INVESTIGATION OF PORTIONS OF THE OLD CHAPEL HILL CEMETERY

CHAPEL HILL, ORANGE COUNTY, NORTH CAROLINA

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INTRODUCTION

Environmental Services, Inc. (ESI), along with its subcontractor, Keith C. Seramur, P.G., PC, was contracted by the Preservation Society of Chapel Hill (PSCH) to conduct an investigation of a portion of the Old Chapel Hill Cemetery (**Figure 1**), which is located on the campus of the University of North Carolina at Chapel Hill (UNC-CH). The Town of Chapel Hill owns the Old Chapel Hill Cemetery and is responsible for its maintenance.

The purpose of the investigation was to identify the locations of unmarked burials in the southern portion of Section B and adjacent portions of Section I of the Old Chapel Hill Cemetery in Orange County, North Carolina. The investigation areas total approximately 1.5 acres in size and focused on open areas within these sections with few marked graves.

Involved in the investigation were Terri Russ and Alex Sames of ESI and Keith C. Seramur, P.G., PC. The investigation included the use of geophysical survey techniques (Ground Penetrating Radar) and soil density testing. The locations of potential grave shafts identified as a result of the investigation were recorded using a investigation Total Station. The investigations occurred in July and August 2012.

GENERAL HISTORY OF THE CEMETERY

The Old Chapel Hill Cemetery is about 7 acres in size. The land was part of a 125-acre grant from the State of North Carolina to the newly established University of North Carolina. George Clark, a student from Burke County who died on 28 September 1798, is the first recorded burial in the cemetery. The original rock wall around the cemetery was built in 1835. The cemetery is divided into six sections (A-B and I-IV) and is estimated to contain over 1,600 interments (**Figure 2**).

The westernmost sections, Sections A and B, comprise the historically African-American part of the cemetery. During the late eighteenth and early nineteenth century, Section B was set aside for the purpose of burying slaves and freemen. Following the end of the Civil War, the racial segregation of the cemetery continued, extending into Section A beginning during the 1880s. The earliest known burial in this part of the cemetery belongs to Ellington Burnett, who died in 1853. Section I represents the earliest white section of the cemetery, with most marked burials dating to the nineteenth century.

The cemetery was listed in the *National Register of Historic Places* (National Register) in 1994 based on both its association with events that have made significant contributions to the broad patterns of history and as it contains grave markers and other construction elements that embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possesses high artistic values, or represents a significant and distinguishable entity (Baten and Little 1994). The cemetery's period of significance ranges from 1798 to 1944.

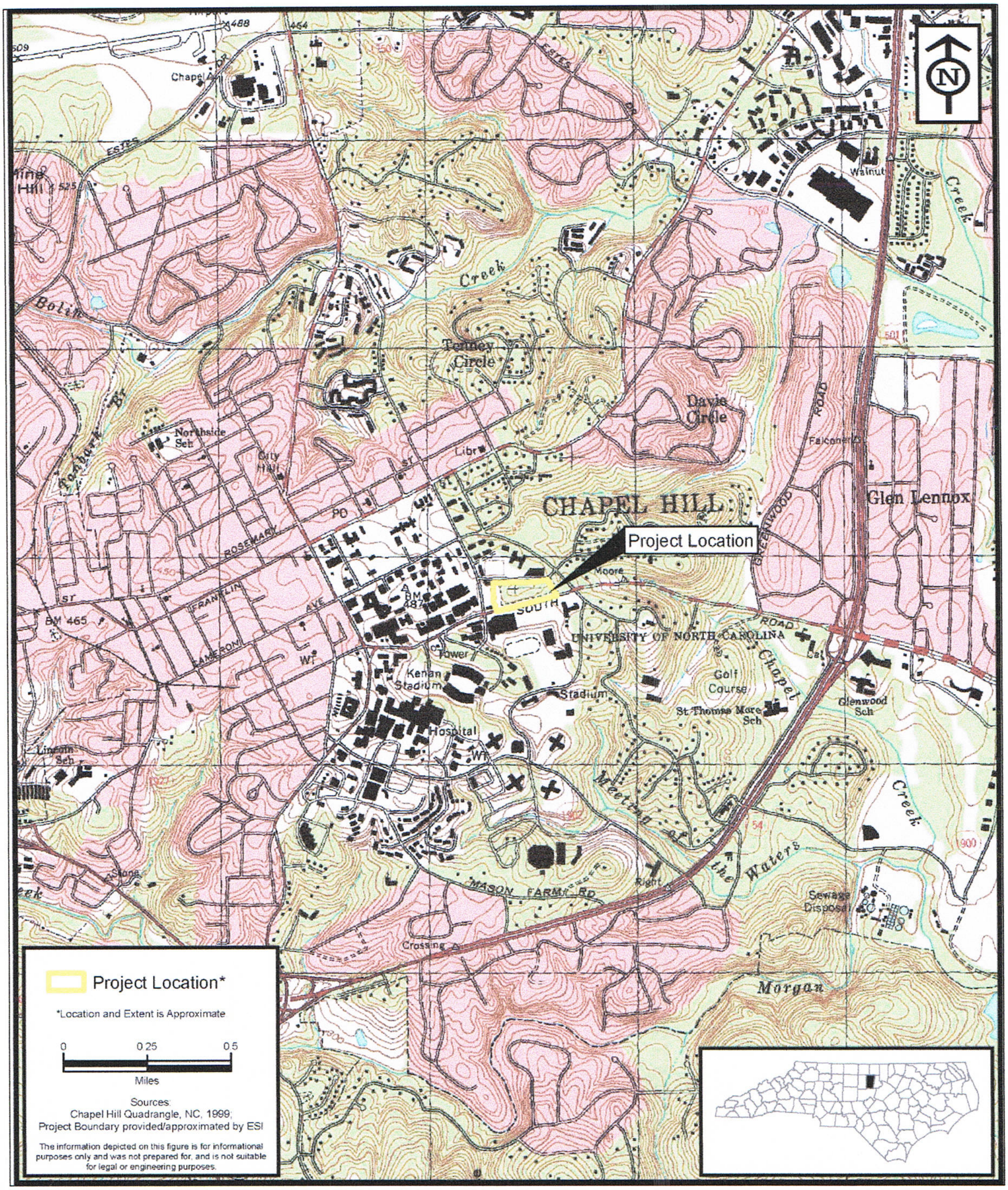

Figure 1: General Project Location

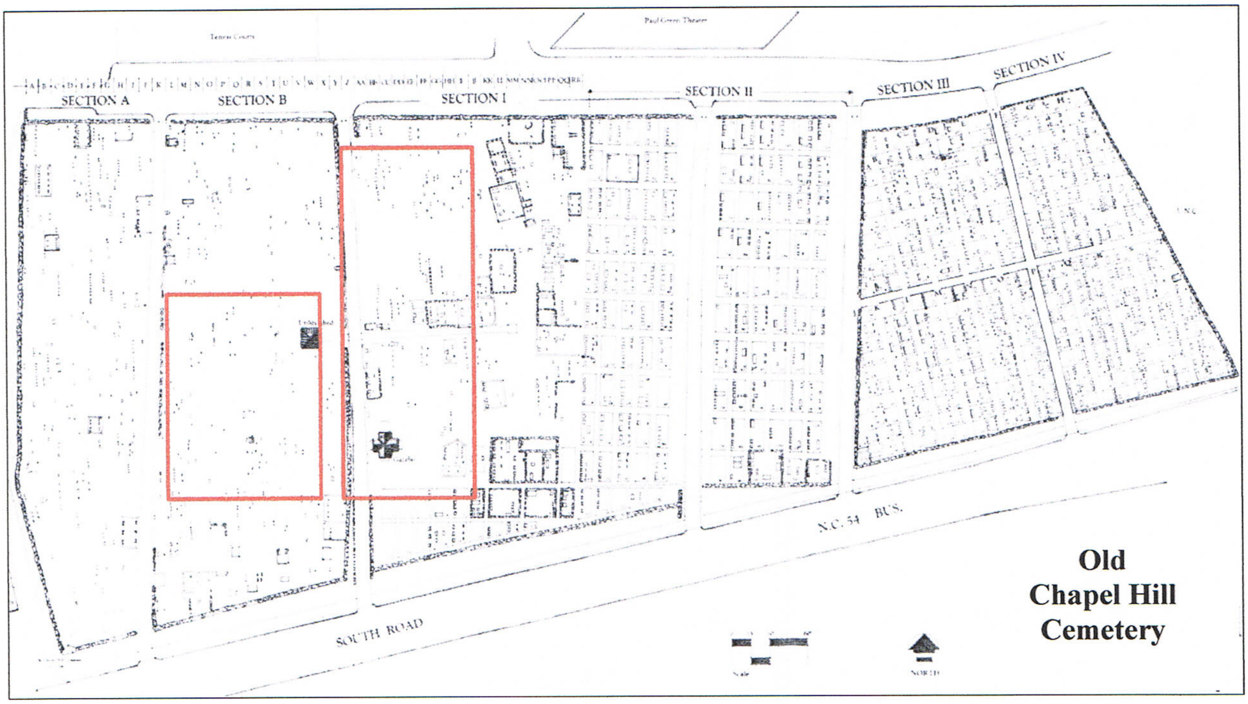

Figure 2: Approximate Study Area Locations

PROJECT METHODOLOGY

The goal of the project was to identify the locations of unmarked graves within the southern portions of Section B and portions of Section I that had few formally marked graves present. Given the size of the study area and the fact that the cemetery is maintained and in use, it was determined that a combination of geophysical survey (Ground Penetrating Radar) and soil density testing (e.g. soil probing) would yield the best results.

Ground Penetrating Radar (GPR) is a geophysical method that transmits pulses of electromagnetic energy (high frequency radio waves) into the earth through a transmitter. The radar waves propagate through the subsurface and are partially reflected back to the receiver when materials with different electromagnetic characteristics (dielectric properties) are encountered below the surface. The GPR detects changes in dielectric properties of subsurface materials. When different layers within a soil profile are disturbed or mixed (e.g. a grave shaft, former tree root or rodent borrow), the dielectric properties of the soil are changed making it possible for the GPR to detect these areas as anomalies.

The GPR survey was completed using a Geophysical Survey Systems SIR-3000 Single Channel GPR Data Acquisition System with a 400 MHz antenna. Radan© software was used to process the geophysical data and produce a 3-dimensional (3-D) block diagram of each survey grid. GPR anomalies were evaluated by producing horizontal slices through the 3-D model at different depths in each grid. These horizontal slices show the radar reflections returned over a particular thickness of the 3-D model.

The software can be used to control the depth and thickness of the horizontal slice through the 3-D block diagram. For example, when the data is initially reviewed, the thickness is set to between 0.5 and 1.0 feet. Then successive depth slices through the 3-D block are projected to observe overall trends in anomalies with depth. The software can also be set up in animation mode that will show a horizontal slice slowly moving down through the grid.

Soil density testing, or soil probing, employs a thin metal or fiberglass rod on a handle. The rod is inserted into the ground to detect differences in the density of the soil. Typically, an area of disturbed soil is looser and less dense than surrounding undisturbed soil.

The study area was divided into 19 grids (Grids A-S) in order to survey around trees, buildings and walkways (**Figure 3**). The Radan© software requires survey lines to be collected along a designated rectangular grid in order to develop a 3-D model. To identify potential unmarked burials, GPR survey data was collected along closely spaced lines (1-foot intervals) across the grid to maximize the resolution of subsurface features (**Figures 4-5**). Subsurface anomalies detected by the GPR surveys were marked in the field using survey pin flags. Soil probing using a 5/8-inch steel probe was then conducted around the pin flags. Linear areas of less dense soil aligned roughly east-west encountered by the probing were then marked in the field as potential unmarked graves (**Figure 6**).

In order to produce graphical plans of the in-field findings, the locations of the GPR survey grid corners, potential unmarked graves, marked graves within the survey grids, and other topographic features were recorded using a Total Station. Two series of three-dimensional visual "slices" of GPR data were produced for each grid square, representing shallow (generally 1.5 feet below surface) and deep (generally 3 feet below surface) images of the subsurface. These images were then integrated with and compared to the Total Station data.

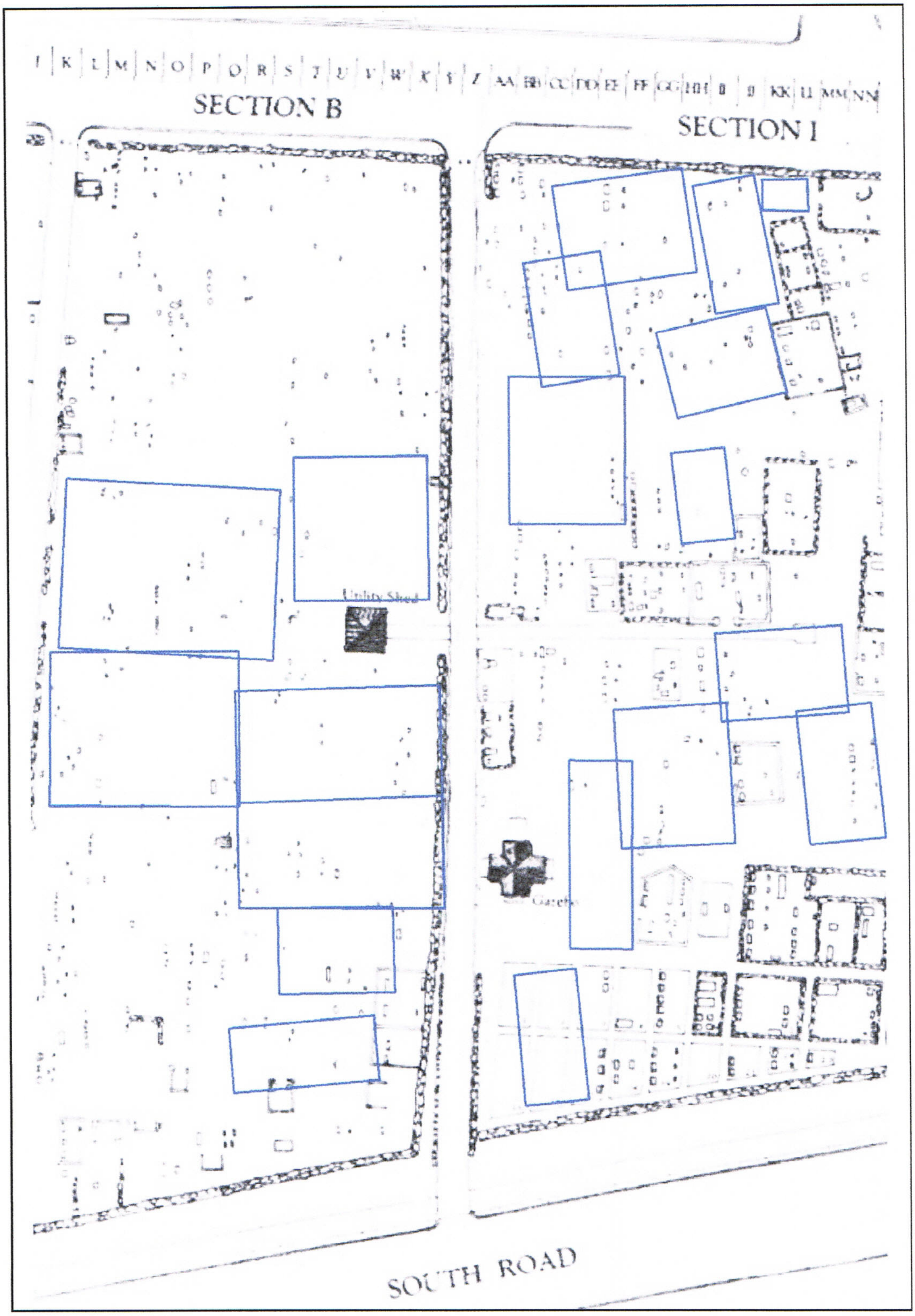

Figure 3: Approximate GPR Grid locations (in Blue) depicted on cemetery plan.

Figure 4: Portions of Section B subjected to GPR investigations. Flags mark likely grave locations.

Figure 5: Running the GPR unit on a test transect along the paved walkway running along the east side of Section B.

Figure 6: Southern portion of Section I, purported to contain several unmarked graves.

FINDINGS

Ground Penetrating Radar

The GPR survey grids crossed numerous marked graves ranging in age from the mid nineteenth century to present. Modern graves produce a very strong anomaly on the GPR record that represents a grave vault and/or coffin. Older graves from the 19th century to the early 20th century do not produce a strong anomaly on the GPR record. The wooden coffins associated with these older graves have decayed and soil in the grave shaft has caved-in, filling the base of the grave shaft. In some cases it is possible to pick up a reflection from the bottom of the grave shaft. However, in most of the older unmarked graves the loose backfill material in the grave shaft produces a transparent image on the GPR record. These unmarked graves can be identified on horizontal GPR records by the strong reflectors along the side of the grave shafts and in some cases a reflector at the base of the grave shaft (**Figure** 7). The GPR records also include many anomalies related to historic disturbance and natural changes in bedrock across the site.

GPR data is initially reviewed as horizontal slices through the 3-D block diagrams produced from each grid. Older unmarked graves will be represented in the GPR data as linear, transparent (or reflection-free) areas oriented east-west and similar in size to a grave. Traditional Christian burials are excavated in this east-west direction. Of particular interest are multiple linear, transparent areas aligned in north-south rows. These anomalies are then reviewed on the vertical cross-sections of the grid lines run for each block. Vertical cross-sections on each side and through the center of the anomalies are reviewed to look for evidence of a grave shaft or multiple grave shafts. Areas where there is evidence of a grave shaft are mapped on the horizontal slices.

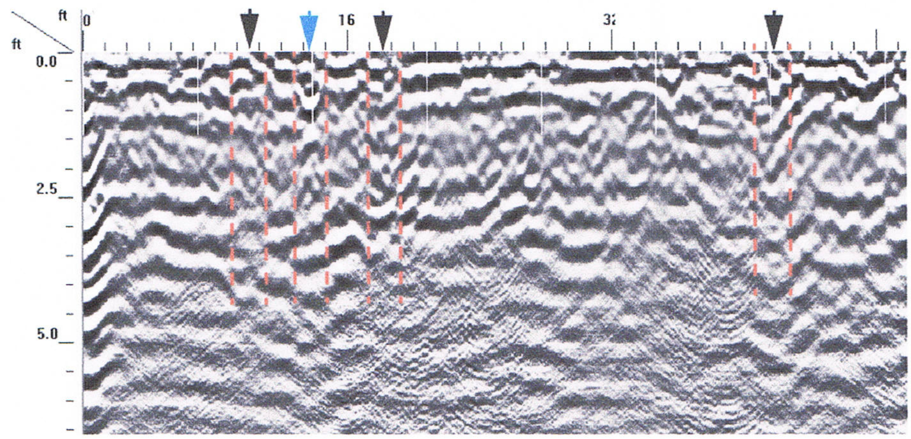

Figure 7: Vertical cross-section of Grid F. Black arrows show unmarked graves. Blue arrow shows buried location of a utility line.

Figures 8 and 9 show representative examples of some of the anomalies detected during the GPR survey. The lighter linear features appear to be underground water lines, trenches, or utilities. Anomalies that extend in an east/west direction and are oriented in north/south rows are most likely graves. The horizontal slices are typically set to a depth of about 3 feet and with a slice thickness of 1 to 2 feet to identify potential unmarked graves. For example, Grid F was sliced at a depth of 3.3 feet and the thickness of the slice was set to 2.0 feet. This slice shows all the reflections between depths of 2.3 and 4.3 feet (see **Figure 9**).

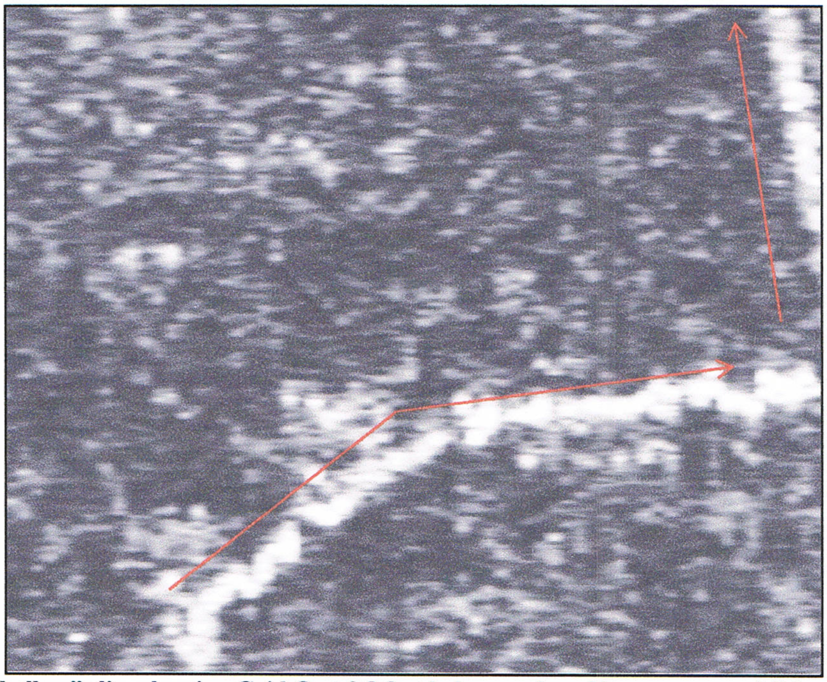

Figure 8: "Shallow" slice showing Grid Q at 0.8 feet below surface. No graves are visible at this depth; however, two subsurface trenches, likely sprinkler lines, are visible.

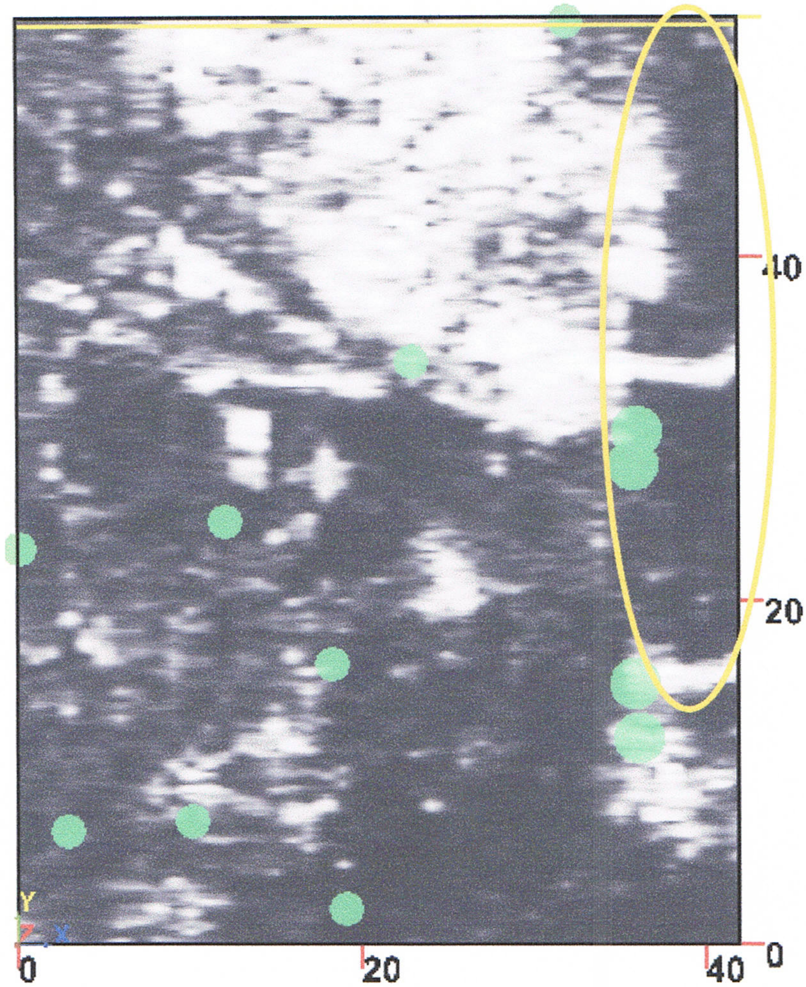

Figure 9: "Deep" horizontal slice through Grid F (depth=3.3 feet; thickness=2.0 feet). Small green dots are stones and large green dots are grave markers. Yellow oval shows area possibly representing a row of unmarked graves.

Soil Density Testing (Probing)

Horizontal slice maps were printed for each grid and used in the field to verify the location of unmarked graves using soil density testing (soil probing). The soil density testing focused on areas where the anomalies had been mapped out on the GPR grids. Soil probing was conducted at and in the vicinity of the location of each of the flagged anomalies to determine if the location represented a potential grave shaft.

The changes in soil density across the Chapel Hill cemetery can be subtle. The soil in the shaft of graves older than 50 to 100 years has had time to compact to a density similar to undisturbed soils. Soil in the Piedmont can become very hard during hot, dry weather. As such, soil density varied considerably across the survey area. Some marked grave shafts had dense, compact soil not typical of disturbed soil, while other marked grave shafts had typical soft, low-density soil. Some anomalies identified by GPR were determined not to be unmarked graves during the soil density testing based on their size and/or alignment. Unmarked graves confirmed by the soil density testing were flagged in the field. The locations of both marked and unmarked graves in each section of the cemetery were recorded with a total station.

A total of 199 burials or potential burials were identified during the investigation based on the soil probing and GPR. Each burial or potential burial was flagged in the field and their locations recorded with a total station. Some of the burial locations are associated with uncarved fieldstones or visible depressions in the soil. Others were detected as subsurface soil disturbance, with no visual indicators of the presence of a grave. **Figure 10** shows the locations of both marked and unmarked graves within and immediately adjacent to the study areas. Unmarked graves depicted outside of the GPR survey area were detected through visual inspection (linear depressions, fieldstones), soil probing, or both. Unmarked graves depicted on **Figure 10** in the northern third of Section B were located during the 2009 investigations (Seibel and Thacker 2010). GPR grids were exported from the Radan© software for ESI to integrate the field survey and GPR (**Figure 11**).

CONCLUSIONS

The investigation of portions of Section B and Section I resulted in the identification of numerous potential unmarked graves. The term "potential" is used as geophysical survey and soil density testing cannot fully confirm or refute the presence of a grave shaft. Only the removal of topsoil to expose the underlying subsoil can absolutely determine if a grave shaft is present, but this was not feasible for the present investigation.

The investigation was not without challenges. The study area had to be divided into multiple rectangular grids in order to work around fences, sidewalks, grave markers, and structures. Because of these above-ground obstacles, some areas were only subjected to soil density testing, not GPR. Soil density testing of the hard, dry surficial soils at the cemetery was a difficult task. Buried utility lines produced some noise in the GPR data, but it was still possible to identify anomalies associated with unmarked graves. However, the GPR surveys provided valuable subsurface data to locate unmarked graves at the Chapel Hill cemetery.

The combination of geophysical survey and soil density testing identified as many as 199 unmarked graves within the study area (see **Figures 10 and 11**). Not surprisingly, the majority of these potential graves were located in Section B, the historically African-American section of the Chapel Hill cemetery.

Figure 10: Soil Probe Data. Green shapes represent marked graves; red ovals represent potential unmarked graves. Blue rectangles represent GPR survey grid locations.

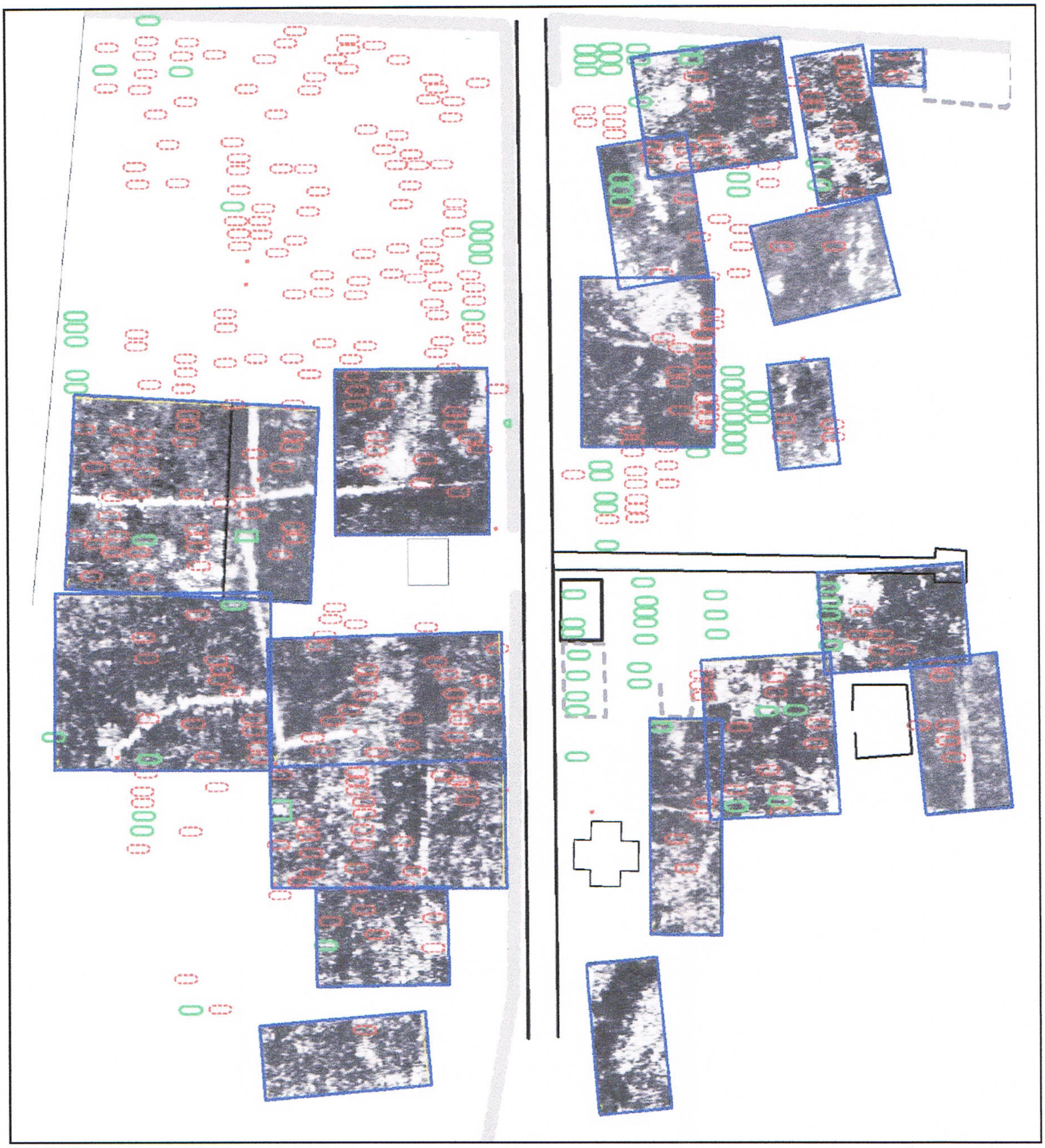

Figure 11: GPR imagery overlain on Soil Probe Data. Green ovals represent marked graves; red ovals represent possible unmarked graves.

REFERENCES CITED

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