation.

had weathered to friable thin sheets marked the extent of the previous investigations (Figure 36). Figure 37 is the west profile of Trench 1 during excavation and shows the weathered shale.

When the profile was cleaned photographs were taken to create a photo-mosaic of the mound for generating a profile view with digital imaging.

Figure 36. Trench 1, Close-up of Weathered Shale in Profile.

Figure 37. Trench 1 West Profile.

These results are presented below in Figure 38. This reveals two distinctive shale lenses in the profile. This had not been observed at the site before, although Faulkner mentions limestone slabs. The shale slabs that occur in the lenses are larger generally than the isolated pieces of shale elsewhere in the profile, and most are flat rectangular slabs, or were presumably before the weathering occurred. Figure 39 shows a close view of the shale lens as it occurs on the northern end of the profile.

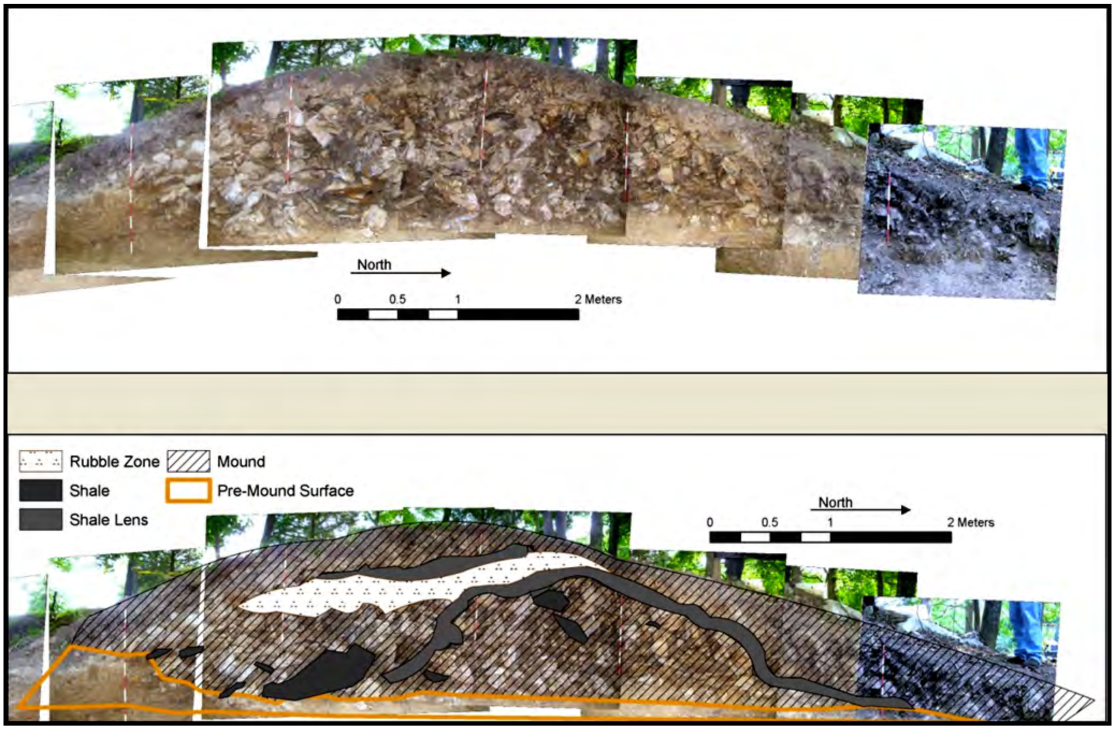


Figure 38. Trench 1 West Profile Geo-Referenced Photo Mosaic.

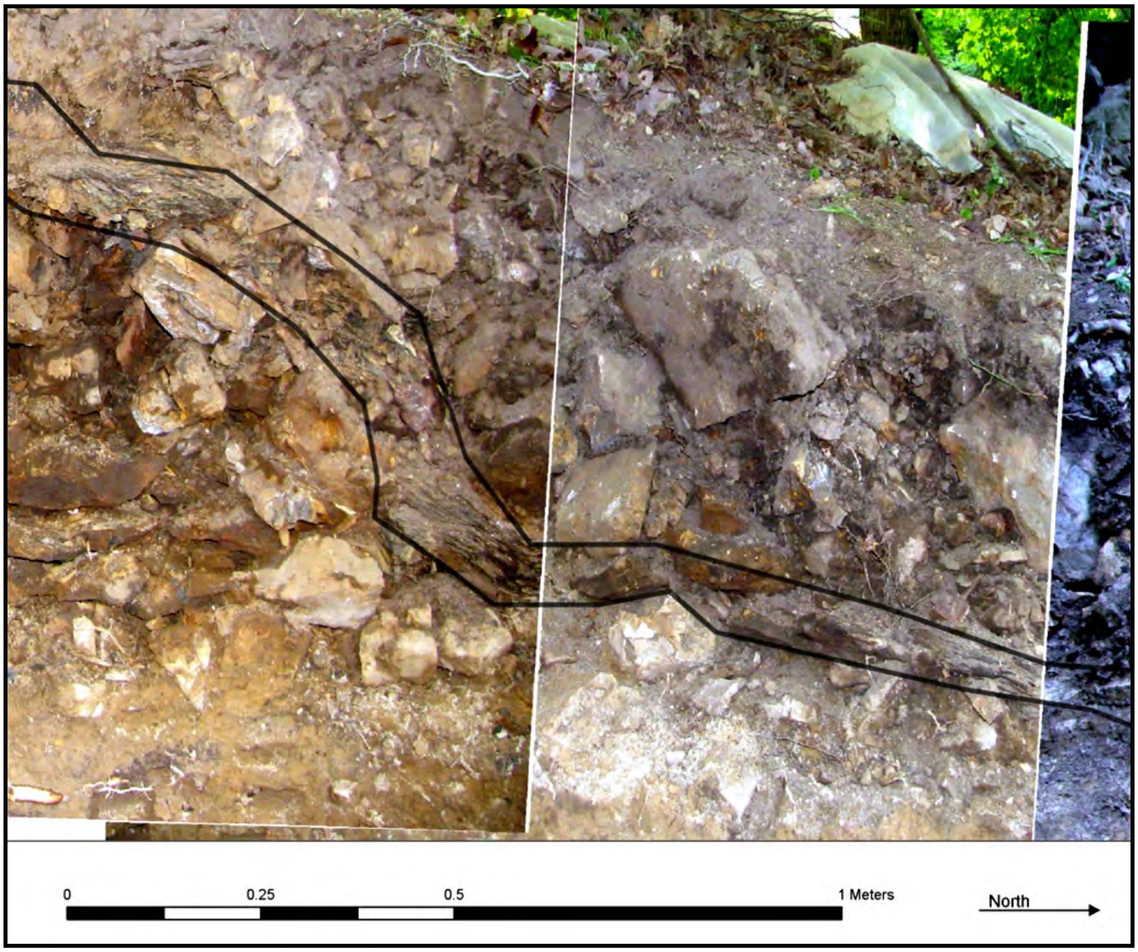


Figure 39. Trench 1 with Shale Lens Outlined.

Figure 40 shows the geo-referenced GPR Profile 4 facing southwest. The shale layer is probably a cause of the deeper reflection data in the radar profile. These data were further processed by correcting for time zero, and by migrating hyperbolas with variable velocity and surface correcting for elevation changes every meter. The shale layer reflects strongly in some cases but is not completely consistent, because large angular rocks in the profile scatter the GPR energy and obfuscate the wave response.

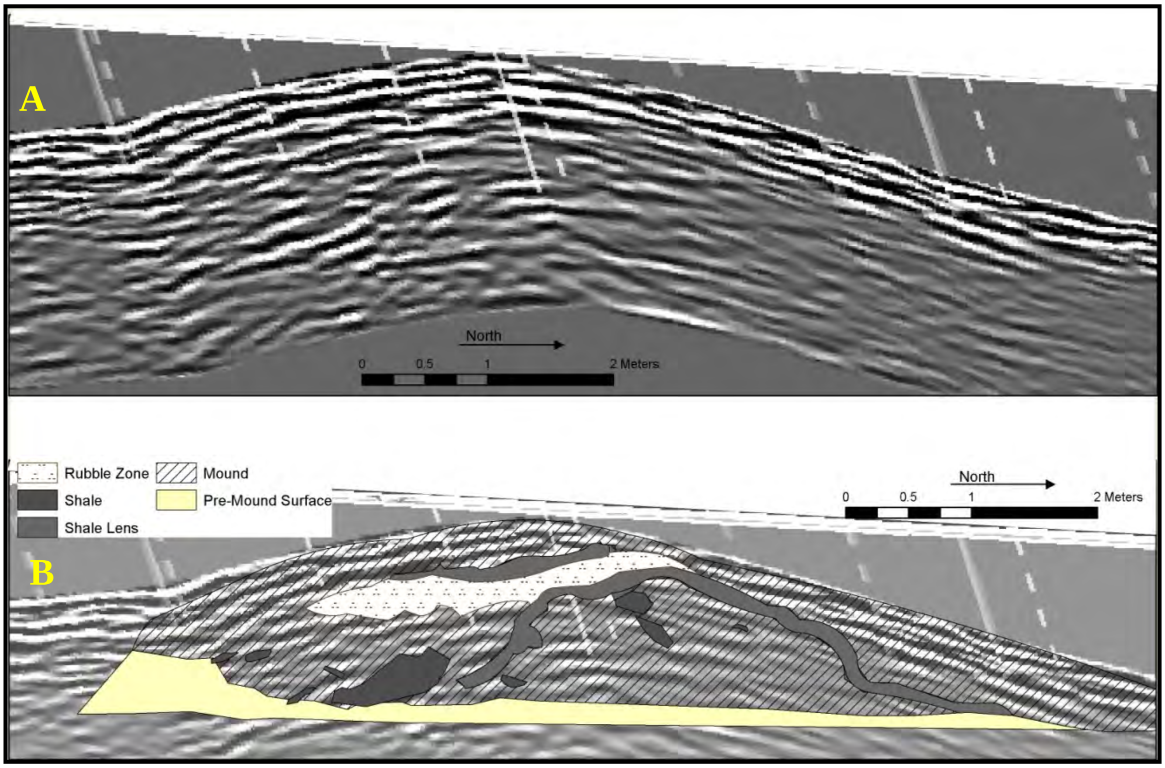


Figure 40. A.) GPR Profile 3 Georeferenced to Transit Dat. B.) with Profile Overlay.

The left lower part of the profile shows layered reflections that match the location of stacked shale in the mound profile, and in the center another layered response correlates to stacked limestone blocks. In the top center of the profile the shale lens produces layered reposes in the GPR data as well. Magnetometer survey was also collected at the site of Trench 1 (Figure 41). The results are informative in that the edge effect from the mound is present like the other embankments, and the interruption from the previous excavations at the site is apparent. In this respect the gradiometer may be the most appropriate instrument for locating mound remnants throughout the rest of the site, although GPR is more informative to structure. In Figure 41 the gradiometer data is draped over the triangulated elevation model which warps the image, but clearly shows where the dense edge response is interrupted at the site of the old excavation trench.

Several modern artifacts were recovered from the backfill deposit in trench one. Additionally one 10 centimeter lithic core, two scraper tools, and debitage ranging from 1 to 4 centimeters all made from local Fort Payne chert were collected during excavation. No diagnostic artifacts were recovered, and no features other than the mound fill were encountered. Although charcoal was present in the mound fill, none was encountered in any stable context or recovered for dating. At the base of the mound, no discernable A Horizon was detected, and the loess sediment was much thicker here (40cm) than in open areas of the field. The absence of a distinct A Horizon may indicate that the surface was prepared prior to mound construction, and the thickness of the loess documents the erosion that has taken place within the open area of the enclosure.

Trench 2

Trench 2 is located about 10 meters west of the westernmost edge of the Eastern Gateway Complex (Figure 32). The trench is 4 meters long by 1.5 meters wide, and was excavated to a depth of 1.5 meters into the cherty residuum. This trench was excavated to expose a large magnetic anomaly that represents a ditch feature associated with prehistoric use of the site. Figure 42 compares results between the gradiometer and EM survey along a 60 m transect. In the northern grid unit there is a very distinctive curvilinear anomaly in the gradiometer data that is not readily discernable in the EM survey.

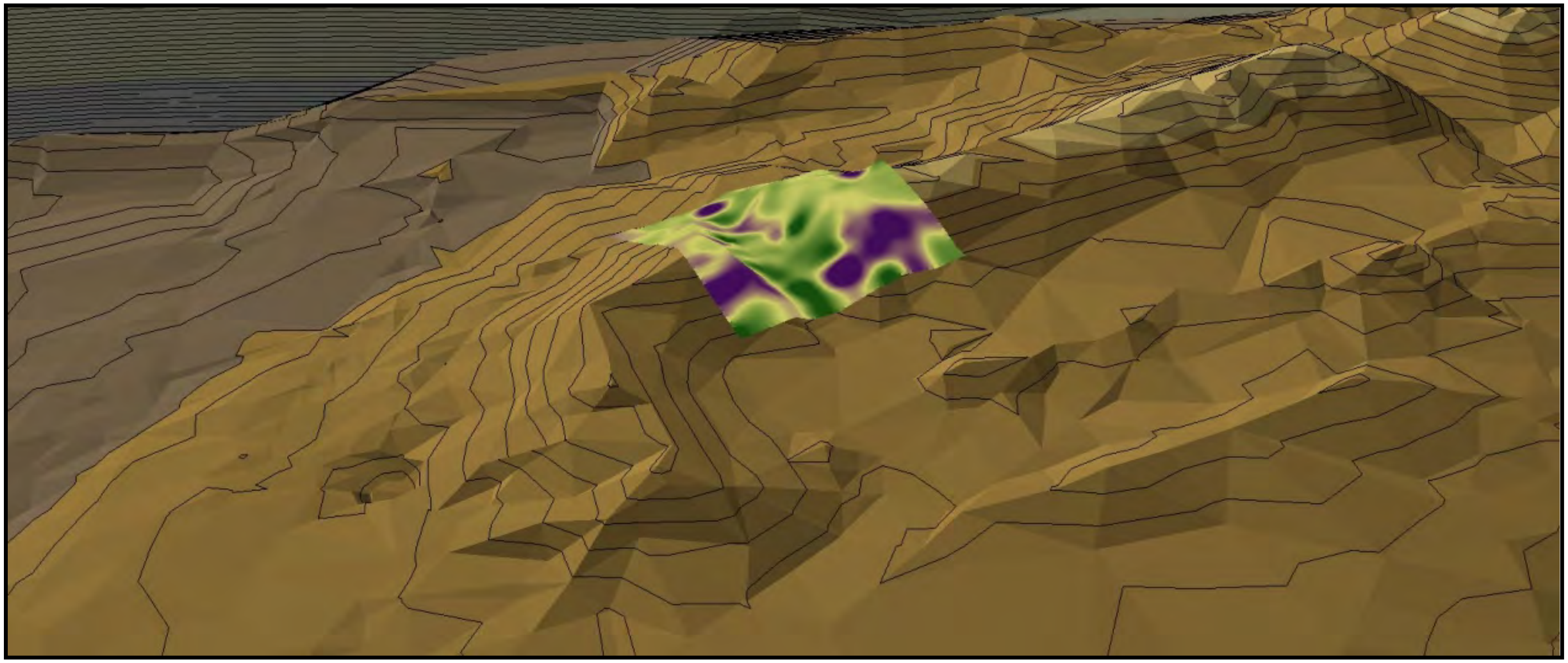
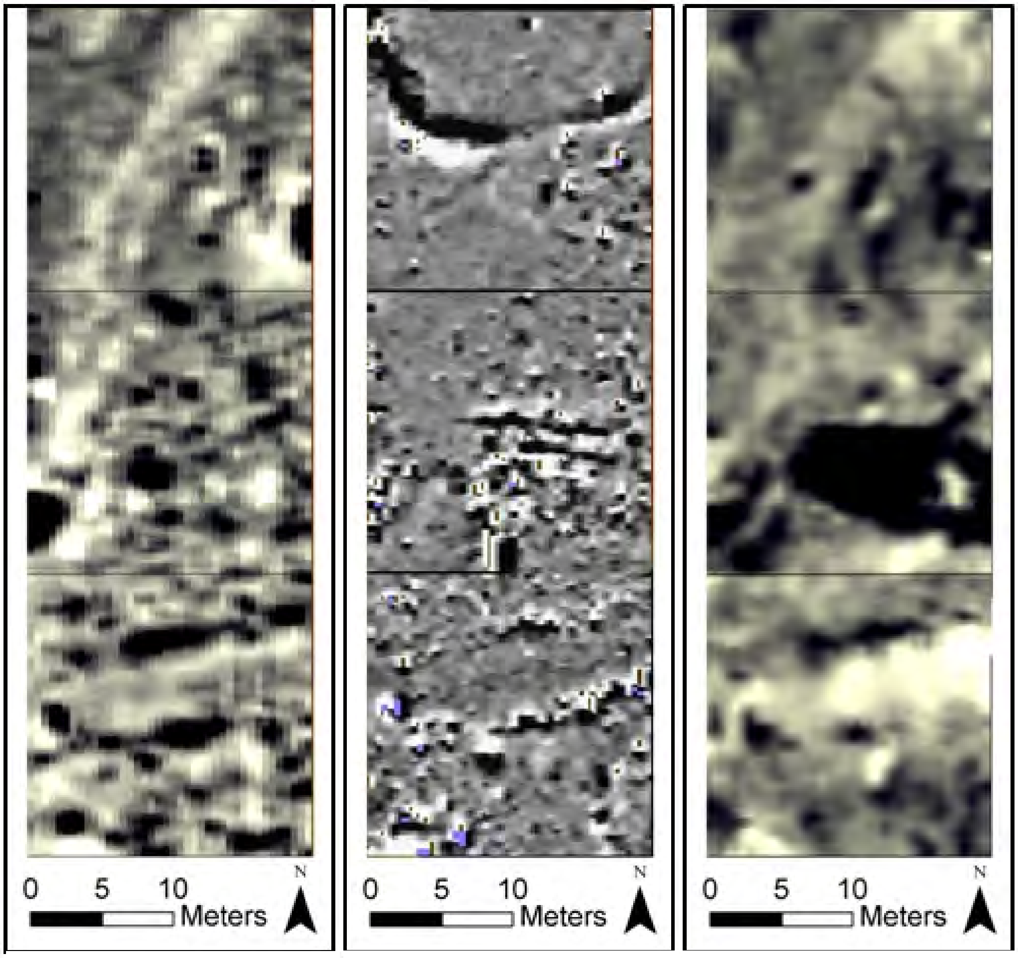


Figure 41. Oblique View of Eastern Gateway Complex with Gradiometer Survey of Trench 1 Overlain.



Conductivity **Gradiometery** **Mag. Susceptibility**

Figure 42. Conductivity, Gradiometery and Magnetic Susceptibility, Area 1 Grids 4, 5 and 6.

The conductivity and the magnetic susceptibility, however, show a road bed that runs diagonally nearly through the center of the gradiometer anomaly.

Trench 2 was placed across the geophysical anomalies (Figure 43). As expected excavation encountered a gravel roadbed (probable driveway for a historic structure that was located west of this area). This deposit was around 6 centimeters thick; below this was eroded loess roughly 10 cm thick at this location. Below the loess sediment is the soil profile produced by the cherty limestone parent material (Figure 44 and Table 1). In the south end of the west half of the trench the ditch feature was encountered as an intrusive feature into the clay subsoil. The feature fill was most likely gradually accumulated through historic erosion. Ditches are common features at Middle Woodland mound sites, and especially enclosures. No artifacts were recovered in this excavation.

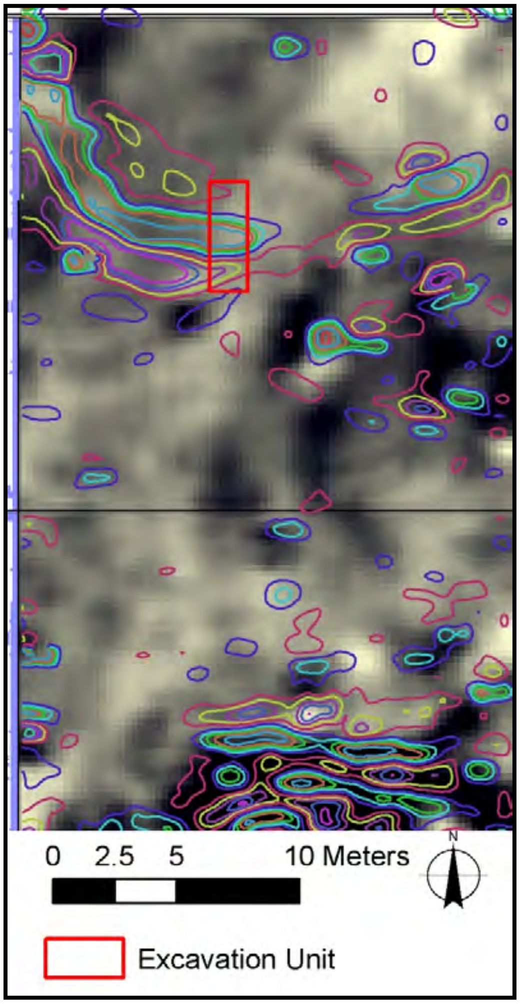


Figure 43. Location of Trench 1 in Relation to Magnetic Susceptibility (Grayscale) and Gradiometery (Contours) Results

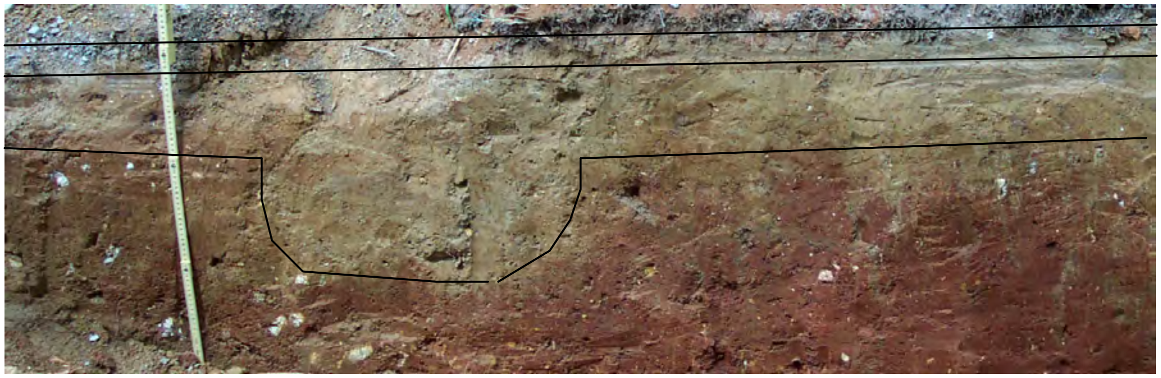
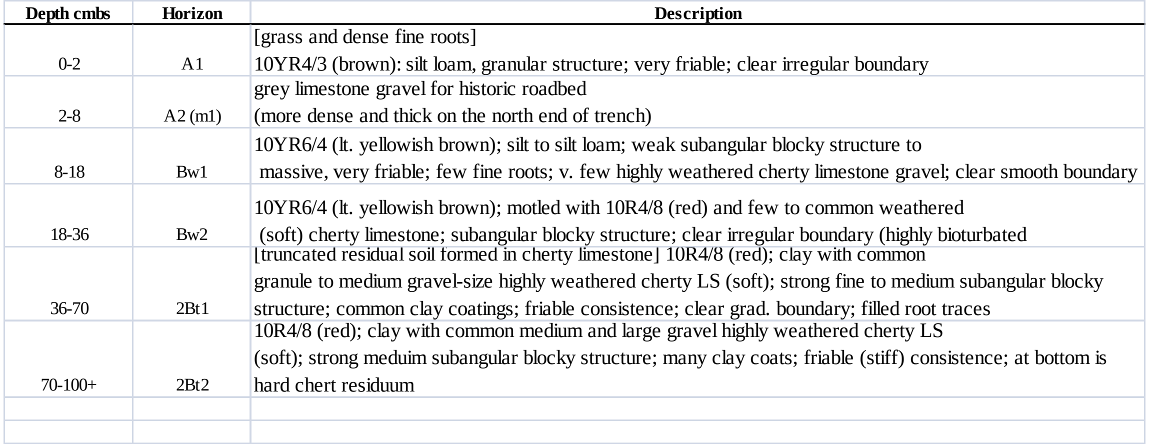


Figure 44. Profile of Trench 2 with Ditch Feature and Major Stratigraphic Units.

Table 1. Trench 2 Stratigraphy.



Depth cmbs	Horizon	Description
0-2	A1	[grass and dense fine roots] 10YR4/3 (brown): silt loam, granular structure; very friable; clear irregular boundary
2-8	A2 (m1)	grey limestone gravel for historic roadbed (more dense and thick on the north end of trench)
8-18	Bw1	10YR6/4 (lt. yellowish brown); silt to silt loam; weak subangular blocky structure to massive, very friable; few fine roots; v. few highly weathered cherty limestone gravel; clear smooth boundary
18-36	Bw2	10YR6/4 (lt. yellowish brown); motled with 10R4/8 (red) and few to common weathered (soft) cherty limestone; subangular blocky structure; clear irregular boundary (highly bioturbated
36-70	2Bt1	[truncated residual soil formed in cherty limestone] 10R4/8 (red); clay with common granule to medium gravel-size highly weathered cherty LS (soft); strong fine to medium subangular blocky structure; common clay coatings; friable consistence; clear grad. boundary; filled root traces
70-100+	2Bt2	10R4/8 (red); clay with common medium and large gravel highly weathered cherty LS (soft); strong meduim subangular blocky structure; many clay coats; friable (stiff) consistence; at bottom is hard chert residuum

Area 1 was surveyed with multiple geophysical instruments and two test units were excavated. Features identified in the geophysical data include a large (2 m by 20 m) ditch, a gravel roadbed, and an area covered with a layer of stone that is associated with mound building/ preparation. Magnetic flux and EM survey indicate high probabilities in distinguishing embankment and other stone features non-invasively. The parallel embankments of the Eastern Gateway were found to contain stages of shale slab lenses.

This method of construction has not been observed in other embankments at the site, and indicates a shift in building practices over time. This further documents how building practices change over time at Middle Woodland enclosures.

Area 2

The northeast corner of Area 2 is 40 meters west of the southwest corner of Area 1. The area is 60 meters east-west and 40 meters north-south. Area 2 is in the open field 20 meters west of the park’s maintenance road (Figure 45). Both gradiometer and resistance survey were recorded over the entire area. Several anomalies are identified that represent archaeological remains. Results of the survey are presented in Figures 46 and 47.

Area 2 Gradiometer Survey Results

The gradiometer data were clipped at 16 to -16 nT since the Area 2 magnetic survey data exhibit lower contrast range than in Area 1. The very large “dipole” linear anomaly (A2-5-1) in the center of the western half of Area 2 is interpreted as a recently created feature since it contrasts so strongly from the rest of the survey data. The faint negative linear anomaly that extends west from the corner of the anomaly was captured in the topographic survey and is a visible ditch feature.

The shape of the anomaly suggests that it is natural feature. In the northeast quadrant of the survey area are several linear anomalies, the most apparent of which is labeled as A2-6-1. Three linear anomalies connect at right angles forming a “U” shaped anomaly with the opening facing southeast. Continuing southeast there appears another anomalous response with the same “U” shape opening to the southeast (A2-6-2).

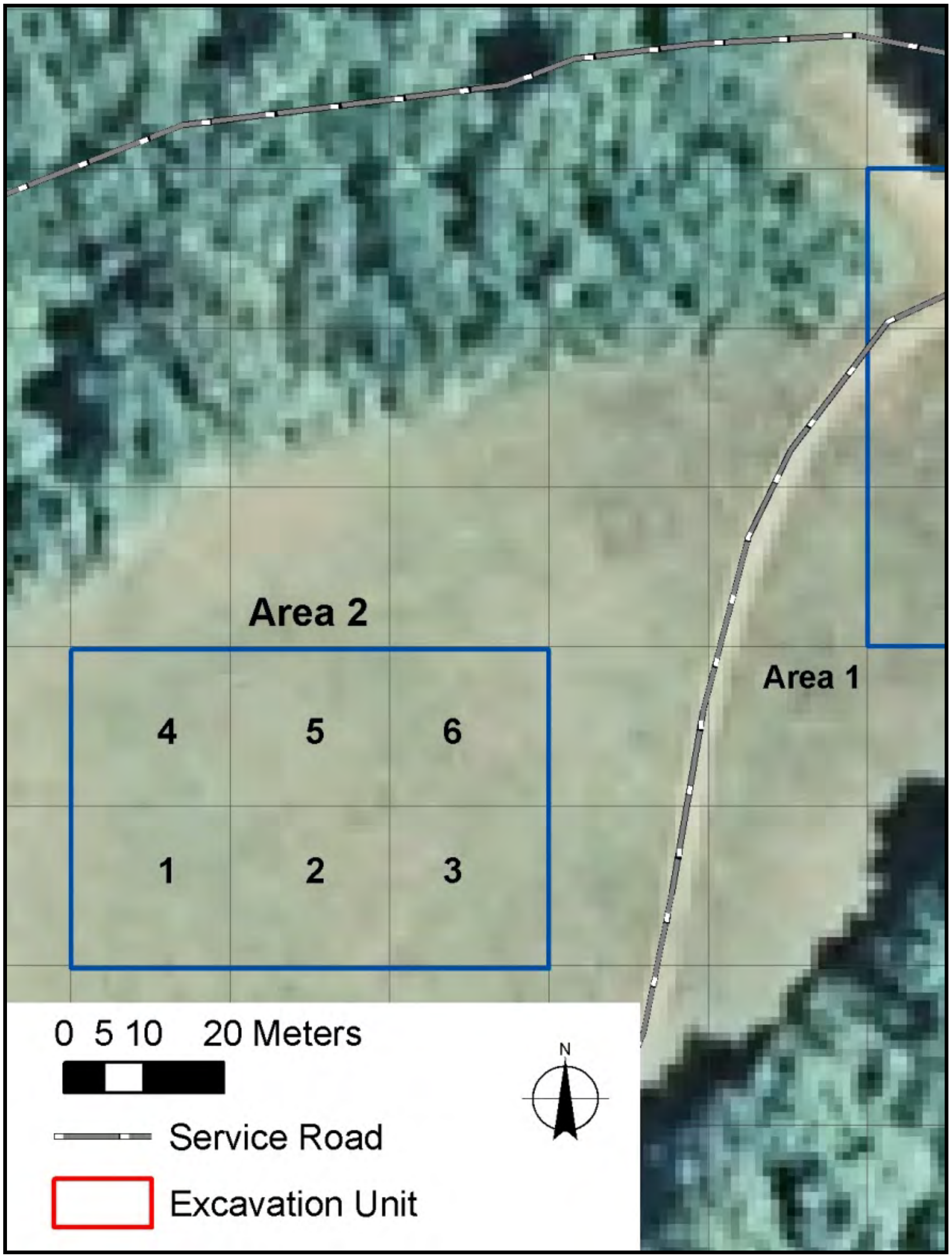


Figure 45. Location of Area 2 Geophysical Survey Grids.

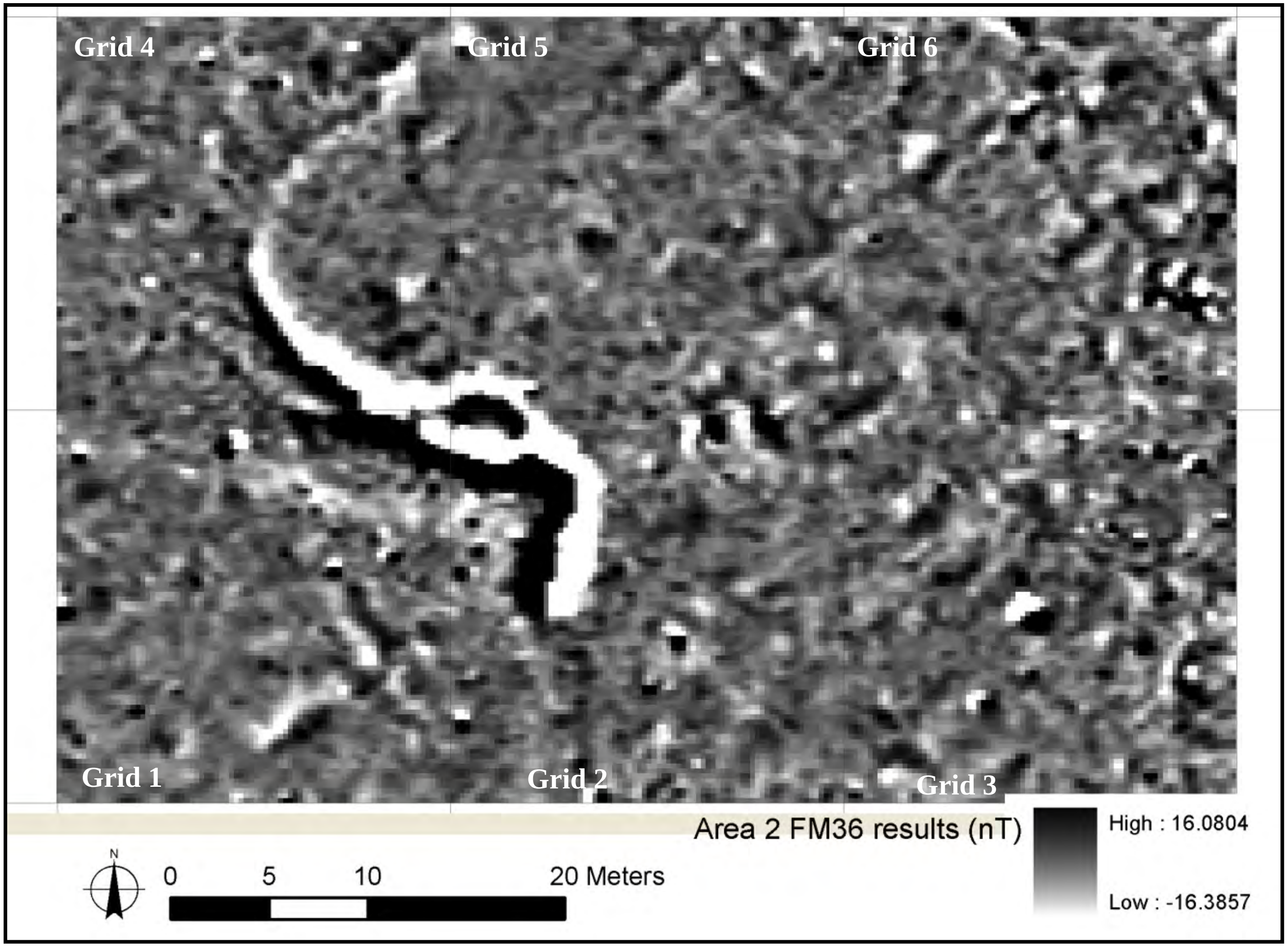


Figure 46. Area 2 Gradiometer Results only.

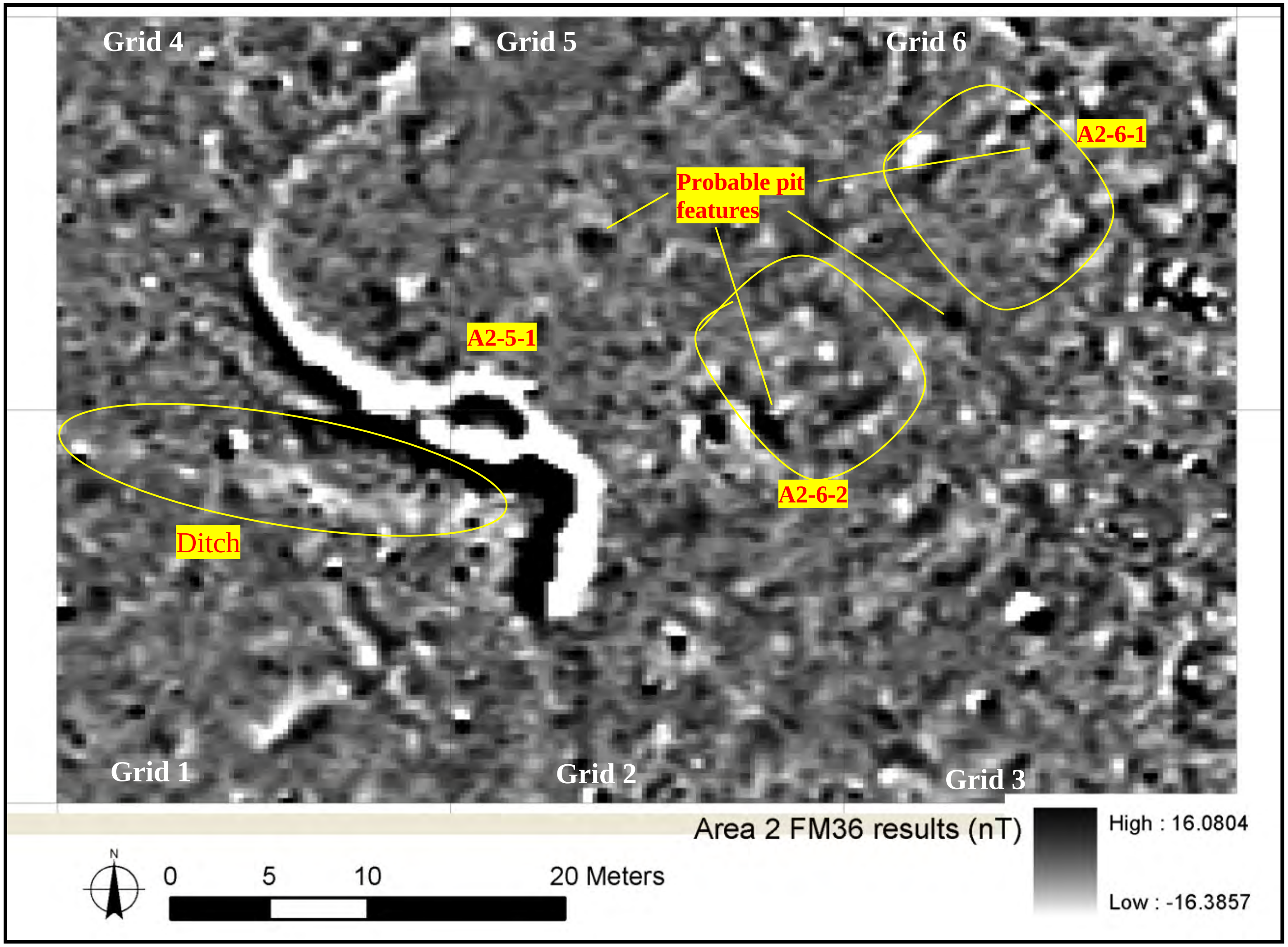


Figure 47. Area 2 Gradiometer Results with Anomalies Highlighted.

Within this area are several medium to high-contrast anomalies with strong boundaries that correlate with expectations for subterranean pits. Initial analysis of these anomalies placed them into the category of probable historic features. There are no records that locate a structure or other historic disturbance at this location, but the right angles suggest an historic origin. Square structures, however, have been found in the Woodland record. For example one is found as a pre-mound structure at an Adena site in Kentucky (Webb, et al. 1952).

When contours of 6 and -6 nT are overlain on the Area 2 survey data, the anomalies that are considered the highest probability for subterranean pit features are highlighted (Figure 48). It is difficult to assess whether these are prehistoric in origin without some type of destructive analysis.

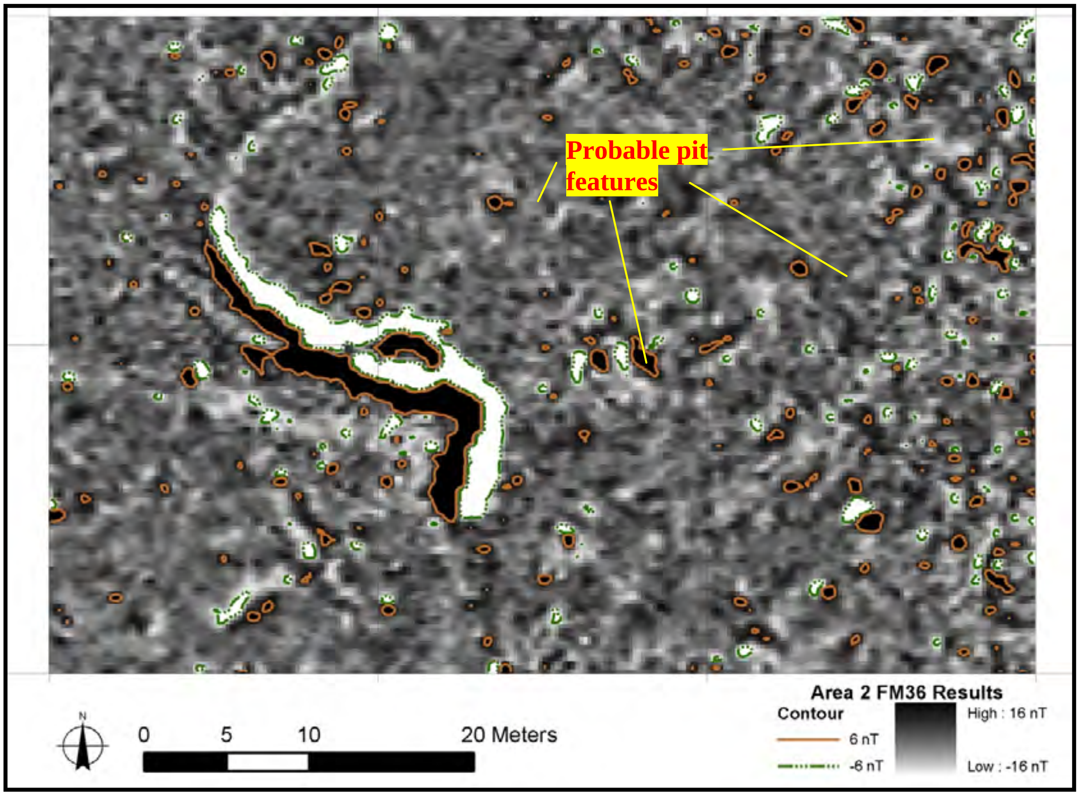


Figure 48. Area 2 Gradiometer Results with Selected Contours.

Area 2 Resistance Survey Results

Resistivity data were collected in Area 2 under the same procedures as discussed for Area 1. These data produced a very low contrast level and were manipulated by despiking the dataset, applying a high-pass 7 x 7 Gaussian filter, clipped at three standard deviations, and then applying a 3 x 3 low-pass Gaussian filter. The data were then georeferenced and smoothed through 0.5 interpolation on both the X and Y axis (Figure 49). Figure 50 displays the same resistance data with the gradiometer survey contours overlain.

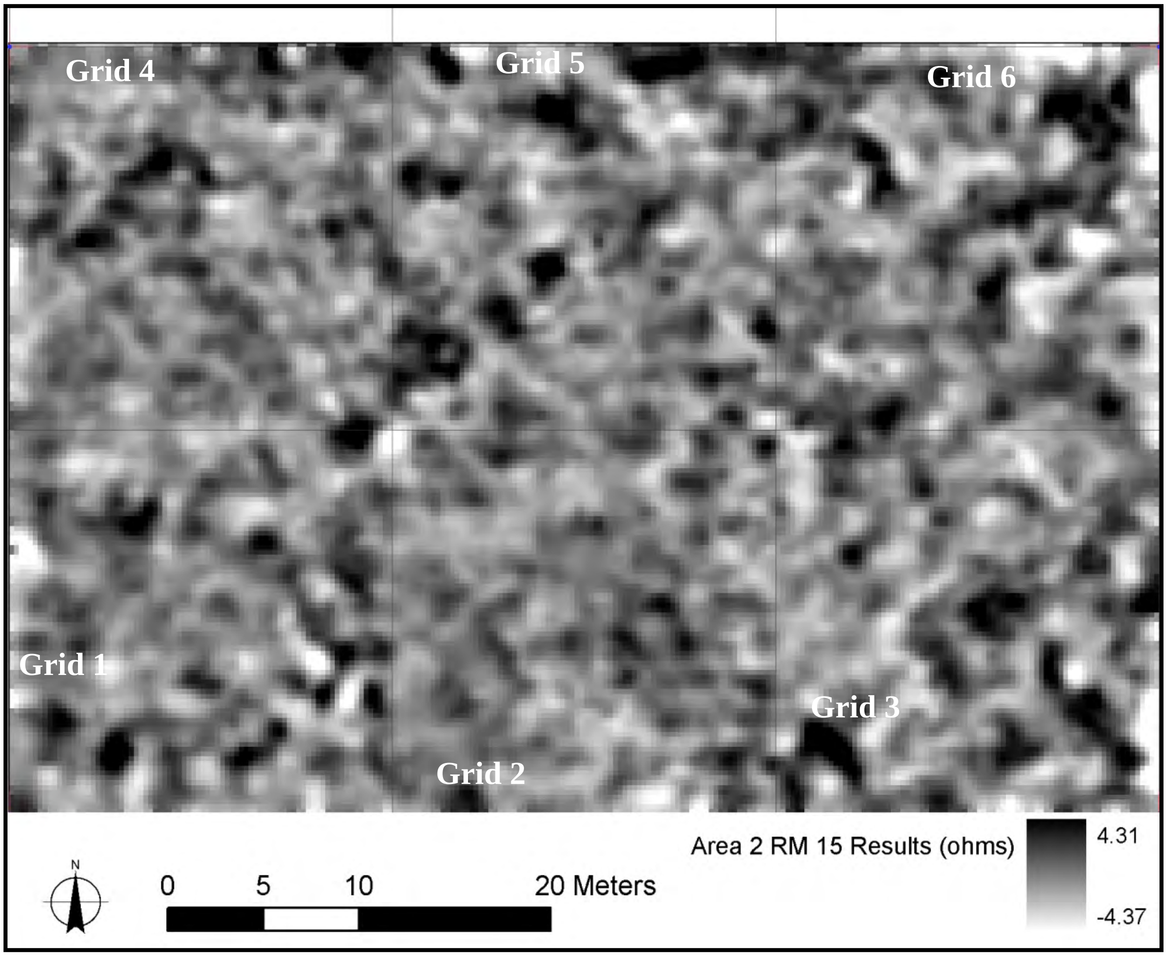


Figure 49. Area 2 Resistance Survey Results

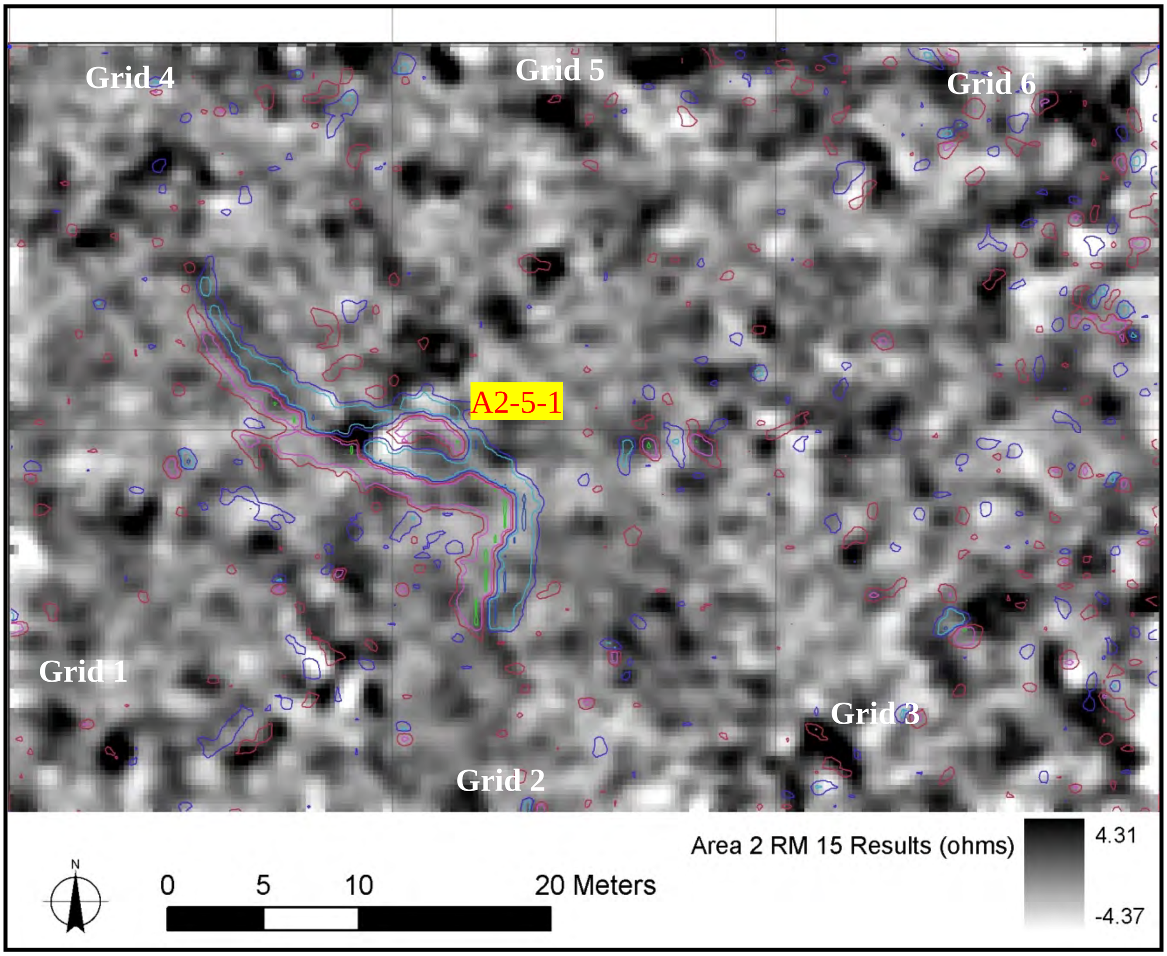


Figure 50. Area 2 Resistance Survey with Gradiometer Contours Overlain.

The large high-contrast feature in the west half of Area 2 (A2-5-1) is barely present in the resistance data. Several anomalies correlate to the gradiometer survey, however. In Grid 1 of Area 2 there is close correlation between magnetic and resistance anomalies. Grid 1 and Grid 6 contain the highest potential for containing subterranean prehistoric features as indicated by the resistance data.

Area 3

Area 3 measures 80 by 80 meters and is located in the center of the open field in the enclosure. The area was surveyed with only fluxgate gradiometery, and no excavations were performed in this area. During collection one of the instrument's sensor arrays malfunctioned and created signal noise. Much of the noise was minimized through low pass filtering. Again these data were collected and processed like the previous gradiometer data sets by adjusting the background to zero, clipping to three standard deviations, and applying a gradual shade for interpolation (Figure 51). Very few anomalies appear to represent prehistoric features in this survey grid. Two high-contrast circular anomalies around one meter in diameter with abrupt boundaries, one in Grid 6 and one in Grid 12, have the highest probability for being prehistoric features. The linear anomaly that runs southeast from the northwest corner of Grid 4 to about the center of Grid 2 represents a narrow ditch that runs across the field. This anomaly most likely resulted from an attempt at draining the field into a small retention pond during the historic occupation of the site. The 15 cm wide and 15 cm deep trench feature can be seen on the surface under the grass, and it continues to a depression in the edge of the tree line that is assumed to be a historic modification of the site. Figure 52 shows selected contours from the gradiometer survey overlaying the grayscale image of the gradiometer survey results to highlight anomalies of interest. The majority of anomalies are considered to be either natural, or of modern origin.

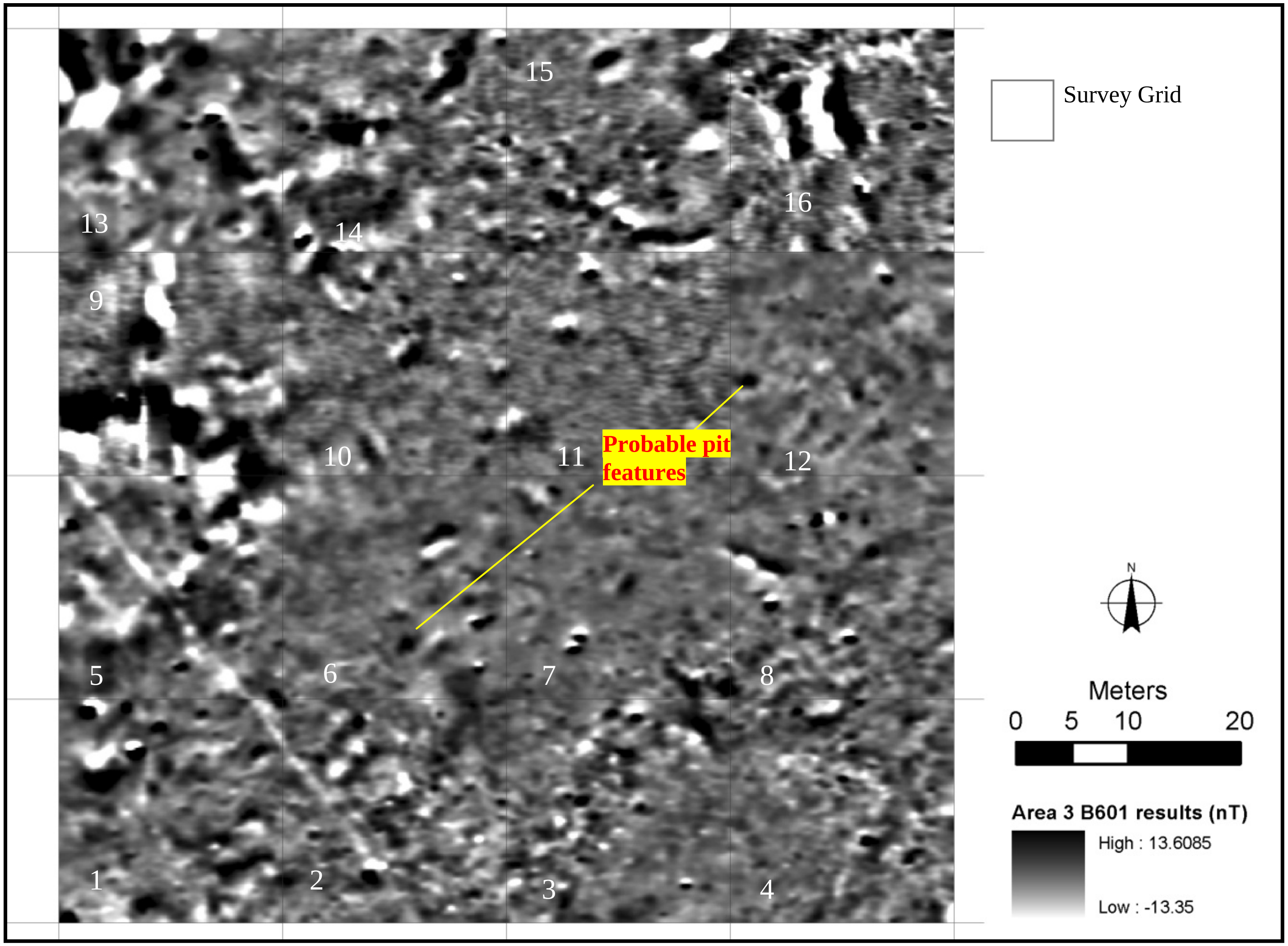


Figure 51. Area 3 Gradiometer Survey Results.

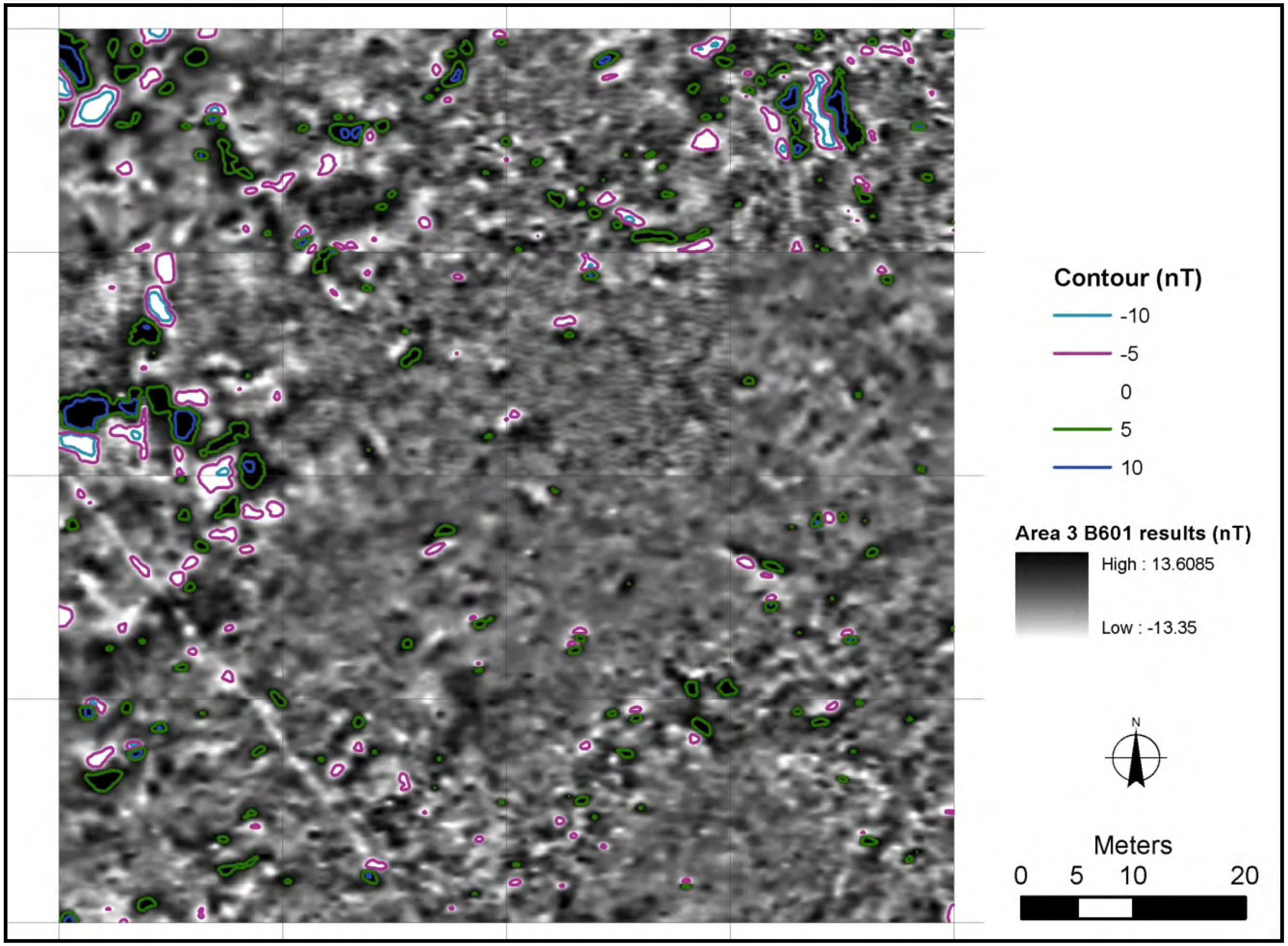


Figure 52. Area 3 Gradiometer Results with Selected Contours Drawn

Area 4

Area 4 is located in the southern most part of the enclosed plateau in the open field. The park maintenance road runs through it, and it appears that soil erosion is most accelerated at this point in the open field. The area is located at the edge of the tree line and covers roughly 100 meters north-south by 40 meters east-west (Figure 53).

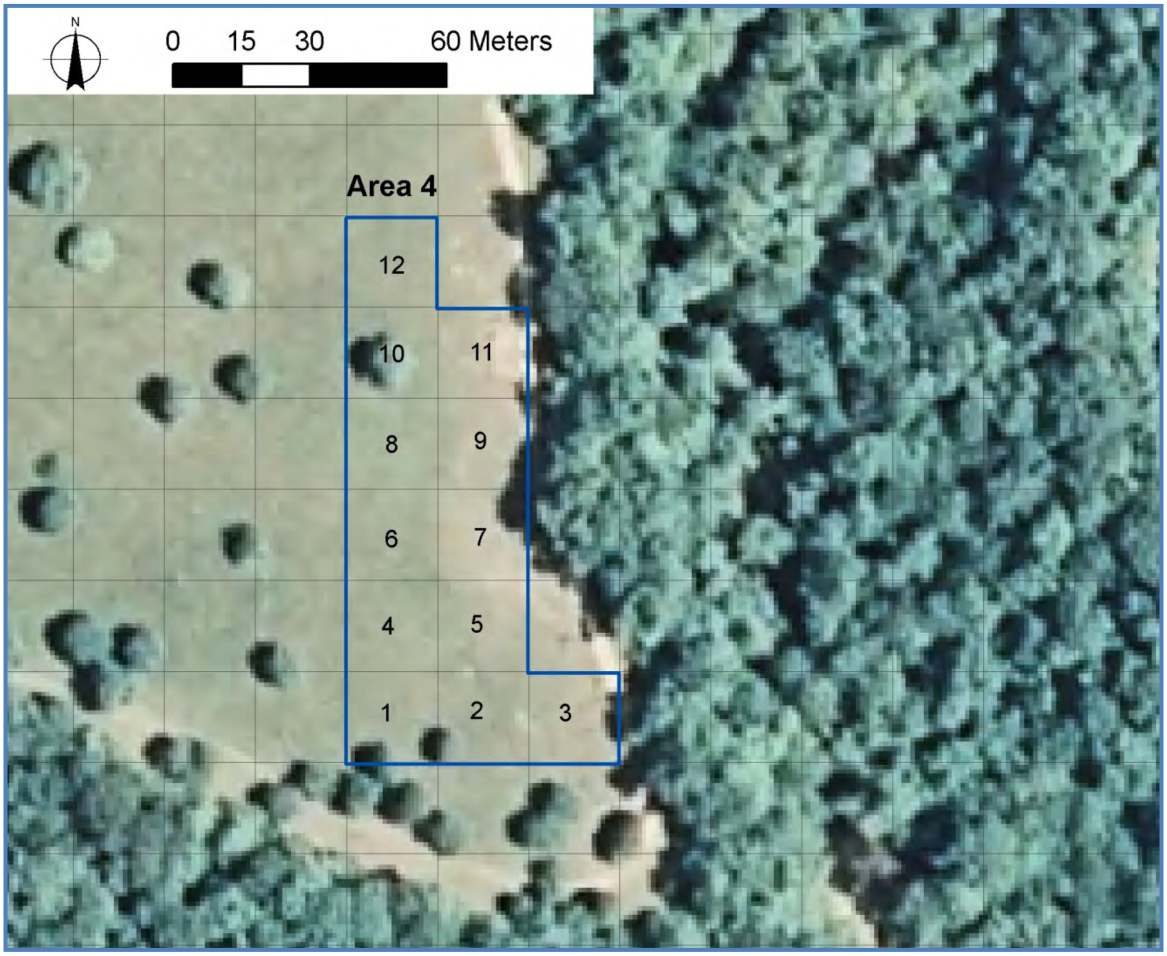


Figure 53. Area 4 Geophysical Survey Grids

Gradiometer survey was zeroed to the mean traverse and smoothed with a small window low pass filter. The survey data were clipped from 30 to -30 nT, and were further smoothed for interpretation with graduated shading (Figure 54). Several distinctive anomalies are present in the data including a curvilinear anomaly that represents a pathway or track. The complicated set of anomalies numbered A4-8-1 in Grid 8 may indicate some type of historic remains. There are remnants of a historic structure 60 meters to the south of Area 4, and this set complex of anomalies may be a result of dumping or a destroyed outbuilding. Figure 55 has contours overlain. There are no substantial deposits that can be confidently associated with the prehistoric use for the site in Area 4. During data collection several pieces of iron were found near the surface.

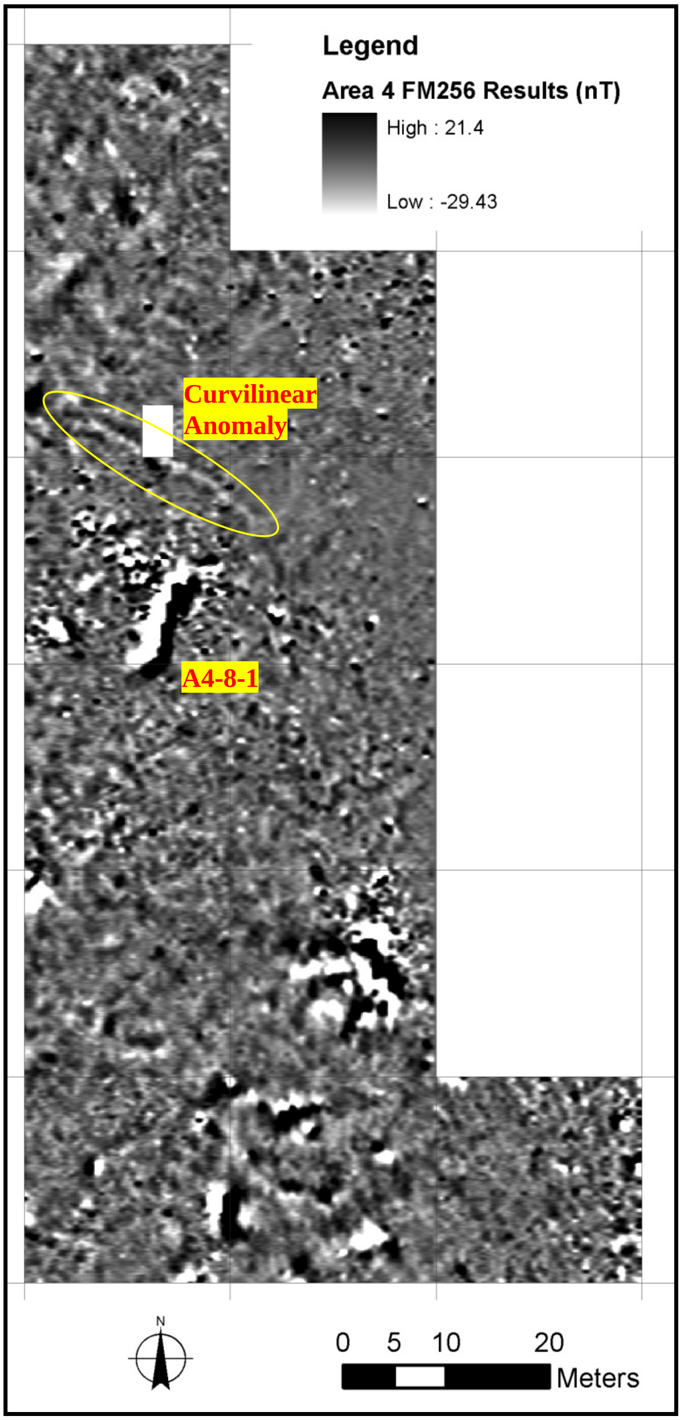


Figure 54. Area 4 Gradiometer Survey Results.

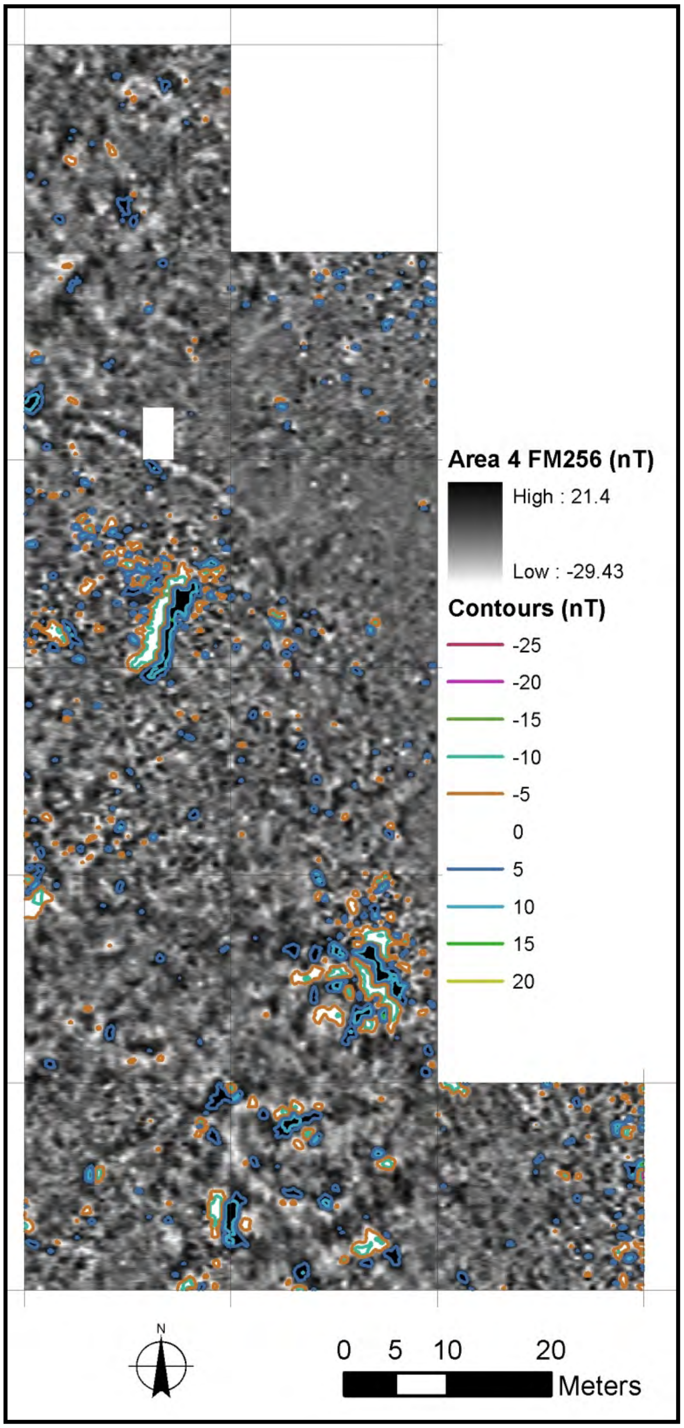


Figure 55. Area 4 Gradiometer Results with Selected Contours.

Trench 3

An excavation trench was placed in a small earth mound that lies 5.5 meters to the northeast of a gap in the western linear mound. The trench was placed in this location to help determine whether or not the feature is of prehistoric origin as suggested by Weems (1995). This excavation yielded no data to show that this feature is of cultural origin. The trench is located well within the tree line (Figure 56).

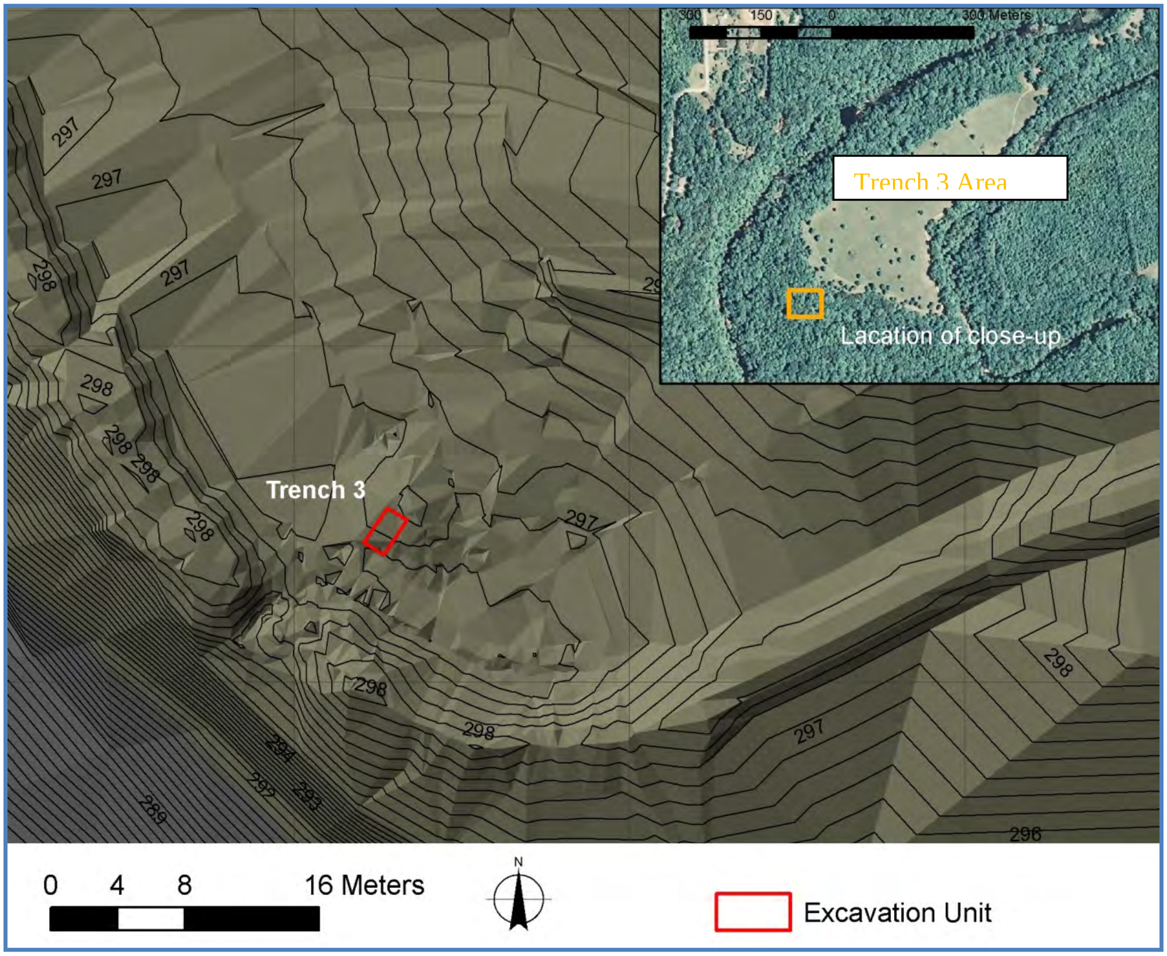


Figure 56. Location of Trench 3.

Large trees and substantial undergrowth prevented collection of interpretable geophysical data here.

Figure 56 also shows the topographic survey results displaying the relationship of the mound of earth to the gap in the mound. The depression and slumping that was the result of the earlier Cox excavation was initially cleaned away (Figure 57), and the trench was expanded to obtain a full profile of the mound of earth.

Figure 57. View of mound with old excavation trench cleaned of organic debris.

Excavation yielded only a few tested chert cobbles and naturally occurring weathered cherty limestone rocks. A single piece of shale appeared in the profile of the trench. The level above the natural ground surface was indistinguishable from the subsoil below and consisted of mostly rocky earth. This matrix is unlike the fill encountered in Trench 1, and no data indicate that this is a cultural feature (Figure 58).

Figure 58. South Profile of Trench 3.

Summary

Four areas within the boundaries of Old Stone Fort were investigated with multiple geophysical techniques. Three test units were excavated, two of which opened trenches dug during previous investigations. Results indicate that limestone mound features can be confidently characterized by both gradiometry and EM conductivity/ magnetic susceptibility survey. A ditch feature was identified in gradiometer survey and was verified through limited excavation. GPR survey can be used to successfully interpret internal mound structure without excavation. Archaeological features were discovered in each survey area, sometimes quite differently depending on technique. For example, the ditch feature that was detected in Area 1 as a strongly contrasting anomaly in the magnetic gradient survey appears only as a weak anomaly with a diffuse boundary in the EM survey. Geophysical techniques were successful in collecting substantial responses over mound features and even more minor topographic features, as well as those not visible on the surface. The detailed topographic survey allows for interpretation of minor topographic features that appear in the geophysical data as anomalies.

One feature of potential interest is a low-lying linear mound feature that has never been confidently associated with the prehistoric mound construction at the site. The magnetic response from the edge of this mound feature is similar to the edges of other prehistoric embankments in Area 1, and this linear anomaly may represent a prehistoric mound feature.

Other features detected include embankments, ditches, probable prehistoric pit features and other landscape modification, as well as historic and modern disturbance.

Within Area 1, several large complicated anomalies with strong boundaries and high contrast readings were identified. Features identified in the geophysical data include a large (2 m by 20 m) ditch, a gravel roadbed, and an area covered with a layer of stone that is associated with mound preparation. Magnetic flux and EM survey indicate high probabilities in distinguishing embankment and other stone features non-invasively. Several anomalies are identified that represent archaeological remains. A semicircular pattern (anomaly 2-1) of small round anomalies spaced about 1.5 meters apart in an arc spanning roughly 7 meters in diameter may represent a prehistoric structure. A ditch over 20 m long constructed in a U-shape is west of the Eastern Gateway. Also west of the Eastern Gateway is a surface dressed with limestone cobbles. GPR traces vary greatly between mound and non-mound surface. Trench 1 was placed into the stone embankment of the Eastern Gateway Complex within previously excavated trenches, and showed a mound stage of shale slabs not previously seen at the site. Trench 2 was placed adjacent to a geophysical anomaly for ground-truthing purposes. This trench was excavated to expose the large a small portion of the ditch feature.

Area 2 magnetic survey data exhibit a lower contrast range than in Area 1. Initial analysis of anomalies suggests that they are historic features. In Area 2, contours of 6 and -6 nT tend to capture most of the anomalies that are considered the highest probability for subterranean pit features. Within the Electrical Resistance survey results, the majority of anomalies correlate to the gradiometer survey.

In Area 3, very few anomalies appear to represent prehistoric features in this survey grid. Two high-contrast circular anomalies around one meter in diameter with abrupt boundaries have the highest probability for being prehistoric features. Several distinctive anomalies are present in the data including a curvilinear anomaly that represents a pathway or track.

Area 4 has potential for containing a substantial buried historic component, but nothing was identified to likely represent a substantial prehistoric deposit.

Lastly, an excavation trench was placed in a small earth mound that lies 5.5 meters to the northeast of a gap in the western linear mound. Large trees and substantial undergrowth prevented collection of interpretable geophysical data here. The feature is considered a natural occurrence.

Chapter 5

Conclusion

The Middle Woodland period in Middle Tennessee dates from 200 B.C. - 400 A.D. and Faulkner (2002) suggests Old Stone Fort dates to the McFarland and Owl Hollow cultural phases. While the site's name suggests a defensive purpose, archaeological investigations consistently conclude that sites such as Old Stone Fort more likely were ceremonial, social, or religious in function (Connolly 1998; Faulkner 1996; Mainfort and Sullivan 1998; Riordan 1998; Weinberger 2006).

Interpretation of the Old Stone Fort must be grounded within the framework of the local historical context. It is a very difficult site to interpret since there is not much in the way of material culture linking directly to the people that built the site. Researchers must rely on observations of the consistencies and inconsistencies within the site and between Old Stone Fort and other seemingly similar sites in eastern North America.

Interpreting a site like this requires us to look at how people interacted with the landscape: how they modified it, and how they situated themselves within it. Middle Woodland hilltop enclosure sites are functional, and adapt and evolve over time. There are a number of contiguous mound formations on hilltops or isolated plateaus in nearly every direction from the Old Stone Fort: Stone Mountain, Georgia; Fort Ancient, Ohio; Pinson, Tennessee; Marksville, Louisiana; Florida; Kentucky.

Available data suggest that any site used over multiple generations can potentially have multiple histories. Old Stone Fort cannot be considered as a standalone entity, but as a functioning part of the local and regional level archaeological record. The common threads and unique contexts require careful analysis.

The research methodologies utilized in this program have led to substantial new discoveries at Old Stone Fort State Archaeological Park. Highlighted below are the final conclusions from some of the most important results from this archaeological project.

The creation of the GIS provides not only a useful visual and interpretive tool, but allows for real-world mathematical and statistical analyses. The model can be used to assess the potential erosion along the main interpretive trail and the site in general. The spatial layers included can be accessed by future researchers, and confidently related to actual places on the earth. A shaded-relief digital model was created to visualize the topography and the mounds. The mound heights were recorded with a total station and then integrated into the USGS digital elevation model. The low-lying linear embankment in Area 1 fits the pattern—and magnetic gradient signature—that is consistent with the pattern found over known embankments at the site, and therefore is considered to be a prehistoric feature of the mound complex. The total length of the buried component of this feature is not known since it is disrupted by the park access roadway.

One grouping of anomalies in Area1 represents a possible prehistoric structure within the enclosure. The anomaly complex consists of a semi-circular arc of post-sized anomalies and large circular anomalies. The coincidence the complex shares with a plan-view map of a circular structure from the McFarland Middle Woodland site less than 2 km from Old Stone Fort strengthens the likelihood that the anomaly complex indeed represents a prehistoric structure. Heretofore no structures have been recorded at the site, and such features within Middle Woodland enclosures are not common.

EM conduction survey produced predictable responses over buried crushed limestone gravel, and limestone cobbles. These results indicate that buried gravel roads, and buried stone mound components or pavements are distinguishable through EM conduction survey. Additionally, gradiometer survey consistently recorded magnetic flux edge effects over the perimeter of the linear stone embankments. Therefore, the two survey methods are appropriate for locating buried mound components throughout Old Stone Fort, and potentially any stone mound site where limestone is the parent material. Additionally the data suggest that the topographic survey can be used to highlight or identify possible mound remnants.

The leveled area to the west of the Eastern Gateway is now considered a prepared limestone surface. It is either a staging area for mound building material or had the surface covered with limestone cobbles. Soil resistance is completely ineffective in this area because of the density of limestone cobbles. The possibility exists that this is an earlier component to the site constructed prior to the Eastern Gateway parallel mounds, and carries implications in sorting out the chronology of site construction. Parallel magnetic anomalies appear within the limestone surface. These may represent burned logs.

GPR was used successfully at the site. Depth of penetration is debatable, but strong reflection responses were received from as long as 40 nS, which in the clay parent material at the site is typical. The GPR was most successful in distinguishing differences in internal mound structure. Within the portion of the mound that was investigated in the Eastern Gateway, evidence of mound staging was recorded. The stages are demarcated with a lens of large, black shale slabs. This has not been seen at the site previously.

A large (~20 m long) U-shaped ditch was discovered in the northeastern portion of the site. No ditches had previously been identified at Old Stone Fort, although they are considered common features at Middle Woodland enclosures. The ditch cuts into the clayey subsoil less than 50 cm deep and is one meter to a half-meter wide. There was no buried A horizon detected in the soil under the mound fill, but there was a detectable A horizon in the enclosure. This is consistent with some kind of surface preparation related to mound construction. Area 3 on the west side of the enclosure yielded very little evidence of prehistoric features. Historic modification in this area may have obscured or destroyed any deposits.

Lastly it was discovered that on top of the soil created by the parent limestone there is a layer of loess of varying thickness. It is considered that this loess may be what is called “native white clay” by P. E. Cox (1929). The loess provided the surface that was utilized during the construction of the mounded enclosure. Unfortunately, the loess within the enclosure is highly eroded, probably through historic use. The thickness of the loess under the mound fill is more than three times the thickness within the open portion of the enclosure. Potentially then subterranean features that did not penetrate the clayey subsoil are completely deflated or destroyed by erosion.

The final conclusion that can be drawn about the work described here relates to the larger debate about the nature of the function of this type of Middle Woodland site, how it relates to the local culture, and how it compares regionally to other sites of the type. Old Stone Fort was a special use corporate-ceremonial center used by local Woodland Period inhabitants of the Upper Duck and most likely Elk River Drainages. The main function was that of cultural intensification; where people who are spread over the landscape for most of the year come together reaffirm cultural bonds and beliefs. This function is not unlike Reichel-Dolmatoff's anthropological description of a ritual of intensification within a corporately structured group of Tukano culture of the northwest Amazon .

> In the course of these ceremonial occasions, when the Universe and all its components are being renewed, one goal becomes of central importance: the reaffirmation of links with the past and future generations, together with the expression of concern about the future well being of society. (Reichel-Dolmatoff 1976:316)

Some Hopewell earthworks are easily recognizable as effigy figures or geometric patterns, but simple hilltop enclosures such as Old Stone Fort tend to follow the natural contours of the landscape. Faulkner (1968) remarks that there is no artifact record to corroborate the ceremonial function of the Old Stone Fort, but rather a marked absence of artifacts, especially domestic remains, that supports the site's use for social rather than defensive purposes. Other researchers have drawn similar conclusions (Connolly 1998, Mainfort and Sullivan 1998). Absence of substantial domestic deposits supports an argument for ceremonial use, but anthropological theory provides the analytical tools needed to support a ritual/ceremonial site use or function not from the absence of deposits, but rather the context which this site is situated.

Research on Middle Woodland enclosures, especially in Ohio, has often focused on gateway complexes. Gateways like the ones found at Old Stone Fort are arrangements of linearly contiguous or single mounds and ditches or some combination of these that represent an opening in the primary enclosure (Mainfort and Sullivan 1998, Connolly 1996, Weems 1995, Faulkner 1968). Pearsall and Malone (1991) suggest the possibility that the Eastern Gateway at the Old Stone Fort has a solar alignment. Measurements of the parallel earthworks that extend into the interior of the enclosure are aligned within one degree of the summer solstice.

Other similarities exist between the Old Stone Fort on the Upper Duck River, and Ohio sites like Fort Ancient. First, the lack of habitation evidence within the enclosure or immediately around it fits well with Prufer's model of the vacant ceremonial center - dispersed agricultural hamlet model (Prufer 1964, 1977). Secondly it shares features such as parallel embankments, summer solstice alignments, limestone pavements and its placement on a prominent bluff (Connolly 1998; Faulkner 1968; Pearsall and Malone 1977). Bluff line mound construction is not limited to, nor likely to originate in the Ohio Hopewell core area, however. In fact, the oldest mound construction occurs in the Southeast. Not surprisingly, many of these Southeastern earthworks have many commonalities. Pinson mounds in Western Tennessee, the Marksville site in Louisiana, the Florence earthworks in Alabama all have a similar shape and placement on the landscape (Boudreaux and Johnson 1998; Jones and Kuttruff 1998; Mainfort and Beck 1986).

The stone fill for the mounds at Old Stone Fort was not selected simply because of its availability over earthen fill. Stone and dirt are at least equally available at the site, and the use of stone required more difficult transport than would have been needed if only earthen fill had been used. The use of large stone slabs mined from the riverbed and its banks is the first indicator that the site had a specific plan for construction, and that expediency was not the main factor. As described in the soil stratigraphy, the loess soil is highly erodible and most likely not well suited for structural stability. Excavations in Trench 1 show that the stone used to construct the mound was carefully selected. A lens of shale represents a distinct stage in mound building, and the cherty, rubble cap indicates another. The shale slabs were collected either from the exposed bluffs, the bedrock behind the waterfalls, or excavated below the river's alluvial deposits, but slabs of the size used in the mound fill do not occur regularly where the limestone boulders were taken. The amount of time that this lens of shale was exposed after deposition is not clear. Nevertheless, the lens of shale proves that the interior parallel walls have a distinct, staged construction pattern that differs from what has been observed in the perimeter walls in previous investigations. This pattern of construction in stages, and changing architectural rules over time, is similar to that observed at other ceremonial centers in the Woodland Period (e.g.: Riordan 1998, Connolly 1998, Greber 1997, Blitz and DeBoer 1992).

Ephemeral Archaic period presence is common on the landscape in the archaeological record of the Upper Duck River. Most of the archaeological sites surrounding Old Stone Fort have Archaic Period occupation. Presumably Archaic period populations moved seasonally or periodically to take advantage of a shifting resource base. The number of sites with recorded Middle Woodland components is much smaller, but the deposits indicate year-round occupation, and a substantial shift in subsistence economy towards agriculture (Faulkner 2002).

Corporate groups may have formed in the Middle Woodland period to deal with the practical matters and problems associated with more permanent settlement. Corporate groups can control access to resources, provide mediation and fellowship, and ratify agreements. In this model, Old Stone Fort serves as a locus at the head waters of the major river in the local drainage system, where local corporate (probably descent) groups came to intensify and strengthen a particular cultural heritage.

Several substantial Middle Woodland occupational areas occur at regular intervals along the course of the Duck River. Faulkner estimates a population of 15-20 at the McFarland site (1996:9) based on a large three room structure. Obviously this site could not have provided the number of individuals needed to build the Old Stone Fort. It is clear that there was a regional population that provided the necessary work force from locations much further than a mile or two away.

If Old Stone Fort functioned primarily as a corporate ceremonial center, archaeological features at and around the site should relate directly to its ceremonial aspect, or be of temporary or short term nature (Weinberger, 2006 ; Neusius, 1998). As was demonstrated by the excavation of the ditch in Trench 2, features that intrude into the clay horizon should be expected to have remained intact. The plow zone is shallow (less than 20 cm deep) in this location, and if this characteristic, then it can be expected that features intruded into the clay horizon will be at least partially intact. Several anomalies that represent prehistoric use at the site were identified. In Area 1 these anomalies are most certainly features associated with the prehistoric activities in the northeastern portion of the enclosure: An elliptical ditch feature, possible low linear embankment, parallel magnetic anomalies underneath what some kind of prepared stone surface, possibly a low or historically modified stone mound. In addition, several anomalies that represent possible pit intrusions were identified.

When first confronted with the Old Stone Fort, especially with the larger trees that grow on top of the mounds, one gets the impression that the mounds complement the natural setting—or at least conform to the natural surroundings. In contrast to the natural setting, however, building Old Stone Fort was an event of cultural intensification; a physical act *that literally transformed and acculturated the landscape*. So although the mound forms appear in accordance with the natural surroundings they are obvious markers of cultural influence on the landscape, and were no doubt viewed as such. This point is illustrated when we consider low mounds built at the summit of a gradually sloping landform. When the mound remains in the contour it has the opposite effect of what logic might dictate, it actually appears as though the whole landform was shaped and built up by human effort rather then that the mound is part of the natural landscape.

I suggest there existed in the Middle Woodland throughout the Eastern Woodlands separate spheres of ceremonial practice. On the one hand there were corporate groups that were making and reifying corporate claims to particular resource areas or making distant alliances and concessions (Greber, 1997). On the other hand there were the ceremonial complex focused on social integration, intensification and renewal. The latter practice most likely being tied to abundant environments that favored nucleated settlements (Dancey and Pacheco 1997), that for the purposes of reducing risk associated with more sedentary living and finding suitable ways to increase social membership, came together to build mounds that were not about corporate display or aggrandizing, but instead emphasized sharing common beliefs and intensifying social bonds.

The idea that mounds and earthworks can simultaneously serve many functions and play differing roles from defining and displaying corporate identity to more loosely tying together autonomous households into a sustainable interaction network is a point that has often been overlooked in Hopewellian studies (Ruby et al. 2005). Clearly the activities of mound building and the activities of acquiring exotic trade goods are not one in the same. Therefore it is not surprising, at what is assuredly the ceremonial center for the people of the Upper Duck River that there is no evidence of intense participation in inter-regional trade. More likely the Old Stone Fort was a center where, through constructing the mounds, social contracts and beliefs were intensified and purification and renewal took place. The enclosure more likely served as an aggregation center for local and maybe more distant nucleated groups, binding them together.

Through this lens it is not difficult to imagine that this enclosure that covers over fifty acres (Faulkner 1968) never served as a locus for the exchange of exotic “Hopewell” commodities. In fact it makes it easier to imagine that the trade of social alliances, marriage partners and “handshaking” is what took place during Middle Woodland gatherings there. Certainly within the Duck and Elk River drainages we find influence from Copena, Marksville and Hopewell, but this is also not surprising considering the central positioning of these waterways between the major loci of trade. This area is a potential boundary between intensively trading peoples, and this makes for fertile ground for research in trying to deconstruct what has been historically called Hopewell and Southern Hopewell.

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Vita

Stephen Jay Yerka was born in New Hartford, New York on October 9, 1976. He spent the first twelve years of his life in the small, rural town of Trenton Falls which can be found on the Remsen USGS topographic quadrangle. He attended Holland Patent Elementary and Middle Schools there. Stephen subsequently spent three years at New Hartford Junior High, and then a year at Leto High School in Tampa, Florida. He then left high school early to attend Simon's Rock College of Bard through an early acceptance program.

Stephen withdrew from Simon's Rock, and never completed high school, but two years later he did receive a GED diploma in Tampa, Florida. Eventually Stephen moved to Murfreesboro, Tennessee where he met his wife, and soon became a father. After finally deciding to go back to school, Stephen enrolled at Middle Tennessee State University (MTSU), and majored in anthropology. His field school experience with Dr. Kevin Smith at the slave quarters at the Wynnewood State Historic Area drew him towards Southeastern Archaeology, and opportunities presented by Dr. Sarah C. Sherwood solidified a commitment to the field. Drs. Peter Rob and Carlos Cornell were also major influences in Stephen's study of database management systems as they apply to archaeology. Stephen received a B.S. degree at MTSU in December, 2002 with a major in anthropology and concentrations in archaeology, and computer information systems.

After working as a ranger for Tennessee State Parks, Stephen entered into the Master's Program at the Department of Anthropology, University of Tennessee (UT). At UT Stephen has concentrated in the application of technology in archaeology. His interests include geophysical survey, GIS, Database Management Systems, the Woodland Period Southeastern Record, and Paleoindian studies.

He received his Master's degree at the University of Tennessee in December, 2010, and is currently working on his doctoral degree at the same institution.