

Appendix E
GEOTECHNICAL ENGINEERING REPORT
BY
GEO-GRAF, INC.



G E O P H Y S I C A L I N V E S T I G A T I O N S

**GEOTECHNICAL ENGINEERING REPORT
TWEED'S TAVERN SITE
SEARCH FOR 19TH CENTURY OUTBUILDINGS
LIMESTONE & VALLEY ROADS
NEW CASTLE COUNTY, DELAWARE
12 FEBRUARY 1999**

Prepared for:

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GEOPHYSICAL INVESTIGATIONS

Summary:

The property known as Tweed's Tavern, located at 420 Valley Road, New Castle County, DE, reportedly contained a tavern house as early as 1801. Present DelDOT plans include the widening of roadways and construction of a storm water retention pond within this property. Before construction begins an effort was made to locate any significant archaeological features and artifacts associated with this site. In an attempt to provide a more cost-effective search for these features a geophysical investigation was completed during a single field day and the data was processed and compiled into a Geo-Graf, Inc., Subsurface Anomaly Map (SAM). The SAM presents areas with the highest probability for successful excavation of archaeological features, that could be related to the 19th century era-of-concern.

Based the geophysical data, five areas were selected by Geo-Graf, Inc., (GGI) for recommended ground-truthing excavations, to be performed by Hunter Research, Inc. These five locations, denoted as ground-truthing location one (GTL-1) through GTL-5, could represent buried building foundations or other indicators of past human activity.

GTL- 1. A possible foundation remnant or other manmade feature was detected in the NW corner of the site. This subsurface feature contains two large intersecting footing-like attributes that are positioned approximately perpendicular to both Limestone and Valley Roads. This area could be a foundation wall within a larger 60' x 60' anomalous area which GGI speculates could represent an outbuilding or barn.

GTL-2. This second proposed ground-truthing location, also contained within the aforementioned possible "barn area", was selected due to its high density of both metallic and nonmetallic features.

GTL-3. The highest density of subsurface targets delineated at this site was within a small, irregular shaped area situated between the tavern house and the possible "barn area". A location was selected for proposed ground-truthing within this area.

GTL-4, GTL- 5. Two additional locations within GPR-detected subsurface anomalous areas in proximity to the tavern house were selected for proposed ground-truthing.

The overall detected target pattern of the site appears to be related to the present house and extends to the NW. The NE section of the site contained dense brush and weeds which was inaccessible for the geophysical investigation.

Trench excavations undertaken within these five selected areas should quickly determine if the GGI-detected targets are related to the 19th century use of the property or are from a more modern era.

February 12, 1999 GGI Project No. 012799

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This report contains the findings of a nonintrusive geophysical investigation performed by Geo-Graf, Inc. (GGI) on January 27, 1999, at Tweed's Tavern, Limestone and Valley Roads, New Castle County, Delaware in accordance with the GGI Geophysical Investigation & Engineering Proposal No.865.

Scope of Work:

Perform a nonintrusive geophysical subsurface investigation within the accessible specified search areas in an attempt to delineate subsurface foundations and/or artifacts associated with 19th century buildings. Nonintrusive delineation techniques will include the collection and interpretation of data from ground penetrating radar (GPR), electromagnetics (EM), radio frequency (RF) and magnetic geophysical instruments. Collected site data will be reviewed, correlated and findings presented on a color GGI Subsurface Anomaly Map (SAM).

Specified Search Area:

An area approximately 250' x 250' at the NW corner of Limestone Road (Route 7) and Valley Road describes the general search area. Not included in the investigated area is an inaccessible section of dense brush in the NE quarter of the site. As well as, the interior of the site buildings. The investigated areas are shown on Figure 1.

Site Background:

A history of property transfers compiled by Hunter Research, Inc.(HRI) was made available to GGI that indicated a "necessary tavern"(with an inn) had existed on this site as early as 1800. The reported original log dwelling is not evident from the exterior of the current house. There are no outbuildings (barns, stables, etc.) one would associate with a rural 19th century setting of this type. A small intermittent stream is located on the north border of the search area. Most of the site contains large trees with the exception of the northwest quarter.

Based on highway construction plans for the site the house will be razed and the area north of the house will be constructed into a storm water retention pond. Before this construction begins an effort to recover artifacts of historic value shall be made. A geophysical investigation was requested in an attempt to cover as much of the site for evaluation as opposed to a random selection procedure.

Field Investigation:

On January 27, 1999, GGI performed a nonintrusive geophysical investigation as directed by Ms. Sue Ferenbach, Senior Archaeologist, HRI.

GGI initially investigated the accessible search area utilizing EM and magnetics in an attempt to locate subsurface metallic targets/anomalies. Detected targets were documented and marked in the field. GPR profiles were subsequently completed at 5' and 10' intervals in both the north-south and east-west grid directions, as time permitted, in an attempt to delineate and identify subsurface metallic and nonmetallic targets and anomalies. GPR data was collected utilizing two different frequency antenna systems; a 550 MHz and a 120 MHz system.

To facilitate documentation of site findings and GPR data collection, GGI created a reference grid with 10' spacings over the specified, accessible search area. The GGI zero/zero reference datum point/line was located at the extended southeastern corner of the concrete block building found at the western-most edge of the property (refer to Figure 1).

Geophysical Instrumentation:

The following is a list and brief description of the geophysical equipment utilized for this investigation.

- **GPR** - Ground Penetrating Radar - A Geophysical Survey Systems, Inc. System 3 ground penetrating radar unit with a System 38 Video Display Unit and a color monitor which provided data that was recorded on site for post-processing at the GGI office. GPR is capable of delineating metallic and nonmetallic: USTs, drums, utilities, pipeline leaks, voids, bed rock layers, product plumes, rebar and rebar spacings, concrete floor thicknesses, grave sites and other subsurface anomalies.

In addition, various computer processing techniques are used at the GGI office in order to improve the image resolution for GPR interpretation and for the generation of a representative color GPR data printout.

Two GPR antenna systems were utilized for the investigation: a 550 MHz and a 120 MHz antenna system. The use of the different antennae are based on the following: the higher the antenna frequency the greater the GPR image resolution (ability to detect smaller targets), but at the "cost" of signal penetration depth. The lower the antenna frequency, the deeper the signal penetration, but at the "cost" of GPR image resolution. A total of 71 GPR profiles were recorded at the site.

- EM - Electromagnetics - An Aqua-Tronics Tracer, model A-6. Capable of locating and delineating metallic masses. Operates by inducing and measuring the returning electric field on subsurface metallic targets. Utilized to delineate USTs, drum piles, subsurface concrete pads, utilities and metallic debris.
- Magnetics - A Schonstedt Locator (Vertical Field Gradiometer), model MAC-51. Capable of detecting small and large ferrous (iron) containing targets. Operates by measuring the remnant vertical magnetic fields from ferrous containing compounds. Utilized to detect buried drums, fill lids, manhole lids, valves, utilities, rebar and iron containing debris.

Findings:

Refer to Figure 1, a color plan-view *SAM*, for the following descriptions.

GPR Anomalies:

Subsurface anomalous areas containing disturbed subsoils with individual targets, indicative of prior human activity, were delineated within the investigated area as shown on Figure 1.

Possible barn or building remnant

An approximate 60' x 60' GPR subsurface anomalous area was delineated extending from near 175' N to 250' N and from 20' E to at least 90' E (accessibility limited complete delineation of the eastern boundary). Several EM and magnetic targets were also detected within this area. GGI speculates this anomalous area could be a former site building, possibly a barn.

Highest target density within site

This 20' x 50' subsurface anomalous area was detected directly south of the "barn area". The highest GPR-detected target density was found within this area. GGI suspects this area has the highest probability of containing evidence of past human activity.

The remaining GPR-detected anomalous areas are primarily positioned directly north of the house. These areas exhibited GPR data indicative of disturbed subsoils and anomalous subsoil layers with targets.

EM & Magnetic Target Areas: -41 Total

A total of six EM subsurface targets were detected within the investigated areas. These targets represent larger-sized buried metallic objects or conductive subsoils.

Thirty-five individual magnetic targets were detected throughout the site. These targets should consist of buried iron containing objects or features.

Detected Utilities: - 4 Found

Several subsurface utilities were also detected by EM and magnetics within the investigated area. Although not specified as an objective for this investigation, these utilities are included on Figure 1. Note, additional utilities and services could exist within the investigated area, GGI recommends a utility search within each ground-truthing location prior to intrusive efforts.

Underground Storage Tanks: - 3 Detected

Three underground tanks were found on site. Two gasoline or fuel oil USTs were detected associated with visible vent and fill piping. One UST was found along the western side of the garage building, centered at 67' N/59' E, and the second along the concrete block building, centered at 85' N/5' E.

A septic tank providing sanitary service to the current house dwelling was detected by EM and magnetics centered near a concrete access lid at 120' N/170' E.

Proposed Ground-Truthing Locations - 5 Areas

By correlating the detected EM, magnetic and GPR data, GGI has selected 5 target areas which have the highest probability of containing building remnants or artifacts. These areas are recommended ground-truthing locations and are denoted GTL-1 through GTL-5.

GTL-1: - Possible foundation feature

Located within the possible building/barn anomaly, an intersecting L-shaped foundation or other manmade feature was delineated by GPR. GGI speculates this L-shaped feature could be related to a west-facing foundation wall.

GTL-2: - Recommended excavation area

This area, also located within the possible "barn area", was selected due to its high concentration of GPR targets and also includes an EM target area. GGI recommends creating a 5' x 20' trench exposing this area.

Figure 2 is a GPR data profile at 230' N extending from 20' E to 90' E. This profile conducted within the "barn area" also crosses the GTL-1 and GTL-2 recommended excavation locations.

GTL-3: Recommended excavation area

This 10' x 20' location is within the irregular-shaped, high target density area.. The selected ground-truthing area is in a location between the house and the possible barn where artifacts would be anticipated.

GTL-4: GPR disturbed subsoils

This small area is positioned between a retaining wall and the existing driveway.

GTL-5: GPR-detected anomalous subsoil layers

This location is north of the house within a GPR-detected anomalous subsoil layer.

Figures 3 and 4 are photos that show site conditions at the time of the field work.

Recommendations:

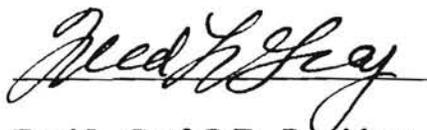
It is suggested that any trench lines be oriented east/west, along the 10' interval GPR lines as any artifacts removed can be compared to the data signature for assistance in other areas.

Although the five GTLs suggested in this report appear to contain subsurface anomalies that could be associated with the 19th century it is also possible that they could be from a more recent era. Should any of the areas excavated yield artifacts of value it is recommended that additional GPR efforts be undertaken in this area to more closely delineate the extent of targets. The one day field effort, because of time limitations, permitted only GPR coverage at 5' and 10' survey intervals.

It should be noted that utilities were not delineated during this project and it is strongly recommended that a one-call utility markout request precede any excavations in this site.

With any geophysical investigation, it must be stressed that careful ground truthing precede any excavation or intrusive testing in proximity to any anomalies/targets indicated in this report. GGI always recommends careful ground-truthing to verify all investigative findings. Also note, the absence of detected geophysical data signals does not preclude the possibility that targets exist.

Respectfully submitted,



Fred L. Graf, P.E., President



Jamieson Graf, Project Manager

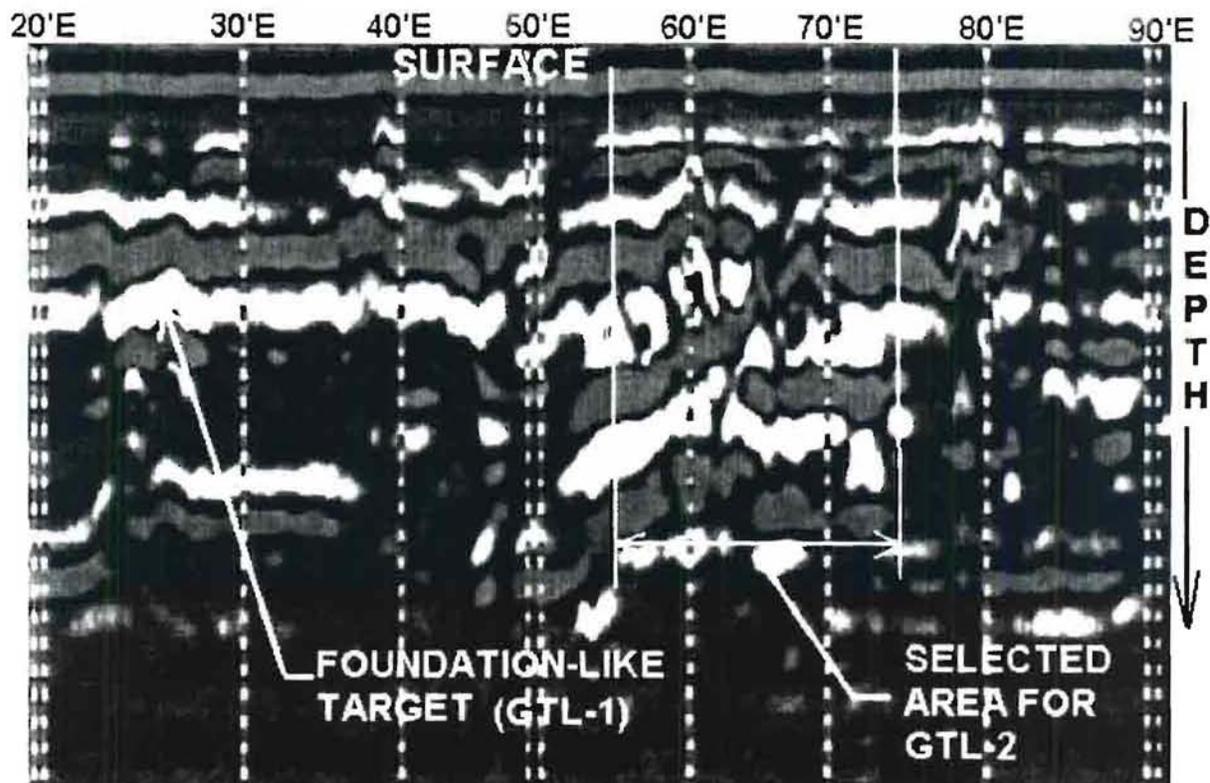


Figure 2 - GPR data profile within GPR-detected possible "barn area", covering proposed ground-truthing locations GTL-1 and GTL-2. The profile is at 230' N extending from 20' E to 90' E. Anomalous GPR data signatures suspected by GGI to be related to a possible barn or building remnant are exhibited throughout the profile. Two sections within this area, selected by GGI for proposed ground-truthing locations (GTL) are also shown. Centered near 25' E a possible foundation wall selected as GTL-1 is shown. Depth to the top of this possible wall features, based on GPR data estimates is 2' to 5' below cover. An area extending from 55' E to 75' E contains a high target density and was selected as GTL-2. 120 MHz GPR antenna system.



Figure 3 - Site Photo



Figure 4 - Site Photo