United States Department of Agriculture
Soil Conservation Service
Northeast NTC
160 E. 7th Street
Chester, PA 19013

Subject: SOI - GPR Trip Summary - New Hampshire, May 13-17, 1985

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To: David L. Mussulman
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PURPOSE

To field test the ground-penetrating radar (GPR) on selected sites within New Hampshire and to establish the feasibility of using the system to determine the depth to bedrock.

PARTICIPANTS

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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, and 300 MH_z antennas were used at various times and under differing conditions. The 120 MH_z antenna is the most suitable antenna for soil and shallow (less than 4 meters) bedrock studies. The high power model 765 HP transmitter was used to extend the depth of penetration to slightly over 12 meters at the Oliverian Brook Watershed.

The GPR system operated well, but components including the 80 MH_z antenna, high power model 765 HP transmitter, model 705DA transducer, model 501 dual antenna box, and the model 4800 control unit were returned to the manufacturer (Geophysical Survey Systems, Inc; Hudson, NH) during this reporting period for corrective maintenance. Maintenance was required on these components following a rigorous field shake-down of the system and the incompatibility of recent modifications with older design. The responsiveness and cooperation of the manufacturer was most commendable.

ACTIVITIES

Prior to the arrival of the GPR, sites were selected in Rockingham and Grafton Counties. Areas of Eldridge (sandy over loamy, mixed, nonacid mesic Aquic Udorthents), Scitico (fine, mixed, nonacid, mesic Typic

Haplaquepts), and Windsor (mixed, mesic Typic Udipsamments) soils were profiled with the GPR during the afternoon of 13 May. Areas of Canton (coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Dystrochrepts), Hollis (loamy, mixed, mesic Lithic Dystrochrepts), and Pennichuck (loamy-skeletal, mixed, mesic Dystric Eutrochrepts) soils were profiled on 14 May. The spillway of the Oliverian Pond dam was profiled on the afternoon of 15 May and on 16 May. The area of Pennichuck soil was retraversed on the morning of 17 May as experience gain on this trip was applied to improve the interpretability of the graphic profiles. Maintenance was performed on the equipment during the mornings of 13 and 15 May, and on the afternoon of 17 May.

Discussion

Imagery obtained in the coarse textured glacial drift and crystalline bedrock of New Hampshire was generally good. In some areas, interpretations were limited by complex patterns of radar imagery.

The GPR profiled the soils to the depth of interest. Generally, the profiled soils lack extensive, well expressed horizons which could be traced laterally for large distances on graphic profiles. The large number and limited extent of subsurface horizons necessitated a greater number of ground-truth observations than was anticipated. Many of the images observed on the graphic profiles were nonpedogenetic and varied with the nature of the glacial drift.

As a rapid reconnaissance or investigatory tool, the GPR offers a highly accurate and reliable alternative method for determining the depth to bedrock. Generally, graphic profiles of the soil/bedrock interface are clear in areas where the bedrock is massive, its surface is sharp and regular, and the overlying soil is relatively thin (less than 7 meters) and free of coarse fragments.

If numerous, jointing patterns, bedding and fracture planes can complicate interpretations. At the Oliverian Dam site, the granite bedrock appeared on graphic profiles to be highly weathered and fractured in the upper part. Also, the overlying material appeared to contain numerous coarse fragments. While the weathered zone of granite was easily defined on graphic profiles, the contact of the overlying material with the coherent bedrock was difficult to discern as a result of the large number of boulders and the highly weathered and fractured nature of the granite bedrock.

It was learned that the imagery of the soil/bedrock interface could be improved by increasing the range or probing depth of the radar and by conducting transects at a slower speed. Extending the range of the GPR can blend the myraid of microfeatures into a discernible pattern which can be more easily identified and traced across the graphic profile. In areas of highly irregular or gradational soil/bedrock interfaces, conducting traverses at slower speeds allows the more discontinuous imagery to form a more continuous pattern. An area of Pennichuck soil was effectively retraced with the GPR using these techniques to improve the interpretability of the imagery.

Proper application and accurate results are based on site-specific characteristics and the experience of the interpreter. GPR techniques are not meant to replace the need for ground-truth observations. In many areas of New Hampshire, GPR techniques can save time and money by reducing the number of required borings and improve the quantity of interpretations by providing a continuous record of subsurface conditions. The results from New Hampshire are encouraging. The potential application of the GPR will depend upon its need, use, and program development.

Thank you for the opportunity to work in your state and with members of your staff.

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