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United States Department of Agriculture
Soil Conservation Service
Northeast NTC
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Subject: SOI - GPR Trip Summary - Mahantango Creek Watershed, USDA-ARS-Northeast Watershed Research Center, Klingerstown, PA, April 28-May 3, 1985.

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PURPOSE

To field test the ground-penetrating radar (GPR) system on selected sites within the Mahantango Creek Research Watershed.

PARTICIPANTS

Clare Artz, Technician, ARS, Klingerstown, PA
Edward Ciolkosz, Professor of Soils, PSUY, University Park, PA
James Doolittle, Soil Specialist (GPR), SCS, Chester, PA
William Gburek, Engineer (Hydrological), ARS, University, Park, PA
James Hoover, Engineer (Agricultural), ARS, University Park, PA
Earl Jacoby, Supervisory Engineering Technician, ARS, Klingerstown, PA
Garland Lipscomb, State Soil Scientist, SCS, Harrisburg, PA
James Urban, Geologist, ARS, University Park, PA

Equipment

The equipment utilized during this field trip was the SIR System-8 with microprocessor, the ADTEK SR-8004H graphic recorder, and the ADTEK DT-6000 tape recorder. The 80, 120, 300, and 500 MH_z antennas were used at various times and under differing conditions. The equipment operated well with one exception. The high power model 765 HP transmitter could not be operated due to the lack of the transmitter trigger cable.

ACTIVITIES

Site selections were completed prior to the arrival of the GPR. Twenty-eight sites were available. Each site was marked by survey flags, freed of brush, and accessible with a 4WD vehicle. Multiple transects were conducted at eleven of these sites during the period of April 29 through May 2, 1985. Inclement weather slowed and impeded field work on

May 2. During the afternoon and evening of May 2, a review of the field results was conducted by Jim Urban and Jim Doolittle. All graphic profiles and tapes were labeled and turned over to Jim Urban.

DISCUSSION

The overall performance of the GPR system within the Mahantango Creek Watershed was poor. High shale contents restricted the depth of signal penetration and the large number of discontinuous and inextensive soil horizons confused interpretations.

The 120 MH_z was the most effective antenna. This antenna provided copious subsurface information, but the graphic profiles were difficult to interpret on the basis of limited ground-truth observations. The effective depth of penetration was restricted to depths of less than 2 or 3 meters in soils formed in materials weathered from shales. The probing depth was slightly greater in soils formed in materials weathered from sandstone or quartzite.

As a result of the restricted depth of penetration, the present GPR system is generally unsuitable for geologic investigations within the Mahantango Creek Watershed. The GPR system is suitable for soil investigations, but its' application is limited by gradational interface boundaries and the large number of discontinuous soil horizons.

The soils within the watershed lack extensive, well developed horizons. Many of the B horizons are weakly expressed and are principally "colored horizons" which show faint evidence of pedogenesis. In many soils, the content of shale fragments gradually increases with depth as soil gradually merges with bedrock.

Gradational or weakly expressed horizons are seldom expressed on the radar's graphic profiles. As a general rule, the more abrupt or the greater the electromagnetic gradient across a boundary of two horizons, the greater the amount of energy that is reflected by the interface and the darker the signal that is impressed on the graphic profile. The lack of an interface signal for the cambic horizon and the soil/bedrock contact is undoubtedly related to the gradational nature and poor reflective qualities of these features.

In some areas, the soils are essentially nondescriptive and lack definable subsurface interfaces. In a study plot near the research center, buried pipes and electrical conduits were discerned on graphic profiles which were otherwise devoid of subsurface interface signals.

On many sideslopes, shaly colluvium grades imperceptibly with depth into shale bedrock. Along road cuts, it was difficult to discern where the soil stopped and the bedrock began. In areas of shale, the soil/bedrock interface was also difficult to define on graphic profiles.

Within the study area, the complexity of the subsurface interfaces posed an interpretive dilemma. Most were irregular in depth, discontinuous, and limited in a real extent. On graphic profiles many of these interfaces were superposed. Superpositioning of interfaces results in signal cancellation and "white-out areas" on graphic profiles.

Unless a graphic signature from an interface is identifiable, it must be confirmed by ground-truth auger borings. The limited lateral extent of the multiple subsurface layers restricts the extension of profiled data from each observation site. In many areas, the large number of discontinuous, subsurface interfaces would require an impractical number of ground-truth borings.

With additional field work, the radar appears to be an effective tool for some soil investigations within the watershed. The present system is too depth restricted for bedrock studies where the depth to bedrock exceeds 2 meters.

This was a very productive field trip for the GPR. Its potential within the watershed has been assessed and findings from this study can be applied to other similar areas within the physiographic province. I wish to thank your staff for their exceptional assistance that made this trip so productive.

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cc:
A. Holland
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