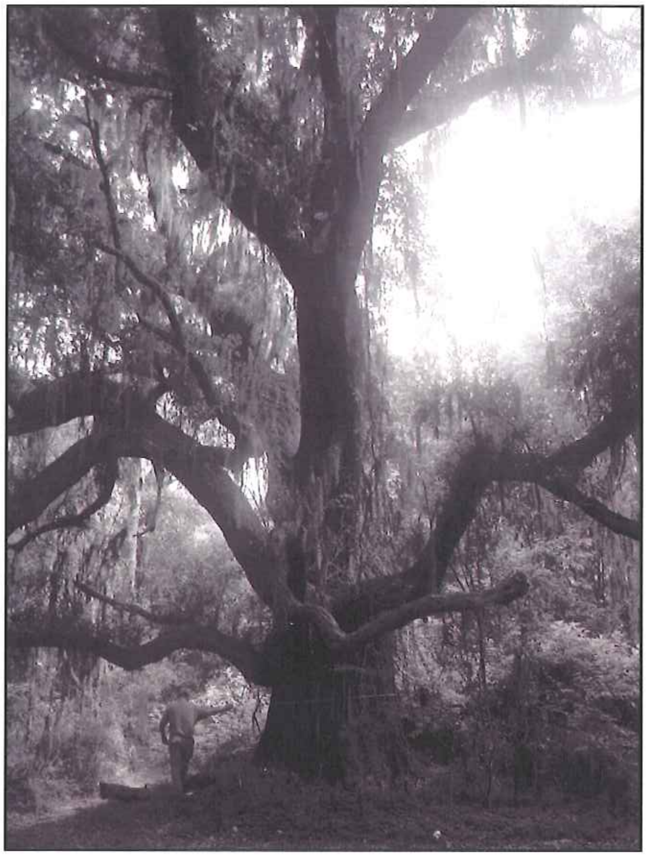

Remote Sensing and Further Testing at Site 9CH1205, Chatham County, Georgia
Project NH-111-1(24), PI #522870

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Abstract

From June 15-17, 2009, staff archaeologists from the Georgia Department of Transportation (GDOT) conducted remote sensing investigations at archaeological site 9CH1205 in Chatham County, Georgia. These investigations included survey with ground penetrating radar (GPR) and magnetic gradiometer. These surveys were done to further investigate the site's potential for intact features and its consideration for preservation in place. This testing was deemed necessary due to the proposal to use the property on which the site sits in the improvement of the intersection at Sensitive archaeological information redacted pursuant to OCGA 50-18-72 [GDOT Project NH-111-1(24), PI #522870]. The original survey of this project and testing of this site was done by Edwards Pitman Environmental, Inc. and was reported in April of 2009 (Quirk and Silliman 2009). Five 20x20 meter grids were surveyed with both pieces of equipment; these grids complement the remote sensing investigations done previously by GDOT during testing by Edwards-Pitman in February of 2009.

Further testing in June also included work done by Garrett Silliman of Edwards-Pitman. Silliman performed a metal detector survey of selected areas at the outskirts of the previously reported site boundary, in order to assess the potential of the Civil War component at 9CH1205. Several transects were surveyed and artifacts were recovered.

Site 9CH1205 was also visited by two arborists, Dennis Goldbaugh from Chatham County's Department of Public Works and Daniel Westcot from the Georgia Forestry Commission. Both investigated numerous live oak trees on the property of the site and provided information regarding the relative health and possible estimated age of the trees. This information had been deemed important to considerations of landscape in relation to Site 9CH1205, which includes a component indicative of a colonial plantation dating to the late 18th and early 19th centuries.

Finally, additional shovel testing was done by GDOT personnel on the OCGA 50-18-72 in July of 2009. These shovel tests were placed relative to the locations of soil test boring holes, which investigated the feasibility of using the matrix of the property in fill for the project and the chosen locations as possible borrow pit/storm retention ponds. No artifactual materials or features were located during this shovel testing. The boring activity was allowed to proceed and was then closely monitored by the project manager.

Table of Contents

Abstract ii
List of Figures iv
Introduction 1
Site 9CH1205 2
Remote Sensing Investigations
Previous Investigations & Potential for Anomalies 3
Methods of Data Collection and Data Processing 5
June 2009 Investigations
Grid 1/4 6
Grid 2/5 7
Grid 3/6 7
Grid 4/7 8
Grid 5/8 10
February 2009 Investigations
Grid 1 10
Grid 2 11
Grid 3 11
Interpretations
Grid 1/4 13
Grid 2/5 15
Grid 3/6 15
Grid 4/7 20
Grid 5/8 20
Grid 1 22
Grid 2 22
Grid 3 23
Conclusions & Recommendations 27
Metal Detection 28
Investigation of Live Oak Trees and Landscape Features 29
Additional Shovel Testing 32
References Cited 34

Appendix I – Remote Sensing Investigations: GPR Slice Maps

Sensitive archaeological information redacted pursuant to OCGA 50-18-72

List of Figures

Figure 1. Site 9CH1205 Map with Test Unit, Metal Detection, and Geophysical Grid Locations, including Additional Metal Detection Areas (June 2009)..........2

Figure 2. View of the area of grid 3/6, looking southwest to cluster of four large live oaks. This area has been cleared of much of the understory which occurs in the central, southern, and southeastern portions of the site..........4

Figure 3. View of grid 2/5 area and data collection, looking southwest..........7

Figure 4. View of grid 3/6 area and data collection, looking west. Metal detection by Garrett Silliman in background..........8

Figure 5. View of grid 4/7 area and data collection, looking south..........9

Figure 6. Data collection with Gradiometer, one sensor, in grid 4/7..........9

Figure 7. View of grid 1 area, looking west. Large live oak at corner of picture..........11

Figure 8. View of grid 3 area and data collection, looking west. Note vegetation, leaf litter, and undulating topography..........12

Figure 9. Gradiometer and GPR results for Grid 1/4, with sketch map. GPR slice is at approximately 48 cmbs..........14

Figure 10. Gradiometer and GPR results for grid 2/5, with sketch map. GPR slice is at 50cmbs..........16

Figure 11. Gradiometer and GPR results for grid 3/6, with sketch map. GPR slice at 50cmbs..........17

Figure 12. Gradiometer and GPR results for grid 4/7, with sketch map. GPR slice at ~70cmbs..........18

Figure 13. GPR slice for grid 4/7 at ~100 cmbs. GPR profiles are keyed to the plan view..........19

Figure 14. Gradiometer and GPR results for grid 5/8, with sketch map. GPR slice at 50cmbs..........21

Figure 15. Gradiometer and GPR results for grid 1, with sketch map. GPR slice at 90cmbs..........24

Figure 16. Gradiometer and GPR results for grid 2, with sketch map. GPR slice at 60cmbs……………………………………………………………………………………...25

Figure 17. Gradiometer and GPR results for grid 3, with sketch map. GPR slice at 70cmbs……………………………………………………………………………………...26

Figure 18. Metal detection by Garrett Silliman…………………………………………………28

Figure 19. Graphic of existing live oak trees on Trellis property. Circled specimens are discussed in the text………………………………………………………………………...29

Figure 20. View of large tree in southeastern portion of site……………………………………30

Figure 21. View of one of four trees in northwestern portion of site…………………………...30

Figure 22. Boring Location Sketch, provided by Ranger Consulting…………………………...32

Figure 23. Boring activities on OCGA 50-18-72 ……………………………………………………33

Introduction

From June 15-17, 2009, testing investigations were conducted at archaeological site 9CH1205 in Chatham County, Georgia. These investigations included numerous goals: to investigate the potential for further intact features via the use of non-invasive methods (remote sensing), to further test the potential for and distribution of the Civil War component associated with the site property, and to evaluate the age, health, and contribution of several vegetative features to the overall site landscape. In June 2009, personnel from GDOT included Project Manager Pamela Baughman and staff archaeologists Heather Mustonen and Jim Pomfret; Kenneth Franks provided additional aid in February of 2009. Personnel from Edwards-Pitman Environmental, Inc. included Garrett Silliman and Brandon Batt. Arborists included Dennis Goldbaugh from the Chatham County Department of Public Works and Daniel Westcot from the Georgia Forestry Commission. In July 2009, additional shovel testing was performed by Pamela Baughman in relation to proposed soil test boring locations. See Figure 1 for a map of the OCGA 50-18-72 with information on areas of testing, remote sensing, and metal detection.

Remote sensing investigations included the use of a ground penetrating radar (GPR) and a magnetic gradiometer instrument. Five 20x20 meter grid locations were investigated, using each instrument. The results of these investigations appear in the first section following and was compiled by Pamela Baughman. Further, this section will reconsider the testing done in February of 2009 and offer recommendations for proceeding with excavation should mitigation be necessary at this site.

Metal detector survey involved the investigation of several transects along the outskirts of the previously known site boundary. These investigations were reported by Garrett Silliman of Edwards-Pitman and are included here in the second section of this report. Information regarding the age and health of the live oak trees in question was compiled by Daniel Westcot of the Georgia Forestry Commission. Additional information from Dennis Goldbaugh and from further observations of landscape features on this property is discussed in section three.

Additional shovel testing that was done by GDOT personnel on the Trellis property in July of 2009 is discussed in section four. Nine shovel tests were placed relative to the locations of soil test boring holes, which investigated the feasibility of using the matrix of the property in fill for the project and the chosen locations as possible borrow pit/storm retention ponds. None of these shovel tests were positive for artifacts or features. The boring activity was allowed to proceed and was closely monitored by the project manager.

9CH1205

Site 9CH1205 has been recorded as a large late 18^{th}-19^{th} century historic farmstead or plantation site, with a Civil War component (Quirk and Silliman 2009). The site is located in a wooded parcel northwest of the intersection of SR 204 and King George Boulevard (see Figure 1). The site was originally estimated to be approximately 350 x 240 meters in area, based on shovel testing and surface investigations. The site was recommended as eligible for the National Register of Historic Places (NRHP) under criteria A and D, following testing involving remote sensing, metal detection, and test unit excavation. These investigations uncovered thousands of artifacts and seven cultural features, and documentary research has supported the components noted in the material culture. This site and its archaeological data are believed to have the potential to address issues related to the early settlement of Coastal Georgia and to the occupation of the area during the Civil War. It is known to have preserved features and domestic artifacts, and the distribution of these remains across the extent of the site, which covers the majority of the surveyed parcel, has become an important consideration. Following the invasive testing, it was decided that less invasive and non-invasive methods would be used to further survey areas of the site so that its potential for further features and preservation could be assessed.

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Remote Sensing Investigations

Previous Investigations & Potential for Anomalies

The potential for locating geophysical anomalies at this site was considered to be rather high, considering the number of archaeological features located during previous testing and the nature of the remains at the site. Concerns existed regarding the thickness of the vegetation across the parcel as well as previous disturbances and modern intrusions and how these could affect the quality of the data. Vegetation in this area consisted of large hardwoods, including numerous live oaks, pines, and much understory, along with heavy root systems. Push piles were evident along with several dirt roads and paths crosscutting the property. Undulations in topography were common, and leaf litter was especially heavy, with some vines and fallen trees causing obstructions. These areas were cleared by hand/machete of large understory vegetation, small trees, and fallen/debris prior to survey. A road and fence bisected the parcel in a northeast to southwest direction. In addition, it was clear that along the outskirts of the site, areas had been cleared of much of the understory and even larger saplings, but these grids (notably 3/6 and 5/8) still exhibited push piles and dirt tracks and even evidence of heavy equipment having been in the area (Figure 2).

The site boundary for 9CH1205 covers nearly the entire parcel but higher concentrations of artifacts were found in shovel tests in the southern portion and southeastern corner of the parcel. From site testing, it is known that soils consisted of a typical profile of plowzone of dark grayish brown (10YR 4/2) and very dark grayish brown (10YR3/2) sandy loam from 20-30 cm thick, underlain by a 10-50 cm thick layer of typically light yellowish brown (2.5Y 6/3) sand. The clay content of the soil increased with depth, resulting in a more compact yellowish brown (10YR 5/8) sandy clay subsoil below Stratum B/II (Quirk and Silliman 2009:49). Clay and moisture content in soil can disrupt the signal from the ground penetrating radar instrument in that materials with a high electrical conductivity, such as saturated clays, greatly impede electromagnetic wave propagation to the point that radar energy is severely attenuated with depth (Conyers 2004:53-55). However, during testing, artifacts were generally found in the range of the plowzone and features beneath the plowzone, beginning approximately 40cmbs, meaning that the targets of the investigation were mostly found above the soils with higher clay and moisture content. Features found included structural pits and posts, and the likelihood of further discoveries of this kind was considered high.

The artifact components of this site, most notably ferrous metal artifacts, were considered targets on an historic site such as this, but were also thought to have the potential to cause interference for the remote sensing equipment, especially for the magnetic gradiometer, with respect to locating more subtle features. In many cases, such anomalies can be identified and eliminated during analysis of the data, but they often mask the remaining signature of the surrounding space (and thus confound the whole of the data). Thus, given that many of the artifacts recovered during survey and testing were of categories that were metallic (nails), structural (tabby), and/or fired (brick), the potential for detecting artifacts and especially artifact concentrations was also deemed to be highly likely, most notably with the magnetic gradiometer.

This site area has also been subjected to previous testing; therefore, shovel tests have disturbed the landscape and could manifest themselves as anomalies in the data. It is important then to compare the site survey and testing map to the grid areas surveyed. It is also important to note that the site was previously investigated with geophysical equipment in February of 2009. Three grids were put into place at that time (labeled grids 1, 2, and 3). During the most recent testing (June), five grids were surveyed and were labeled in a dual manner (grids 1/4, 2/5, 3/6, 4/7, and 5/8) to track how they related to the current site visit and to geophysical testing overall. Two of these later grids partially overlap those surveyed previously (see Figure 1). This is due to the fact that the original grids were not fully staked and due to the fact that grids had to be placed largely based on the ability to clear vegetation and obstructions prior to survey. Thus grids were placed with the goal of locating structural or landscape features and in association with the previous survey and testing results but often had to be compromised by the superficial site conditions. In this vein, grids were placed so that they were oriented north-south; only two deviated from this pattern – grid 2/5 was oriented at 40° and grid 4/7 was oriented at 20° off north.

The geophysical testing done in February of 2009 will be discussed following that done in June of 2009, given that the data from February had been previously analyzed and tested, with positive ground-truthing results (see Quirk and Silliman 2009). However, this data was not fully considered due to time constraints and has further implications should mitigation be recommended for this site. Therefore, the February data will be reconsidered here and more thorough recommendations will be made.

Figure 2. View of the area of grid 3/6, looking southwest to cluster of four large live oaks. This area has been cleared of much of the understory which occurs in the central, southern, and southeastern portions of the site.

Methods of Data Collection and Data Processing

All of the GPR data in this survey was collected using a GSSI SIR-3000 with a 400MHz antenna. In general, ground-penetrating radar data is acquired by transmitting pulses of radar energy into the ground from a surface antenna, reflecting the energy off buried objects, features, or bedding contacts and then detecting the reflected waves back at the ground surface with a receiving antenna. When collecting radar data, surface antennae are moved along the ground in transects, typically within a surveyed grid. A large number of subsurface reflections are collected along each line. During this survey, the data in all survey grids was collected at 50 cm intervals with a range of 30-32Ns set prior to survey. This range is equivalent to just over 1 meter in real depth. Below this depth, extraneous background noise affects the signal, leading to attenuation and making resolution of any features difficult, but given the range of feature occurrences at this site, a 0-1 meter range was considered appropriate.

Survey grids were placed in areas believed to contain the footprint of the remains of the structures and landscape features of the plantation component of the site. Survey grid corner locations were demarcated in the field with stakes. Obstructions and uneven topography were at issue, and the survey grids, nearby features, and features within the grid were mapped to aid in later processing of anomaly patterns. Transects started in the southwest corner of each grid and proceeded in a north-south (Y) zig-zag pattern across the grid area.

The GPR data was processed using RADAN software. Post-processing steps included setting time zero and removing background noise from the raw data vertical profiles; migration was not attempted. These steps improved the researcher's ability to view data and determine the size, depth, and morphology of subsurface features. RADAN was also used to view the data in 3D amplitude horizontal slice-maps, which produced a plan view of the differences in reflected amplitudes across a given surface at various chosen depths. Two-dimensional reflection profiles were analyzed to determine the validity of the features identified on the amplitude slice-maps. The reflection profiles show the geometry of the more continuous reflections, which can lend insight into whether the radar energy is reflecting from a flat layer (seen as a distinct band in profile) versus a single object or wall (seen as a hyperbola in profile). Using these profiles to confirm or refute ideas about the nature of buried materials seen in the three-dimensional slice-maps, features of potential cultural significance were delineated. Once the slices were created in RADAN 6.6, they could be exported to a mapping software, such as *Surfer*, as was used in this study.

In these geophysical maps, cultural features (as well as other discrete disturbances) appear as anomalies, i.e., spatially discrete areas characterized by values that differ from those of the surrounding area. However, some of the visible anomalies can be deceivingly representative of clutter, clutter referring to non-archaeological, non-random, discrete phenomena that complicate feature detection. Clutter can include plow furrows, rocks, tree roots, rodent burrows, and modern metallic debris such as pipes. At some sites, anomalies associated with clutter can be stronger and more numerous than anomalies related to cultural features. In this case, it was known that there was a lot of clutter (from tree roots and metallic debris) in the area and that they had the potential to interfere with the detection of the cultural remains.

The gradiometer data in this survey was collected using a Bartington Grad601 Magnetic Gradiometer with dual arrangement. The sensors had a 1-m separation, the lines were spaced at 0.5 m, and two lines of data were recorded during each pass. The range was recorded at 100nT, and 8 samples were taken per unit. The data were post processed using ArcheoSurveyor 2.0.1. Data processing steps included clipping, destaggering, destriping, high and low pass filters, and interpolation. The gradiometer data during the June survey was collected using the Bartington Grad601 with a single arrangement, one sensor. Thus, only one line was collected at a time; this was done to improve its usage in the heavy vegetation. The range was recorded at 100nT, 2 lines per meter (0.5 meter spacing), and 8 samples per unit.

Operator variability and operator error should be considered as variables in the following results, due to the multiple operators in play and the sometimes trying superficial conditions under which the surveys occurred. Consistent speeds of survey were not always attainable, due to the differing operators and variable ground conditions, but it is hoped that much of this operator error has been reduced and/or eliminated with post-processing.

June 2009 Investigations

Grid 1/4

The first grid (grid 1/4) was 20x20 m and was placed in between two previously surveyed grids. Data in this grid was collected in the "Y" direction, meaning that transects were 20 m long, running north and south. A significant push pile with trees growing out of it caused an obstruction in the southwestern corner of this grid square (see sketch in Figure 9); therefore, survey along transects of this grid was suspended following the 14 meter line and dummy values were entered for the remainder. Operators for the GPR included Heather Mustonen and Pamela Baughman. Slice maps from the GPR survey of this grid [GPR files 1-29] appear in Appendix I; one of these maps, a slice at approximately 48 cmbs, was chosen for overall interpretation, which will be discussed later. These slices are presented at depths of centimeters below surface (cmbs) but are perhaps more accurate considered in nanoseconds (Ns). Data was collected within a range of 32Ns during June 2009 survey, and this range is equivalent to just over one (1) meter of actual depth. The slices include an average of a range of results over approximately 25 cm.

The gradiometer survey involved one sensor and data was collected along north-south transects, 2 lines per meter and 8 samples per meter. Survey began in the SW corner of the grid. Processing steps in ArcheoSurveyor for Grid 1/4 included clipping, destriping, and destaggering. The operator for the gradiometer was Jim Pomfret. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Grid 2/5

Grid 2/5 was placed northwest of grid 1/4 and measured 20x20 m. Grid 2/5 was difficult to navigate and was bisected by a road, along which a row of trees was planted and a metal/barb wire fence had been erected at one time (Figure 3). Data in this grid were also collected in the "Y" direction, so that transects were 20 m long, running north and south; however, the grid itself was laid out so that it diverted from north by approximately 40°. This grid was placed in this location to target possible outbuildings or road signatures just off the main structural site area. Operators for the GPR included Heather Mustonen and Pamela Baughman. Slice maps from the GPR survey of this grid [GPR files 30-70] appear in Appendix I; one of these maps, a slice at approximately 50 cmbs, was chosen for overall interpretation, which will be discussed later.

The gradiometer survey involved one sensor and data was collected along north-south transects, 2 lines per meter and 8 samples per meter. Survey began in the SW corner of the grid. Processing steps in ArcheoSurveyor for Grid 1 included clipping, destriping, and destaggering. The operator for the gradiometer was Jim Pomfret. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Figure 3. View of grid 2/5 area and data collection, looking southwest.

Grid 3/6

Grid 3/6 was placed north and west of grids 1/4 and 2/5, near Test Unit 9 on the outskirts of the previously recorded site boundary. This grid measured 20x20 m. Data in this grid were collected in the "Y" direction, so that transects were 20 m long, running north and south. This grid was placed in the midst of four large live oak trees and in a triangle formed by three of them; therefore, the potential for root intrusions was high (Figure 4). Operators for the GPR included Heather Mustonen, Brandon Batt, and Pamela Baughman. Slice maps from the GPR survey of this grid [GPR files 71-111] appear in Appendix I; one of these maps, a slice at approximately 50 cmbs, was chosen for overall interpretation, which will be discussed later.

The gradiometer survey involved one sensor and data was collected along north-south transects, 2 lines per meter and 8 samples per meter. Survey began in the SW corner of the grid. Processing steps in ArcheoSurveyor for Grid 1 included clipping, destriping, and destaggering. The operator for the gradiometer was Jim Pomfret. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Figure 4. View of grid 3/6 area and data collection, looking west. Metal detection by Garrett Silliman in background.

Grid 4/7

Grid 4/7 was placed south of the large live oak in the southeastern corner of the site boundary. This grid was situated directly south of the originally tested grid 1 (February 2009). Based on previous results in grid 1 (see Quirk and Silliman 2009), it was believed that this grid had great potential for anomalies associated with the colonial plantation component. However, this grid also exhibited a great deal of surface undulations, push piles, and vegetation, along with being intruded by a banked/ditch dirt path (being used by locals on dirt bikes). Operator for the GPR was Jim Pomfret (Figure 5). Slice maps from the GPR survey of this grid [GPR files 112-152] appear in Appendix I; two representative slice depths (at 70cmbs and 100cmbs) are discussed in the following section.

The gradiometer survey involved one sensor and data was collected along north-south transects, 2 lines per meter and 8 samples per meter. Survey began in the SW corner of the grid. Processing steps in ArcheoSurveyor for Grid 1 included clipping, destriping, and destaggering. Operator for the gradiometer was Heather Mustonen (Figure 6). Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Figure 5. View of grid 4/7 area and data collection, looking south.

Figure 6. Data collection with gradiometer, one sensor, in grid 4/7.

Grid 5/8

Grid 5 was placed north and east of grid 4/7. This grid also was situated on the outskirts of the previously recorded site boundary, in an area that mostly included negative shovel tests. This area had also been previously cleared of most understory and small vegetation but still included large trees, push piles, and superficial debris. Operator for the GPR was Pamela Baughman. Slice maps from the GPR survey of this grid [GPR files 153-193] appear in Appendix I; one of these maps, a slice at approximately 50 cmbs, was chosen for overall interpretation, which will be discussed later.

The gradiometer survey involved one sensor and data was collected along north-south transects, 2 lines per meter and 8 samples per meter. Survey began in the SW corner of the grid. Processing steps in ArcheoSurveyor for Grid 5 included clipping, destriping, and a low pass filter. Operator for the gradiometer was Heather Mustonen. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

February 2009 Investigations

Grid 1

Grid 1 was surveyed on February 17, 2009, and was placed just south of the *large* live oak tree in the southeastern corner of the site boundary. This grid area included a sizable push pile and was impacted by several paths/trails running through its boundaries (Figure 7). Operator for the GPR was Pamela Baughman. During this survey the data in the survey grid was collected at 50 cm intervals with a range of 30Ns set prior to survey. Transects started in the southwest corner of the grid and proceeded in a north-south (Y) zig-zag pattern across the grid area. Slice maps from the GPR survey of this grid [GPR files 1-41] appear in Appendix I; one of these maps, a slice at approximately 90 cmbs, was chosen for overall interpretation, which will be discussed later.

The gradiometer survey involved a dual sensor arrangement and was collected along north-south transects. Survey began in the SW corner of the grid and included 2 lines per meter and samples per meter; two lines of data were collected at once. Processing steps in ArcheoSurveyor for Grid 1 included clipping, destriping, destaggering, low and high pass filters, and interpolation. Operator for the gradiometer was Heather Mustonen; processing of this data was accomplished by Sara Gale. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Figure 7. View of grid 1 area, looking west. Large live oak at corner of picture.

Grid 2

Grid 2 was placed northwest of the area of grid 1. Grid 2 fit neatly between two areas exhibiting test units (see Figure 1). Operator for the GPR was Pamela Baughman. During this survey the data in the survey grid was collected at 50 cm intervals with a range of 30Ns set prior to survey. Transects started in the southwest corner of the grid and proceeded in a north-south (Y) zig-zag pattern across the grid area. Slice maps from the GPR survey of this grid [GPR files 42-82] appear in Appendix I; one of these maps, a slice at approximately 60 cmbs, was chosen for overall interpretation, which will be discussed later.

The gradiometer survey involved a dual sensor arrangement and was collected along north-south transects. Survey began in the SW corner of the grid and included 2 lines per meter and samples per meter; two lines of data were collected at once. Processing steps in ArcheoSurveyor for Grid 2 included clipping, destriping, destaggering, low and high pass filters, and interpolation. Operator for the gradiometer was Heather Mustonen; processing of this data was accomplished by Sara Gale. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Grid 3

Grid 3 was placed west of grid 2 and TU 5. This grid area included a number of push piles and large vegetation (Figure 8). Operator for the GPR was Kenneth Franks. During this survey the data in the survey grid was collected at 50 cm intervals with a range of 30Ns set prior to survey. Transects started in the southwest corner of the grid and proceeded in a north-south (Y) zig-zag pattern across the grid area. Slice maps from the GPR survey of this grid [GPR files 83-123] appear in Appendix I; one of these maps, a slice at approximately 70 cmbs, was chosen for overall interpretation, which will be discussed later.

The gradiometer survey involved a dual sensor arrangement and was collected along north-south transects. Survey began in the SW corner of the grid and included 2 lines per meter and samples per meter; two lines of data were collected at once. Processing steps in ArcheoSurveyor for Grid 2 included clipping, destriping, destaggering, low and high pass filters, and interpolation. Operator for the gradiometer was Heather Mustonen; processing of this data was accomplished by Sara Gale. Analysis of the gradiometer information produces an averaged display in plan view; this overall result will be discussed below, along with the GPR results.

Figure 8. View of grid 3 area and data collection, looking west. Note vegetation, leaf litter, and undulating topography.

Interpretations

Interpretations of the GPR data were made based upon both amplitude slice-maps and two-dimensional vertical radar profiles. Depth slices from 0-130 cmbs (~1.3 m) were reviewed in RADAN, but the depth slices from 0-25 cmbs and over 100 cmbs were not considered really useful for interpretation, due to the thick vegetative cover and root matter known to exist at the top of the profile, the attenuation of the radar signal in the clay at the bottom of the profile, and the focus on the range of ~40-70cmbs for feature delineation. Amplitude slice maps were produced for a series of depths (~20cmbs-130cmbs in most cases; see Appendix I) but interpretations were based on one or more chosen slice depths. These slice maps, in general, can be interpreted as follows: Areas of low-amplitude waves (blue as presented here) usually indicate uniform matrix material or soils while those of high amplitude (red/pink) denote areas of high subsurface contrast such as buried archaeological features, voids, or important stratigraphic changes (Johnson 2006:142). Study of vertical profiles allowed a complementary view of an anomaly's geometry through depth and quickly demonstrated its classification as either a "point-source" type, or composite, one with multiple reflections; comparison through and across profiles allowed the identification of possible planar surfaces and linear features. In the following interpretation, it should be noted, however, that a full understanding of the stratigraphic and electrical characteristics of the soil conditions and the geometry of the geologic units and archaeological features did not exist in this case, so interpretations from these results should be considered general and preliminary. Depths are approximate since wave velocity was not calculated for the site and its particular soil conditions.

Interpretations of the gradiometer data were based on processed graduated shade maps, as presented here. In general, anomalies in the gradiometer image are indicated by their contrast (positive or negative) with the overall average, surrounding soil. The magnitude of the detected contrast can be based on the subject's magnetic susceptibility, volume, and depth.

Interpretations discussed below are based on the gradiometer and GPR images presented in Figures 9-17. It is possible to find a suite of interesting features by comparing the gradiometer results to those of the ground-penetrating radar; sometimes the results complement each other, while perhaps more often, one instrument indicates an anomaly where the other does not. The GPR also allows the viewer to study how anomalies increase/reduce through depth, whereas the gradiometer data shows an overall average of the below-surface environment.

Grid 1/4

Gradiometer and GPR results for grid 1/4 were limited by the fact that a substantial amount of the data collection area had to be nullified due to the superficial interferences, resulting in a grid actually 20x14 meters. This grid, however, does show several interesting anomalies and some patterns. The red arrows and red circles in Figure 9 highlight the anomalies, and the red dashed lines follow the possible patterns. Some of the anomalies can be ruled out as possible metallic artifacts or interference; these are usually the ones with distinct bipolar (black/white, positive/negative) signatures on the gradiometer image. In the GPR data, there are numerous

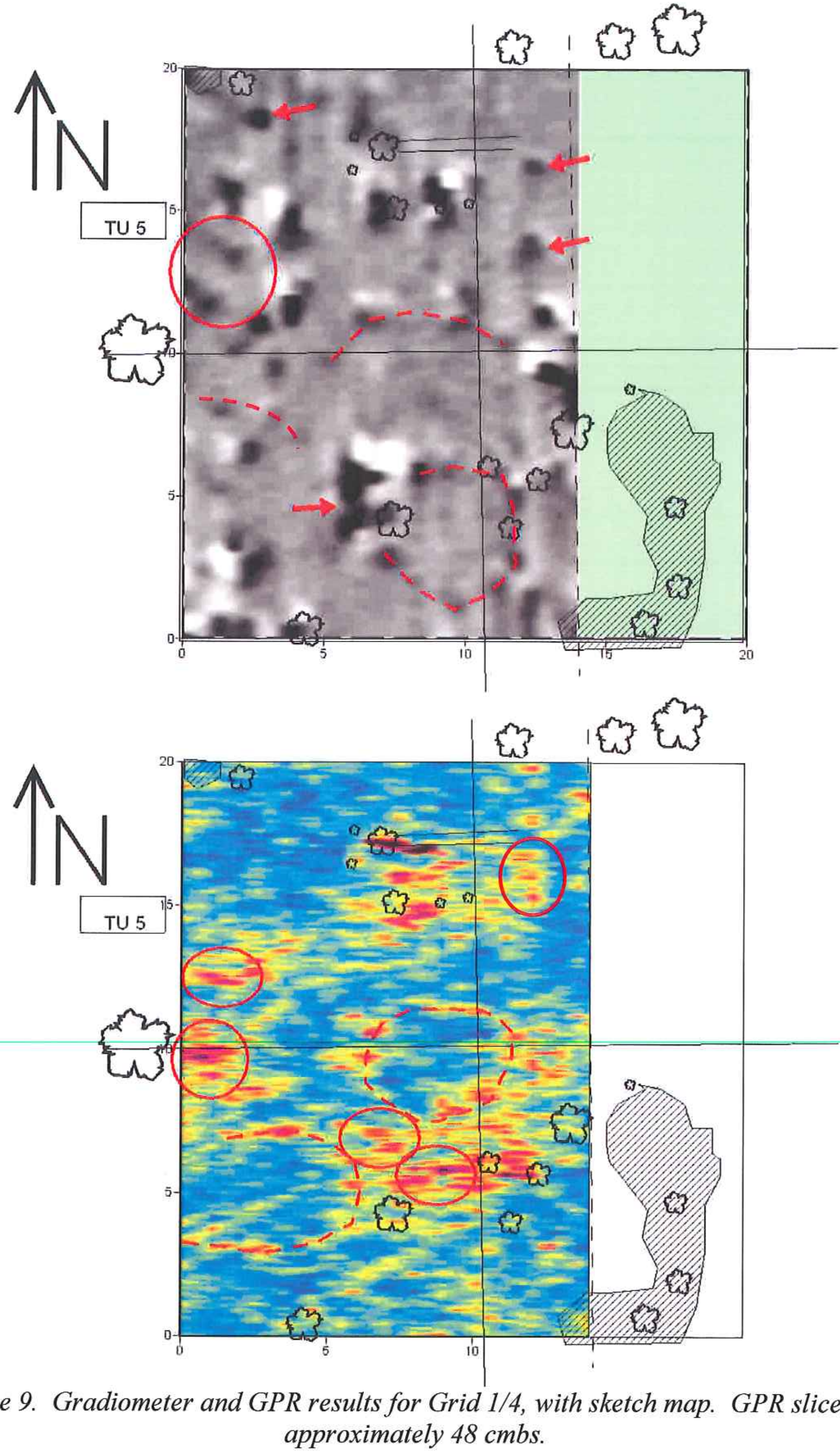

Figure 9. Gradiometer and GPR results for Grid 1/4, with sketch map. GPR slice is at approximately 48 cmbs.

point-source anomalies which could be indicative of discrete artifacts and/or small features. Several composite anomalies were also evident in the GPR profiles, sometimes crossing multiple profile lines; these generally had multiple hyperbolic reflections and have the potential to be representative of small pits or postholes, but it must be remembered that shovel testing has been done in the area previously, and some of these anomalies could instead be disturbances associated with that testing. In the gradiometer data, these appear as small, rounded positive (black) anomalies. A comparison of the remote sensing grid area to the shovel testing grid/overall site map will allow consideration of which anomalies may be the result of shovel testing as opposed to cultural processes. Additionally, Figure 1 shows Test Unit 5 as being within the boundaries of this geophysical grid; however, field notes reported it as being on the western edge. Nonetheless, an excavated and backfilled test unit could be the source of the anomaly shown circled in red on the western boundary of this grid. The composite anomalies also have the potential to be larger structural artifact concentrations, such as brick pier fragments or tabby concentrations. The patterns shown in the grid may be lines of these structural elements or scattered debris piles, but also perhaps piled/excavated natural areas. It is also clear from the GPR in this grid that there are indications of a planar surface in the profile, starting at approximately 70 cmbs. This surface may represent a soil horizon, zone of increased water content, or a layered interface related more to the natural geology of the site area than to cultural modifications, and will be explored further in other grids across the site.

Grid 2/5

Grid 2/5 was placed northwest of grid 1/4, and the intention of this placement was to investigate the area just outside the core of the dense site area. This grid area was cleared of vegetation but still had to be oriented at 40° of north because of surface obstructions. A dirt road/path ran through the grid in a southwesterly to northeasterly fashion, and just east of this path remained a tree line with an associated barbed wire fence. Much of this fence remained on the ground and its presence shows up in both the gradiometer and GPR results, unfortunately obscuring any possible results below or in the vicinity of the fence line (see Figure 10). There were still a few anomalies of interest found during analysis of this grid, however. The red circles indicate these anomalies in Figure 10. These anomalies correlate to composite features in the GPR profile and are likely small pits or structural concentrations. At least one can probably be attributed to shovel testing, following comparison of the grid's location to shovel test locations in Figure 1.

Grid 3/6

Grid 3/6 was placed in a recently cleared, open area in the middle of a stand of four live oak trees. This area was thought to exhibit a high probability for having an historic structure, due to its overall appearance above ground. The results of the gradiometer and GPR surveys show no anomalies of cultural interest, but several point-source anomalies appear in the GPR data and bipolar anomalies in the gradiometer data (see Figure 11). Most of these anomalies can most likely be attributed to tree roots, metallic artifacts, and/or to the large push pile of debris in the northwest quadrant of the grid. An old road/path also runs through the middle of the grid, and many of the anomalies seen in the gradiometer data could be related to this impact. Some surface obstructions (trees) caused disturbances in the data collection for this grid and therefore, gaps in the data.

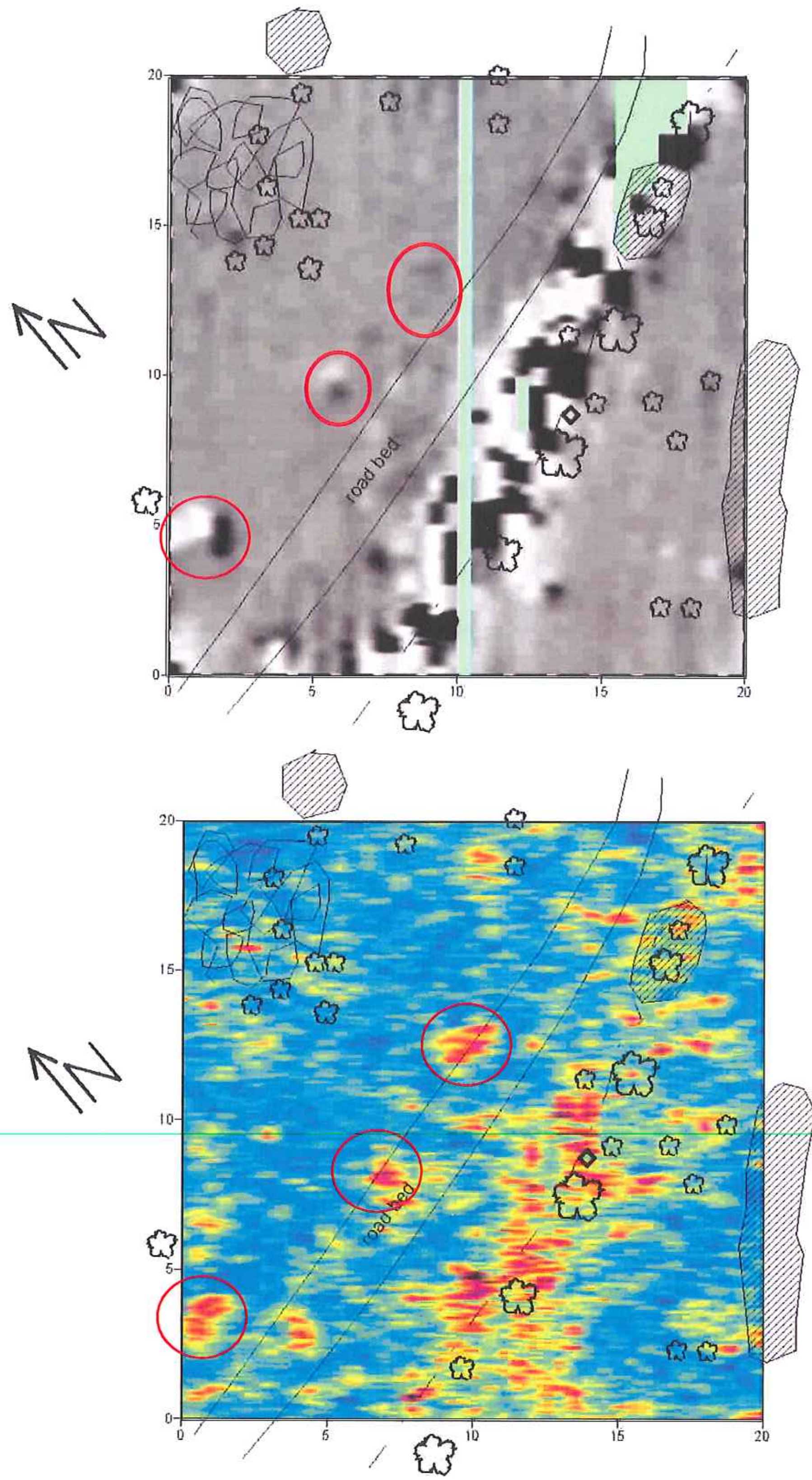

Figure 10. Gradiometer and GPR results for grid 2/5, with sketch map. GPR slice is at 50cmbs.

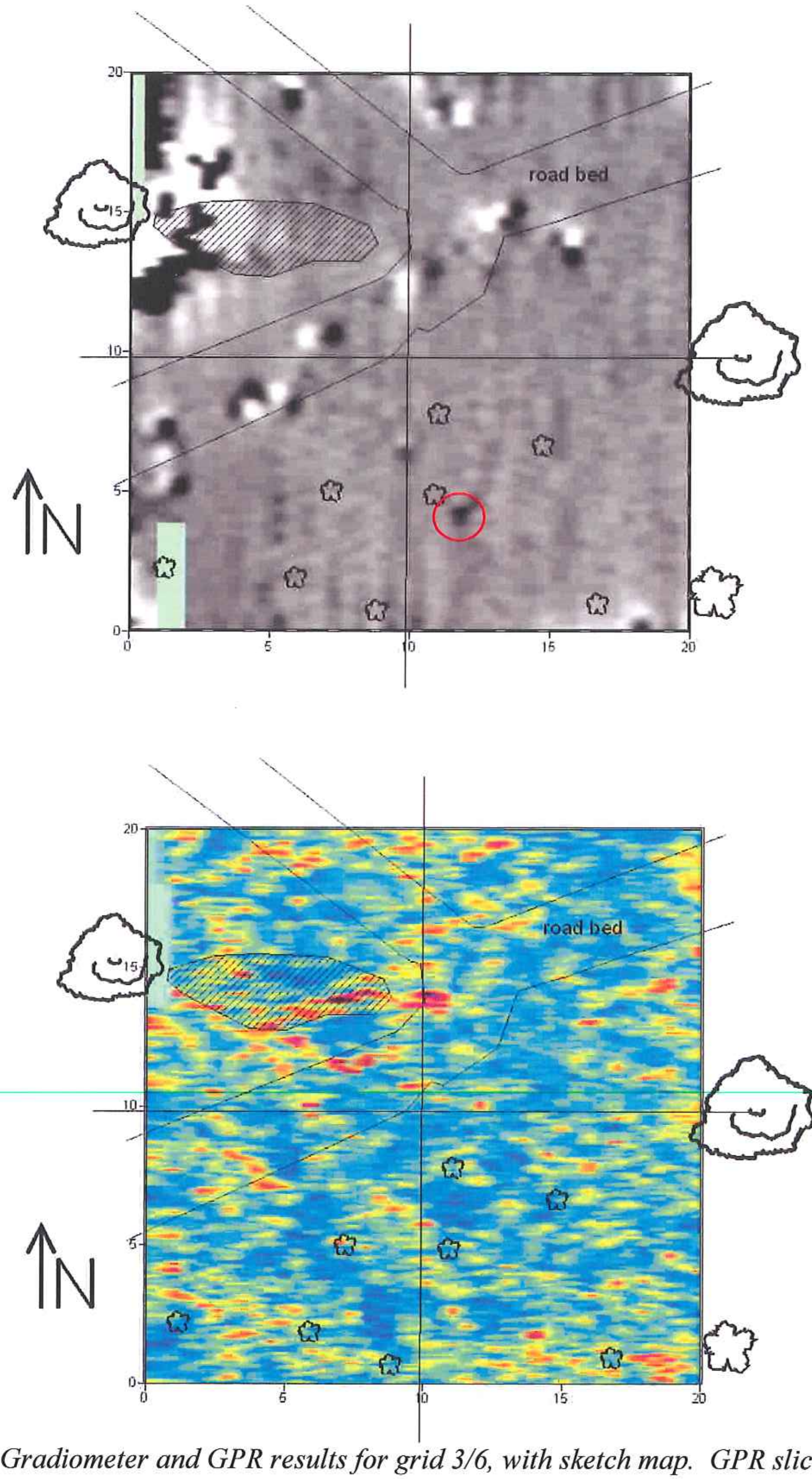

Figure 11. Gradiometer and GPR results for grid 3/6, with sketch map. GPR slice at 50cmbs.

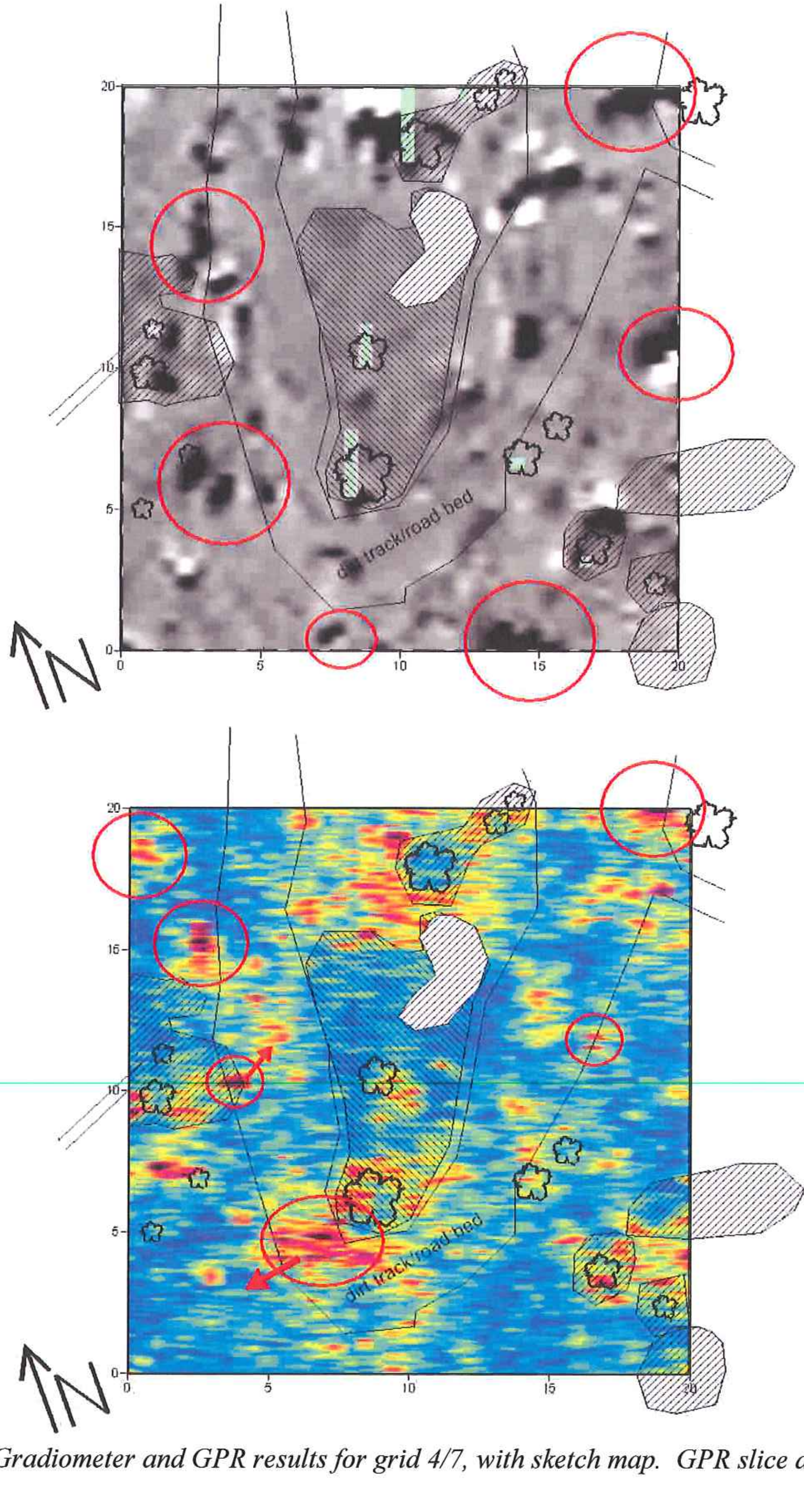

Figure 12. Gradiometer and GPR results for grid 4/7, with sketch map. GPR slice at ~70cmbs.

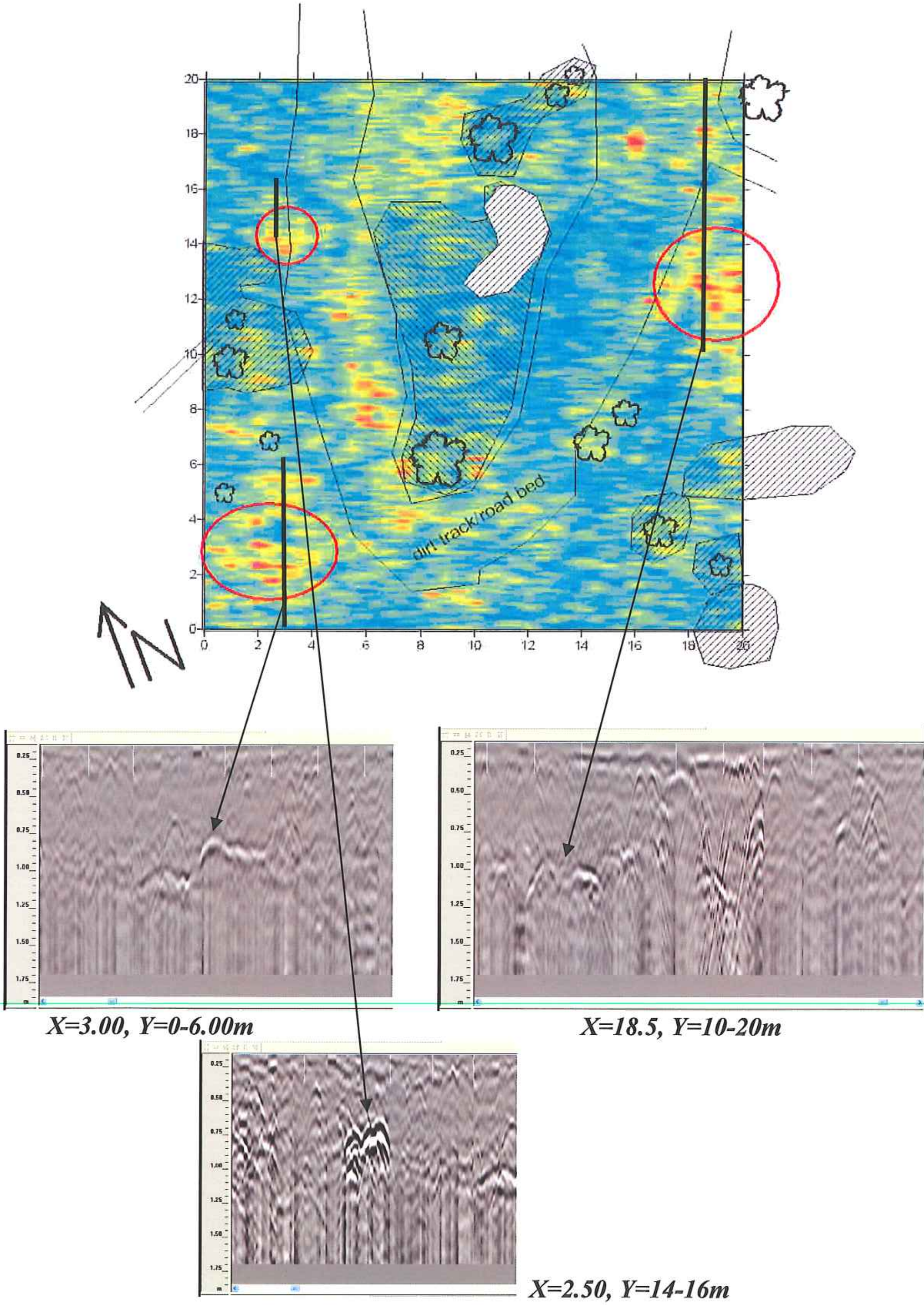

Figure 13. GPR slice for grid 4/7 at ~100 cmbs. GPR profiles are keyed to the plan view.

Grid 4/7

Grid 4/7 was situated directly south of the originally tested grid 1, in the southeastern corner of the site. This area was believed to have a high potential for structurally-related anomalies, and indeed the results of the surveys indicate several anomalies worth testing or investigating further. Because this area is so undulating in topography, and full of large vegetative obstructions and push piles, it can be easy to dismiss the results from the remote sensing surveys, but in this case, the concentration of anomalies and piles in this area makes it more interesting. Figure 12 presents the results of the gradiometer and GPR surveys at ~70 cmbs. GPR results are presented for another slice, at ~100 cmbs, demonstrating how some anomalies develop with depth, and giving examples of the profile views for certain anomalies (Figure 13).

Several large, irregularly-shaped positive anomalies are evident in the gradiometer data for this grid. These could be related to biogenic activity (tree throws or rodent burrows) or to human constructions such as pits filled with topsoil, mounds/debris piles, and/or structural artifact concentrations. The GPR results show a complex series of anomalies, many with composite signatures of multiple reflections and some which develop across the grid in a linear or planar fashion (those that develop across profiles are shown in the image along with arrows indicating the direction of development of the feature). The profiles for this grid are obscured to a certain extent by the significant amount of vegetation, i.e. tree roots at the surface, in this area and the reflection of those point-source hyperbolas deep into the profile. However, two slice-maps show particularly high amplitude anomalies (red circled areas) most likely representative of pit or pile features and maybe structural surfaces.

Grid 5/8

Grid 5/8 was placed north and east of grid 4/7, in an area on the outskirts of the previously recorded site boundary. This area had also been previously cleared of most understory and small vegetation but still included large trees, push piles, and superficial debris. Several survey transects included gaps in collection for the gradiometer, and collection error should be considered as a factor in these results. A number of anomalies are indicated in the gradiometer and GPR results, however (see Figure 14); the GPR slice is presented for an approximate depth of 50 cmbs.

Three rounded, positive anomalies appear in the gradiometer data for this grid, but the two high amplitude anomalies that appear in the GPR data do not correspond to any seen in the gradiometer data. In the GPR profiles, much is obscured by superficial interference and wave reflections mirroring through the ground. The two highlighted anomalies in the plan appear as composite, multiple reflection anomalies in profile. A number of point-source reflections were noted in the profiles and may represent metallic artifacts or debris; these are also seen in the bipolar reflections of the gradiometer data.

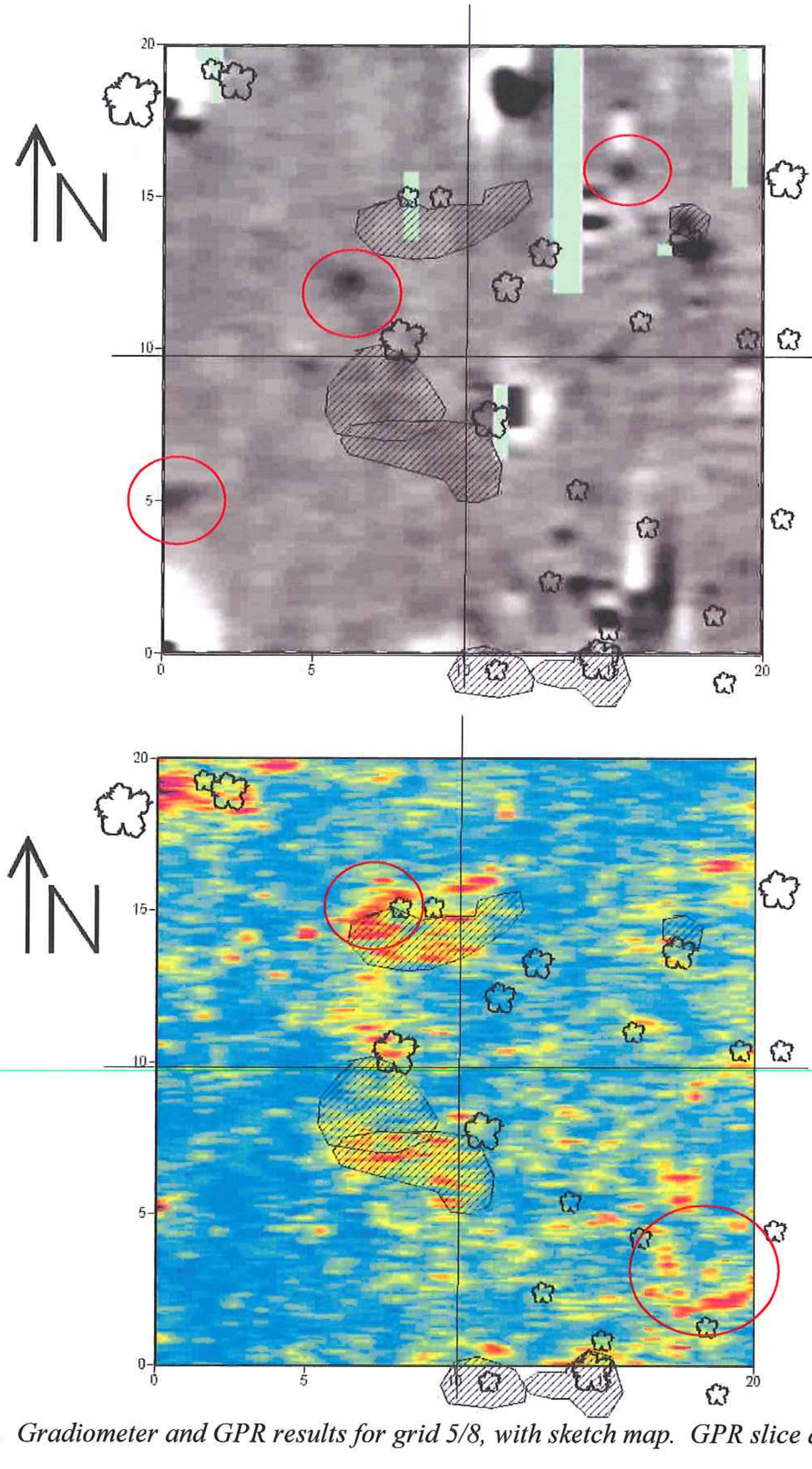

Figure 14. Gradiometer and GPR results for grid 5/8, with sketch map. GPR slice at 50cmbs.

Grid 1

Grid 1 was surveyed on February 17, 2009, and was placed just south of the *large* live oak tree in the southeastern corner of the site boundary. This grid area included a sizable push pile in the north central portion of the grid and was impacted by several paths/trails running through it. The data from the gradiometer and GPR surveys was quickly processed at that time and recommendations for testing were provided to Edwards-Pitman Environmental, Inc. In particular, an anomaly at approximately N 15, E 2.4 from the SW corner was highlighted. In the gradiometer data, this anomaly appeared as a strong positive, and in the GPR data, it appeared as a composite anomaly with multiple reflections across multiple profiles. A 1x2 meter test unit (Test Unit 10) was placed in the area of this anomaly, and Feature 7 was revealed. A 1x1 meter test unit (Test Unit 12) was then placed adjacent to Test Unit 10 to further expose Feature 7. Feature 7 was partially excavated and found to include at least two zones of material and large amounts of structural artifacts such as brick and tabby. Edwards-Pitman's conclusion was that this feature could be a large refuse pit adjacent to a structure and/or the edge of a structural feature, such as a chimney pad, building corner, or entryway (Quirk and Silliman 2009:108). Additionally, this feature is known to extend to the north and east of this point and is further indicated in anomalies in these areas of the grid. Further excavation would be recommended to delineate this feature in whole.

In looking again at the GPR data for Grid 1 (Figure 15), there are several anomalies of interest; however, much of the gradiometer data seems to be masked by bipolar signatures (metal artifacts and/or trash). It is hard to isolate feature-type anomalies in this situation, except as cross-referenced with the data from the GPR. GPR data indicates a number of high amplitude anomalies, and these appear as large hyperbolas in the profiles. These anomalies have significant potential to be pit and post features and/or articulated concentrations of structural debris. Two anomalies in particular in the eastern half of the grid demonstrate reflections which are more complex than a singular hyperbola and seem to reflect possible surfaces/interfaces. It is difficult in this grid to determine which anomalies may be related to cultural phenomena and which may be related to natural phenomena or more modern disturbances, but the significant amount of reflections on both instruments does make this grid worthy of further study.

Grid 2

Grid 2 was placed northwest of the area of grid 1. Grid 2 fit neatly between two areas exhibiting test units; Test Units 1, 3, and 7 lay to the south of the grid, and Test Unit 4 lay immediately to the east in the northeast corner. Again, the data from the gradiometer and GPR surveys for this grid was quickly processed, and recommendations were provided to Edwards-Pitman for further testing. An anomaly at approximately N 13.5, E 15 from the SW corner of the grid was recommended for testing at the time, and Edwards-Pitman placed Test Unit 11 (1x2 meter) in this location. Test Unit 11 revealed two features, Feature 8, a small pit, and Feature 10, an historic post (Quirk and Silliman 2009:103-107).

GPR and gradiometer results for Grid 2 are presented in Figure 16; the GPR slice is approximately 60 cmbs. A number of anomalies are indicated in both datasets, but the overall pattern is difficult to see due to the number of bipolar signatures causing interference. This situation is especially acute in the southwestern corner of this grid. Interestingly, this grid is within the area subjected to metal detection during initial testing, but numerous metal artifact and/or trash signatures seem to still show up in the gradiometer data. A few of the gradiometer anomalies are strong positives which could indicate small pit or post features as in previous testing; these anomalies are circled in red and are shown in Figure 16. It is possible to see some faint patterns of small positives in the gradiometer data (shown as dashed lines), but the interference of isolated bipolar signatures, probably metal artifacts, makes these difficult to distinguish or substantiate. The GPR indicates anomalies with large, wider hyperbolas, which could indicate small pit or post features. As in grid 1/4, this grid shows indications of a planar surface in the GPR profile, starting at approximately 70 cmbs. This surface may represent a soil horizon or layered interface related more to the natural geology of the site area than to cultural modifications.

Grid 3

Grid 3 was placed west of grid 2 and TU 5. This grid area included a number of push piles and large vegetation which required clearing prior to survey. The ground vegetation also caused obstructions during survey. The GPR and gradiometer results for this grid were processed quickly (Figure 17), but no recommendations were made to Edwards-Pitman for immediate testing in this grid at the time. Further evaluation of the results reveals few anomalies of interest, but analysis of the gradiometer data and the GPR profile demonstrated a number of metal artifacts and/or trash (bipolar signatures) that are interesting and could be revealing of intra-site distributional artifact patterns. This area was not previously subjected to metal detection efforts but seems to show the potential occurrence of these types of artifacts in the area.

The GPR slice is at approximately 70 cmbs. The GPR profile is significantly disturbed towards the bottom due to interference in the radar signal. No anomalies of interest were noted based on these results.

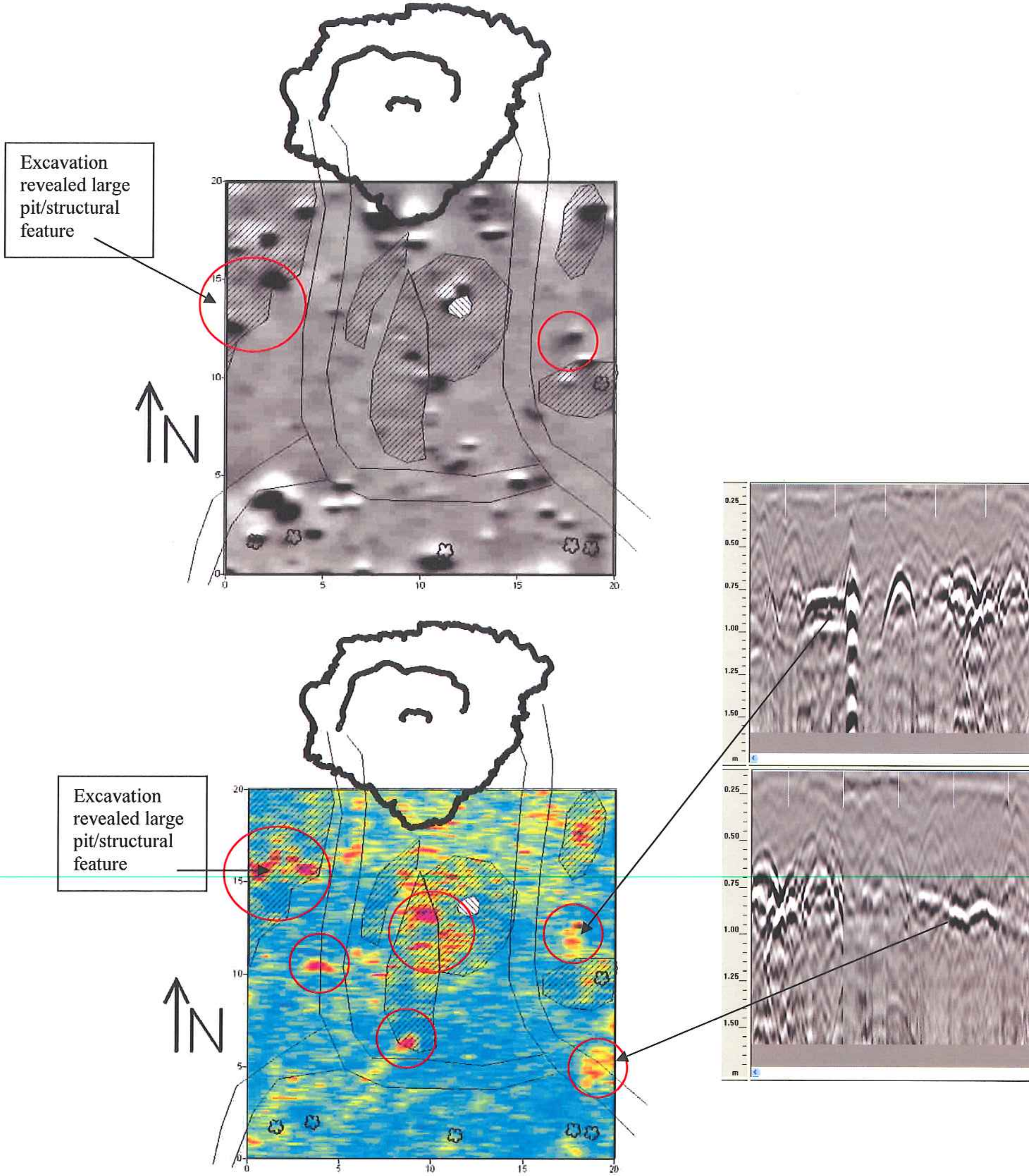

Figure 15. Gradiometer and GPR results for grid 1, with sketch map. GPR slice at 90cmbs.

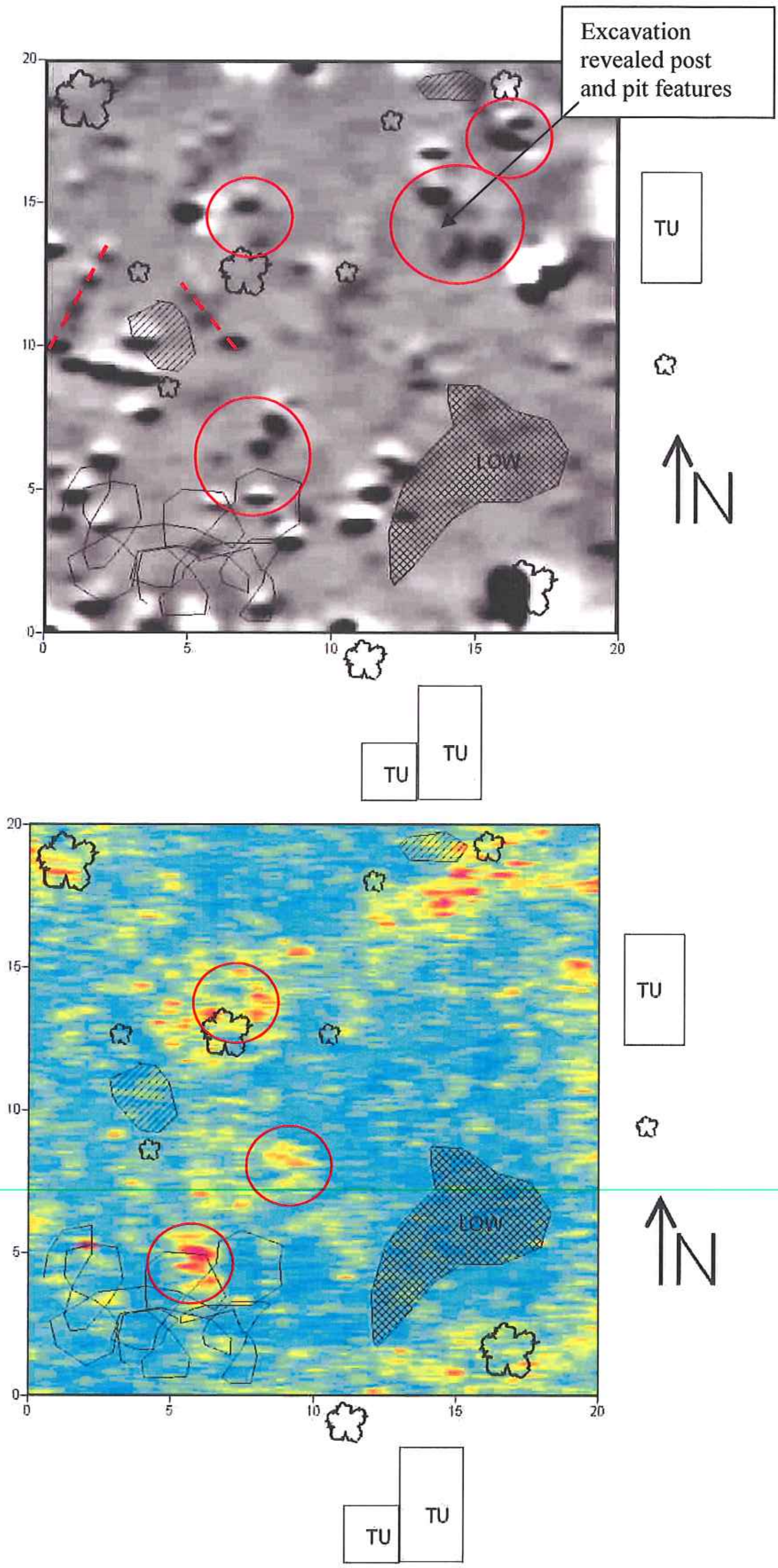

Figure 16. Gradiometer and GPR results for grid 2, with sketch map. GPR slice at 60cmbs.

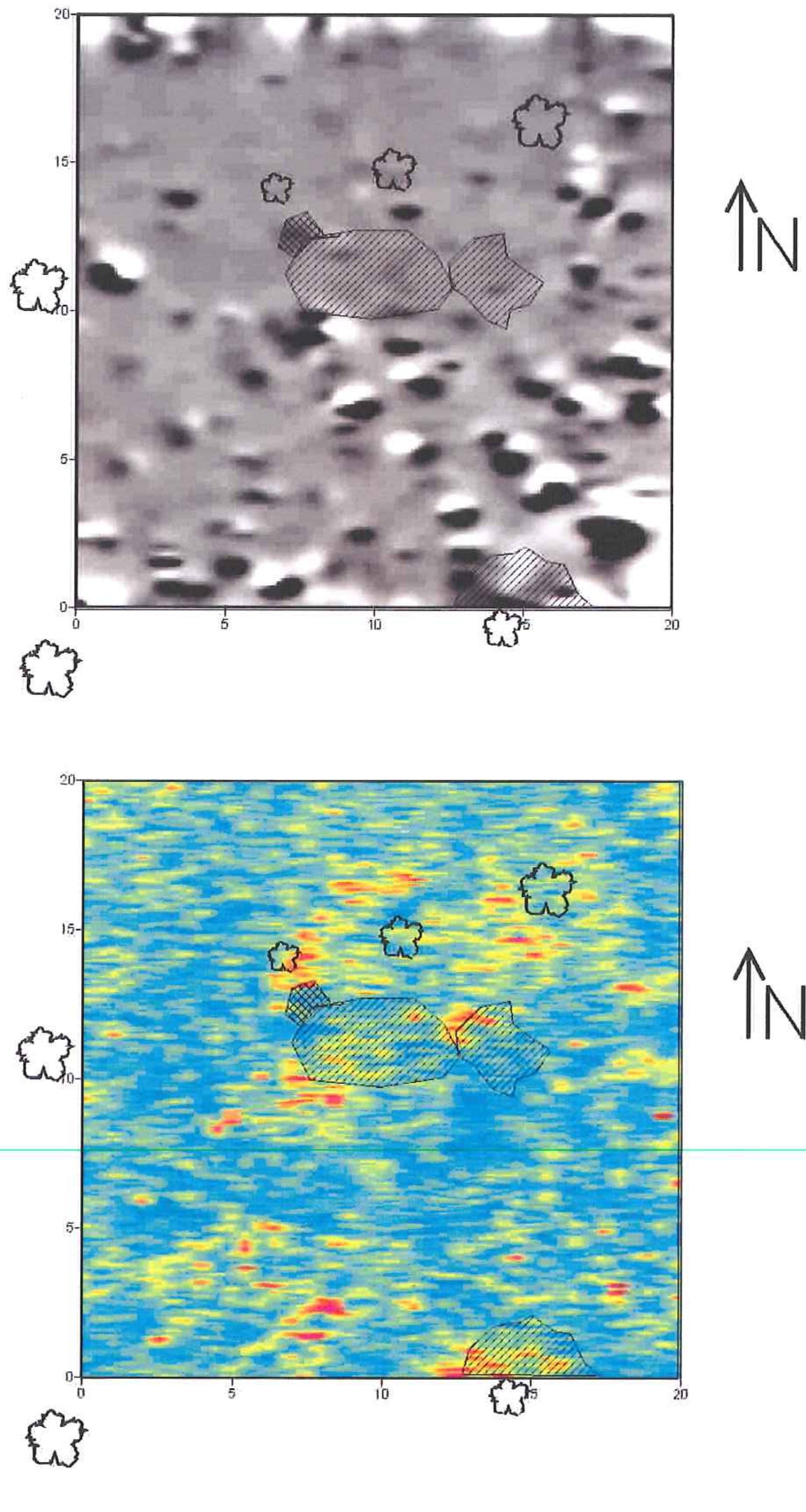

Figure 17. Gradiometer and GPR results for grid 3, with sketch map. GPR slice at 70cmbs.

Conclusions & Recommendations

Based on the results of this testing, and on the successful ground-truthing of previous testing recommendations, it is further recommended that additional geophysical investigations be done, especially in areas with more potential for cultural anomalies and less superficial disturbance. Results seem to indicate that subsurface features are present at this site and that they can be located using geophysical methods, most notably ground-penetrating radar (GPR) and magnetic gradiometer.

It can thus be concluded that grids 1/4 and 4/7, along with grid 1 and 2, as previously indicated, seem to have the greatest potential for preserved structural features related to the colonial plantation occupation of the site. The anomalies located during this survey should be considered when further testing and/or data recovery efforts are planned for this site, should project development dictate that such efforts be undertaken. Grids 2, 1/4, and 3 also demonstrated a number of metallic signatures that are perhaps revealing when intra-site distribution of historic artifacts is considered. Perhaps this area was more heavily occupied during the Civil War encampment period, and further metal detection efforts should be focused in these areas as well as across the whole site. Based on the testing of the site area, it has been recommended that remote sensing be undertaken in the areas of TU 8 and 9, which both revealed concentrations of structural artifacts although no features. This recommendation is further supported by this recent remote sensing work, in that the instruments used seem to have significant potential for identifying anomalies reflecting both artifacts and features within the soil environment. Further, it is recommended that grids be placed in the area of TU 6, which revealed substantial amounts of brick during testing, and in the remaining portions of the southeastern site corner, south of the previously surveyed grids and closer to the road.

It would be extremely useful to have the area cleared of much of the smaller vegetative material and debris so that investigations, GPR in particular, could be done with a more level surface. Additionally, it would be wise to preface investigations, especially with the gradiometer, with a metal detection survey and recovery scheme so that the metal artifacts present on the site don't interfere with the investigation of below-ground features. Following investigation by remote sensing equipment, a plan of unit excavation and/or stripping should be undertaken to test the results of the surveys, and all features should be mapped and considered in relation to the originally recorded anomalies. Doing so and studying the profiles of the excavated features would do much to aid further surveys of historic features on sites in this area and to the understanding of using remote sensing on historic sites.

Ground-penetrating radar and magnetic gradiometer are tools for detecting subsurface anomalies. In this case, these were used in an effort to detect the structural and landscape remains associated with a colonial plantation and Civil War encampment. These surveys were successful, in that a number of anomalies seem to point to the potential for structural features in the southeastern corner of the site. These surveys also provided information regarding the possible density of distribution of features across the larger site area and gave indications of artifact type distribution (for example, metal artifacts) across the surface of the site.

Metal Detection

Further metal detection investigations were performed by Garrett Silliman, of Edwards-Pitman Environmental, Inc. at the same time that geophysical investigations were being made by GDOT personnel. The findings and recommendations of these investigations are presented in Appendix II. In general, these investigations were able to examine the distribution and integrity of the Civil War component of the site and resulted in a small expansion of the site boundary. The site boundary was expanded approximately 60 meters to the west of the original outline, towards the railroad. The transects of investigation by Silliman can be seen in Figure 1, along with the revised site boundary, and in the appended report. An updated site form appears in Appendix IV.

Figure 18. Metal detection by Garrett Silliman.

Investigation of Live Oak Trees and Landscape Features

Studies of the parcel's resident live oak trees were undertaken as a part of these further investigations so that the context of these landscape features could be considered in light of the proposed project. Two arborists were consulted, Dennis Goldbaugh from Chatham County's Department of Public Works and Daniel Westcot from the Georgia Forestry Commission. Both investigated numerous live oak trees on the property of the site and provided information regarding the relative health and possible estimated age of the trees. Correspondence from Daniel Westcot is included in Appendix III.

The information from both of these arborists was in general agreement and positive on the overall healthy condition of the trees in question. Age estimates were given for two groups of trees on the property (Figure 19). These were investigated in particular because they were considered to be in the main site area; a few more isolated specimens exist on the parcel. One large live oak (Figure 20), situated in the southeastern corner of the parcel, was estimated at approximately 88 inches in diameter. According to the arborists, this tree probably grew in an open environment; this tree and its environment are indeed evident in the 1970 aerial photo in the survey and testing report (Quirk and Silliman 2009:57). This tree was estimated to possibly be 300-400 years old; however, such an estimate comes with many caveats, such as growing conditions and climate.

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Figure 20. View of large tree in southeastern portion of site.

A cluster of four similar live oaks northwest of the large specimen was investigated in the same manner. These were estimated to be generally healthy, averaging around 4' in diameter, and possibly 100-200 years in age (Figure 21). The arborists were of the opinion that the growth and arrangement of these trees indicated intentional planting.

Figure 21. View of one of four trees in northwestern portion of site.

The investigation of these trees contributed to a greater fuller understanding of the site's landscape and its historical context as to above-ground features. Historic documentation has aided and directed research efforts at this site and has also provided context for the archaeological remains. Even though these trees could date to the period of significance for the site (18^{th}-19^{th} century), they have not been identified as part of any historic inventory for the property and cannot be definitively linked to the present archaeological remains. There are no further extant historic structures that have been identified on this property as being associated with its period(s) of significance, and thus its archaeological materials contribute the majority, if not all, of its information potential. This archaeological site was, therefore, not considered part of a larger historic property type, such as a rural historic landscape, and is evaluated singularly for its eligibility to the NRHP for Section 106 purposes and for its importance for preservation in place under Section 4f of the Department of Transportation Act. While this site is eligible for the NRHP under Criteria A and D, its potential lies largely in the site's ability to contribute information to the history and prehistory of Georgia (Criterion D); therefore, the site would not be considered a candidate for preservation in place under Section 4f. Further discussion of this property's evaluation as a rural historic landscape and the assessment of its potential for Section 4f evaluation can be found in a memorandum in the GDOT History file (correspondence from Edwards-Pitman, dated October 26, 2009).

Additional Shovel Testing

Additional shovel testing was done by GDOT personnel on the OCGA 50-18-72 in July of 2009. These shovel tests were placed relative to the locations of planned soil test boring holes, which were to investigate the feasibility of using the matrix of the property in fill for the project and the chosen locations as possible borrow pit/storm retention ponds (Figure 22). Plans included nine testing locations, four of which would be dug by hand auger to a depth of approximately 5 feet (ft.) and five of which would be bored with a truck mounted drill rig up to 25 ft. Monitoring wells would be then positioned at the five deeper test locations.

These test locations were all situated within the outer perimeter of the archaeological site area, within the previously cleared section of vegetation. This area had low artifact density in shovel tests and exhibited no features during testing excavations. In advance of this boring activity, nine shovel tests were excavated by Pamela Baughman. None of these shovel tests were positive for artifacts or features. The soil profiles of these shovel tests were typical of the property, with a dark grayish brown sandy loam underlain by a yellow sand and clayey inclusions increasing with depth. Most shovel tests were excavated to approximately 75 cmbs; soil was sifted through ¼ in. metal screen.

Following these shovel tests and negative results, the boring activity was allowed to proceed and was closely monitored by the Project Manager. No further material was recovered during boring.

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Figure 22. Boring Location Sketch, provided by Ranger Consulting.

Figure 23. Boring activities on Trellis property.

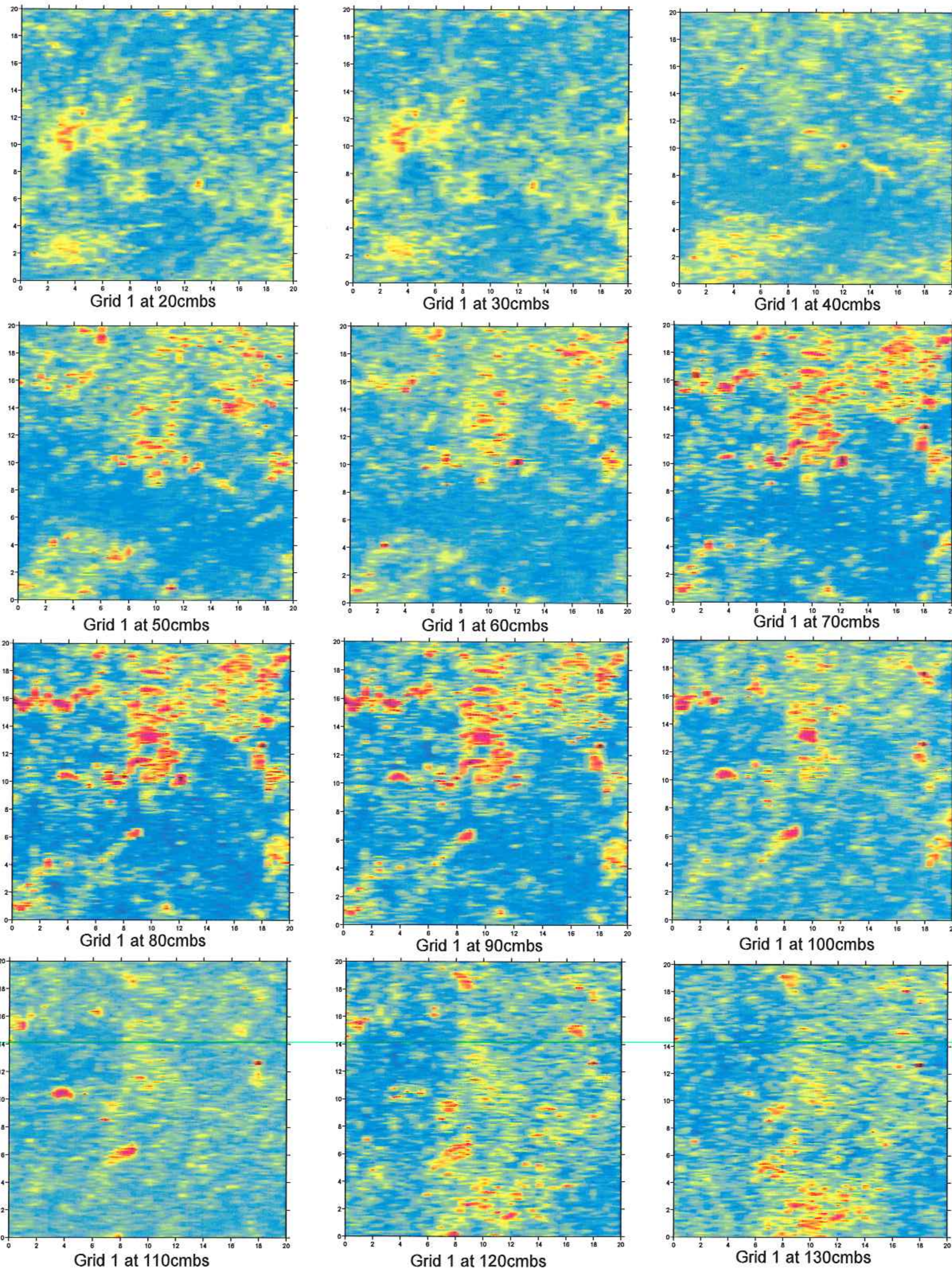
References Cited

Conyers, Lawrence B.
2004 *Ground Penetrating Radar for Archaeology.* Altamira Press, New York.

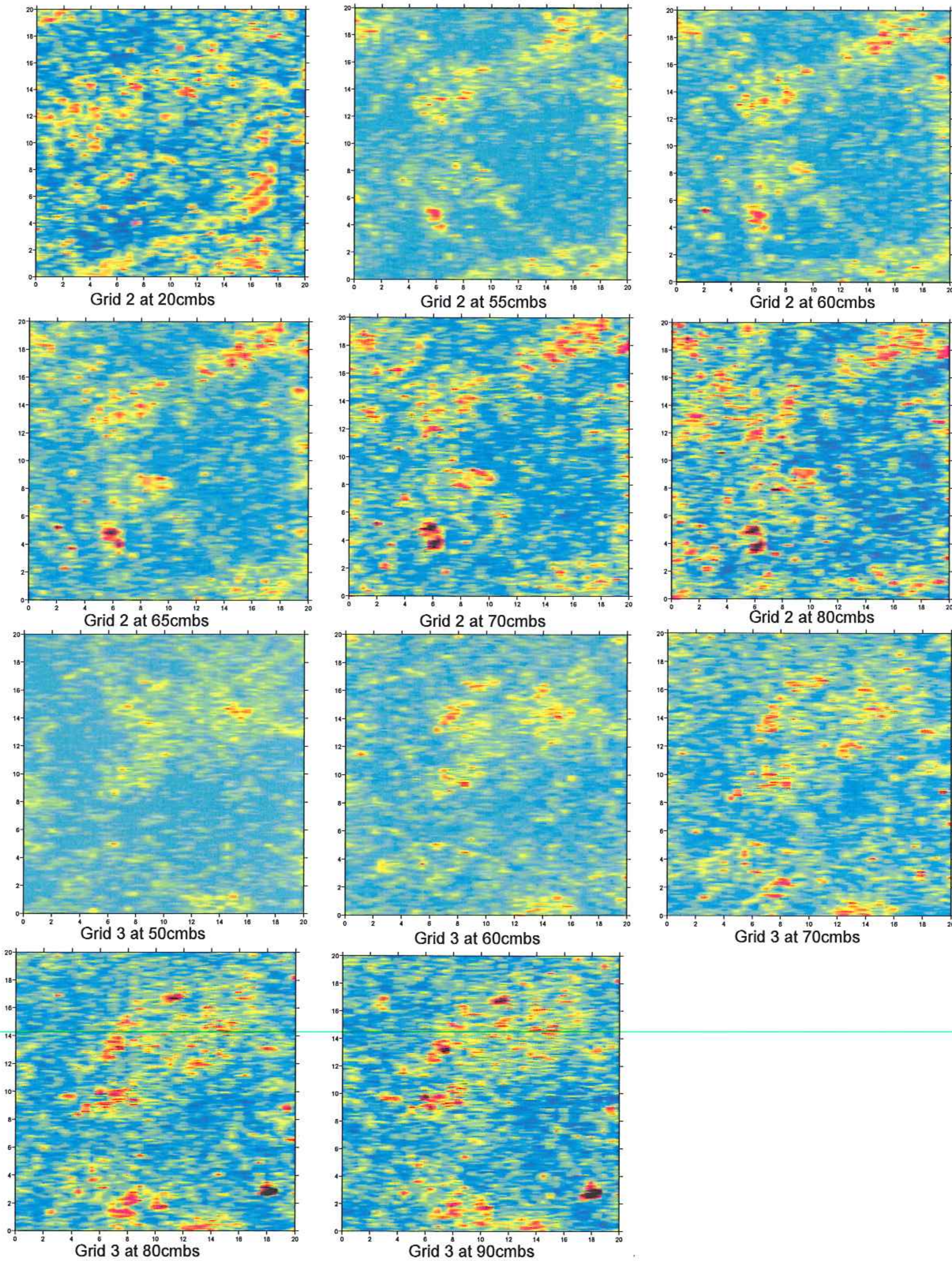
Johnson, Jay K., editor
2006 *Remote Sensing in Archaeology: An Explicitly North American Perspective.* The University of Alabama Press, Tuscaloosa.

Quirk, Phillip W. and Garrett W. Silliman
2009 Sensitive archaeological information redacted pursuant to OCGA 50-18-72

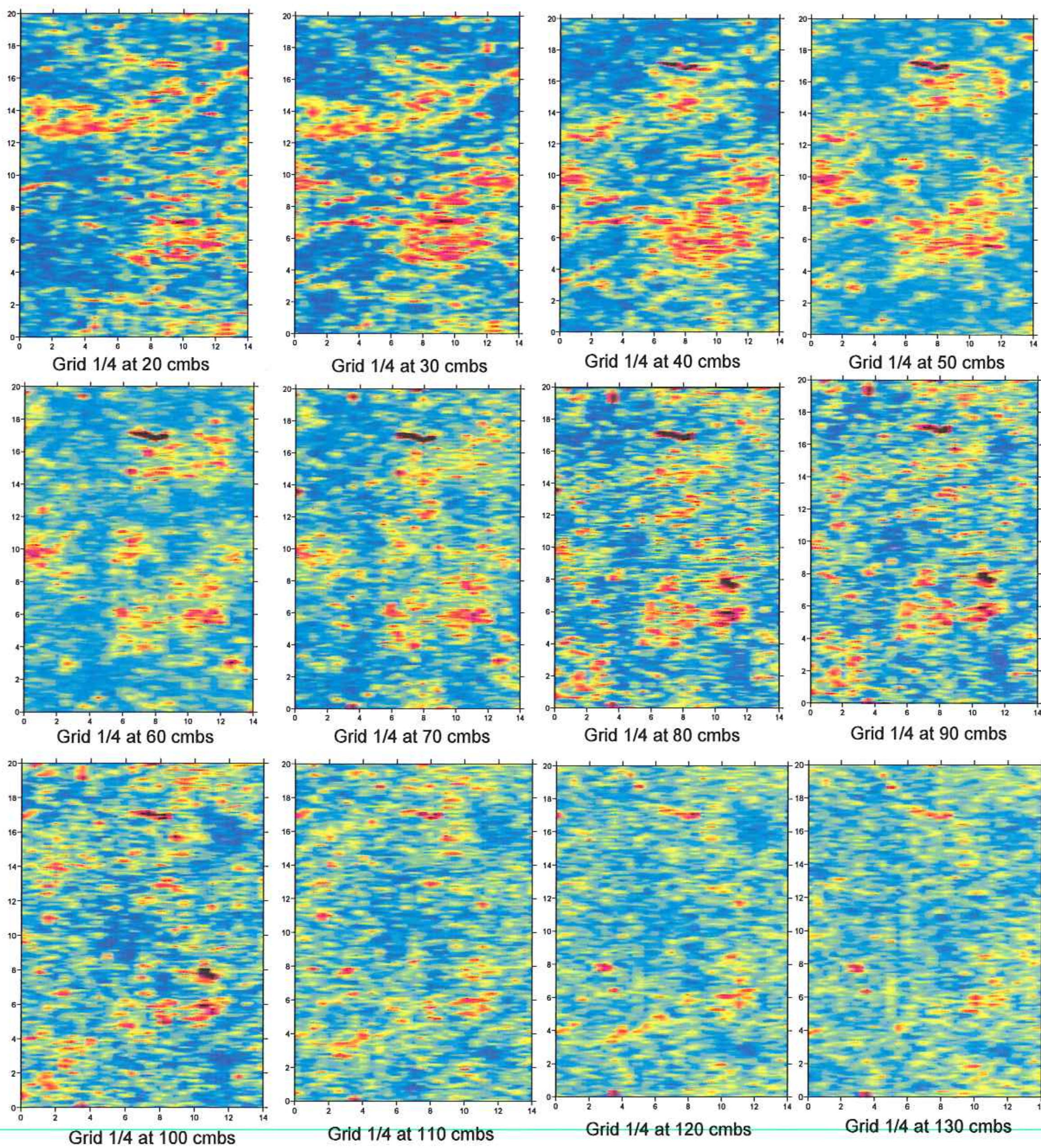
APPENDIX I: Remote Sensing Investigations: GPR Slice Maps



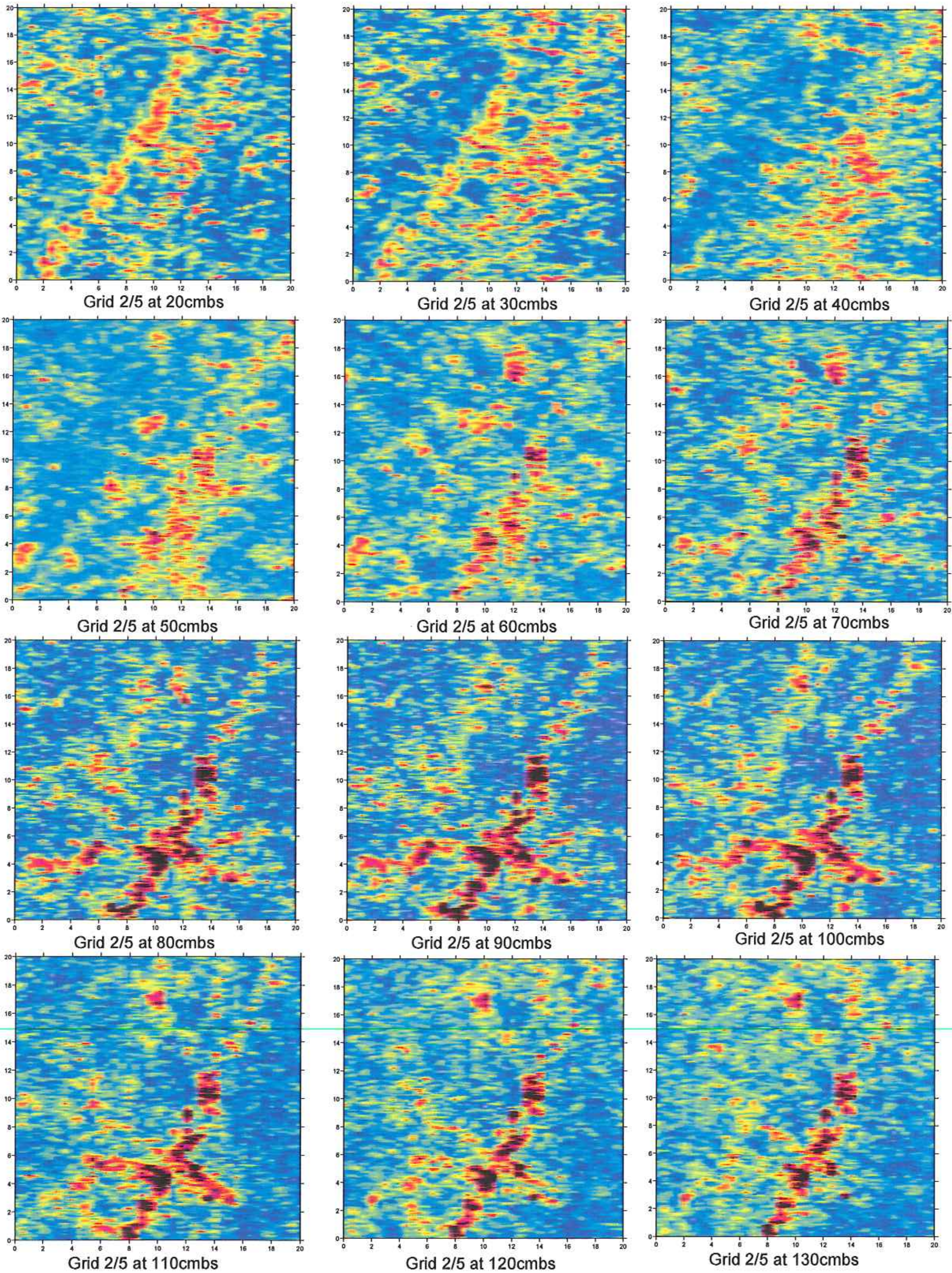
Grid 1 GPR slice maps



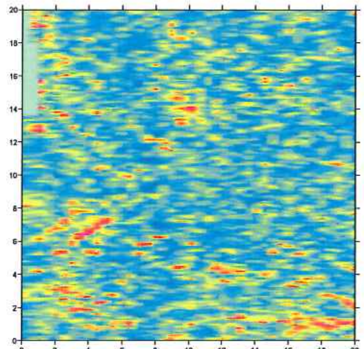
Grid 2 and 3 GPR slice maps



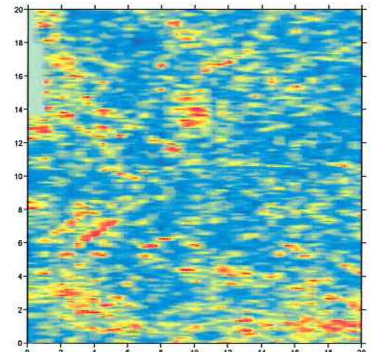
Grid 1/4 GPR slice maps



Grid 2/5 GPR slice maps



Grid 3/6 at 20cmbs



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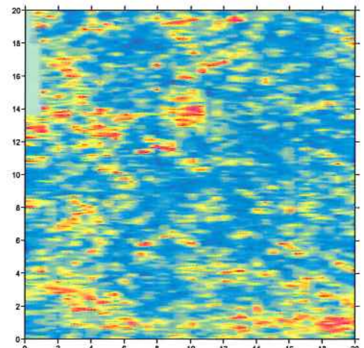
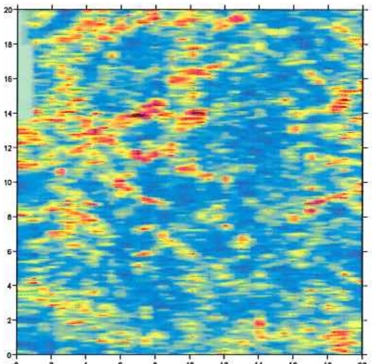
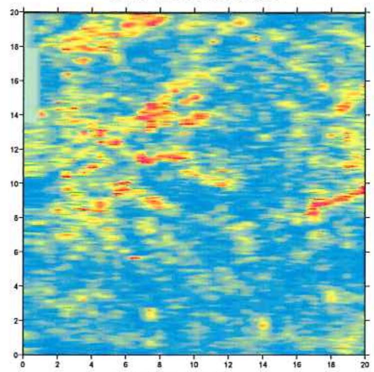


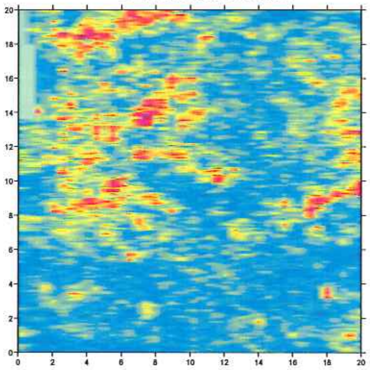
Grid 3/6 at 40cmbs



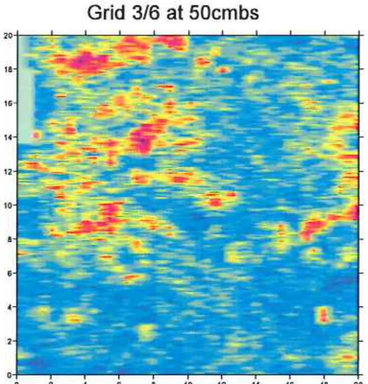
Grid 3/6 at 50cmbs



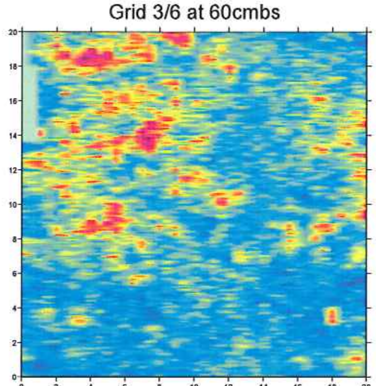
Grid 3/6 at 60cmbs



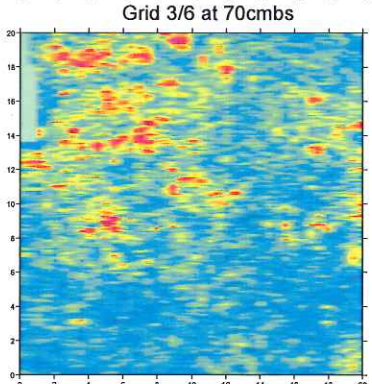
Grid 3/6 at 70cmbs



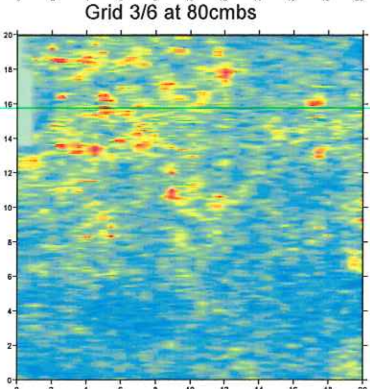
Grid 3/6 at 80cmbs



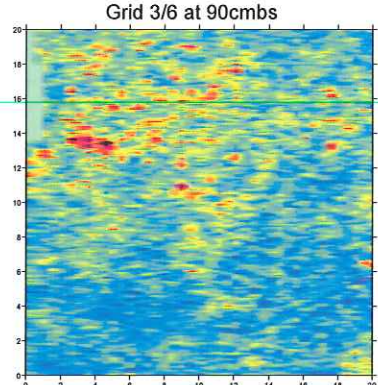
Grid 3/6 at 90cmbs



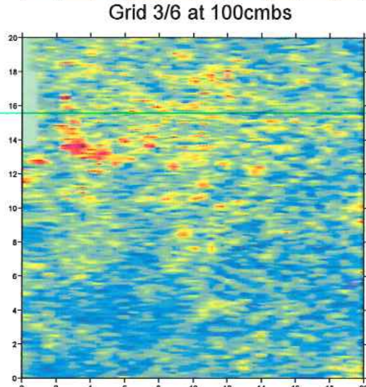
Grid 3/6 at 100cmbs



Grid 3/6 at 110cmbs

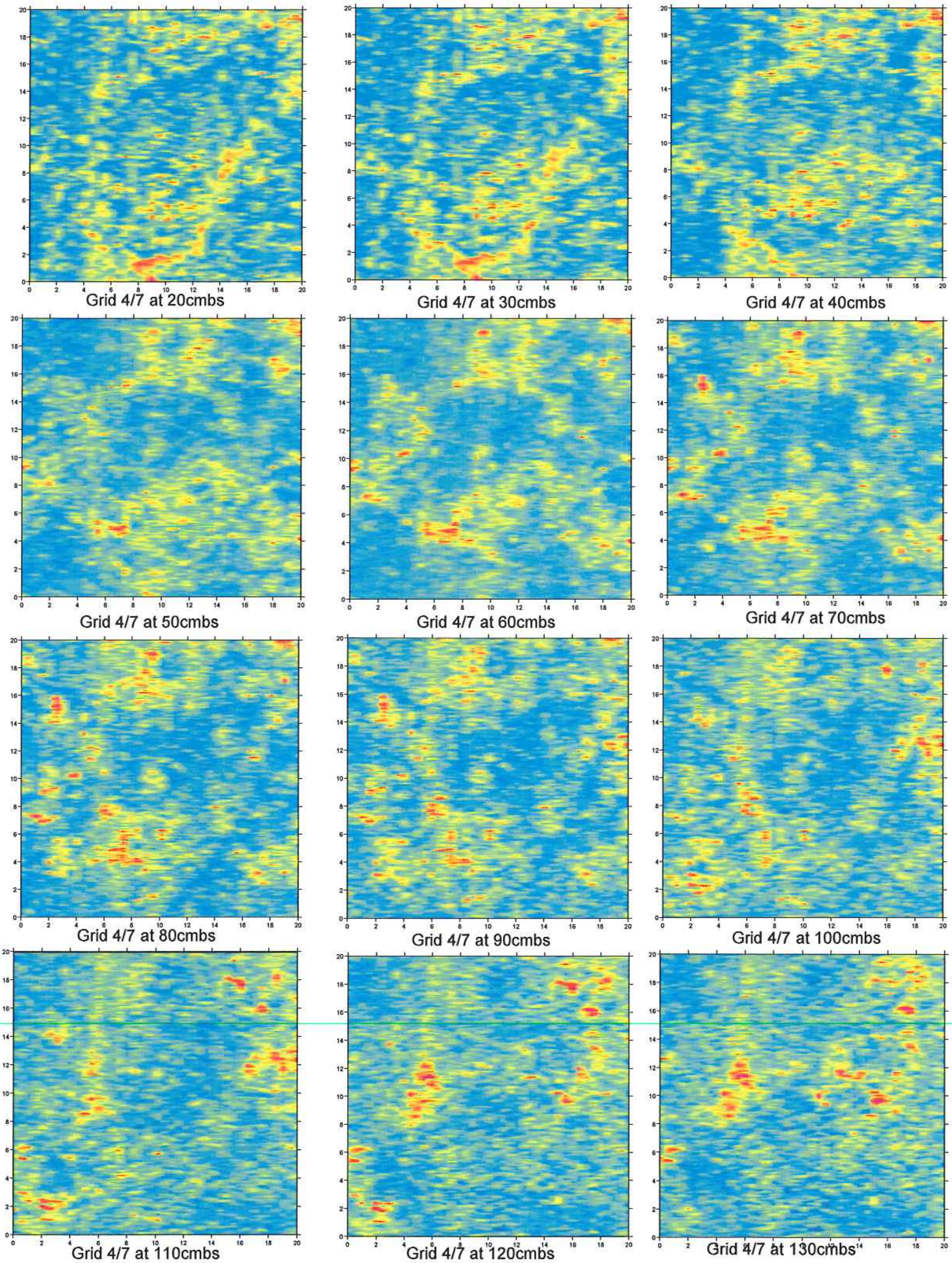


Grid 3/6 at 120cmbs

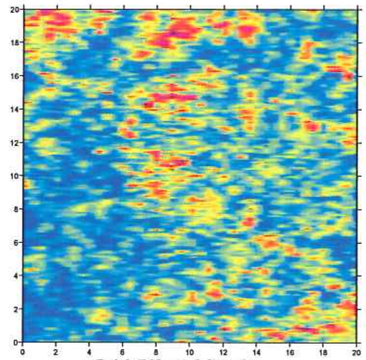


Grid 3/6 at 130cmbs

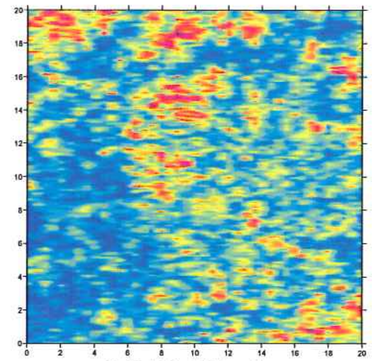
Grid 3/6 GPR slice maps



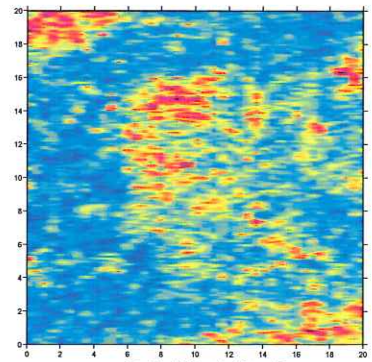
Grid 4/7 GPR slice maps



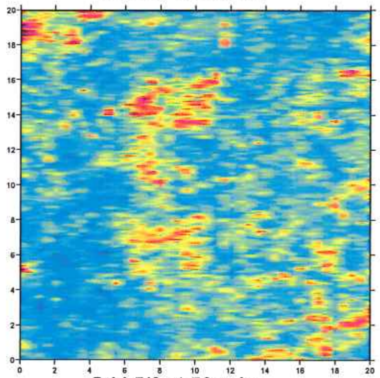
Grid 5/8 at 20cmbs



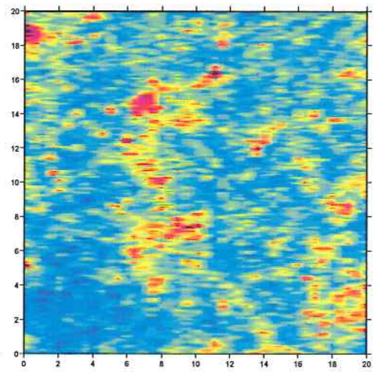
Grid 5/8 at 30cmbs



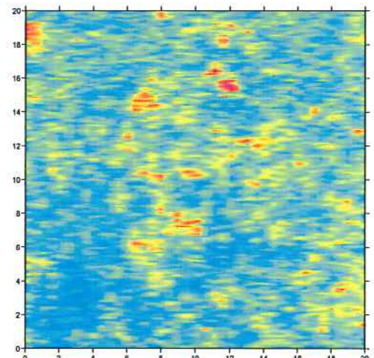
Grid 5/8 at 40cmbs



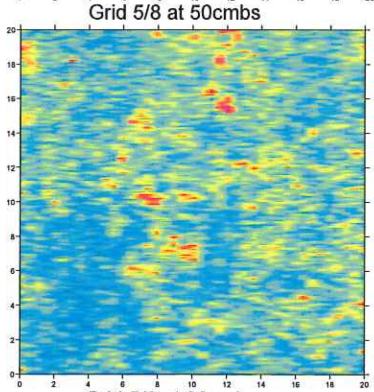
Grid 5/8 at 50cmbs



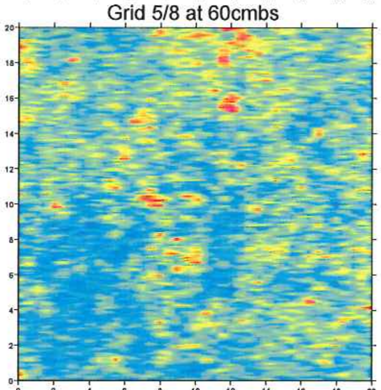
Grid 5/8 at 60cmbs



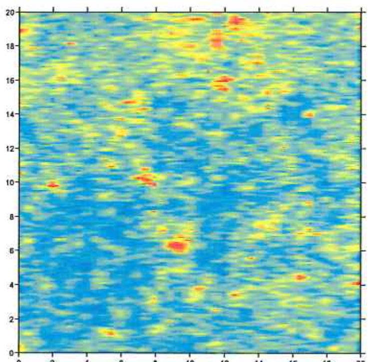
Grid 5/8 at 70cmbs



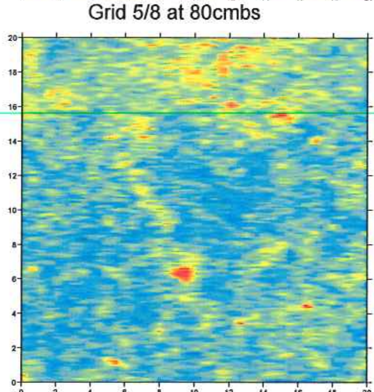
Grid 5/8 at 80cmbs



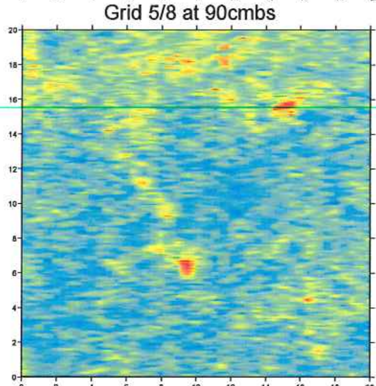
Grid 5/8 at 90cmbs



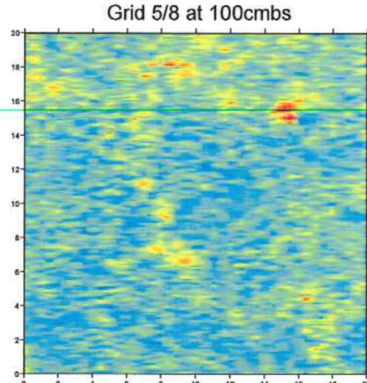
Grid 5/8 at 100cmbs



Grid 5/8 at 110cmbs



Grid 5/8 at 120cmbs



Grid 5/8 at 130cmbs

Grid 5/8 GPR slice maps