UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Northeast NTC
CHESTER, PA 19013

SUBJECT: Ground-Penetrating Radar (GPR) Study of Coastal Wetlands of Louisiana.

DATE: 15 April 1992

To: Horace J. Austin
State Conservationist
USDA-Soil Conservation Service
Alexandria, LA

Purpose:
Field assistance supported the NASA study "Evaluating soil organic matter in Louisiana Coastal Wetlands utilizing low frequency remote sensing." Participants in this research project include NASA/Stennis Space Center, USDA-Soil Conservation Service, and Louisiana State University. The purpose of this period of field work was to evaluate the potential of using GPR and electromagnetic induction (EM) methods to characterize the thickness of organic materials in coastal wetlands.

Participants:
Jim Doolittle, Soil Specialist, SCS, Chester, PA
Wayne Hudnall, Department of Agronomy, LSU, Baton Rouge, LA
Arville Touchet, State Soil Scientist, SCS, Alexandria, LA
Romona Travis, Soil Scientist, NASA Science and Technology Lab., Stennis, MS

Activities:
Field studies were conducted within the Point Au Chien Wildlife Management Area in Lafourche Parish, the Salvador Wildlife Management Area in St Charles Parish, and near the Intercoastal Waterway in Vermilion Parish.

Equipment:
The ground-penetrating radar unit used in this study is the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc. [1]. Components of the SIR System-8 used in this study were the model 4800 control unit, ADTEK SR 8004H graphic recorder, ADTEK DT 6000 tape recorder, power distribution unit, transmission cable (30 m), and the models 3110 (120 MHz) and 3207 (100 MHz) antennas. The system was powered by a 12-volt marine battery.

The electromagnetic induction meter was the EM31 manufactured by GEONICS Limited. [1]. Measurements of conductivity are expressed as milliSiemens per meter (mS/m). At most sites, measurements of

1. Use of trade names in this report is for identification purposes only and does not constitute endorsement by the author or SCS.

apparent conductivity were taken in both the horizontal and vertical dipole modes.

Discussion:
This portion of the study investigated the feasibilities of using GPR in the different peatland settings of southern Louisiana. The GPR is not equally suited for use in all peatlands. The GPR appears to have good potential in areas of Allemands (clayey, montmorillonitic, euic, thermic Terric Medisaprists) and Kenner (euic, thermic Fluvaquentic Medisaprists) soils where apparent conductivity values are less than 150 mS/m. In these soils, GPR profiled to the first mineral soil interface. Image processing of recorded radar data will be needed to penetrate mineral interfaces and assess stratification and variations in degrees of humification.

The potential for using GPR techniques in areas of saline Clovelly (clayey, montmorillonitic, euic, thermic Terric Medisaprists) and Lafitte (euic, thermic Typic Medisaprists) soils is very poor. Selected areas of these soils were observed to have apparent conductivity values greater than 200 mS/m. In these soils the radiated electromagnetic energy was rapidly attenuated and profiling was restricted to the soil surface. Image processing will not significantly increase the interpretability of radar data.

Large, accessible areas of suitable peatlands were located within St Charles and Vermilion Parishes. Sites within the Point Au Chien Wildlife Management Area in Lafourche Parish were generally too saline for the use of GPR techniques. In Lafourche Parish, measurements made with the EM31 meter in an area of Allemands muck were surprisingly high with values ranging from 320 to 390 mS/m in both the horizontal and vertical dipole modes. In addition, values of apparent conductivity increased with increasing depth scanned (vertical versus horizontal dipole modes) indicating potential intrusion of salt water. These values reflect soil conditions which are too conductive for the operation of the GPR.

Both antennas provided similar results. The thickness of organic materials probed with these antennas ranged from about 2 to 5 feet. Depth was restricted by presence of layers of finer textured soil materials or salinity.

The model 3110 (120 MHz) antenna is smaller and more maneuverable than the larger model 3207 (100 MHz) antenna. In studies conducted within the Salvador Wildlife Management Area, the model 3110 antenna was successfully operated while being towed (in the water) behind and latched to the side of an airboat. The airboat was able to traverse fairly open areas of shallow water. However, the antenna often became ensnared by vegetation. In order to cross vegetated areas, the airboat driver recommended conducting GPR transects during the winter.

A small flat floored boat was constructed to house the larger model 3207 antenna. This boat was successfully towed behind a motorboat in Vermilion Parish.

In Vermilion Parish, a 180 foot transect was conducted with the model 3110 antenna across an area of Kenner (euic, thermic Fluvaquentic Medisaprists) soils on a natural levee. For this transect, the GPR unit was placed on the levee and the antenna pulled by hand. This was a rather slow process as the boat had to be moored, equipment unloaded, setup, operated, and loaded. Though apparent conductivity values were relatively low (37 and 70 mS/m in the horizontal and vertical dipole modes respectively) at this site, penetration was limited by thin stratified layers of finer textured soil materials occurring at depths of about 16 to 20 inches. Organic materials were observed to underlie the thin, stratified mineral layers to depths of about 1.4 meters.

Results:
This field trip has confirmed the potential for using GPR techniques to determine the thickness of organic soil materials in some peatland settings in Louisiana. Soil features which limit data collection with GPR have been identified by the participants. Suitable sites have been located and survey techniques identified.

Romona Pelletier is planning to make several short trips to Louisiana to begin collecting soil data with GPR. Several long, continuous transects should be made with the GPR this winter across suitable areas in St. Charles and Vermilion Parishes. These transects will provide the information needed to complete this research project.

With kind regards.

James A. Doolittle
Soil Specialist

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Subject: MGT - Schedules - GPR Assistance - Wetlands Study, Louisiana

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To: Horace J. Austin
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Jim Doolittle has approval to participate in a Ground Penetrating Radar study of the coastal wetlands of Louisiana in conjunction with Dr. Ramona Pelletier of NASA, Stennis, Mississippi, and Wayne Hudnall, Louisiana State University. Arville Touchet will coordinate this operation.

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