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Ground Penetrating Radar Survey at the Possible Location of Liberty Church, Kettle Creek Revolutionary Battle Ground, GA



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Introduction

The Kettle Creek Battlefield Association contracted Bigman Geophysical to conduct a ground penetrating radar (GPR) survey on a bluff top at Kettle Creek Revolutionary Battle Ground which is the suspected location of Liberty Church. This bluff top is located north of War Hill. The goal of the investigation was to identify the possible location of Liberty Church and evaluate the presence or absence of an associated cemetery. A Human Remains Detection Dog search was conducted in this area in 2015, no alerts were made by the dogs that indicated the presence of human remains scent. It is planned that a log cabin be re-located to this site and the data collected during this survey would be used to protect the integrity of human graves. The site however has been disturbed and push piles were observed outside of the survey boundaries.

GPR Method

This survey utilized GPR to image the subsurface and evaluate the presence or absence of possible unmarked historic graves. GPR sends electromagnetic pulses to a transmitting antenna at the ground surface which produces a radio wave that travels through the subsurface (Koppenjan 2009). Wave speed depends on the ability of a given medium to transfer energy (Annan 2009, Conyers 2004). When an approaching wave encounters a discontinuity in the physical properties of the soil and the wave's speed changes, some of the wave front's energy is reflected back toward the ground surface (Annan 2009). The two-way travel time (usually recorded in nanoseconds) and the amplitude of the reflection are recorded at the surface by a receiver antenna. Each traverse with the GPR provides a two-dimensional profile of the subsurface.

GPR is a popular and often successful technique for mapping cemeteries and locating unmarked burials. Numerous cemetery case studies document the success of the technique in historic contexts (Bevan 1991; Bigman 2014; Conyers 2006; Davenport 2001; Dionne et al. 2010; Fiedler et al. 2009; Gleason et al. 2011; Honerkamp and Crook 2012; Hunter 2012; Jones 2008; Shaaban et al. 2009; Sjostrom et al. 2009; Tarver and Bigman 2013; Torgashov and Anderson 2012). Several researchers developed accurate expectations of various burial anomalies by dragging antennas over wood caskets, metal caskets, and grave shafts (Conyers 2006; Fiedler et al. 2009; Sutton and Conyers 2013). While wood and metal caskets create a clear high-amplitude reflective signature; burial pits, grave shafts, or deteriorated wooden caskets are more difficult to detect. Grave shafts or burial pits can produce lower amplitude reflections at the ground surface since the top of the grave shaft is less compact than the surrounding, undisturbed ground surface (Bigman 2014). However, it can be difficult to identify graves when the site has been systematically disturbed from construction machinery as was the case at Liberty Church.

Survey Strategy

The survey utilized a SIR-4000 GPR with a 400 MHz antenna manufactured by GSSI (Figure 1). This frequency is appropriate for detecting buried objects, historical features and unmarked graves. The survey team collected data in a 30 m x 30 m grid with 0.5 m transect spacing. A total of 61 transects were collected in this grid. The northwest corner of the grid

suffered from water accumulation and couldn't be adequately surveyed. GPS coordinates of the grid corners were recorded with a Trimble GeoX 2008 for future reference.

All GPR data were processed using Radan v.7 software. A zero-time correction was used to adjust data traces to a common zero point. A background filter was used to remove horizontal banding pervasive in profile data. A band-pass filter was used to remove extraneous noise. Finally, hyperbola matching was used to adjust wave velocities for accurate depths and migration of 3D time-slices.

Results and Discussion

The GPR recorded a concentration of high-amplitude reflections (Figure 2) approximately 20 cm to 75 cm below ground surface. This cluster was circular in shape when mapped in time-slice view (Figure 3) and may indicate the remains of Liberty Church. This is the only systematic geometric distribution of GPR reflections, however it is possible that these represent the remains of disturbance. Based on metal detection survey conducted by Dr. David Noble, this area contained a high concentration of metal which would coincide with expectations of the church.

There are no substantial evidence for an associated cemetery on top of this bluff, however, there were several isolated reflection events consistent with the expectations of possible unmarked graves (Figures 4 and 5). These responses were not systematically distributed which would be expected of a cemetery, but the sizes conformed to those expected of graves containing human remains. Caution should be taken when interpreting these responses as unmarked graves, since an uprooted tree or other natural phenomena might create a subsurface characterization similar to that of an unmarked grave.

Conclusions

This site might be the location of the Liberty Church. GPR data collected during this investigation supports the findings of previous metal detection survey and mapped the boundary of a cluster of responses. It is recommended that minimally invasive excavations be conducted to validate this conclusion. It might be the case that the cluster actually represents the results of modern disturbance and may be a "push pile". Based on the GPR data, there does not appear to be a cemetery inside the survey boundaries, but several responses recorded by the GPR indicate the possibility of individual unmarked graves. Due to the complex history at this site it cannot be ruled out that these responses are the remains of fallen soldiers or might be the responses from non-human disturbance such as fallen trees. These responses were located roughly in the center of the survey grid and my recommendation is that if a log cabin is brought to this location in the future that it be placed on or near the possible location of Liberty Church following archaeological testing.

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Figure 1. Photograph of GPR survey in progress on War Hill in 2016 with same 400 MHz antenna used at Liberty Church.



Figure 2. GPR profile showing the response recorded from the possible buried remains of Liberty Church.



Figure 3. GPR time-slice showing the distribution of high-amplitude reflections at approximately 25-50 cm below ground surface. Labels A and B indicate locations of 2 possible unmarked graves shown in Figures 4 and 5 respectively.



Figure 4. GPR profile showing hyperbolic reflection indicative of possible grave (labeled "A" in Figure 3).



Figure 5. GPR profile showing hyperbolic reflection indicative of possible grave (labeled "B" in Figure 3).