United States Department of Agriculture

NRCS

Natural Resources Conservation Service
National Soil Survey Center
11 Campus Blvd., Suite 200
Newtown Square, PA 19073

Phone: (610) 557-4233
FAX: (610) 557-4136

Subject: SOI – Geophysical Field Assistance

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To: Michael Castellano
PhD Candidate
116 Agricultural Sciences and Industries Building
Pennsylvania State University
University Park, PA 16802

Dr. Henry Lin
Associate Professor of Hydropedology/Soil Hydrology
Crop & Soil Sciences Department
415 Agricultural Sciences and Industries Building
Pennsylvania State University
University Park, PA 16802

Dr. Jason Kaye
Assistant Professor of Soil Biogeochemistry
Crop & Soil Sciences Department
416 Agricultural Sciences and Industries Building
Pennsylvania State University
University Park, PA 16802

Dean Cowherd
Acting State Soil Scientist
USDA-Natural Resources Conservation Service
John Hanson Business Center
339 Busch's Frontage Road #301
Annapolis, MD 21401-5534

File Code: 330-7

Purpose:
Ground-penetrating radar (GPR) records had been previously collected along seven traverse lines at the Maryland Natural Research Reserve, in Abingdon, Maryland (my trip report of 7 October 2008). During the present fieldwork, elevation data were collected at each flagged reference point along these traverse lines. This data allowed the radar records to be *surface normalized*, a processing technique used to improve the interpretability and association of subsurface features with different landscape components in sloping terrains.

Activities:
All field activities were completed on 20 January 2009.

Participants:
Mike Castellano, PhD Candidate, Crop & Soil Department, Pennsylvania State University, University Park, PA
Jim Doolittle, Research Soil Scientist, USDA-NRCS-NSSC, Newtown Square, PA
Steve Kinner, Technician, Crop & Soil Department, Pennsylvania State University, University Park, PA

Summary:
Ground-penetrating radar was used to characterize the subsurface and different stratigraphic units (to depths of about 3 m) within the catchment. S*urface normalization* was used to adjust the reference marks (observation points spaced at 3-m intervals) appearing on the previously collected radar records for changes in elevation. It is hoped that Mike Castellano can used the *surface normalized* images to improve interpretations and the association of subsurface reflectors with soils and landscape components.

Copies of the *surface normalized* radar records have been e-mailed to Mike Castellano and Dr Henry Lin.

It was my pleasure to participate in this study and to work with the Mike and Steve.

JAMES A. DOOLITTLE
Research Soil Scientist
National Soil Survey Center

cc:
Stephen G. Carpenter, MLRA Office Leader, USDA-NRCS, 75 High Street, Room 301, Morgantown, WV 26505
M. Golden, Director, Soil Survey Division, USDA-NRCS, Room 4250 South Building, 14th & Independence Ave. SW, Washington, DC 20250
K. Hipple, Acting Director, National Soil Survey Center, USDA-NRCS, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, NE 68508-3866
W. Tuttle, Soil Scientist (Geophysical), National Soil Survey Center, USDA-NRCS, P.O. Box 60, 207 West Main Street, Rm. G-08, Federal Building, Wilkesboro, NC 28697
L. West, National Leader for Soil Survey Research and Laboratory, National Soil Survey Center, USDA-NRCS, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, NE 68508-3866

Processing Software:
The RADAN for Windows (version 6.6) software program (Geophysical Survey Systems, Inc., Salem, NH) was used to process the radar records. [1] The radar records that were previously collected at this site (7 October 2008) were further processed using: color table and transformation selection, range gain adjustments, and surface normalization (see Daniels (2004) for a discussion of these techniques).

Surface normalization assigns elevation data to all user marks in the database. This process corrects the radar record for changes in elevation. As surface normalization corrects for differences in topography, it provides graphic displays that more closely approximate the topography of the landform.

Survey Procedures:
Seven GPR traverse lines of varying lengths had been established along east-facing side slopes of the catchment. Survey flags had been inserted in the ground at 3-m intervals along each traverse line. These flags provided ground control. Each line descends from a shoulder slope composed of Coastal Plain deposits onto a toe slope composed of alluvium. An engineering level and stadia rod were used to collect relative elevation data at each flagged reference point along these seven traverse lines. Data were recorded to the nearest tenth of a foot. During the post-processing of the data, it was noticed that a station had been missed along traverse lines 1, 4, and 6. As Steve Kinner had been very attentive to the distance between each flagged position, it is assumed that the location of unidentified station was at the down slope end of the traverse line (the last position). This position was assigned the same elevation as the last recorded, flagged reference point

All elevations data were measured in tenth of a foot. These measurements were corrected to meters for display purposes. Because of the relative large relief that occurred over short distances on the side slopes of this catchment, the vertical scale had to be compressed in order to display the entire surface normalized radar records. This resulted in a compression of the vertical axis and vertical scale by a factor of 4.

The topography of the site was exceedingly variable. Irregular slopes with widely varying gradients occur between many of the flagged reference points. As data were only collected at the reference points, the displayed slope gradients represent averaged rather than actual conditions of relief.

Results:
The s*urface normalized* radar records are displayed in Figures 1 thru 7. This process adjusts the vertical scale and allows the topography along the traverse line to be better visualized and approximated. It is hoped that these s*urface normalized* radar records will help to improve interpretations and the association of subsurface reflectors with soils and landscape components.

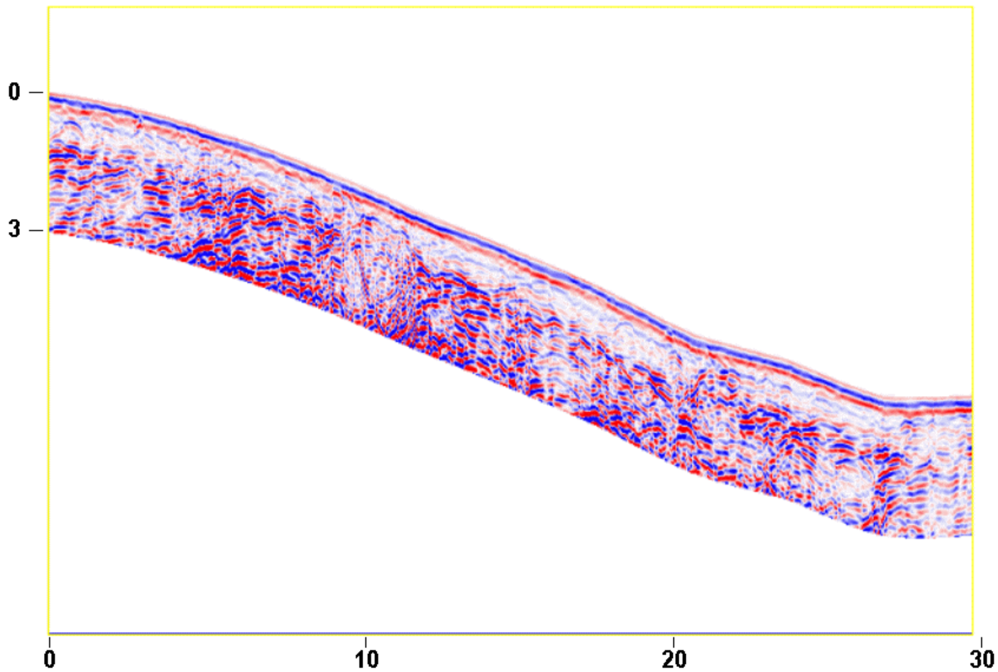

Figure 1. Radar record collected with the 400 MHz antenna along Line 1.

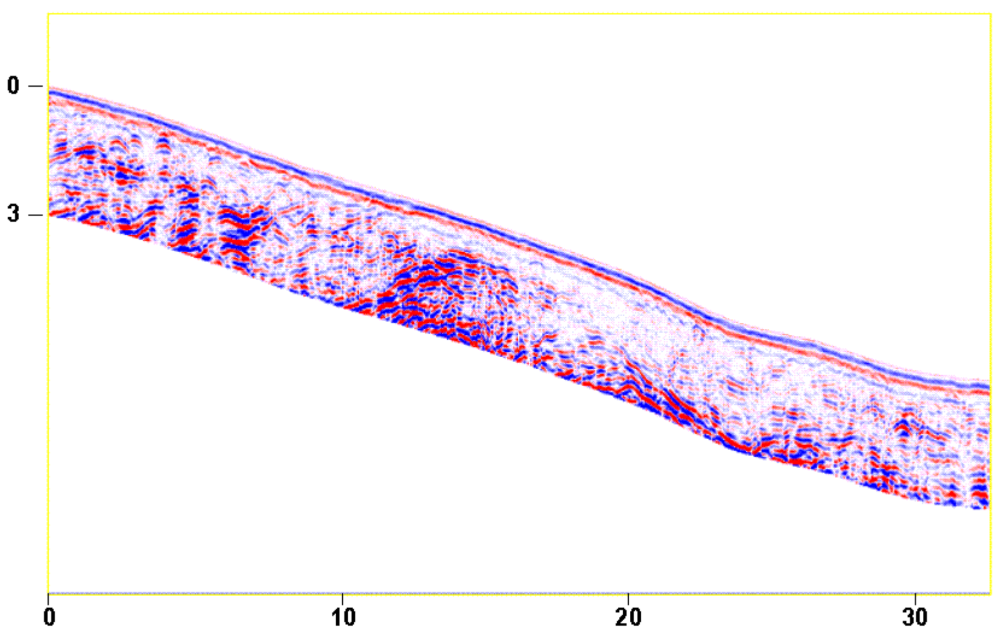

Figure 2. Radar record collected with the 400 MHz antenna along Line 2.

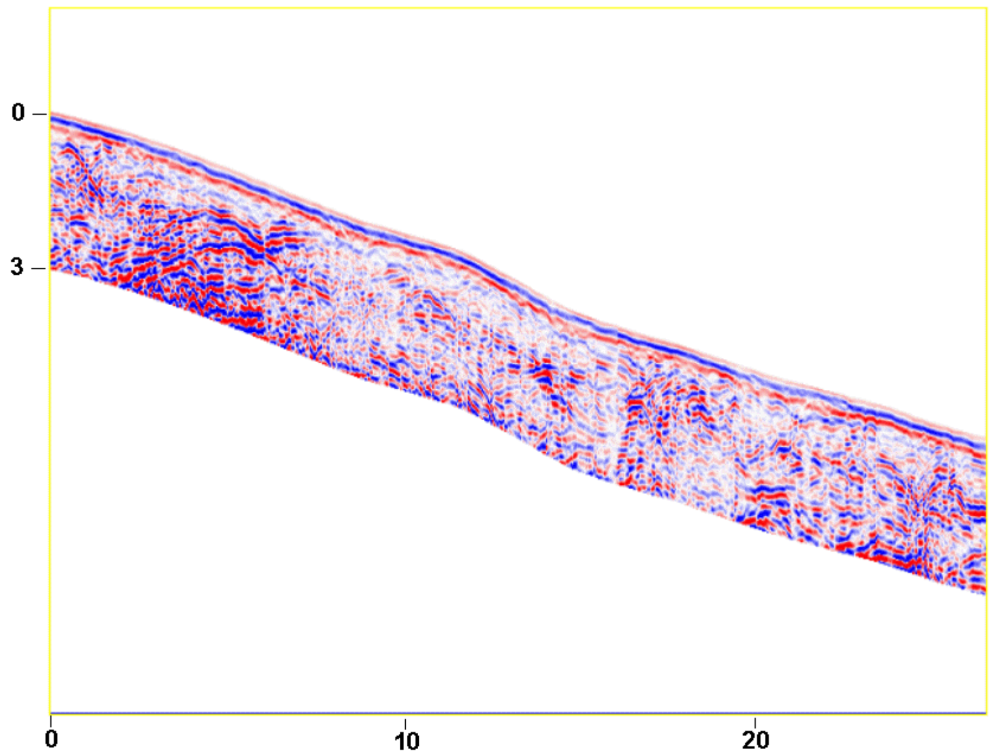

Figure 3. Radar record collected with the 400 MHz antenna along Line 3.

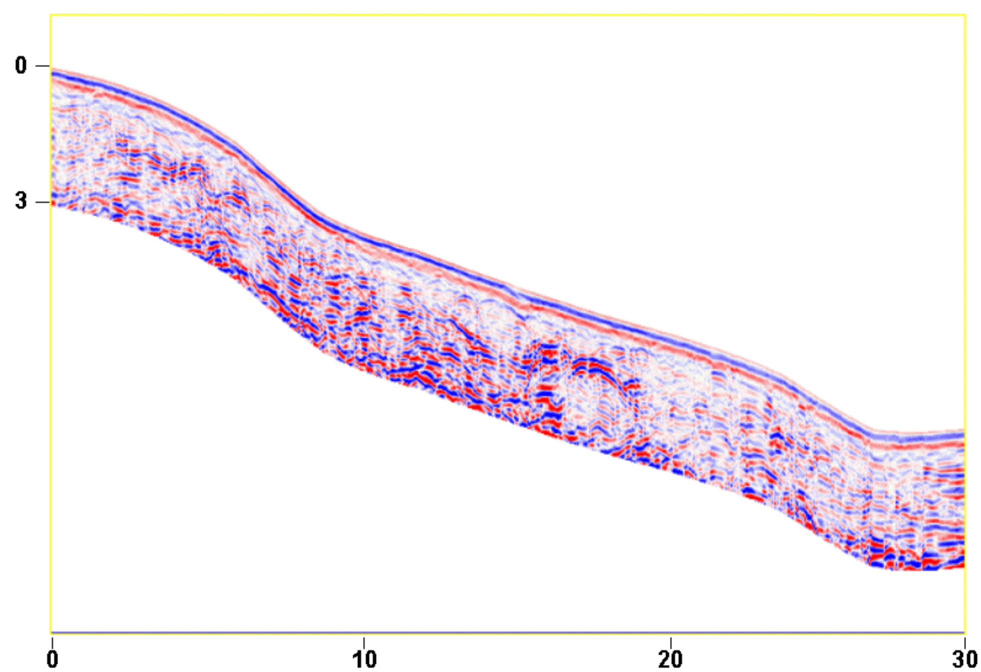

Figure 4. Radar record collected with the 400 MHz antenna along Line 4.

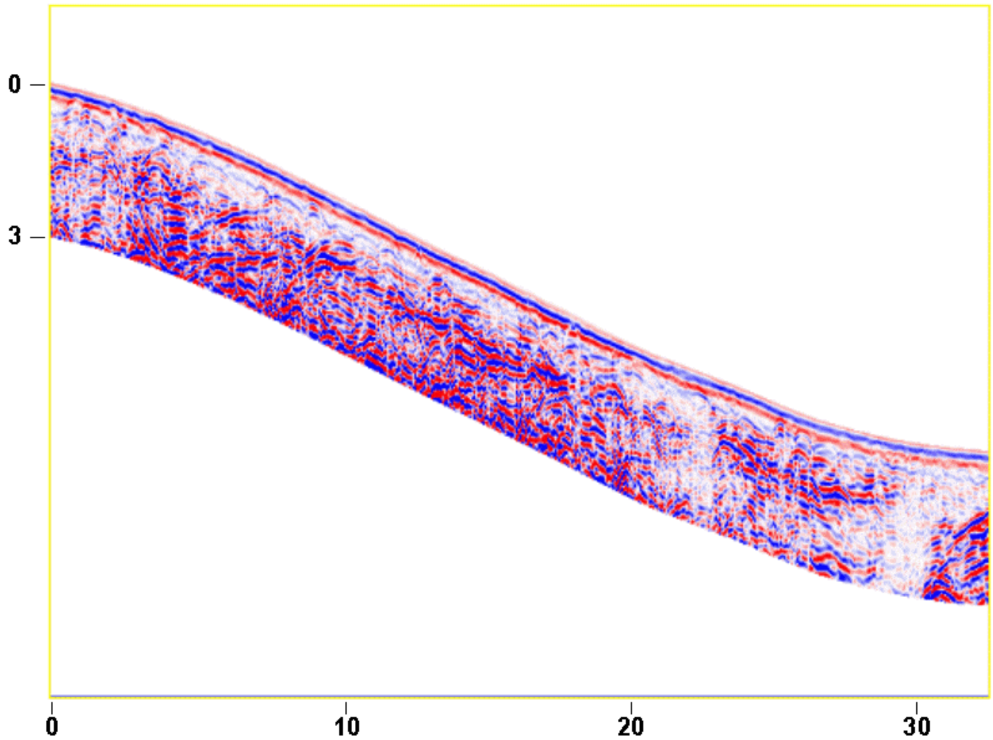

Figure 5. Radar record collected with the 400 MHz antenna along Line 5.

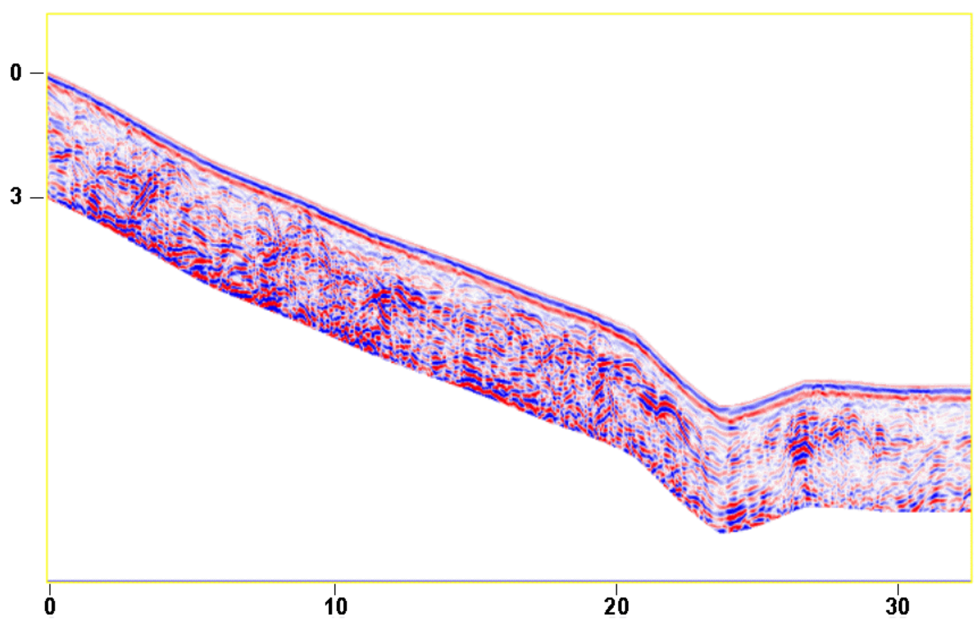

Figure 6. Radar record collected with the 400 MHz antenna along Line 6.

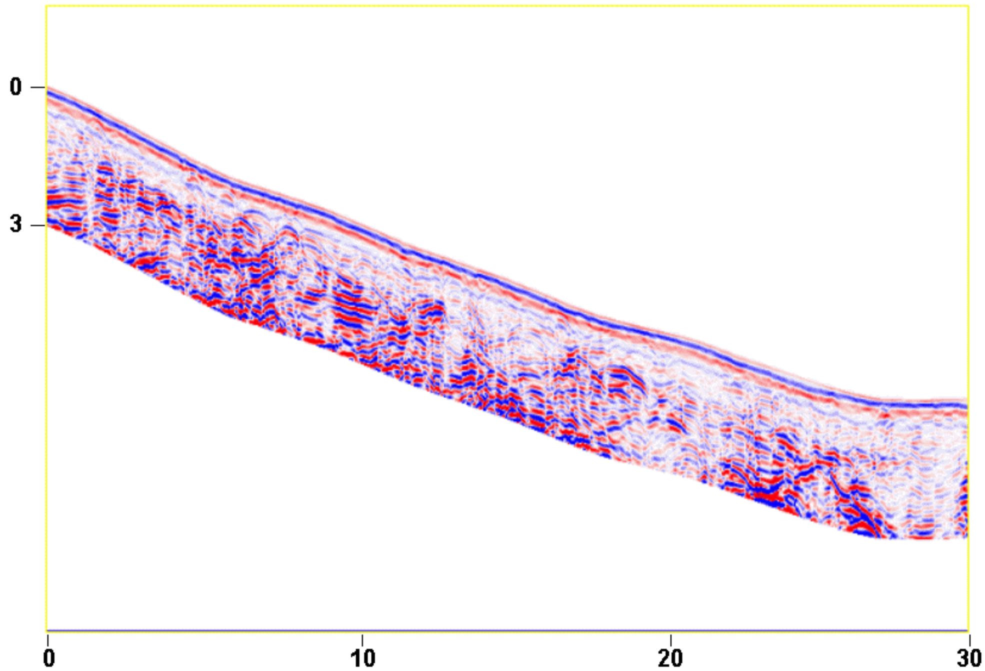

Figure 7. Radar record collected with the 400 MHz antenna along Line 7.

As discussed in an earlier report, most radar records from the catchment can be segmented into three distinct stratigraphic facies based on differences in type, distribution, and arrangement of subsurface reflectors. The upper slope components are characterized by multiple, closely spaced, inclined, sub-parallel, linear reflectors. These reflectors are believed to represent sedimentary beds of contrasting grain-size distributions. This higher-lying facies is underlain by a second facies on lower mid-slopes portions. The second facies is often bounded by a broad arching pattern, and largely consists of hummocky-appearing reflectors. These reflectors are interpreted to represent more thickly-bedded materials. The lower facies (right-hand portion of each radar record) consists of a large number of point anomalies, which appear to be interconnected with or a part of short, linear layers. These segmented, linear reflections more closely parallel the soil surface than reflectors in the previous two facies. This lower-lying facies is interpreted to represent recent alluvial deposits. Isolated, larger hyperbolic patterns within the lowest-lying facies may represent parent rock or more indurated sediment.

References:

Daniels, D. J. 2004. Ground Penetrating Radar; 2nd Edition. The Institute of Electrical Engineers, London, United Kingdom.