J. D. Doolittle
File

United States Department of Agriculture
Soil Conservation Service **Chester, PA 19013**

Subject: Geophysical Investigations- Columbia County, New York 8 to 9 September 1993.

Date: 10 September 1993

To: Will Hanna
State Soil Scientist
USDA-Conservation Service
Syracuse, New York

Purpose:
To conduct ground water and soil investigations using ground-penetrating radar (GPR) techniques. To demonstration the use of the EM38 meter to characterize and map the dissemination of contaminants from animal waste holding areas.

Participants:
James Calhoun, District Conservationist, SCS, Hudson, NY
Carl Campbell, District Technician, Columbia County SWCD, Hudson, NY
Robert Dibble, District Conservationist, SCS, Millbrook, NY
Jim Doolittle, Soil Specialist, SCS, Chester, PA
Tom Kilcer, Soil Specialist, Cornell Cooperative Extension, Troy, NY
Richard Mall, Engineering Technician, SCS, Middletown, NY
Art Morge, District Technician, Columbia County SWCD, Hudson, NY
Ken Piester, Crop Specialist, Cornell Cooperative Extension, Kinderhook, NY
George Sisco, Area Conservationist, SCS, Middletown, NY
Joan Wrigley, Manager, Columbia SWCD, Hudson, NY

Activities:
During the afternoon of 8 September, an area of Hoosic soil was examined with GPR at the Valatie Research Farm in Kinderhook, New York. The purpose of this survey was select a site for a well and characterize the vadose zone and assess depths to the water table and subsurface strata. On the morning of 9 September an area of Pittstown soil was examined with GPR at the Columbia County Industrial Park. The purpose of this study was to assess the suitability of the site for a building. Later in the morning, a demonstration of the use of EM38 meter to detect surface contaminants emanating from a manure storage area was conducted at a farm near Martindale in eastern Claverick township.

Equipment:
The radar units used in this study were the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc. The system was powered by a 12-volt vehicular battery. The model 3110 (120 mHz) antenna was used in the field studies. The Model 705DA transceiver was used with the Model 3110 antenna. For the study at the Valatie Research Farm, a scanning time of 140 nanoseconds (ns) was used. For the study at the Columbia County Industrial Park, scanning times of 140 and 70 nanoseconds (ns) were used.

The electromagnetic induction meter was the EM38 manufactured by Geonics Limited+. The meter is portable and requires only one person to operate. The depth of penetration is dependent upon the intercoil spacing, transmission frequency, and coil orientation relative to the ground surface. The EM38 meter integrates values of apparent conductivity over the upper 0.75 m in the horizontal dipole orientation, and over the upper 1.5 m in the vertical dipole orientation.

Discussion:

Valatie Research Farm, Kinderhook, New York

A 200 by 900 foot grid was established across an area of Hoosic gravelly sandy loam, 0 to 3 percent slopes. The grid interval was 100 feet. At each grid intersect (26), a transit was used to measure the relative elevation of the ground surface. Traverses were conducted with the 120 mHz antenna along north-south trending grid lines.

Hoosic is a member of the sandy-skeletal, mixed, mesic Typic Dystrochrepts family. This deep, nearly level, somewhat excessively drained soil formed in outwash deposits. This soil has a mixed mineralogy within the rock fragment component. However, included in mapping are areas of Blasdell soils (loamy-skeletal, mixed, mesic Typic Dystrochrepts). Blasdell soils are mostly shale in the rock fragment. Depth to water table is greater than 6 feet.

A metallic reflector was buried at a depth of 1.5 feet and identified on the radar profile. This reflector was used to depth scale the radar profiles. Figure 1 is a representative radar profile. Several continuous reflectors are evident in the upper part of the radar profile. These reflectors represent interfaces separating layers with different textures, amounts of coarse fragments, and/or densities. A continuous, high-amplitude layer attenuated the radar signal and limited the depth of observation. It probable that the attenuating layer represents the water table, a layer of finer-textured materials, or more shale-enriched strata. The depth to this restricting layer (and the observation depth of GPR) averaged 7.0 feet and ranged from 5.9 to 8.4 feet. To confirm the identity of this layer, a backhoe excavation is advised.

Data were used to construct two-dimensional plots of the relative elevation of the soil surface (Figure 2, upper), depth to conductive layer (Figure 2, middle), and relative elevation of the conductive layer (Figure 2, lower). These figures portray a nearly level area with a uninterrupted, level subsurface layer at depth varying from about 6.0 to 8.5 feet.

+ Trade names have been used to provide specific information. Their mention does not constitute endorsement.

Columbia County Industrial Park
The proposed Columbia County SWCD Building will be constructed at this site. Three traverse lines were established across the proposed site. The site is located in an area of Pittstown shaley silt loam. Pittstown is a member of the coarse-loamy, mixed, mesic Aquic Dystrochrepts family. This very deep, moderately-well drained soil formed in till on uplands. This medium textured soils has a layer of dense till at a depth of 15 to 30 inches. The firm Cd horizon was recognized on the radar profiles. The high shale content and moderate clay content of Pittstown soil limited GPR observations to depths of less than 6 feet.

At the Columbia County Industrial Park, the radar survey reveal consistent patterns and seemingly homogeneous soil conditions to a estimated observation depth of 4 to 6 feet. However, the limited profiling depth of the GPR seriously reduced the usefulness of this tool for site assessment. No conclusions were drawn from the radar survey.

Results:
1. GPR can be used effectively in areas of Hoosic and Pittstown soils for most soil survey investigations.

2. In similar drift deposits, GPR appears to be an inappropriate tool for site investigations where observation depths greater than 6 to 8 feet are required. At the Valatie Research Farm, a continuous, high-amplitude layer attenuated the radar signal and limited the depth of observation. It is believed that the limiting layer represents a strata of finer-textured materials or the water table. The identify of this layer should be verified with an observation pit. As the depth of observation was less than 8.5 feet, GPR provided limited information, and was ineffective in characterizing the aquifer or selecting a site for a proposed well.

At the Columbia County Industrial Park, the radar survey reveal subsurface features to a estimated observation depth of 4 to 6 feet. However, in areas of Pittstown soils, the limited profiling depth of the GPR seriously reduced the usefulness of this tool for engineering site assessments.

3. Results from the EM demonstration support the use of the EM38 meter to assess the dissemination of contaminants from animal holding areas by surface runoff. Additional demonstrations and training sessions for area personnel are encouraged.

With kind regards

James A. Doolittle

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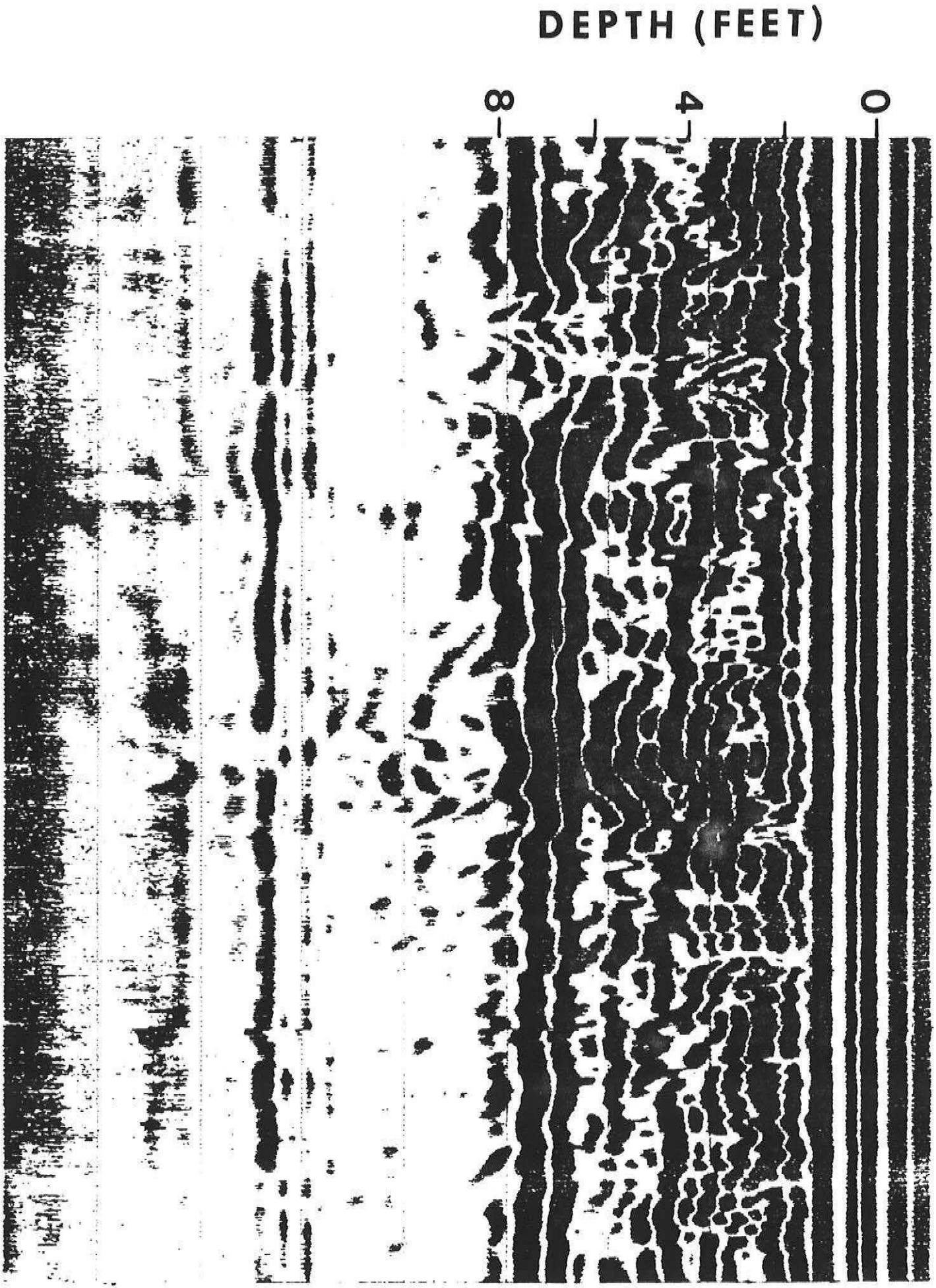
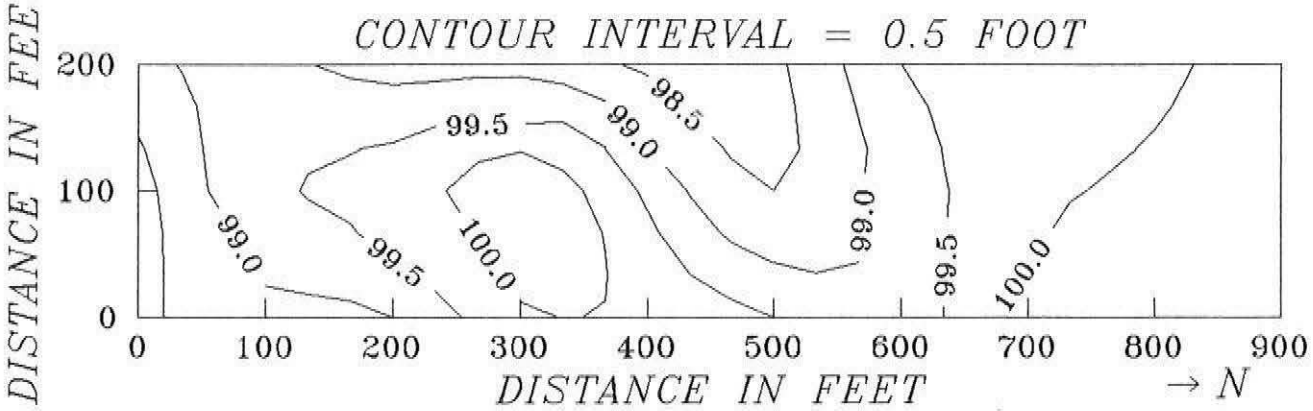
Soil Specialist


DEPTH (FEET)
0
4
8

VALATIE RESEARH FARM

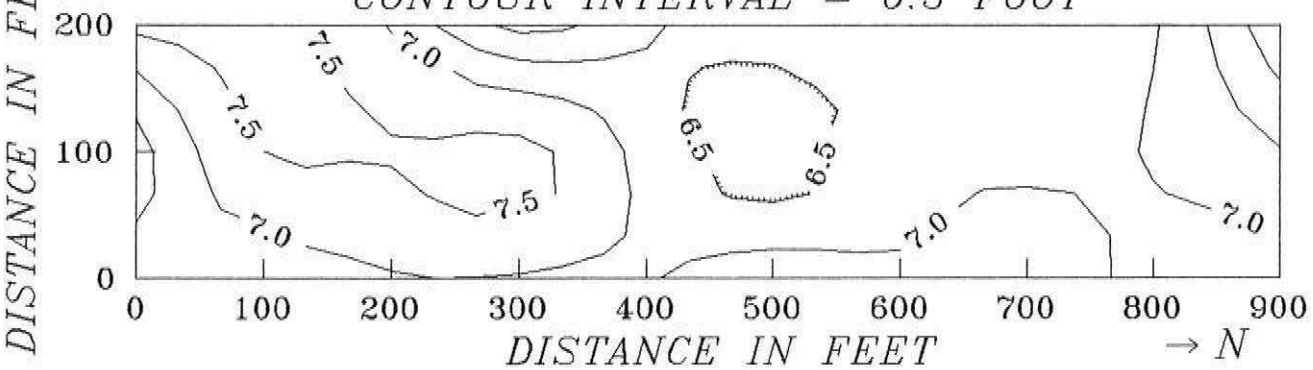
RELATIVE ELEVATION

CONTOUR INTERVAL = 0.5 FOOT



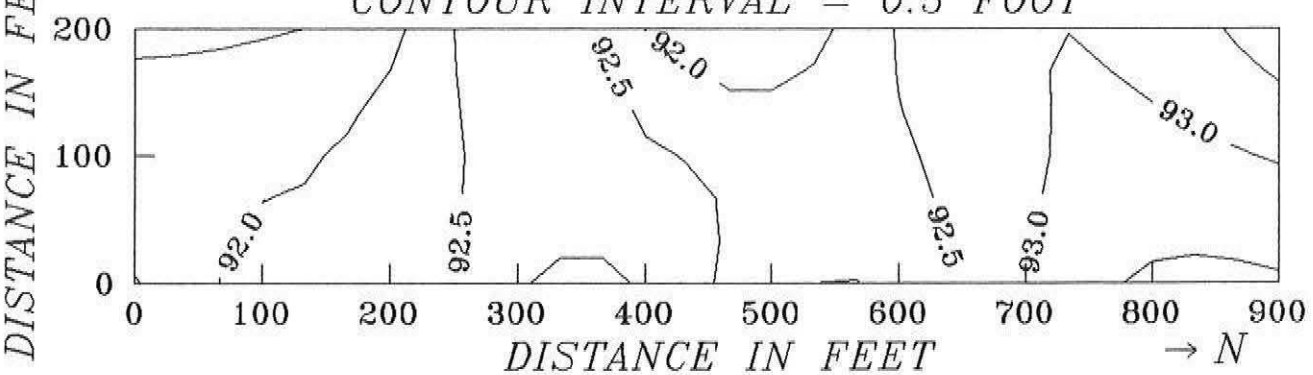
DEPTH TO CONDUCTIVE LAYER

CONTOUR INTERVAL = 0.5 FOOT



RELATIVE ELEVATION OF CONDUCTIVE LAYER

CONTOUR INTERVAL = 0.5 FOOT



cc:
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