Results of Archaeology – Geophysical Field Assistance; July 21, 2015

by Deborah Sheridan, CT and RI State Soil Scientist

Extracted results for Whittlesey Museum at Music Vale Seminary, Salem, Connecticut reprinted with permission of the author

SUBJECT: Archaeology – Geophysical Field Assistance: July 21, 2015

TO: Nicholas F. Bellantoni, PhD
Emeritus State Archaeologist
Connecticut Archaeology Center
2019 Hillside Road, U-1023
University of Connecticut
Storrs, CT 06269-1023

Purpose:
At the request of the Emeritus Connecticut State Archaeologist, ground-penetrating radar (GPR) surveys were conducted at historical sites located in Danbury, Torrington, Salem, and Wethersfield, Connecticut; and Fishers Island, New York.

Activities:
All activities were completed Tuesday, June 30, 2015 through Thursday, July 2, 2015.

Summary:
7. At the Whittlesey Museum at Music Vale Seminary in Salem, Connecticut, a GPR grid survey and random traverses were conducted in an attempt to locate outbuildings or other significant cultural resource areas on the property. While no recorded reflection pattern could be conclusively identified as a significant cultural resource structure or object, several locations having anomalous reflection patterns were identified and marked for further investigations by archaeologists. Identifying historically significant building structures, sites, and objects is just one of the evaluation criterion for inclusion on State Register.

Equipment:
The radar unit is the TerraSIRch Subsurface Interface Radar (SIR) System-3000 (SIR-3000); manufactured by Geophysical Survey Systems, Inc.[1] The SIR-3000 consists of a digital control unit (DC-3000) with keypad, SVGA video screen, and connector panel. One 10.8-volt lithium-ion rechargeable battery powers the system. The SIR-3000 weighs about 9 lbs (4.1 kg) and is backpack portable. A 400 MHz antenna was used in the studies described in this report. Scanning rates of 64 scans/sec and a scanning time of 50 ns was used. With a scanning time of 50 ns, the maximum penetration depth is about 2.5 m.

The RADAN for Windows (version 7) software program developed by Geophysical Survey Systems, Inc, was used to process the radar records. 1 Processing included setting the initial pulse to time zero, color table and transformation selection, and marker editing.

Ground-Penetrating Radar and Archaeological Investigations:
GPR is a non-invasive geophysical method that uses the reflection of radar pulses to produce an image or record of subsurface features. A favorable feature of GPR for archaeological investigations is its ability to produce high-resolution images of the subsurface, and detect disturbances and intrusions of foreign materials in soils.

On radar records, the depth, shape, size, and location of subsurface features may be used as clues to infer buried cultural features. However, even under favorable site conditions (i.e. dry, coarse-textured soils) the detection of a buried feature is never assured with GPR (Doolittle, 2004). The detection of burials is affected by (1) the electromagnetic gradient existing between the feature and the soil, (2) the size, depth, and shape of the buried feature, and (3) the presence of scattering bodies within the soil (Vickers et al., 1976).

The amount of energy reflected back to an antenna by a buried object is a function of the contrast in dielectric properties that exists between an object and the surrounding soil. The greater and more abrupt the difference in dielectric properties, the greater the amount of energy that is reflected back to an antenna, and the more intense will be the amplitude of the reflected signals on the radar record.

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[1] Manufacturer's names are provided for specific information; use does not constitute endorsement.

Results:

Whittlesey Museum at Music Vale Seminary, Salem, Connecticut
In 2014, the Salem Historical Society purchased the oldest known house in Salem (circa 1690) thru a generous gift and a matching grant. In the early 19th century, this structure served as the seat of the Whittlesey family, founders of Salem's Music Vale Seminary, a famed early American music school that drew thousands of students from throughout the nation. The house, as seen today in Figure 21, is in need of much repair.

In 1815, the Reverend John Whittlesey of Saybrook, Connecticut moved to Salem with his wife and three sons. They brought with them a family heirloom, the Lady Fenwick Harpsichord, believed to be the oldest cultural instrument in the United States. The boys learned to play the harpsichord and displayed an early aptitude for music. The Reverend, inspired by his boys' talents, established a factory for piano keys on their new farm in Salem. Soon, the boys began to manufacture "Whittlesey" pianofortes. These musical instruments were highly sought after across the United States. In 1839, building on his family's early success, Orramel Whittlesey founded the Music Vale Seminary.

The Salem Historical Society would like to establish a new institution, the Whittlesey Museum at Music Vale, which will be located in the original family home (shown in Figure 21) after it is restored and renovated. The museum will focus on the history of Music Vale, the early formal education of women in the United States, and the Whittlesey' ivory and piano factory. Curators and academics throughout Connecticut and beyond support the project. To succeed, the Salem Historical Society needs support to get the house on the State restored and renovated Registry. Identifying historically significant building structures, sites, and objects are evaluation criteria for inclusion in the State Historical Register.

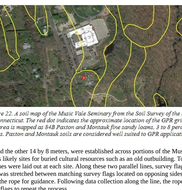

Figure 21. A photograph taken in 2015 of the Music Vale Seminary in Salem, Connecticut.

A soil map of the area surrounding the Music Vale Seminary from the Soil Survey of the State of Connecticut is shown in Figure 22. The red dot indicates the approximate location of the GPR grids. The area is mapped as 84B Paxton and Montauk fine sandy loams, 3 to 8 percent slopes. Paxton and Montauk soils are considered well suited to GPR applications.

Figure 22. A soil map of the Music Vale Seminary from the Soil Survey of the State of Connecticut. The red dot indicates the approximate location of the GPR grids. The area is mapped as 84B Paxton and Montauk fine sandy loams, 3 to 8 percent slopes. Paxton and Montauk soils are considered well suited to GPR applications.

Two grids, one 8 by 8 meters and the other 14 by 8 meters, were established across portions of the Music Vale Seminary grounds. The grid areas had been identified as likely sites for buried cultural resources such as an old outbuilding. To facilitate the construction of the grids, two parallel survey lines were laid out at each site. Along these two parallel lines, survey flags were inserted into the ground at a spacing of 1 meter. A rope was stretched between matching survey flags located on opposing sides of the grid area and the 400 MHz antenna was towed along the rope for guidance. Following data collection along the line, the rope was sequentially moved 1 meter to the next pair of survey flags to repeat the process.

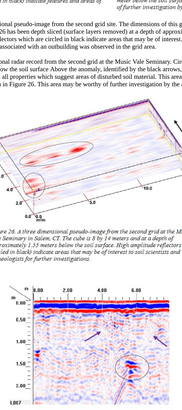

Figure 23. A photograph of the GPR survey grid areas at the Music Vale Seminary in Salem, Connecticut.

Figure 24 shows a three dimensional pseudo-image from the first grid at the Music Vale Seminary. The cube is 8 by 8 meters and the pseudo-image has been depth-sliced at a depth of approximately 1 meter below the soil surface. Several groups of noticeably higher amplitude reflectors, which are circled in black, indicate subsurface features and areas that may be of interest to archeologists for further investigations. However, the 3D GPR survey revealed no obvious clustering of anomalies that could be clearly associated with an outbuilding in the grid area.

In Figure 25, a radar record from the first grid clearly shows a large subsurface feature (circled in black) at about 1 meter below the soil surface. This area may be worthy of further investigation by the archaeologist.

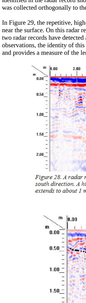

Figure 24. A three dimensional pseudo-image from the first grid at the Whittlesey Museum at Music Vale. The cube is 8 by 8 meters in size. In this pseudo-image, the surface layers have been removed, to a depth of approximately 1 meter below the soil surface. High amplitude reflectors (circled in black) indicate features and areas of interest.

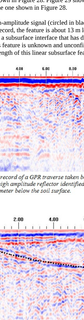

Figure 25. A radar record from the first grid showing an anomaly (circled in black) at a depth of about 1 meter below the soil surface. This area may be worthy of further investigation by the archaeologist.

Figure 26 shows a three dimensional pseudo-image from the second grid site. The dimensions of this grid are 14 by 8 meters. The pseudo-image shown in Figure 26 has been depth sliced (surface layers removed) at a depth of approximately 1.55 meters below the soil surface. High amplitude reflectors which are circled in black indicate areas that may be of interest. However, no obvious anomalies that could be clearly associated with an outbuilding was observed in the grid area.

Figure 27 shows a two-dimensional radar record from the second grid at the Music Vale Seminary. Circled in black is a conspicuous anomaly at about 1.5 meters below the soil surface. This anomaly, identified by the black arrows, it appears that the soil layers are broken, tilted, and scattered; all properties which suggest areas of disturbed soil material. This area coincides with the one of the high amplitude reflectors shown in Figure 26. This area may be worthy of further investigation by the archaeologist.

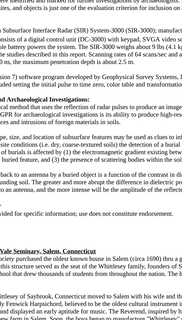

Figure 26. A three dimensional pseudo-image from the second grid at the Music Vale Seminary in Salem, CT. The cube is 8 by 14 meters and at a depth of approximately 1.55 meters below the soil surface. High amplitude reflectors (circled in black) indicate areas that may be of interest to soil scientists and archeologists for further investigations.

Figure 27. A radar record from the second grid at the Music Vale Seminary. Circled in black is a noticeable feature at about 1.5 meters below the soil surface. Above the anomaly, identified by the black arrows, it appears that the soil layers are broken, tilted, and scattered which may represent areas of disturbed soil. This area coincides with the one of the high amplitude reflectors shown in Figure 26.

Several random GPR traverse were conducted across various portions of the property. Figure 28 shows a two-dimensional record of a GPR traverse taken behind the garage of the Seminary in a north to south direction. A high amplitude, linear reflector (identified by the white dashed line) extends from the soil surface to about 1 meter below the soil surface. The length of this feature is 8 meters. Additional, parallel radar traverses were conducted behind the garage in an attempt to more clearly define the subsurface feature identified in the radar record shown in Figure 28. Figure 29 shows a second radar record from behind the garage. This radar record was collected orthogonally to the one shown in Figure 28.

In Figure 29, the repetitive, high-amplitude signal (circled in black) are believed to be reverberations from a piece of metal buried near the surface. On this radar record, the feature is about 13 m long and extends from a depth of about 0.5 meter to 1 meter deep. The two radar records have detected a subsurface interface that has dimensions of about 8 by 13 m. Without some ground-truth core observations, the identity of this feature is unknown and unconfirmed. The photograph in Figure 30 shows the area behind the garage and provides a measure of the length of this linear subsurface feature

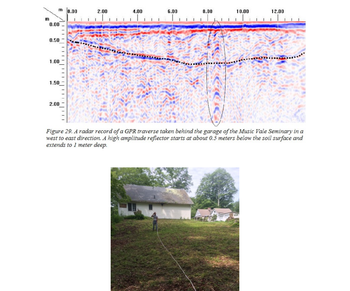

Figure 28. A radar record of a GPR traverse taken behind the garage of the Music Vale Seminary in a north to south direction. A high amplitude reflector identified by the white dashed line starts at the soil surface and extends to about 1 meter below the soil surface.

Figure 29. A radar record of a GPR traverse taken behind the garage of the Music Vale Seminary in a west to east direction. A high amplitude reflector starts at about 0.5 meters below the soil surface and extends to 1 meter deep.

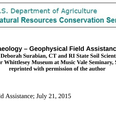

Figure 30. A photograph of a GPR traverse that was done behind the garage at the Music Vale Seminary. A subsurface layer identified in Figures 28 and 29 was measured in this area.