

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Northeast NTC
CHESTER, PA 19013

Subject: Ground-Penetrating Radar - Date: 19 November 1993
Soil Investigations; Clinton County, Pennsylvania
November 1 and 2 1993

To: Richard N. Duncan
State Conservationist
USDA-Soil Conservation Service
Harrisburg, PA

Purpose:

To use ground-penetrating radar (GPR) techniques to assess soil properties.

Participants:

Ellen Dietrich, Soil Scientist, SCS, Mill Run, PA
Jim Doolittle, Soil Specialist, SCS, Chester, PA
Jake Eckenrode, Soil Scientist, SCS, State College, PA

Activities:

On the morning of 1 November, 1993, a presentation on the use of geophysical techniques in soil investigations was presented before Dr. Gary Petersen's Soils 415 class at Pennsylvania State University. During the afternoon of 1 November, an area of Sequatchie soils near Lock Haven was traversed with GPR. Bedrock investigations were conducted in upland areas of Clinton County on 2 November, 1993.

Equipment:

The ground-penetrating radar used in this study is the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc. Components of the SIR System-8 used in this study were the model 4800 control unit, ADTEK SR 8004H graphic recorder, power distribution unit, transmission cable (30 m), and the model 3110 (120 MHz) antenna. The system was powered by a 12-volt battery.

Discussion:

Area of Sequatchie loam near Lock Haven, Clinton County

The purpose of this survey was to evaluate the potential of using GPR techniques to chart variations in subsurface stratifications within a nearly-level area of Sequatchie loam. Sequatchie (fine-loamy, siliceous, thermic Humic Hapludults) is a very deep, well drained soil formed in alluvium. Ground-penetrating radar techniques were found to be useful in evaluating and charting variations in stratigraphic layers to depth of about 2 meters. All radar profiles were discussed in the field and given to Ellen Dietrich for further analysis.

Bedrock investigations in Clinton County

A 7.9 mile transect was conducted with GPR in upland areas of west-central Clinton County. Areas of Albrights (fine-loamy, mixed, mesic Aquic Fragiudalfs), Cookport (fine-loamy, mixed, mesic Aquic

Fragiudults), Dekalb (loamy-skeletal, mixed, mesic Typic Dystrochrepts), Gilpin (fine-loamy, mixed, mesic Typic Hapludults), Hartsells (fine-loamy, siliceous, thermic Typic Hapludults), and Leetonia (sandy-skeletal, siliceous, mesic Entic Haplorthods) soils were traversed. These moderately-deep to deep soils formed on upland areas underlain by sandstone, siltstone, and shale. The following map units were transected with GPR:

- AbB - Albrights silt loam, 3 to 8 percent slopes
- CoB - Cookport loam, 3 to 8 percent slopes
- CpB - Cookport very stony loam, 0 to 8 percent slopes
- DkB - Dekalb very stony soils, 0 to 8 percent slopes
- DkC - Dekalb very stony soils, 8 to 25 percent slopes
- GpB - Gilpin silt loam, 3 to 8 percent slopes
- HrB - Hartsells channery loam, 3 to 8 percent slopes
- LnB - Leetonia very stony sandy loam, 0 to 8 percent slopes

The GPR provided a continuous, high resolution profile of the subsurface. The observation depth was limited by the operator to 13 feet (157 inches). In some areas, the depth of observation was restricted by finer-textured soil materials or the presence of shale bedrock. Reference marks were impressed on the radar profile at 0.1 mile intervals. The depth to bedrock was estimated at each of these reference marks (80). The depth to a buried metal culvert (@ 36 inches) was used to depth scale the radar imagery.

The data appearing in Table 1 are the interpreted depths to bedrock (by soil-depth classes) along the 7.9 mile transect. If these interpretations are correct, seventy-three percent of the area traversed is very deep to bedrock. Soil maps published in 1966 depict this area as being composed of predominantly moderately-deep and deep to bedrock.

Radar interpretations and soil depths will be later confirmed by auger observations conducted by Jake Eckenrode.

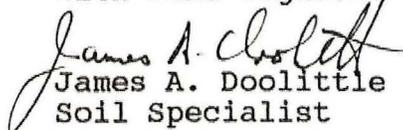
TABLE 1

DEPTH TO BEDROCK BY SOIL-DEPTH CLASS

DEPTH CLASS	OBSERVATIONS	FREQUENCY
0 - 20"	0	
20 - 40"	9	11%
40 - 60"	13	16%
60 - 80"	12	15%
80 - 100"	13	16%
100 - 120"	16	20%
120 - 140"	5	6%
> 140"	12	15%

All radar profiles have been returned to Jake Eckenrode under a separate cover letter.

With kind regards,


James A. Doolittle
Soil Specialist

cc:

- J. Culver, National Leader, SSQAS, NSSC, SCS, Lincoln,
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TABLE 2

GPR Transect Data of Depths to Bedrock

<u>Mile Marker</u>	<u>Depth (inches)</u>	<u>Mile Marker</u>	<u>Depth (inches)</u>
0.0	151	4.1	46
0.1	113	4.2	35
0.2	40	4.3	107
0.3	31	4.4	33
0.4	54	4.5	>157
0.5	52	4.6	34
0.6	56	4.7	119
0.7	92	4.8	65
0.8	83	4.9	70
0.9	72	5.0	95
1.0	72	5.1	144
1.1	115	5.2	75
1.2	>157	5.3	118
1.3	>157	5.4	86
1.4	127	5.5	69
1.5	48	5.6	54
1.6	133	5.7	95
1.7	87	5.8	35
1.8	88	5.9	67
1.9	138	6.0	148
2.0	96	6.1	58
2.1	>157	6.2	>157
2.2	150	6.3	>157
2.3	123	6.4	113
2.4	145	6.5	106
2.5	86	6.6	103
2.6	78	6.7	102
2.7	96	6.8	68
2.8	102	6.9	69
2.9	117	7.0	31
3.0	138	7.1	30
3.1	82	7.2	78
3.2	111	7.3	55