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October 28, 2016

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RE: A Ground-Penetrating Radar Survey for a 0.16 ha (0.41 acre) Area Beyond the North and East Borders of Mars Hill Cemetery, Knoxville, Tennessee.
CRA Project No.: L16A001
Contract Publication Series No.: 16-416

Mr. Alley:

On October 20, 2016, Cultural Resource Analysts (CRA) archaeologist, Jeremy W. Pye, Ph.D., RPA, conducted a ground-penetrating radar (GPR) survey over approximately 0.16 ha (0.41 acre) of land outside of the presumed northern and eastern boundaries of Mars Hill Cemetery in Knoxville, Tennessee (see Figure 1). Mars Hill Cemetery is thought to be the final resting place of the victims of the Cavett's Station massacre, which occurred in 1793. The massacre was memorialized by a marker placed in the Mars Hill Cemetery in 1921 by the Tennessee Society of the Sons of the Revolution. The marker indicates that the Cavett's Station, or blockhouse, was located at the cemetery, but its location has never been identified and current research by Faulkner (2013) suggests that the location of the blockhouse was well to the south of the project area near a spring. Faulkner (2013) reports that subsequent family members may have been interred at the cemetery as late as 1820, although these early burials likely would have been marked with wooden or fieldstone markers and their exact locations are not confirmed. According to Faulkner (2013) the cemetery was not used again until after the construction of the Gallaher View Baptist Church, which was founded in 1855. The church, now known as Gallaher Memorial Baptist Church, was moved in the early 1890s to its present location on Gallaher View Road (Faulkner 2013). Even though the church was no longer directly associated with the Mars Hill Cemetery, extant markers in the cemetery attest to the fact that family members of those individuals buried in the cemetery during its association with the church continued to use the cemetery for burial during the early twentieth century. The latest marked grave site in the cemetery dates to 1931.

Mars Hill Cemetery is located east of Broome Road NW and north of Doublehead Lane, and is bounded by a residence and shed to the west, two residences to the south, and open pasture to the north and east. At some point in the past, a wooden fence was erected around what was perceived to be the boundary of the cemetery as indicated by the extent of the marked grave sites. Only the posts of the fence remain on the north and east sides of the cemetery. It is our understanding that plans call for the construction of a residential development on the property adjacent to the cemetery. CRA personnel conducted a soil probing survey in July, 2016, within a project area extending approximately 10 m (30 ft) to the north and 10 m (30 ft) east of the presumed northern and eastern boundaries of the Mars Hill Cemetery in order to determine if unmarked graves were present (Avery 2016). Disturbed areas, possibly associated with tree roots or other bioturbation, were noted in portions of the project area, while heavy vegetation precluded survey in other areas. No unmarked

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graves were located during the probing survey, but one possible, small, shallow, pet burial was documented within the project area (Avery 2016).
In August, 2016, Dan Brock, a graduate student from the University of Tennessee, conducted a limited GPR survey of a 10 x 20 m (33 x 66 ft) block, the southern boundary of which was located approximately 5 m (16 ft) north of the Mars Hill Cemetery fence line. Two grave-like anomalies were found in the southeast portion of this survey block, and thus a smaller 3 x 3 m (10 x 10 ft) block extending toward the cemetery fence was also investigated to see if the row continued toward the cemetery. Brock found evidence of three additional presumed grave features in this smaller block (Brock 2016).

Current efforts to investigate the area around the cemetery were aimed at confirming the results of the CRA probing survey within the area that was investigated by probing, and providing support for the presence or absence of unmarked burials within the portions of the current project area that were not investigated through probing. In addition, although all of the presumed grave features identified by Brock lay beyond the southern boundary of the current project area, the present efforts sought to support the absence of burials within the portion of the current project area that overlapped Brock's survey block. The ultimate purpose of this work is to make sure that any potential burials present within the project area might be encompassed by the cemetery boundary and avoided by proposed construction activities.

A GSSI SIR-3000 GPR system coupled with a Model 50400S 400 MHz antenna mounted on a cart system (see Figure 2) was utilized for investigation of the survey area in accordance with the geophysical methods as outlined below. GPR works through the antenna sending radio waves into the ground, which differentially interact with the variable physical and chemical (and therefore electrical) properties of the area passing under the antenna as it is moved across the ground surface. Unlike other geophysical survey methods, GPR has the ability to convert the two-way travel time of a radio wave (i.e., the time is takes for the radio wave to reflect off of a buried target and return back to the receiver) into a distance, thus giving an approximate depth-to-target. Because of the nature of how GPR works, this device is applicable for use on archaeological sites anticipated to have large, or "hard," subsurface features, such as large pits, ditches, unmarked burial locations, and historic foundations (Kvamme 2002). Conyers (2005) states that graves should generally be indicated as hyperbolas within the radar profile (see Figure 3), particularly when "hard" items, such as vaults or intact burial containers, are encountered by the radar waves, yet hyperbolic reflection are not the only responses to graves. Often, the contents of graves are not immediately detectable, but what is detected is the disturbance cause from the digging and filling processes. Examples of possible radar representations of historic grave features were described by Bevan (1991), and include the following as shown in Figure 4: (1) "burial contrast", which results in the standard hyperbolic reflections; (2) "subsidence strata", which is represented by settling or slumping of the grave fill; (3) "fill scattering" cause by rubble or unconsolidated clay nodules within the grave fill; (4) "strata break", or soil substrate truncation; and (5) "surficial subsoil", or superficial soil truncations or disturbances.

The first task of the current geophysical study was to establish a grid across the project area that was used to orient the field data collection. Historic Euro-American burials, particularly Protestant graves, are typically oriented east-west, with the head to the west and the feet to the east. In the case of the Mars Hill Cemetery, marked graves were oriented more in a WSW-ENE direction. The geophysical survey blocks were oriented in a similar direction as the marked burials to increase the likelihood that burials would be identified if present, and in keeping with the property boundaries and previous surveys. A Trimble 3000 series Geo-XT handheld GPS unit and pull tapes was used to lay out two contiguous survey blocks for the geophysical survey and the UTM of each of the survey block corners was recorded. Block 1 measured approximately 15 x 69 m (50 x 225 ft) and was located to the north of the cemetery with the southwest corner of the block acting as the grid origin. Block 2 measured approximately 54 x 10 m (175 x 30 ft) and was located to the east of the cemetery with the southwest corner of the block acting as the grid origin (see Figure 5).

As mentioned above, the physical and chemical properties of soils including the moisture content and electrical conductivity, can affect the results of a GPR survey. For example, changes in soil moisture, texture, and density can cause data echoes or reflections that can mask potential targets, and increasing electrical conductivity can decreased radar penetration. Therefore, the dielectric constant, or the relative permeability of a substance, can be set within the GPR unit. USGS soils data for the area suggest that the site consists of shallow silty loam soils atop clay. The dielectric constant suitable for the data collection in silty and loamy soils, as well as dry clays is 8, so this is the setting input into the GPR unit. The data was further set to be collected in a 16-bit format, with 50 radar scans being collected per meter and 512 data samples being collected in each scan as is accepted practice in ground-penetrating radar studies of historic cemeteries.

Even though burials are not considered to be small features in a general sense, adult supine burials only measure approximately 1 x 2 m (3 x 6 ft). It is necessary for the geophysical instrument to pass over a grave feature several times so that there is an observable radar return pattern in neighboring transects. Therefore, the current survey was conducted so that transects were spaced 0.5 m (1.6 ft) apart and oriented to NNW-SSE. This allowed for the transects to cross perpendicularly to potential grave features, thus increasing the likelihood of recording anomalous radar returns along multiple transects. Transects were traversed in a zig-zag transecting pattern, which means that the first transect (Transect 1) started at the grid origin in the southwest corner of a block and the GPR being pushed along the transect to the NNW. At the end of the transect along the northern baseline, the instrument was moved over 0.5 m (1.6 ft) to Transect 2, turned, and pushed along until reaching the end of the transect along the southern baseline. In this manner the GPR data collection continued across each of the survey blocks. The above methodology resulted in the collection of a total of 139 transects of GPR data in Block 1 and 21 transects in Block 2.

The majority of the project area was in short grasses and other low plants at the time of the survey as the developers had the area cleared using a rotary mower prior to the geophysical fieldwork. Areas previously inaccessible to CRA personnel during the probing survey were cleared leaving most of the project area accessible to the ground–penetrating radar. That said, some obstacles remained that hindered, or may have affected the results of, the geophysical data collection. The far western end of Block 1 was tightly hemmed in by a raised garden bed on the northern side and child's wooden playhouse and slide surrounded by overgrown blackberries, poison ivy, and other weeds (see playhouse and slide in right foreground of Figure 6 and garden and playhouse in background of Figure 7). A large brush/debris pile, resulting from the clearing of the vegetation from the project area was located just off the northeastern corner of Block 2 (seen left center in Figure 6). While the majority of the brush pile was outside of the project area, it was necessary for me to clear a few clusters of medium sized branches and trash from the project area. It was not possible to clear all of the trash out of Block 2, however, as there was a sizeable surface scatter of modern trash, including metal debris, concentrated largely in the middle of the block. A small dirt pile was also present in the vicinity of the trash scatter, which was a hindrance to data collection as well (see Figures 8 and 9).

The collected GPR profiles were processed using RADAN v.6, and manually viewed looking for evidence of grave features. Graphical plan-view plots, or "time slices," of the data were produced using GPR Slice v.7 and ArcGIS. Interrogation of the individual radar profiles collected revealed numerous high contrast radar reverberations associated with metallic debris located in both surface and subsurface contexts throughout the project area, the most prevalent concentrations of which were in Block 2 (see Figure 10). No overt anomalies reminiscent of unmarked grave features were seen in the GPR profiles. Similarly, the production of plan-view time slices of the GPR data did not highlight any obvious anomalous patterns conforming to rows of grave features within the project area. That said, as can be seen in Figure 5, the survey did reveal something of note. In the western portion of Block 1, there appears a large rectangular anomaly as also seen in Figure 11, measuring roughly 28 m (92 ft) in length from WSW-ENE. The width of the anomaly is not precisely observable as it extends to both the northern and southern extents of the project area; however, given the width of the anomaly's eastern and western sides, it is approximately 17 m (56 ft) in width. There also appears to be a roughly 5 x 5 m (16 x 16 ft) projection extending from the western side of the larger rectangular anomaly. Evidence of the rectangular anomaly appears in the times slices starting around 50 cm (20 in) below the ground surface and extends to roughly 150 cm (59 in). While outstanding in plan-view, the representation of this anomaly in the radar profiles is fairly subtle as can been seen in Figure 12, which depicts the profile of Transect 35 and which crosses the middle of the larger rectangular anomaly (see Figure 11).

Given the shape of the rectangular geophysical anomaly discovered in Block 1, as well as the apparent depth of the anomaly, it is interpreted to be either direct remains of a structure foundation, or evidence of the excavations for the construction of a foundation. Without additional archaeological and historical research, it is not possible to determine whether the rectangular anomaly does correspond to structural remains, and if so, to make interpretations as to the origin or function of said structure. Based on what is known at this time, assuming that additional archaeological work supports the belief that the anomaly does represent the footprint of a structure, there are three potential explanations for its presence. The most likely possibility is that the anomaly represents the original location of the Gallaher View Baptist Church given its shared orientation and proximity to the Mars Hill Cemetery. Additionally, although renovations are evident and no formal architectural analysis of the structure has been undertaken, the dimensions of the anomaly are similar to those of the present-day Gallaher Memorial Baptist Church. While the church seems like a reasonable candidate, the property adjacent to the Mars Hill Cemetery has been used in the past for agricultural purposes/pasture, so the anomaly might instead represent a barn, or other structure associated with a farmstead on the property. Finally, it is possible that the anomaly could represent Cavett's Station, given the historical belief that the Mars Hill Cemetery is located on the site of the blockhouse. This is a much more remote possibility than the other options as the dimensions and appearance of the anomaly do not conform to other blockhouse structures in the region, and current research by Faulkner (2013) has suggested that the blockhouse was located elsewhere, as was mentioned previously. Due to the potential that a structure in this location could have historical and archaeological importance, it is recommended that the rectangular anomaly be investigated by a professional archaeologist.

As discussed above, the previous GPR survey work conducted by Brock (2016) indicated that unmarked burials appear to be present beyond the presumed northern boundary of Mars Hill Cemetery. These burials lay south of Block 1 of the current project area, and were marked by plastic yellow pin flags at the time of the current survey. While the burials appear to lay outside of the current project area, it is recommended that a buffer of at least 8 m (25 ft) be maintained from the cemetery fence line so that all of these potential graves are effectively protected from construction activities. The results of the current GPR survey suggest that there do not appear to be any unmarked human graves present within the investigated project area. It cannot be stressed enough, however,

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that GPR is not absolute and there are many reasons why grave features might not be indicated in the present data. The surest way to determine if graves are present is to strip off the top soil using a backhoe, or similar heavy equipment, which would reveal soil stains appearing from the contrasts between the homogenized grave fill and the surrounding undisturbed subsoils. It would, therefore, be prudent for a professional archaeologist to be present on-site during initial stripping/grading of the parcel investigated during the current geophysical survey in order to monitor the construction disturbance and determine if soil stains reminiscent of grave features are present. If grave features are encountered during construction activities, said graves should be encompassed by the Mars Hill Cemetery boundary and the construction buffer should be extended. If actual human skeletal material is discovered during construction activities, all work should cease. The Tennessee Historical Commission (THC) and local law enforcement should be contacted immediately, and THC guidelines should be followed.

Mr. Alley, I appreciate the opportunity to assist you with this project. If you have any comments or questions regarding our work or this report, please do not hesitate to contact either myself or Travis Hurdle, director of the CRA Knoxville office (Phone: 865 249-6035, Email: twhurdle@crai-ky.com). We look forward to working with you again in the future!

Sincerely,

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Enclosures:

Figures 1-12

Figure 1: Project area as depicted on 2014 aerial image.

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Figure 2: Jeremy Pye using the GSSI SIR-3000 GPR unit to collect geophysical data near the southeast corner of Block 1 north of Mars Hill Cemetery, view northeast toward the large brush pile northeast of the project area.

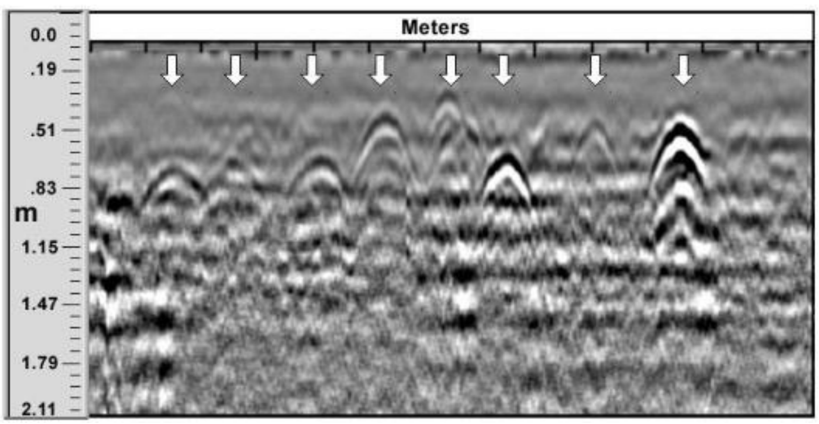

Figure 3: Example of regularly spaced hyperbolic reflections from grave features as seen in radar profiles collected at the Fort Riley Cemetery, Manhattan, Kansas (Kvamme 2002).

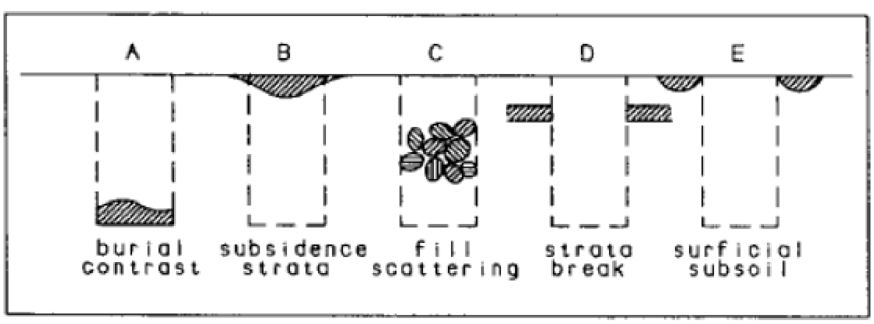

Figure 4: Examples of possible soil contrasts, other than hyperbolic reflections, suggestive of historic grave features as seen in radar profiles (Bevan 1991).

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Figure 5: Project area, geophysical survey blocks, and plan-view of GPR time slice from approximately 100 cm (39 in) below ground surface, as seen on the 2014 aerial image. Block 1 grid origin in SW corner at UTM Z16N N3980617.9, E765406.4 (NAD83). Block 2 grid origin in SW corner at UTM Z16N N3980602.0, E765484.6 (NAD83).

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Figure 6: Overview of project area north of Mars Hill Cemetery, view east-northeast from the southwest corner of Block 1.

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Figure 7: Overview of project area north of Mars Hill Cemetery, view west-southwest from the southeast corner of Block 1.

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Figure 8: Overview of project area east of Mars Hill Cemetery, view south-southeast from the northwest corner of Block 2.

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Figure 9: View of small dirt pile and scattering of modern trash and metal debris of Block 2 east of Mars Hill Cemetery, view northwest from near the center of the block.

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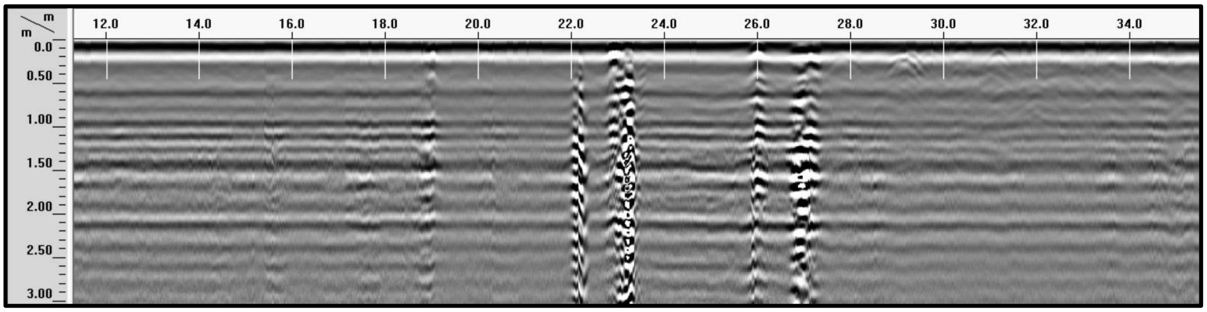

Figure 10: Segment of the radar profile corresponding to Transect 8 in Block 2, which shows examples of strongly contrasting reverberations from surface and subsurface metallic debris.

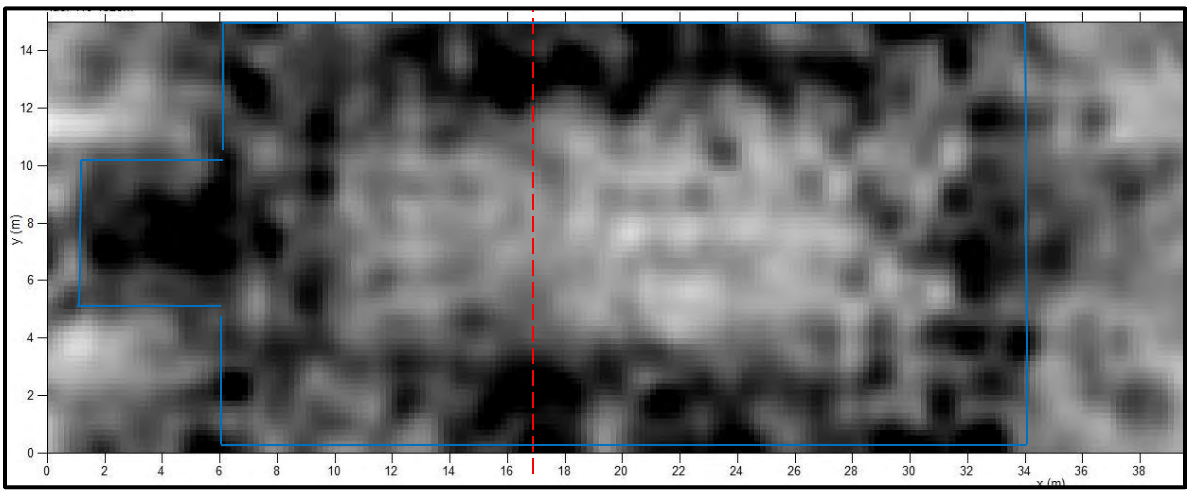

Figure 11: Close-up of rectangular anomaly as seen in plan-view of GPR time slice from approximately 100 cm (39 in) below ground surface. Blue lines indicate extent of anomaly. Red dashed line indicates location of Transect 35.

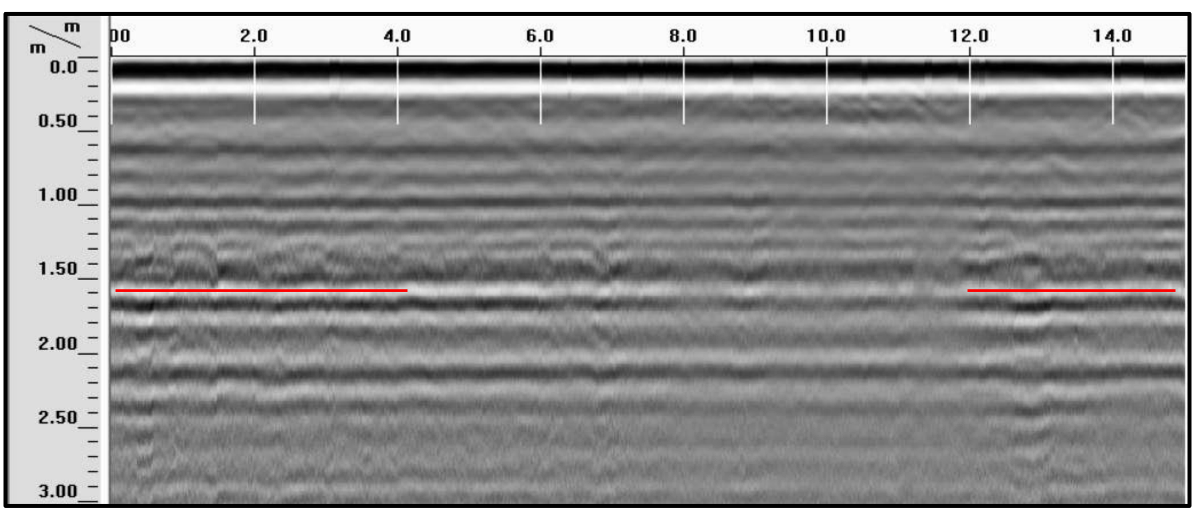

Figure 12: Radar profile corresponding to Transect 35 in Block 1, illustrating subtle reflections of corresponding to rectangular anomaly as indicated by the red lines.