Ground Penetrating Radar Survey at Fort Hollingsworth, 9BA7, Banks County, Georgia

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Introduction

This report details the results of a Ground Penetrating Radar (GPR) survey by the LAMAR Institute at Fort Hollingsworth, Georgia. Fort Hollingsworth, or the White homestead, 2307 Wynn Lake Road, Alto, Georgia, is a unique historical resource in northern Georgia and Banks County (Figure 1). Fort Hollingsworth was a late 18^{th}-20th century fortified farmstead on the Georgia frontier. The historic building is currently listed in the National Register of Historic Places. Its associated archaeological site was recorded by Max White in the archaeological files in 1969 as site 9BA7 and that site designation is continued for this report (White 1969). No prior archaeological studies of the historic period resources have been undertaken at Fort Hollingsworth. The GPR survey was accomplished on November 9, 2012 by LAMAR Institute researcher Daniel Elliott with assistance from volunteer Gregory Beavers. Mr. Beavers also provided several useful photographs taken of the study area during the survey.

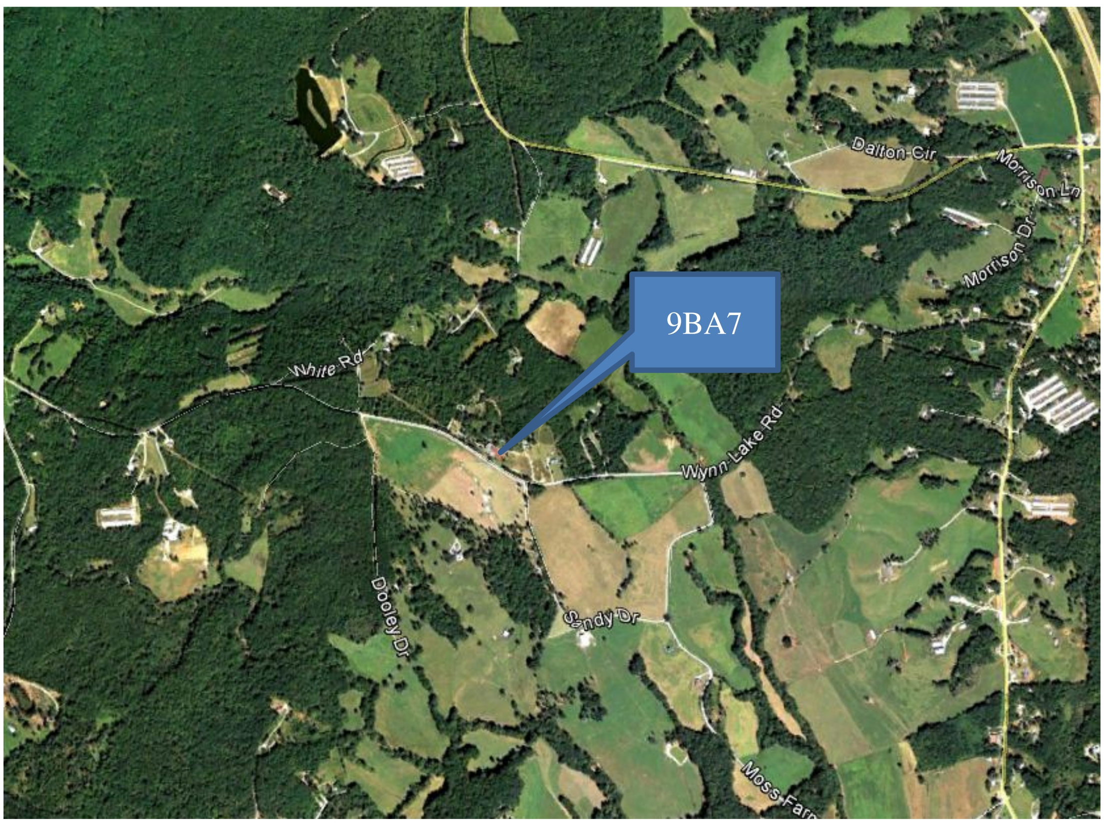

Figure 1. Project Location (Google Earth 2012).

Historical Background

Fort Hollingsworth was located within an area of frontier Georgia known historically as Wofford's Settlement, which was a four mile-long tract ceded to the United States of America by the Cherokee Nation by treaty at Tellico in 1804 (Gilmer 1989; Wilson 1914:27; Flowers 1977; Hollingsworth 1978:35; Gray-White 1988:10-14; Chambers 2003; Friends of the Fort 2005; Martin 2012). The location of the Wofford tract is shown in Figure 2. In the years after the American Revolution the Woffords and several other Euro-American frontier settlers established farms at the boundary between Georgia and the Cherokee Nation. Fort Hollingsworth is one of the early settlements. The Hollingsworth's farm was a fortified farmstead and today it stands as the only intact architectural example of a settlement from the late 18th-early 19th century in the Wofford Settlement. The original construction date of Fort Hollingsworth is subject to debate but generally ranges between 1787 and 1793 (Gray-White 1988:10; Friends of the Fort n.d.).

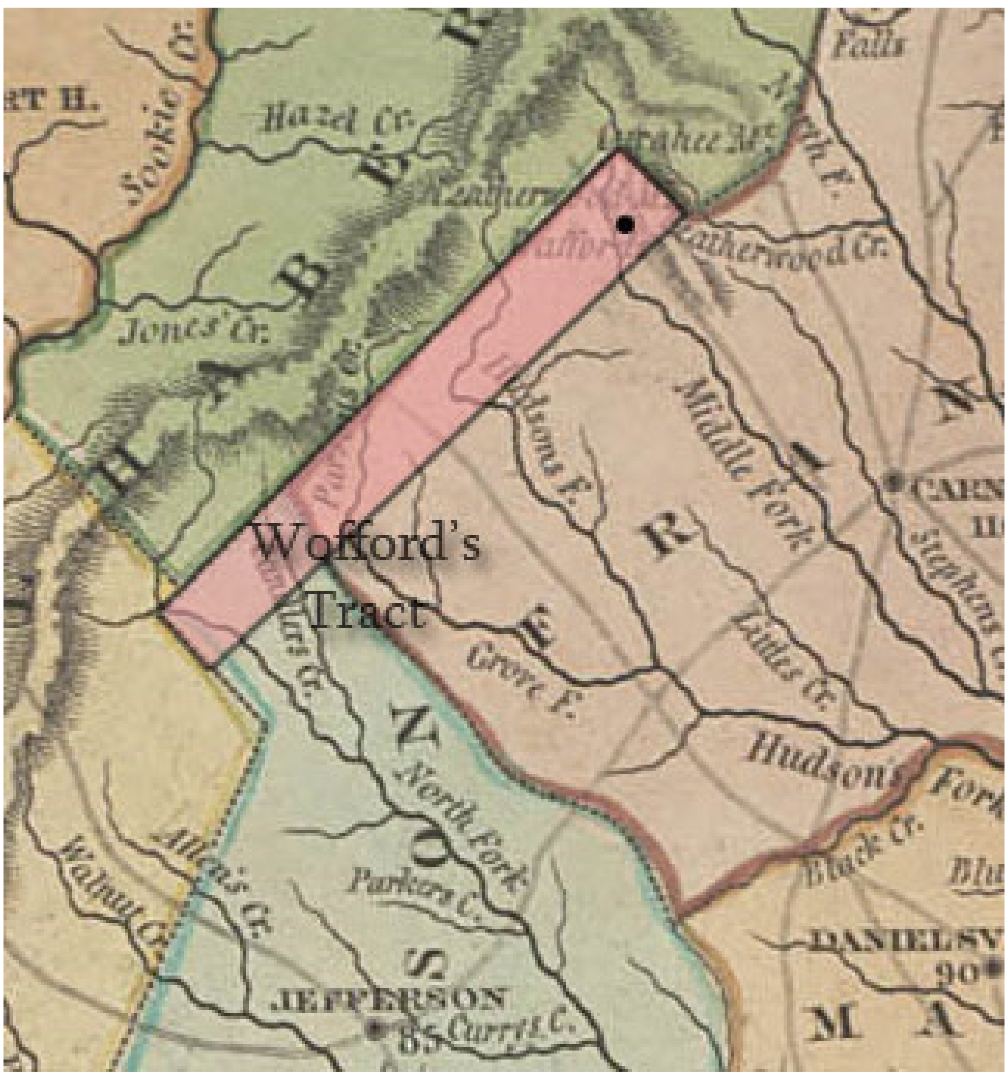

Figure 2. Wofford's Settlement.

Non-Native American settlement in the study area began following the American Revolution and the Treaty of Hopewell in 1785. Several forts, or fortified farmsteads, in the study vicinity had been constructed by 1792, when Georgia's Adjutant General Elholm toured the region and assessed the areas defenses (Elholm 1793). The person whose name lends itself to the name of the border settlement was Colonel William Wofford, a Revolutionary War veteran. Wofford made his settlement, known as Wofford's Station and Fort Carns, near Currahee Mountain (Clark 1990:285). The Wofford settlement had already in existence for nearly a decade when the 1804 treaty was signed.

Figure 3. Elholm's Map of the Defenses of the Western Frontier, December 31, 1792 (Elholm 1793).

In 1796, Private Jacob Hollingsworth served in a Georgia militia detachment at Fort Carns, Wofford's Station, then under the command of Lieutenant John Collins (Clark 1990:285). The Georgia militia at Fort Carns had been ordered into service by the Georgia Governor, as authorized by the President of the United States. After 1796 the military threat in the region was greatly reduced. Hollingsworth established his farmstead.

The standing historic structure at 9BA7 contains two distinct construction stages. The western portion possibly dates to the 1790s, whereas the eastern part was built about 1861. The two sections are linked by a dog-trot hallway. Shed additions are located on the northern and southern walls. The building has two exterior chimneys, which are made of local fieldstone. The building's foundation is raised on stone piers.

Figure 4. Rear View of Fort Hollingsworth, 9BA7, Facing Southwest (Beavers 2012).

Figure 5. Rear View of Fort Hollingsworth, 9BA7, Facing Southwest (Beavers 2012).

Figure 6. Panoramic View of GPR Survey Areas, Fort Hollingsworth, 9BA7, Facing West.

Methods

GPR is an important remote-sensing tool used by archaeologists (Conyers and Goodman 1997). The technology is particularly effective in mapping historic cemeteries. The technology uses high frequency electromagnetic waves (microwaves) to acquire subsurface data. The device uses a transmitter antenna and closely spaced receiver antenna to detect changes in electromagnetic properties beneath them. The antennas are suspended just above the ground surface and are shielded to eliminate interference from sources other than directly beneath the device. The transmitting antenna emits a series of electromagnetic microwaves, which are distorted by differences in soil conductivity, dielectric permitivity, and magnetic permeability. The receiving antenna records the reflected waves for a specified length of time (in nanoseconds, or ns). The approximate depth of an object can be estimated with GPR, by adjusting for electromagnetic propagation conditions.

GPR has been successfully used for archaeological and forensic anthropological applications to locate relatively shallow features, although the technique also can probe deeply into the ground. The machine is adjusted to probe to the depth of interest by the use of different frequency range antennas. Higher frequency antennas are more useful at shallow depths, which is most often the case in archaeology. Also, the longer the receiving antenna is set to receive GPR signals (measured in nanoseconds, or ns), the deeper the search. The effectiveness of GPR in various environments on the North American continent is widely variable and depends on solid conductivity, metallic content, and other pedo-chemical factors.

GPR signals cannot penetrate large metal objects and the signals are also significantly affected by the presence of salt water. Although radar does not penetrate metal objects, it does generate a distinctive signal that is usually recognizable, particularly for larger metal objects, such as a cast iron cannon or man-hole cover. The signal beneath these objects is often canceled out, which results in a pattern of horizontal lines on the radargram. For smaller objects, such as a scatter of nails, the signal may ricochet from the objects and produce a confusing signal. Rebar-reinforced concrete, as another example, generates an unmistakable radar pattern of rippled lines on the radargram.

The LAMAR Institute performed a ground penetrating radar (GPR) survey at Fort Hollingsworth on November 9, 2012. The GPR equipment used by the LAMAR Institute for the GPR study at Fort Hollingsworth consisted of a RAMAC/X3M Integrated Radar Control Unit, mounted on a wheeled-cart and linked to a RAMAC XV11 Monitor (Firmware, Version 3.2.36). A 500 megahertz (MHz) shielded antenna was used for the data gathering. MALÅ GeoScience's Ground Vision software (Version 1.4.6) was used to acquire and record the radar data (MALÅ GeoScience USA 2006). The radar information was displayed as a series of radargrams. Output from the survey was first viewed using GroundVision. This provided immediate feedback about the suitability of GPR survey in the area and the effective operation of the equipment. GPR-Slice software (Version 7.0) was used in post-processing the data. The same RAMAC X3M GPR system as that used in the present study has been used successfully by the author on numerous archaeological sites in the southeastern United States. The methods employed for the GPR survey were consistent with similar projects conducted by the LAMAR Institute.

The GPR samples in this study area were composed of a series of parallel transects, or traverses, which yielded a two-dimensional cross-section or profile of the radar data. These samples are termed radargrams. This two-dimensional image is constructed from a sequence of thousands of individual radar traces. A succession of radar traces bouncing off a large buried object will produce a hyperbola, when viewed graphically in profile. Multiple large objects that are in close proximity may produce multiple, overlapping hyperbolas, which are more difficult to interpret.

The GPR signals that are captured by the receiving antenna are recorded as an array of numerals, which can be converted to gray scale (or color) pixel values. The radargrams are essentially a vertical map of the radar reflection off objects and other soil anomalies. It is not an actual map of the objects. The radargram is produced in real time and is viewable on a computer monitor, mounted on the GPR cart.

The time window that was selected allowed data gathering to focus on the upper 1.5 meters of soil, which was the zone most likely to yield archaeological deposits. Additional filters were used to refine the radar information during post-processing. These include adjustments to the gain. These alterations to the data are reversible, however, and do not affect the original data that was collected.

Upon arrival at Fort Hollingsworth the RAMAC X3M Radar Unit was set up for the operation and calibrated. Several trial runs were made on parts of the site to test the machine's effectiveness in the site's soils. Equipment settings and other pertinent logistical attributes included the following:

- Time Window: 54.6 ns
- Number of Stacks: 4
- Number of Samples: 416
- Sampling Frequency: 7,617.56 MHz
- Antenna: 500 MHz shielded
- Antenna Separation: 0.18 m
- Trigger: 0.04 m
- Radargram orientation: Block A-East to West
- Radargram progress: Block A-South to North
- Radargram Spacing: 50 cm
- Total Radargrams: 65

Weather conditions at the time of the survey were an extended drought. No precipitation had fallen in the area for at least two weeks, so residual rainfall as shallow groundwater was not a significant issue for GPR mapping.

The survey was accomplished by Daniel Elliott, assisted by Gregory Beavers (Figure 7). GPR Block A examined an area of the property measuring 70 m East-West by 26 m North-South. The coverage consisted of the eastern side yard and a portion of the rear yard of the farmstead, along with minor coverage along the front yard. Researchers collected 65 radargrams from east to west while progressing from south to north (Figure 10). This sample represents a total collection of 2,293.5 m of subsurface radar data at Fort Hollingsworth.

Figure 7. GPR Survey Equipment in Operation, 9BA7.

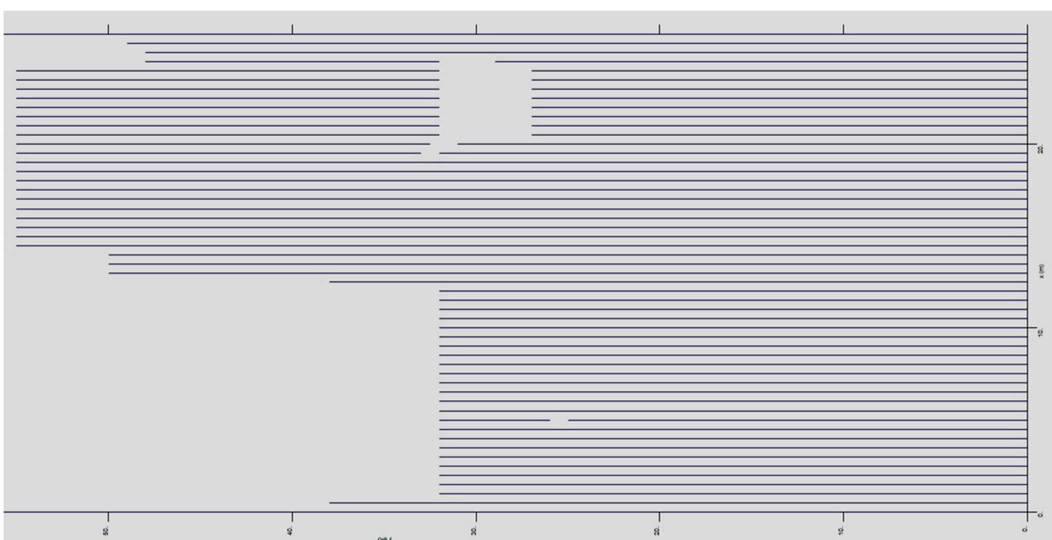

Figure 8. GPR Radargram Coverage Map.

GPR Survey Results

GPR Block A surrounded the house at Fort Hollingsworth on two sides. A very narrow sample also was collected along its west side, but this sample provided minimal GPR data. Block A yielded excellent results and it displayed many radar anomalies that may relate to the early settlement. Figure 6 shows six GPR plan views at increasing depth of Block A. Figure 7 shows an overlay GPR plan map in which the GPR information from different depths are compressed into a single image. GPR data from Block A may be visualized in three dimensions. Figure 8 shows a GPR 3-D isometric map of Block A.

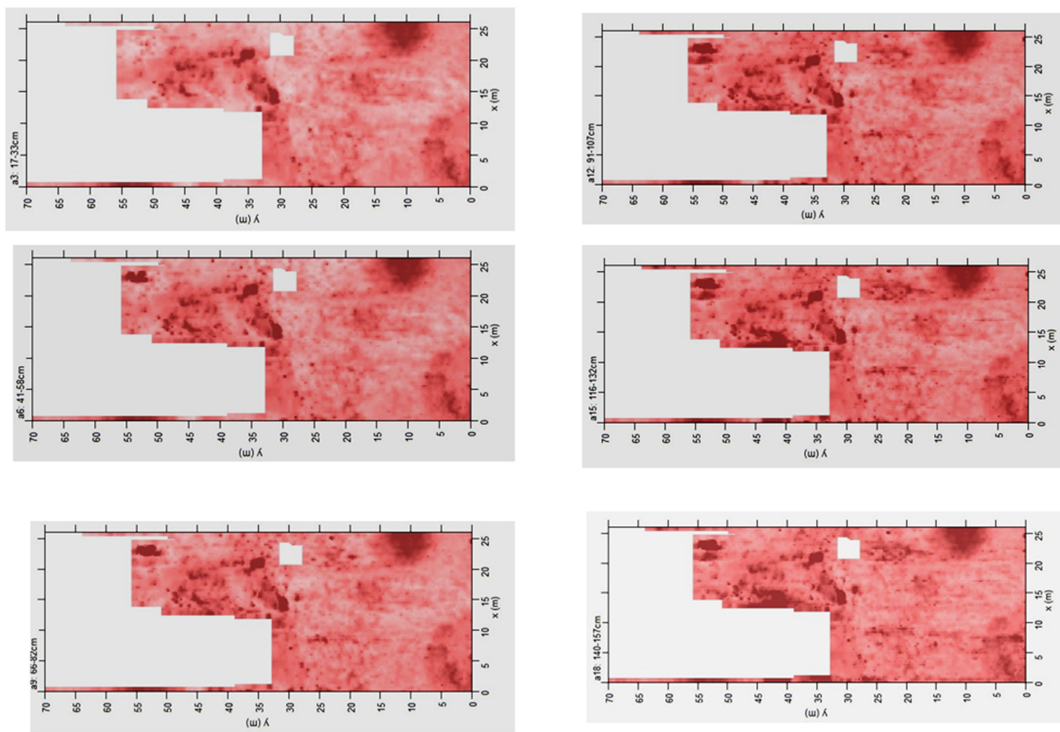

Figure 9. GPR Plan Views at Increasing Depths, Block A, Fort Hollingsworth.

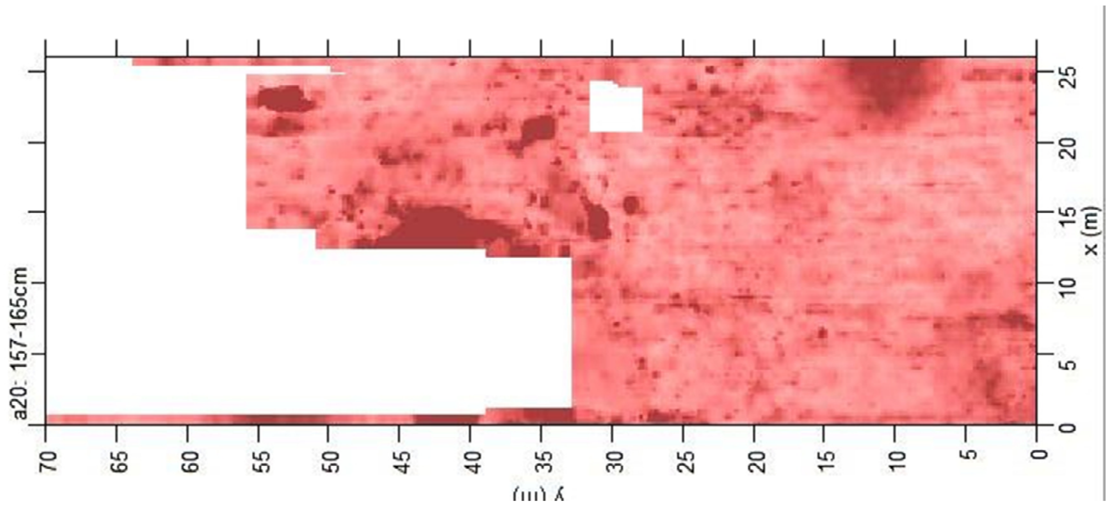

Figure 10. Overlay Plan View of GPR Block A, 9BA7 (North is Up).

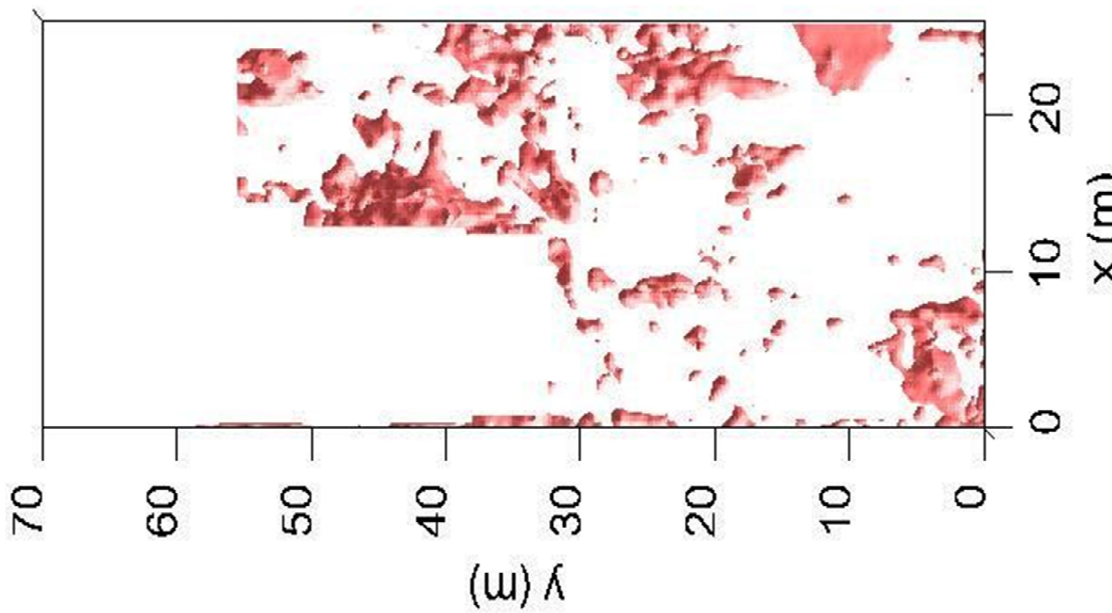

Figure 11. Isometric Plan View of GPR Block A, 9BA7.

Figures 12 and 13 show the GPR map superimposed on aerial photographs of the Fort Hollingsworth vicinity. In these views the dwelling house is located in the angle of the "grayed out" area immediately southwest of the GPR image. Figure 14 shows the GPR image with four areas of interest outlined in green. Within the green areas are numerous radar anomalies that may pertain to the early history of the Hollingsworth farmstead. Other anomalies that area located outside of the green areas also may be historic features, but these do not display any obvious patterning. The GPR data does not contain any indication of a palisaded compound or ditch surrounding the dwelling. It should be noted, however, that the GPR survey sampled only a portion of the yard and any such defensive feature may have been located beyond the sampled area.

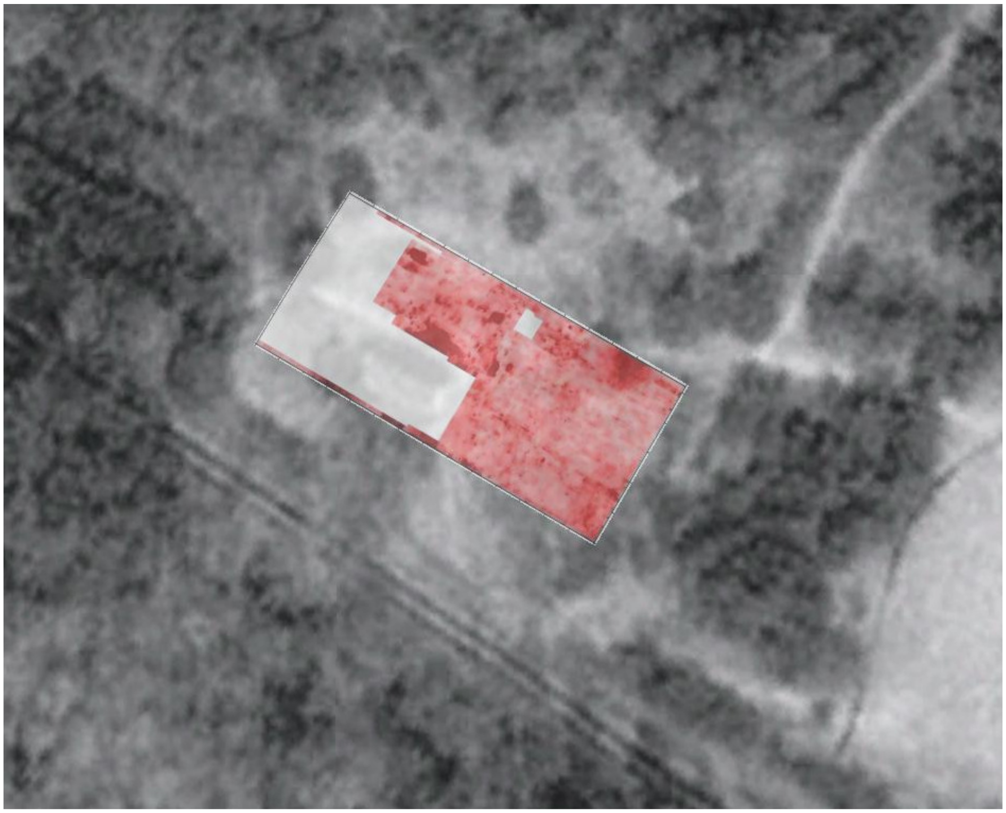

Figure 12. Superposition of the GPR Plan Map on a Black and White Aerial Photograph of Fort Hollingsworth.

Figure 13. Superposition of the GPR Plan Map on a Recent Color Aerial Photograph of Fort Hollingsworth.

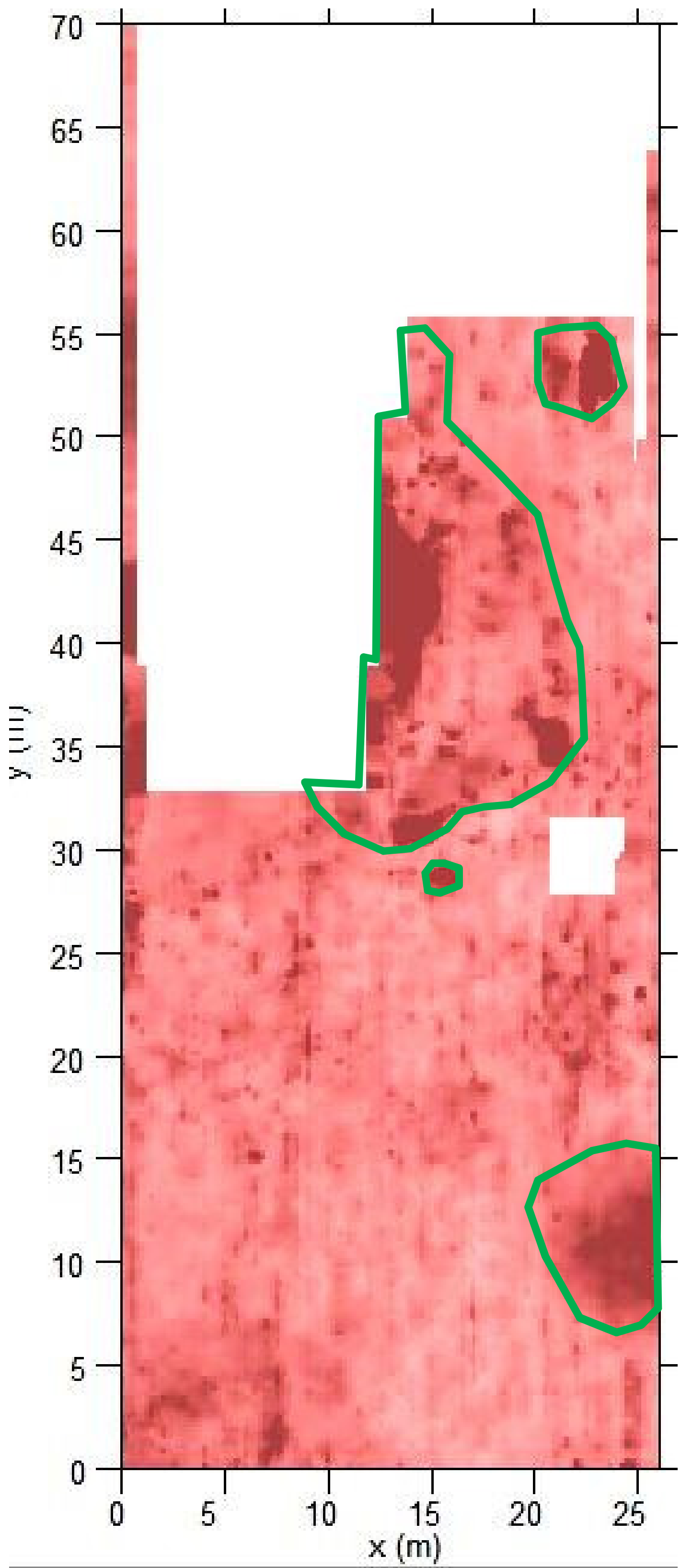

Figure 14. Potentially Significant Radar Anomalies, GPR Block A , Fort Hollingsworth.

The GPR anomaly clusters should be investigated and “ground truthed” by future archaeological excavations. These data should help to refine the areas of the grounds of Fort Hollingsworth that are archaeologically-sensitive. The GPR results are quite promising and may indicate that Fort Hollingsworth (9DA7) has many stories to tell us about the Hollingsworths, the Wofford Settlement and the Georgia-Cherokee frontier.

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