United States Department of Agriculture **Chester, PA 19013**
Soil Conservation Service **610-490-6042**

Subject: Geologic Investigations within the at Rush Creek Watershed using Electromagnetic Induction Techniques; August 1, 1994

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To: James L. Kearney
Engineering Geologist
USDA - Soil Conservation Service
Midwest NTC, Mail Stop 23
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866

Purpose:
To provide further field training and familiarization with the operation of the EM31 and EM34 meters.

Participants:
Jerry Ayers, Geophysicist, Nebraska Conservation and Survey Division, Lincoln, NE
Jim Doolittle, Soil Specialist, SCS, Chester, PA
Jim Kearney, Eng. Geologist, SCS, MNTC, Lincoln, NE
Jennifer Kouba, Geologist, SCS, Lincoln, NE
Scott Sumsion, Geologist, SCS, Lincoln, NE
Doug Wysocki, Research Soil Scientist, SCS, Lincoln, NE

Equipment:
The electromagnetic induction meters used were the EM31 and EM34, manufactured by Geonics Limited+. The depth of penetration is dependent upon the intercoil spacing, transmission frequency, and coil orientation relative to the ground surface. The EM31 meter integrates values of apparent conductivity over the upper 2.75 m in the horizontal dipole orientation, and over the upper 6.0 m in the vertical dipole orientation. A 20 meter intercoil spacing was used with the EM34. The EM34 meter with a 20 m intercoil spacing integrates values of apparent conductivity over the upper 15 m in the horizontal dipole orientation, and over the upper 30 m in the vertical dipole orientation.

Discussion:
The selected site was in an area of Salmo silty clay loam, channelled, 0 to 2 percent slopes. Salmo is a member of the fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls family. The soil is slightly to moderately saline.

Recent rain made the selected sites inaccessible. Because this was a training exercise, participants felt that any site would be suitable. Therefore, a transect line was established on the embankment of a county road. The transect line consisted of 22 observation point, spaced 20 m apart.

+ Trade names have been used to provide specific information. Their mention does not constitute endorsement.

Figure 1 summarizes the data collected with each meter and orientation. In general, EM responses decreased and became less variable with increasing soil depth (responses with the EM34 greater than with the EM31 meter, and responses in the vertical greater than in the horizontal dipole orientation). These patterns suggest the presence of more conductive materials (i.e. greater clay, soluble salt, and/or water contents) near the soil surface. The relatively high (> 100 mS/m) responses near the soil surface (upper 15 m) were attributed principally to the concentration of soluble salts.

Electromagnetic responses were relatively high and variable along the transect line. With the EM31 meter, the average apparent conductivity was 218 mS/m, with a range of 124 to 352 mS/m in the horizontal mode. One-half of the observations collected in the horizontal dipole orientation had apparent conductivity values between 161 and 248 mS/m. The average apparent conductivity was 211 mS/m, with a range of 131 to 244 mS/m in the vertical mode. One-half of the observations collected in the vertical dipole orientation had apparent conductivity values between 202 and 224 mS/m. At fifty-five percent of the observation points, EM responses (as measured with the EM31 meter) increased with increasing depth. A majority of these observation points were located along the eastern portion of the transect line.

With the EM34 meter and using a 20 m intercoil spacing, the average apparent conductivity was 148 mS/m, with a range of 115 to 170 mS/m in the horizontal mode. One-half of the observations collected in the horizontal dipole orientation had apparent conductivity values between 135 and 160 mS/m. The average apparent conductivity was 68 mS/m, with a range of 46 to 82 mS/m in the vertical mode. One-half of the observations collected in the vertical dipole orientation had apparent conductivity values between 62 and 73 mS/m. The relatively low, and less variable responses with greater observation depths, were believed to reflect lower concentrations of soluble salts and/or clay in the underlying materials.

Figure 2 summarizes the data collected earlier, with the EM31 meter at another site.

Recommendations:
The EM31 and the EM34 meters are well suited to the investigation at Rush Creek. Use of these meters along established transect lines will provide insight into the distribution and origins of soluble salts within the watershed.

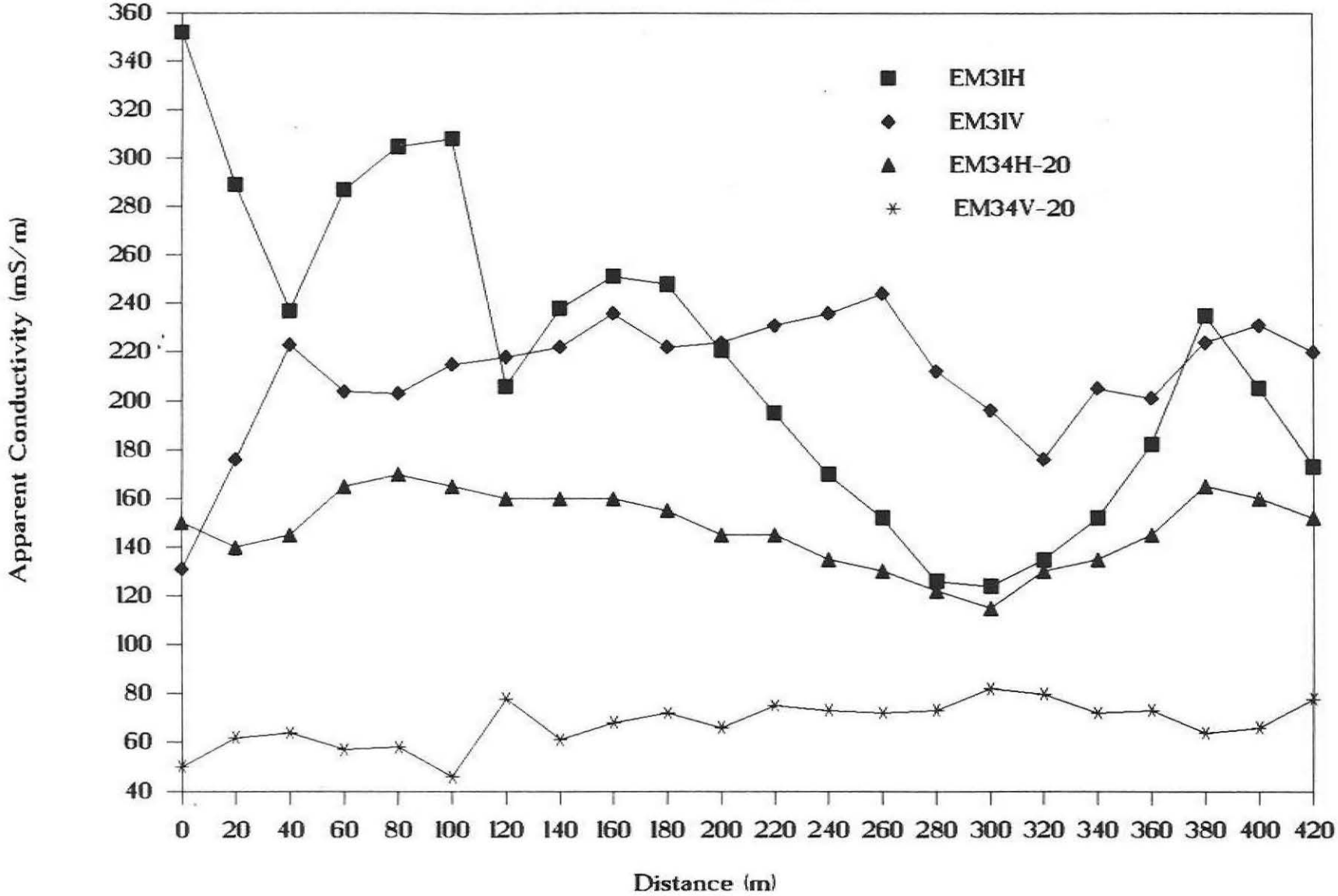
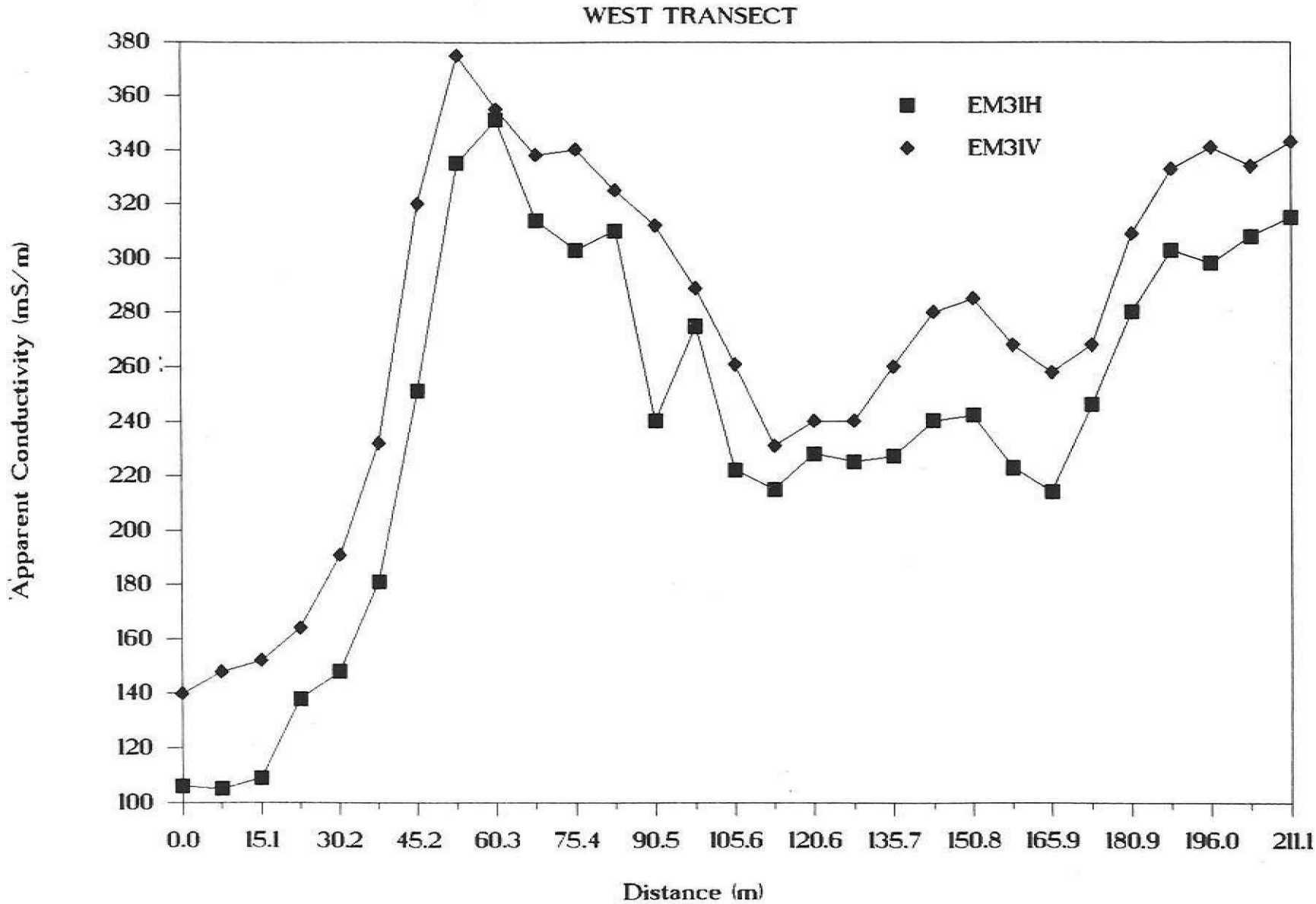
It was my pleasure to work with you and participate in your project.
With kind regards

James A. Doolittle
Soil Specialist

cc:
James Culver, Assistant Director, NSSC, MNTC, SCS, Lincoln, NE
Steve Holzhey, Assistant Director, NSSC, MNTC, SCS, Lincoln, NE

EM SURVEY OF RUSH CREEK WATERSHED

EAST TRANSECT



EM SURVEY OF RUSH CREEK WATERSHED