United States Department of Agriculture
Natural Resources Conservation Service
11 Campus Boulevard Suite 200 Newtown Square, PA 19073

Subject: -- Geophysical Assistance **Date:** 14 December 2004

To: Dr. John Kimble
Acting National Leader for Soil Investigations
Soil Survey Investigations
USDA-Natural Resources Conservation Service
National Soil Survey Center
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Lincoln, Nebraska 68508-3866

Purpose:
The USDA-NRCS staff in Durham, New Hampshire, recently purchased a TerraSIRch Subsurface Interface Radar (SIR) System-3000. Training was provided to Don Keirstead (Soil Scientists, Durham, NH) on the operation of this ground-penetrating radar (GPR) system. In addition, participants attended a training session at Geophysical Survey Systems, Inc., (GSSI) entitled *RADAN Data Processing*.

Participants:
Jim Doolittle, Research Soil Scientist, USDA-NRCS-NSSC, Newtown Square, PA
Don Keirstead, Soil Scientist, USDA-NRCS, Durham, NH
Wes Tuttle, Soil Scientist, USDA-NRCS-NSSC, Wilkesboro, NC

Activities:

All activities were completed during the period of November 29 thru December 3, 2004. Don Keirstead received training on the use and operation of GPR and the interpretation of radar data on Monday in the conference room of the New Hampshire State Office. Basic principles and procedures for calibrating and operating the radar unit were reviewed. On Tuesday morning, GPR surveys were completed at the University of New Hampshire's farm and in a nearby cemetery. On Tuesday afternoon, GPR data transferred and processing procedures were reviewed in the State Office. Wes Tuttle joined us on Tuesday evening, and all participants attended a three-day *RADAN Data Processing* training course at GSSI, in North Salem, New Hampshire. The course covered advanced data processing of radar data.

Results:

1. Don Keirstead has been designated as the radar operator for NRCS in New Hampshire. The NSSC provided introductory training to Don on the operation of New Hampshire's newly purchased SIR-3000 unit. Additional training on the operation of this SIR-3000 unit and processing and interpretation of radar data have been planned. To accomplish this training, Don Keirstead has received authorization from the New Hampshire's State Soil Scientist (Steve Hundley) to accompanying Jim Doolittle on assignments in Rhode Island (January 24-28, 2005). In addition, Jim Doolittle is scheduled to work two weeks in New Hampshire (February 7 to 18, 2005).

2. All participants successfully completed a training course entitled *RADAN Data Processing* at the GSSI facility

in North Salem, New Hampshire. This training was beneficial as it provided excellent guidance into the use of RADAN for Windows (version 6.0) software. Instructions and guidance were provided from the initial processing of radar data thru the more advanced processing steps required to develop two- and three-dimensional radar images.

3. Ground-penetrating radar technology has advanced substantially since the NSSC purchased its two SIR-3000 radar units in the fall of 2003. While at GSSI, Jim Doolittle's SIR-3000 radar unit was upgraded (at no costs) and additional software installed. Wes Tuttle's unit must be returned to GSSI for similar upgrades and installations.

4. Major foci of developing GPR technology are (1) the collection and integration of global-positioning (GPS) data with GPR data and (2) the real-time or immediate viewing of three-dimensional (3D) radar images. The most recent radar software integrates GPR and GPS data. With this software, GPS data can be stored and quickly retrieved in a Microsoft Access format. State-of-the art radar software allows two-dimensional radar records collected with GPS data to be viewed in 3D. This viewing option enables the within-field animation of 3D data sets from any slice (X, Y, or Z axis) orientation. This option will greatly assist detailed soil, engineering and archaeological radar site-investigations. To sustain our GPR capabilities, the purchase of additional hardware and software is recommended for the NSSC.

5. The attachment to this report is forwarded for consideration. This quote provides hardware and software that will keep the NSSC current with the changes that have been made in radar technology:

    A. Radar units that were recently purchased by NRCS staffs in California and New Hampshire are using the RADAN version 6.0 software. The NSSC will provide training to these states but is using RADAN version 5 software. Version 5.0 software does not allow the integration of GPS and GPR data. A RADAN software upgrade to version 6.0 is requested for both Doolittle's and Tuttle's systems. Each upgrade will cost $750.

    B. Request the purchase of two GPS units that fit into ports on the SIR-3000 radar units. These GPS units are compatible with the SIR-3000 system and are needed to automatically geo-reference radar data. The recommended GPS receiver costs $400 apiece.

    C. The NSSC has one Model 623 Survey wheel cart (available for Tuttle's unit). A cart or survey wheel is required to operate the SIR-3000 unit and create three-dimensional (3D) radar images with the real-time viewing option. A survey wheel (Model 620; $2000) with a 3-m antenna control cable ($800) is requested for Jim Doolittle's unit.

    D. Wes Tuttle wishes to use and field-test a newly developed 270 MHz antenna (Model 5104). This antenna should provide intermediate ranges and resolution for soil survey investigations.

With kind regards,

James A. Doolittle
Research Soil Scientist
National Soil Survey Center

cc:
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