A Report on the Ground Penetrating Radar Survey 205 Little Plains Road Southampton, NY

November 18, 2016



Conducted by Robert W. Perry TOPOGRAPHIX, LLC Hudson, NH

Requested by Southampton Town Historical Burial Ground Committee 116 Ham Hampton Road Southampton, NY 11968

TOPOGRAPHIX® LLC

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November 18, 2016

Mr. Roger Tollefsen 23 Bay Ave West Hampton Bays, NY 11946

Subject: GPR report – Southampton Historical Burial Grounds

Dear Mr. Tollefsen

I would like to thank you for allowing TOPOGRAPHIX LLC to service your GPR requirements.

At your request a Ground Penetrating Radar (GPR) survey was performed at the Southampton Historical Burial Grounds located at 205 Little Plains Road, Southampton, NY. The GPR survey was done to try and locate unmarked human graves on a parcel of land with open grassy terrain approximately 1.72 acre in size. Three Scan Zones (CZ) were set up for exploratory scanning to determine the presence of unmarked graves. The exploratory scanning was to also determine the population of graves within a given length and width of ground distance if graves were discovered.



Figure 1: Shows the location of 3 Scan Zones (CZ) and ground distance.

In addition to exploratory scanning, a Robotic Mapping Assessment (RMA) of the burial ground was performed, mapping the location of underground anomalies that indicated the presence of human graves as well as the location of headstones within the tall hedge line that bordered the burial grounds. A printed copy of the Robotic Mapping Assessment has been added as the last page of this report

Two types of GPR scanning were performed. The first type is commonly referred to as utility or exploratory scanning where the ground is randomly scanned looking for anomalies which would indicate the presence of human graves.

The second type of scanning was a grid scan where scan lines are laid down and GPR data was collected and analyzed using interactive 3D module software called RADAN. Figure 2 below shows a typical layout of scan lines and direction. The total ground area scanned for each Scan Zone (SZ) was as follows: $SZ1 = 28' \times 235'$, $SZ2 = 28' \times 118$ and $SZ3 = 16' \times 112'$. Scanning was performed in a north-south direction, starting with the northeast corner of each scan zone marked on the RMA as "Stake Point".



Figure 2: A section view of the attached GPR Survey Map

Ground stakes were placed 4' apart x's the length of the scan area at both ends making up a grid zone. Guide lines were laid down and looped around each ground stake running the length of the scan area setting up a straight line for grid scanning. The grid area was set up in the direction based on the likelihood that any burial holes being perpendicular to existing headstones. The X axis determines the width and the Y axis determines the length of the grid area as seen in the attached RAM.

GPR Test Scanning:

To survey the hyperbolic characteristics and soil conditions from known grave sites, a test area with dated headstones were selected for scanning. The test scan provides a visual reference for the type of anomalies and soil conditions for the area.



Figure 3: Test scanning of 3 headstones with radar anomalies showing 3 graves

A second test site was selected for scanning in an open area where ground-penetrating radar revealed 12 subsurface anomalies over a distance of 30 feet at a penetration depth of 10 feet, were of good interpretative quality.



Figure 4: Profile image of 12 unmarked graves

Summary of GPR Results:

Using exploratory and grid scanning techniques, both methods revealed a total of 117 anomalies with a high probability rating for unmarked graves within all three scan zones. See below for Probability Rating System for Unmarked Graves.

Position of Headstones and Graves:

While performing exploratory scanning of marked gravesites, it was noted that many of the graves did not line up with the position of the headstones indicating that the head/foot stones at one point may have been moved or relocated from a different area. The close proximity of unmarked graves would provide an explanation for misalignment.



Figure 5: Red flags indicating the position of the graves to the headstone positions.

Probability Rating System for of Unmarked Graves:

Operating by the fact that burial holes are typically longer than two feet, the confidence level rating on whether an anomaly could be considered a human grave was determined by the observation of the same anomalous pattern repeating itself in the neighboring two foot lateral scan.

- An anomaly detected on one pass along the survey line would be rated as Low Probability of human grave.
- The anomaly detected on the second and third pass along the adjoining lateral survey lines would be rated as High Probability of human grave.

In addition to the position of the anomaly along the survey line, the hyperbolic signature of each anomaly was compared to the unique hyperbola characteristic typically observed from the presence of tree roots, layering or bedding of various rocks, ground voids, disturbed soil layers and burial holes.

GPR Equipment Used:

The radar unit used for the project was the SIR-3000, manufactured by Geophysical Survey Systems, Inc. (GSSI). A 400 MHz antenna was used with a scanning rate of 24 scans per foot at a penetration depth of 10 feet.

Ground Penetrating Radar (GPR):

Ground-penetrating radar uses a high EM pulse transmitted from a radar antenna to probe the earth. The transmitted radar pulses are reflected from various materials within the ground, and this return is detected by the radar receiver.

Different materials reflect energy back to the surface in different ways and there are a number of factors that come into play when collecting GPR data. Collecting GPR data is subject to earth material properties location and ground conditions. Heat, humidity, ground water saturation, salt, iron deposits as well as interfering effects such as radio frequency, cell phones, including extensive metal structures such as cars passing by and traffic lights all have effect on the radar data being collected.

Examples of Commonly Detected Objects

The examples shown below are presented for informational use only. The examples illustrate how a single ground-penetrating radar scan along a survey line can reveal a unique hyperbolic (curve) characteristic of each of the targeted objects. Vertical scales include Time (ns) or Depth (ft/m) as well as horizontal scale for ground distance viewed at the top of the images.



Graves (Coffin)

Rebar

Conduits



Burial Vaults

Graves Late 1800s



Scan Image of the Six Dated Graves with One Unmarked Anomaly (Revolutionary Cemetery)



Scan Image shows the roof tops of eight above ground burial vaults along a cemetery roads way

Regards,

RWPen

Robert W. Perry Topographix LLC 603-429-4417

Preliminary report of the findings of a Ground Penetrating Radar Survey of the Old Burial Ground in Southampton, NY – October 6, 2016

Author by: Roger C. Tollefsen

The site is made up of two abutting rectangular areas. The largest rectangular area measures 220' x 366 'and borders Post Lane along its longest and southern side. All of the forty-seven visible gravestones are in this area. The smaller rectangular area measures 36 x 326' and borders Little Plains Road on its shortest side to the east.

Robert W. Perry of Topographix, Inc., Hudson, New Hampshire did the Ground Penetrating Radar Survey. The goal was to determine the boundaries of the burial areas and create an estimate for the number of graves within them. Three ten foot wide transects were chosen within the largest rectangular area; each ran from North to South. The transects were:

- 1) Along the extreme western border
- 2) Along the eastern edge of the major grouping of the visible gravestones
- 3) Along the extreme eastern edge where the two rectangular areas meet

The cemetery was laid out with the longest side of each burial plot in a north to south orientation. Unmarked graves were present in regular intervals in all transects. Based upon their distribution, grave plots appeared to be 10' long by 5'foot wide in the most easterly areas, but appeared narrower (4' 4") in the westerly areas. In some cases, the density of graves within a plot was much greater; this may have been an attribute of a family plot.

The survey also attempted to determine if there were any graves within the smaller rectangular area. Three transects running west from Post Lane west to the larger rectangular area revealed no graves with the exception of the most westerly part of this area. Here, ten graves were found. This appeared to be an extension of the larger burial area and there was evidence that graves continued under the hedges to the south. In fact, where access permitted, graves were also found under the hedges along the east of the larger rectangular area.

The nine transects of the larger rectangular area covered over 20,000 sq ft. They revealed approximately 50 gravesites/transect. This number varied from 47 to 53 with the largest number in the western areas. Each transect explored an area of 10' by 220'. The gravesite density was calculated at 50 graves per 2,200 sq ft. Since the area of the larger rectangular plot is 74,000 sq ft, the number of graves could be estimated to be 1,680 graves. The graves within the small rectangular area were added to that and the total became 1,690. For rounding purposes, the Old Burial Ground appears to contain 1,700 graves.

Mr. Perry has over twenty years experience locating graves and surveying burial areas. He offered the following observations:

- The entire site appears to have been covered with at least one foot of topsoil. He concluded this by both how the soil appeared through his radar equipment and the unusual depth of the graves. Most graves show-up some 3-4 feet below the surface, the graves in the Old Burial Ground were found at the significantly lower depth of 4.5–5 feet.
- 2) Because the bases of the existing gravestones are not sunken into the ground, they appear to have been set after the topsoil was added.
- 3) Many of the graves associated with visible gravestones are misaligned with the markers. This indicates that the grave markers may have been placed years after the original interment.

After the transect surveys, Mr. Perry attempted to locate any gravestones that may have been buried. Although he specifically targeted these markers to a depth up to two feet below the surface and probed any suspected location, no buried gravestones were found in the 5,000 sq ft area of his search.

The next day, Mr. Perry returned to the site and located the GPS coordinates of every grave he had found, all visible gravestones and the Burial Ground boundaries.

The contract with Mr. Perry allowed for a survey area of 10,000 sq ft. Because of our initial findings on the survey date, we elected to cover a greater area more quickly rather than concentrate on a smaller area that might have given us more precise grave locations. Because of this, he scanned over twice the contracted area of the Burial Ground and all but eliminated the presence of buried gravestones. His professional experience provided a valuable prospective for this site.

Roger C. Tollefsen