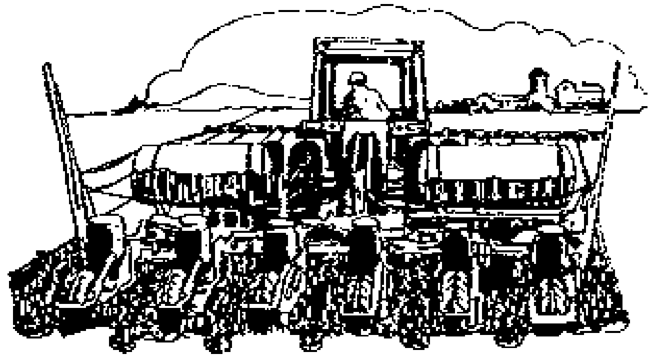
NATIONAL COOPERATIVE SOIL SURVEY

North Central Soil Survey Conference Proceedings

Rapid City, South Dakota
May 19-23, 1996

PROCEEDINGS
1996 North Central Regional Cooperative Soil Survey Conference



SOIL SURVEY NEEDS in the 21st CENTURY- ARE WE READY?

1996 North Central Regional Cooperative Work Planning Conference for the National Cooperative Soil Survey

Soil **Survey Needs in the 21st Century**

Soonsored by
Bureau of Indian Affairs
Natural Resources Conservation Service
South Dakota State University
United States Forest Service

Special Assistance from
Bureau of Land Management
Golden Reward Mining Company
National Park Service
North Central Agricultural Experiment Stations (NCR-3)
Rapid City Chamber of Commerce
SD Waste Management Association
US Army Environmental Center
Wharf Mining Company

Other Contributina Oraanizations
Giddings Machine Company
Horizon's Inc.
South Dakota Professional Soil Scientists Association

Howard Johnson Lodge and Convention Center
Rapid City, South Dakota
May 19-23, 1996

Registration List

Agenda

Steering Committee

Study Committee Charges

1996 NCSS REGISTRATION LIST

Ahrens, Robert - Natural Resources Conservation Service, Lincoln, NE
Bachman, Wayne - Natural Resources Conservation Service, Huron, SD
Balogh, James - Spectrum Research
Belohlavy, Francis - University of Nebraska, Lincoln. NE
Boeckman, Louis - Natural Resources Conservation Service, Des Moines, IA
Brady, Dan - Natural Resources Conservation Service. Vermillion. SD
Ceolla, Dale - Natural Resources Conservation Service, Des Moines, IA
Cooley, Kent - Natural Resources Conservation Service, Rapid City, SD
Doolittle, Jim A - Natural Resources Conservation Service, Radnor, PA
Doolittle, Jim J South Dakota State University, Brookings. SD
Emerson, Kathy - US Forest Service, Cody, WY
Ensz, Ed - Professional Soil Scientist Assoc. of SD, Rapid City, SD
Fenton, Tom - Iowa State University, Ames, IA
Ferguson, Henry - Natural Resources Conservation Service, Macon, MO
Filholm, Mindy - South Dakota State University, Brookings, SD
Folsche, Richard - Natural Resources Conservation Service, Ft Worth, Tx
Franzmeier, Don - Purdue University, Lafayette, IN
Freeouf, Jerry - US Forest Service, Lakewood. CO
Gehring, Richard - Natural Resources Conservation Service, Columbus, OH
Gerber, Tim - Ohio Department of Natural Resources, Columbus, OH
Gerken, Jon - Natural Resources Conservation Service, Columbus, OH
Giencke, Allan - Natural Resources Conservation Service, St Paul, MN
Glanzer. Joni - Natural Resources Conservation Service, Huron, SD
Glaum, Stanley - Natural Resources Conservation Service, Salina, KS
Hall, Barb - Natural Resources Conservation Service, Huron, SD
Heidt, Corneilius - Natural Resources Conservation Service, Bismarck, ND
Heil, Dennis - Natural Resources Conservation Service, Bismarck, ND
Heil, Ken - Natural Resources Conservation Service, Pierre, SD
Holzhey, Steve - Natural Resources Conservation Service, Lincoln, NE
Keatts, Pat - Bureau of Indian Affairs, Aberdeen, SD
Kelsea, Russ - Natural Resources Conservation Service, Lincoln, NE
Kunze, Bruce - Natural Resources Conservation Service, Brookings, SD
Kuzila, Mark - University of Nebraska, Lincoln, NE
Malo, Doug - South Dakota State University, Brookings, SD
McCaleb, Nathan - Natural Resources Conservation Service, Lincoln, NE
Meland, Arvid
Millar, Jim - Natural Resources Conservation Service, Redfield. SD
Miller, Ed - Ohio Department of Resources, Columbus, OH
Mokma, Delbert - Michigan State University, East Lansing, MI
Mount, Henry - Natural Resources Conservation Service, Lincoln, NE
Oelmann, Douglas - Natural Resources Conservation Service, Altoona, IA
Olness, Alan - ARS Morris, MN
Olson, Kenneth - University of Illinois, Urbana, IL
Preston, Eugene - Natural Resources Conservation Service, Sioux Falls, SD

Pytlik. Lea Ann - Natural Resources Conservation Service, Lincoln, NE
Ransom, Mickey - Kansas State University, Manhattan, KS
Reedy, Thomas - Natural Resources Conservation Service, Des Moines, IA
Reinsch. Thomas - Natural Resources Conservation Service, Lincoln, NE
Reyher. Deanna - US Forest Service, Custer, SD
Robert Pierre - University of Minnesota, St Paul, MN
Robinson, Dennis - Michigan Department of Agriculture, Marquette, MI
Schaar, Jerome - Natural Resources Conservation Service, Huron, SD
Schellentrager, Gregg - Natural Resources Conservation Service, Lincoln, NE
Schultz, Loren D - Natural Resources Conservation Service, Aberdeen, SD
Schumacher, Tom M - Natural Resources Conservation Service, Mitchell, SD
Sinclair, H Raymond Jr - Natural Resources Conservation Service, Lincoln, NE
Smeck, Neil - Ohio State University, Columbus, OH
Steele, Cindy - Natural Resources Conservation Service, Huron, SD
Sullivan, Tim - US Forest Service, Lakewood, CO
Teachman, George - Natural Resources Conservation Service Liaison US Army
Wacker, Carl - Natural Resources Conservation Service, Madison, WI
Winter, Steve - Natural Resources Conservation Service, Redfield, SD
Yeck, Ron - Natural Resources Conservation Service, Lincoln, NE

Agenda for the 1996 NCSS Regional Meeting in Rapid City, South Dakota
May 19-23, 1996

Sunday, May 19, 1996

12:oo	Bus leaves for the Badlands (lunch **is on your own)**
1:00 - 4:oo	Bus tour of the Badlands
4:oo	Leave for Wall Drug
5:00 - 6:00	Tour and eat at Wall Drug **(dinner is on your own)**
6:00	Leave for hotel
7:00 - 8:30	Social/Registration - Washington Room Cash bar - Snacks provided by PSSASD
8:00 - 9:00	NCR-3 meeting - Badlands Room

Monday, May 20, 1996
(Events will take place in the Washington Room)

Jerry Schanr
Chrirperson

7:30 - 8:30	Registration
8:30 - 8:45	Welcome from Assistant State Conservationist - Rod Baumberger
8:45 - 9:00	Welcome from Rapid City Council Representative - Karen Bulman
9:oo - 9:30	Arvid Meland - Using Soil Surveys for Equalization
9:30 - 10:00	Deborah Barton - Impacts of Soils on Solid Waste Facility Operations
10:00 - 10: 15	Break - Refreshments provided by Giddings
10:15 - 11:00	Kathy Emerson - Bighorn National Forest Integrated Resource Inventory - Using Published Soil Surveys
11:00 - 11: 15	Steve Holzhey - The NRCS National Science and Technology Consortium
11:15 - 11:30	George Teachman - Soil Survey in the Army Installations
11:30 - 12:00	Jim Balogh - Licensing of Soil Scientists
12:oo - l:oo	Lunch - Jefferson and Roosevelt Rooms (pay at registration)

Wayne Bachman
Chairperson

1:00 - 1:30	Steve Holzhey - NRCS Reorganization and its effects on NCSS/Agency Report
1:30 - 2:30	Agency Reports - Jerry Freeouf (USFS), Pat Keatts (BIA), Bill Volk (BLM), Larry Pointer (National Park Service)
2:30 - 2:45	Break - Refreshments provided by Giddings
2:45 - 3:45	Agency Meetings - (NCR-3, NRCS, and others)
4:oo - 7:oo	Leave for Jewel Cave (box lunch on **the bus)**
7:oo - 9:oo	Leave for Mt. Rushmore from Jewel Cave
9:oo	Return to hotel

Tuesday, May 21, 1996

Doug Malo
Chairperson

Poster Review - Badlands Room (7:30am -

1996 NORTH CENTRAL REGIONAL COOPERATIVE WORK PLANNING CONFERENCE
FOR THE NATIONAL COOPERATIVE SOIL SURVEY
Steering Committee

Jerry Schaar
State Soil Scientist and Conference Chair
USDA-NRCS
200 4th St SW
Huron, SD 57350-2475
605-352-1252 FAX 605-352-1270
email jms@sdhrndb.sd.nrcs.usda.gov

Wayne Bachman
Assistant State Soil Scientist
USDA-NRCS
200 4th St SW
Huron, SD 57350-2475
605-352-1252 FAX 605-352-1270
email wjb@sdhrndb.sd.nrcs.usda.gov

Kent Cooley
Area Soil Scientist
USDA-NRCS
515 9th St Rm 239
Rapid City, SD 57701-2663
605-343-1643 FAX 605-343-6310

Deanna Reyher
Soil Scientist, USFS
Black Hills NF
RR 2 Box 200
Custer, SD 57730
605-673-225 1 FAX 605-673-5567

Doug Malo
Professor and Conference Co-Chair
South Dakota State University
Plant Science Department
NPB 247 Box 2140C
Brookings, SD 57007-2141
605-688-4586 FAX-605-688-4452
email filholmm@mg.sdstate.edu

Pat Keatts
Natural Resource Specialist, GIS Coordinator
Bureau of Indian Affairs
1154th Ave SE
Aberdeen, SD 57401
605-226-7621 FAX 605-226-7358

Barb Hall
Database Specialist
USDA-NRCS
200 4th St SW
Huron, SD 57350-2475
605-352-1252 FAX 605-352-1270
email bmh@sdhrndb.sd.nrcs.usda.gov

Mindy Filholm
Secretary
South Dakota State University
Plant Science Department
NPB 247 Box 2140C
Brookings, SD 57007-2141
605-688-4450 FAX-605-688-4452
email filholmm@mg.sdstate.edu

SUGGESTED COMMITTEE CHARGES
(can be modified by the committee)

Committee One: Soil Data Delivery Systems. Chairs - Pierre Robert (Univ. of Minn) and Nathan McCaleb (NRCS)

Charges:
1. How to get soil information in the hands of users, if soil surveys are not going to be published?
2. Soils information and the Inter-net.
3. Should there be a NCSS standard for electronic data entry? How should the data be certified?
4. What should be the requirements for storage and retrieval? Who should have access and/or responsibility for the data sets?
5. What are the benefits/disadvantages of using soil interpretations from MLRA data sets versus county specific data sets?
6. What level of data (field notes, complete description, lab sites, etc) should be used for data aggregation?

Committee Two: Soil Research Needs. Chairs - Mickey Ransom (Kansas State Univ.), Richard Schlepp (NRCS), and H. Raymond Sinclair (NRCS)

Charges:
1. Identify NRCS soil research needs for the North Central Region and develop a mechanism to determine who or what agencies (AES, USFS, BIA, BLM, USGS, state agencies, private consultants, and others) may be addressing or willing to address some of those needs.
2. Evaluate field methods for measuring soil quality.
3. Identify meaningful hydric soil indicators for mollisols.
4. What training and procedures are needed to improve the quality of the soil properties, landscape features, and climatic data in the soil survey database for making soil survey interpretations and soil performance data?

Committee Three: Eroded Soils and Classification. Chair - Tom Fenton (Iowa State Univ.).

Charges:
1. Develop recommendation(s) to send to the NCSS for action based on the Eroded Soils Report from the 1995 NCSS Meeting in San Diego, CA.
2. Develop guidelines for mapping unit design and interpretations that could be used for eroded soils regardless of their soil classification:
3. Suggest diagnostic criteria of accelerated erosion, a quantification of accelerated erosion.

Committee Four: Soil Correlation and Classification. Chair - Dennis Heil (NRCS).

Charges:
1. Prairie Alfisols in western ND and SD.
2. Compatible mapping scales/interpretations between MOs within a state.
3. Is the current method of review and comment adequate for updates to Soil Taxonomy.
4. Should standards and guidelines be developed for updating published soil survey materials? What should they be?
5. What benefits/disadvantages exist when changing classifications to existing published soil surveys and other publications?

Monday Morning - May 20, 1996

Presentations

1. Land Valuations by Soils and Productivity

2. Soil Impacts on Solid Waste Facilities

3. Bighorn National Forest Integrated Resource Inventory Using a Published Soil Survey

4. NRCS Soil Science and Resource Assessment Organization Plan

5. Pedon Description Plan

6. Soil Survey Needs for the Next Decade

LAND VALUATIONS BY SOILS AND PRODUCTIVITY

ARVID C. MELAND

I'M GOING TO BREIFLY DISCUSS THE USE OF SOIL SURVEYS FOR FOR ARRIVING AT LAND VALUES FOR TAXATION PURPOSES.

THIS PROJECT IN SOUTH DAKOTA WAS A JOINT EFFORT BETWEEN SOUTH DAKOTA STATE UNIVERSITY AND THE SOIL CONSERVATION SERVICE, COORDINATED THRU THE SOUTH DAKOTA DEPT. OF REVENUE.

OVERHEAD # 1.

OVERHEAD # 2.

PRODUCTIVITY OF EVERY SOIL IN THE COUNTY WAS DETERMINED BY COMBINING YEILD AND PRODUCTION INFORMATION GATHERED FROM THE SOIL SURVEY REPORT FOR THE INDIVIDUAL COUNTY, THE COUNTY EXTENSION SERVICE AND SOUTH DAKOTA STATE UNIVERSITY.

OVERHEAD # 3

THE SOILS WERE THEN ARRAYED IN DECENDING ORDER FROM THE MOST PRODUCTIVE TO THE LEAST PRODUCTIVE. THEY WERE THEN GIVEN A RATING COMPARING EACH INDIVIDUAL SOILS PRODUCTIVITY AGAINST THE MOST PRODUCTIVE SOIL IN THE COUNTY. THE SOILS IN CAPABILITY CLASSES SUITED TO CROPPING WERE GIVEN A CROP RATING. SOILS IN CAPABILITY CLASSES NOT SUITED FOR CROPPING WERE GIVEN A GRASS RATING. CAPABILITY CLASS 4 IS THE TRANSITION CLASS IN WESTERN SOUTH DAKOTA.

OVERHEAD # 4

OVERHEAD # 5

THE SOIL SURVEY WAS DIGITIZED AND THE PROGRAM INSTALLED IN A COMPUTER PROGRAM. THE PROGRAM ALLOWED US TO MARK OFF OWNERSHIP BOUNDARIES AND IDENTIFY THE KINDS OF SOILS WITHIN THOSE BOUNDARIES AND COMPUTE THE ACREAGE OF EACH SOIL. THIS ENABLES US TO COME UP WITH THE TOTAL ACRES OF EACH SOIL IN THE COUNTY, OR TOTAL ACRRES OF EACH SOIL BY LEGAL OWNERSHIP.

OVERHEAD # 6

-OVERHEAD # 7

AFTER FIGURING THE PRODUCTIVE VALUE OF THE NUMBER ONE SOIL IS THE COUNTY, WE CAN THEN ADD UP ALL THE ACRES OF EACH RATED SOIL IN THE PARCEL WE ARE INTERESTED IN AND FIND THE AVERAGE RATING FOR THAT PARCEL. WE THEY: MULTIPLY THAT RATING TIMES OUR TOP DOLLAR VALUE TIMES THE ACRES IN THE PARCEL AND ARRIVE AT A PRODUCTIVITY VALUE.

OVERHEAD # 8

OVERHEAD # 9

OVERHEAD # 1

In 1989, the South Dakota Legislature passed Senate Bill 12 which requires #at land use, soil productivity, and sales be used to determine real estate property values. As a 'result of this law; the South Dakota Department of Revenue contracted with the Plant Science Department at South Dakota State University to:

1. Obtain current crop and range yield data by soil mapping unit for every county that has a published modem detailed soil survey;
2. Develop a crop rating for each soil mapping unit in each county; .
3. Develop a range/grass rating for each soil mapping unit in each county;
4. Develop soil productivity ratings which tie together the crop and range productivity arrays; and
5. Prepare a yield/productivity table and reportfor each county.

The'ratings developed in this report are comparative ratings, and they apply to the soil mapping units in McPherson County. The soil mapping unit ratings used in this publication are for local use and will differ somewhat from soil mapping unit ratings in adjacent or nearby counties.

Additional information, in addition to the McPherson County Soil Survey (Schultz, 1981), about the extent of the major soil series found in McPherson County is available (Westin and Bannister, 1971; Westin and Malo, 1978). The local USDA Soil Conservation Service and the South Dakota Cooperative Extension Service are other excellent Sources of soils information.

Soil ratings determined by the methods described in this publication compare soils and should not change relative to each other with fluctuations in economic conditions since they are based on the physical and chemical properties of soils. Advancements in technology also should not greatly alter the ranking of soils, because soils tend to behave similarly. The potential yield advantage of one soil over another usually does not change because a new form of fertilizer or a new grain variety has been developed.

DATA

The data used in this study includes crop and range yields, range composition, and modern detailed soil survey information. Data for each soil series phase was obtained from the SCS-USDA data files. Current individual soil series Sheets listing crop and range yields and range plant species composition were used. Yields selected were for normal climatic conditions with average management.

10-6-33.1. Factors considered in determining value of agricultural land. The true and full value in money of agricultural land, **as** defined by §

VERHEAL

Map Symbol	Map Unit Name	Acres	Pct Slope	% Comp.	Land Cap Subcl	Corn Bu/a	%	Oats Bu/a	%	Spring Wheat Bu/a	%	Winter Wheat Bu/a	%	Barley Bu/a	%	Alfalfa Hay T/a	%	Ave %	Final Crop Rating	Range Site	Range Yld lbs/a	Adj Range Rtg
	Sutley							27	35	12	35	---	---									----
	Sutley-Linton							27	34	13	38	---	---									.311
	Sutley										---											----
	Linton										44											
	Arveson										74											
	Farnuf										100											
	Farnuf										88											
	Bryant-Grassna										90											
											82					2	65					
											100					3.1	100					
											79											
											65											
											41											
											56											

											76											
											68											

OVERHEAD # 4

CAMPBELL COUNTY - TABLE 1B - SOIL PRODUCTIVITY RATINGS
RATINGS AND DOLLAR VALUES BASED ON SOIL MAPPING UNITS
SORTED BY FINAL CROP RATING
DEVELOPED BY DEPARTMENT OF REVENUE

September 1992

Map Symbol	Map Unit Name	Acres	Pct Slope	Land Cap Subcl	Final Crop Rating	Crop Dollar Value	Adj Range Rtg	Grass Dollar Value	Foot Notes
4	Grassna	5,260	0-2	2c	1.000	292	.657	NU	
21A	Linton-Grassna	10.670	0-3	2c	.905	264	.447	NU	
1A	Bowbells	10.040	0-3	2c	.891	260	.599	NU	
2	Grail	4,325	0-2	2c	.866	253	.458	NU	
67A	Farnuf	3,945	0-,	2c	.862	252	.297	NU	
57A	Williams-Bowbells	19,683	0-3	2c	.851	248	.413	NU	
68A	Bryant-Grassna	9,510	o-3	2c	.847	247	.526	NU	
7A	Hamerly	1.255	o-3	2s/2e	.810	237	.534	NU	
57B	Williams-Bowbells	71.580	3-6	2e	.802	234	.376	NU	
678	Farnuf	2.40,	S-6	2e	.783	229	.282	NU	
28	Wyndmere	1,280	O-J	3e	.753	220	.526	NU	
21B	Linton	16.31,	3-6	2e	.753	220	.290	NU	
7B	Hamerly	460	Y-6	3e/2e	.723	211	.519	NU	
54	Divide	835	o-4	3s	.723	211	.496	NU	
74A	savage	650	0-3	2c	.723	211	.292	NU	
51	Tonka	9.970	0-1	2w	.722	211	.471	NU	
66	Arveson	285	O-2	3w	.692	202	.685	NU	
58B	Williams-Vida	4.150	3-6	2e/3e	.684	200	.312	NU	
68B	Bryant	28.18,	3-6	2e	.654	191	.416	NU	
13A	Tally	3,320	0-3	3e	.643	188	.365	NU	
748	Savage	460	J-6	2e	.640	167	.278	NU	
18	Parshall	1,070	O-,	3e	.640	187	.305	NU	
,	Williams-Noonan	4.64,	0-4	2e/4s	.632	185	.264	NU	
41A	Promise	2,065	0-3	3s	.632	185	.410	NU	
17	Hecla	1,020	0-3	4e	.628	183	.386	NU	
22B	Linton-Sutley	2,170	2-6	2e/3e	.627	183	.325	NU	
29	Vallers	1.250	o-2	2w	.617	180	.921	NU	
41B	Promise	2,210	J-6	3e	.599	17,	.393	NU	
80	Ranslo	5,495	o-2	3w	.596	174	.824	NU	
13B	Tally	14,886	3-6	3e	.585	171	.,$I	NU	
56	Regan	1,320	O-1	3w	.568	166	.602	NU	
22C	Linton	1.860	6-v	3e	.563	164	.276	NU	
38	Parnell	5,105	o-1	3w	.562	164	.459	NU	
68C	Bryant	3,050	6-v	3e	.559	163	.401	NU	
65B	Bryant-Sutley	3,600	2-6	2e/3e	.559	16,	.409	NU	
57C	Williams-Vida	35,630	6-v	3e	.554	162	.298	NU	
400	Opal	1.00,	3-6	3e	.551	161	.359	NU	
34A	Bowdle	6.660	0-3	3s	.519	152	.363	NU	
41C	Promise-Opal	1.245	6-v	4e	.497	14,	360		
21C	Linton-Sutley	4.90,	6-v	3e	.484	141	.315		
34B	Bowdle	5,555	3-6	3e	.478	140	.349		
13C	Tally	3,525	6-v	4e	.469	137	.337		
40C	Opal	2.183	6-Y	4e	.463	135	.342		
27B	Haddock	6,025	O-6	4e	.447	131	.326		
65C	Bryant-Sutley	4,185	6-Y	3e/4e	.446	130	.391		
71	Ranslo-Harriet	3,045	O-2	3w/6w	.423	124	.683		
52A	Lehr	5,525	0-3	4s	.417	122	.182		
52B	Lehr	9,160	3-6	4e	.393	11s	.170		

14

OVERHEAD # 5

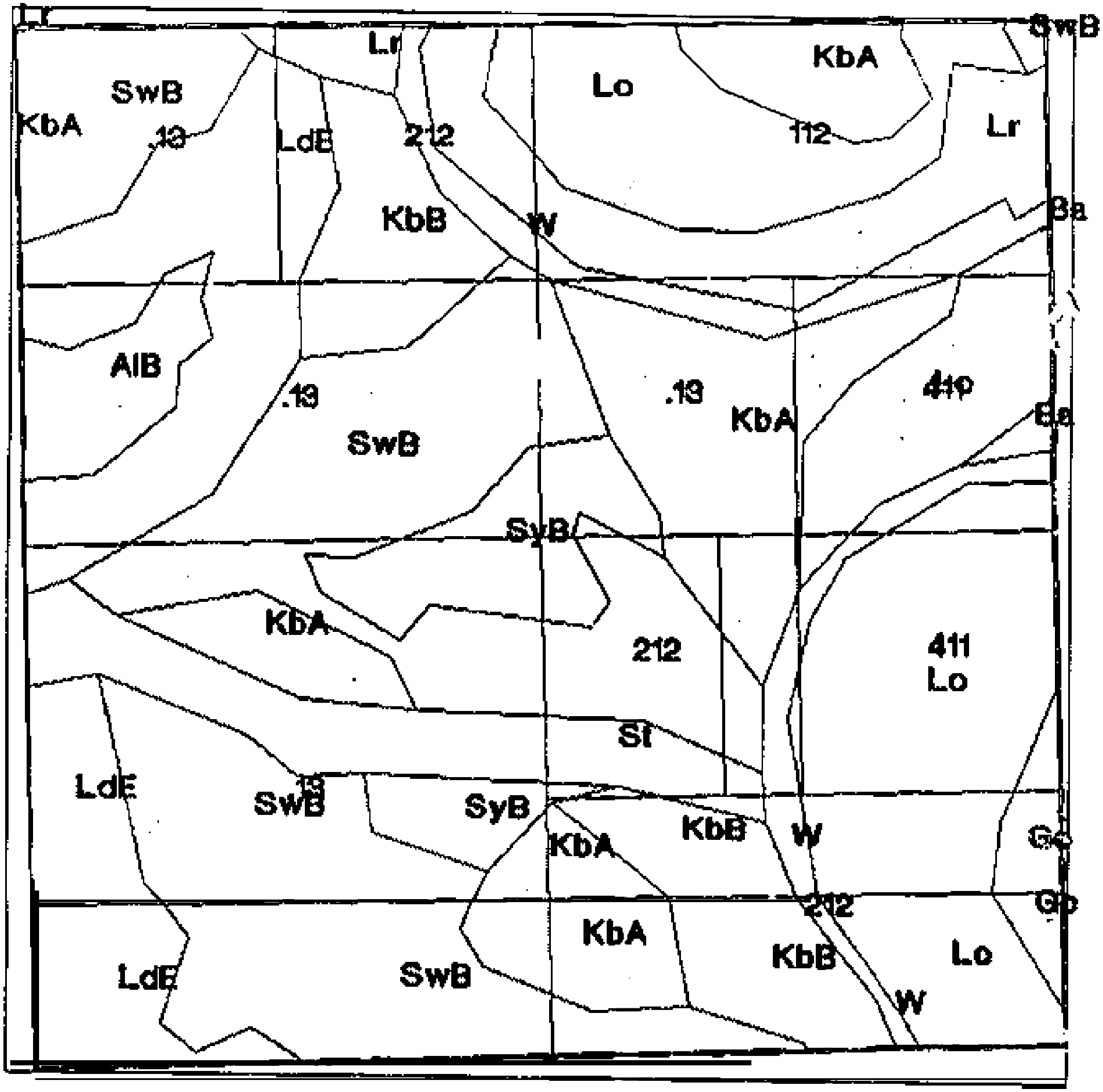
CAMPBELL COUNTY - TABLE 18 · SOIL PRODUCTIVITY RATINGS
RATINGS AND DOLLAR VALUES BASED ON SOIL MAPPING UNITS
SORTED BY FINAL CROP RATING
DEVELOPED BY DEPARTMENT OF REVENUE

September 1992

Map Symbol	Map Unit Name	Acres	Pct Slope	Land Cap Subcl	Final Crop Rating	Crop Dollar Value	Adj Range Rtg	Grass Dollar Value	Foot Notes
24A	Yecross	8,320	0-6	4e	.391	114	.384	NU	
59D	Vida-Zahl	28,280	6-15	4e/6e	.366	107	.293	NU	-
65D	Sutley-Linton	695	9-15	4e	.344	100	.311	NU	
36B	Lehr-Wabek	9,590	2-6	4e/6s	.334	98	.149	NU	
20D	Sully	3,080	9-25	6e	.270	NU	.229	67	1
19	Heil	1,650	0-1	6s	.270	NU	.351	102	1
27C	Maddock	985	6-12	6 6	.270	NU	.302	88	1
24C	Yecross	1,010	6-10	6e	.270	NU	.368	107	1
16	Egas	1,185	0-2	6w	.270	NU	.362	106	1
72	Straw, channeled	1,660	0-2	6w	.270	NU	.577	168	1
10	Hurley	4,750	0-6	6s	.270	NU	.161	47	1
9C	Seroco	395	2-15	6e	.270	NU	.183	53	1
1C	Harriet	6,820	0-1	6s/6w	.270	NU	.455	133	1
40D	Opal-Sansarc	8,325	6-15	6e	.270	NU	.296	87	1
31E	Lihen	1,435	9-20	6e	.270	NU	.304	89	1
3CC	Wabek	1,565	9-20	6s	.270	NU	.097	28	1
0CC	Wabek-Lehr	7,810	6-15	6e/4e	.250	NU	.130	38	1
11	Hurley-Slickspots	2,305	0-6	6s/7s	.220	NU	.135	39	1
21D	Sully-Zahl	1,395	9-40	6e/7e	.220	NU	.204	60	1
61E	Zahl-Vida	9,560	9-30	6e/7e	.220	NU	.252	74	1
9E	Seroco-Dune land	315	9-25	7e/7s	.160	NU	.121	35	1
77	Pits, gravel	375	0-40	7s	.160	NU	.184	54	1
29	Vida, very stony	1,390	3-15	7s	.160	NU	.365	107	1
30	Parnell, ponded	2,980	0-1	7w	.160	NU	.246	72	1
39E	Sansarc-Opal	18,705	15-40	7e	.160	NU	.265	77	1
32F	Flasher	660	25-50	7e	.160	NU	.175	51	1

15

OVERHEAD # 6

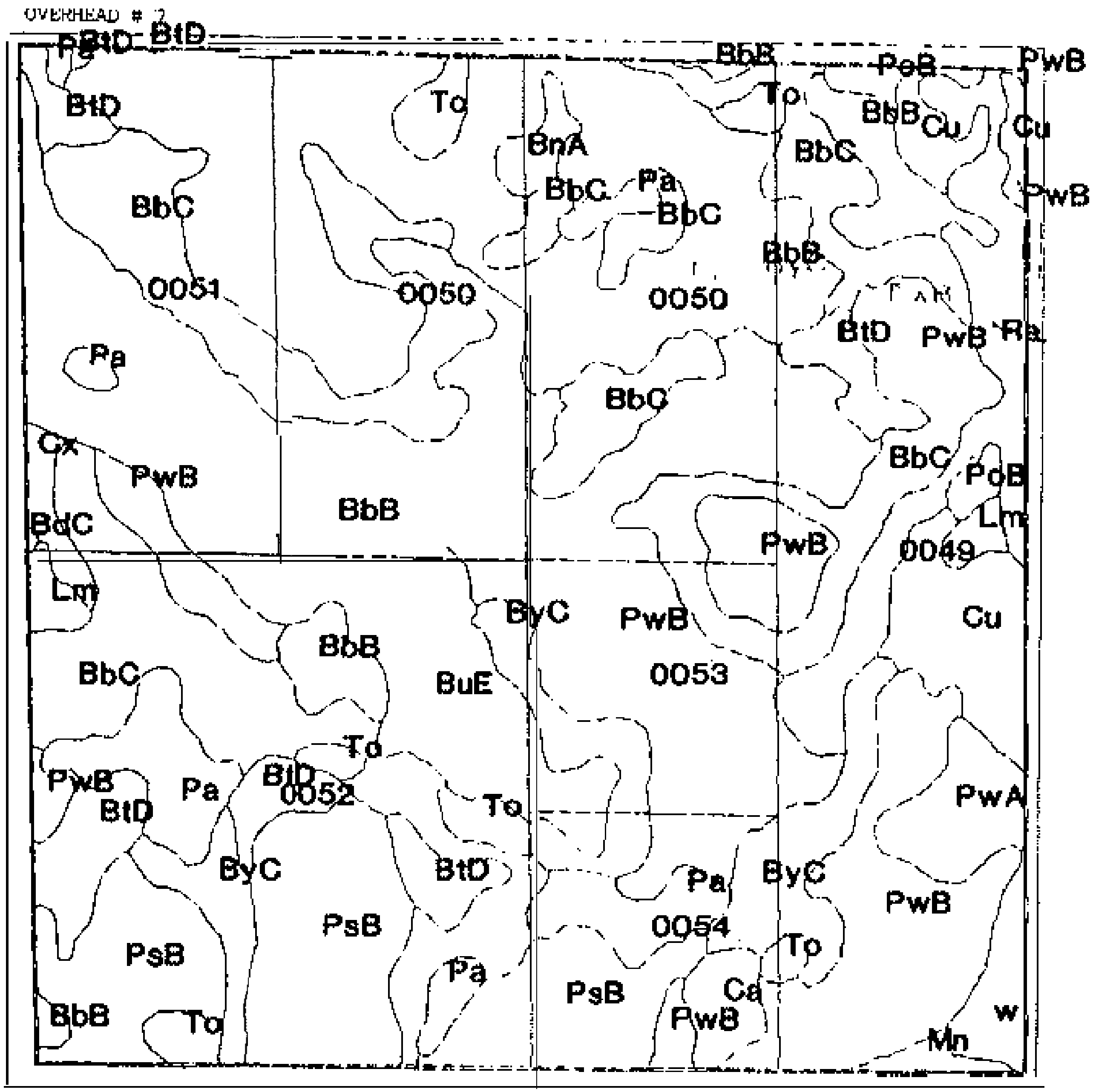


Meade

Township
005N

Range
009E

Section
24



Hamlin

Township
115N

Range
053W

Section
10

DATE 9/30/93 OVERHEAD # 8 MEADE COUNTY SOIL SURVEY REPORT

PARCEL NUMBER DIST OWNERS NAME S T R LEGAL DESCRIPTION

PUB SYMBOL	SOIL DESCRIPTION	SLOPE PERCENT	LAND SUBCLASS	RATING	SPOT ADJUST	ACRES	$ VALUE PER ACRE	TOTAL ASSIGNED VALUE	ASSIGNED VALUE AFTER TWP ADJUST	ASSESSED VALUE
57.00.11	U-462 STURGIS,CALVIN		0 11 11	ALL						
ACB	ABSHER-SLICKSPOTS	2-6	6s/8s	.098 G		5.670	23.52	133	133	133
BTE	BLACKHALL-TWILIGHT	9-40	7e/6e	.242	G	3.870	58.08	221	225	225
BPB	BULLOCK-PATCHIN	0-4	4s/4e	.189 t		62.280	41.31	2,025	2,121	2,121
BSB	BULLOCK-SLICKSPOTS	0-6	6s/8s	.098 G		.220	23.52	5		5
CAE	CADBART	9-40	7e	.224 G		60.110	u.71	3,662	3,662	3,662
DEC	DEERTIDGE-CADBART	6-15	6e	.230 6		40.560	55.20	2,239	2,231	2,239
EAB	EAPA	2-6	3e	.720 C		33.920	172.80	5,861	5,861	5,861
EBB	EAPA-DEERTIDGE	2-6	3e/4e	.615 C		27.720	147.60	4,091	4,091	4,091
EBC	EAPA-DEERTIDGE	6-9	4e	.556 C		76.430	133.44	10,199	10,199	10,199
GRA	GERDRUM	0-4	4s	.333 G		199.930	71.12	15,978	15,978	15,978
MC	MAVIE, CHANNELED	0-4	6w	.235 G		75.270	56.40	4,245	4,241	4,245
PBB	PATCHIN-BULLOCK	2-6	4e/6s	.144 G		20.490	34.56	708	708	708
W	WATER,GREATER THAN 5 ACRES			.075 G		23.930	18.00	431	431	431
YAC	YAWDIM	6-9	6e	.265 G		1.620	63.60	103	103	103
				.310		649.020		50,705	50,705	50,705
	TOWNSHIP TOTALS			.330		649.020		50,705	50,705	50,705
	GRAND TOTALS			.330		649.020		50,705	50,705	50,705

OVERHEAD # 9

CAMPBELL HOMME COUNTY TABLE 1B - SOIL PRODUCTIVITY RATINGS
RATINGS AND DOLLAR VALUES BASED ON SOIL MAPPING UNITS
SORTED HIGH TO LOW ON FINAL CROP RATING
DEVELOPED BY SOUTH DAKOTA DEPARTMENT OF REVENUE

MAPPED ACRES	468,461
ADJUSTED VALUE OF MAPPED ACREAGE	$ 79,638,370
HIGHEST DOLLAR VALUE (DRYLAND)	$292.00
AVERAGE COUNTY RATING	.582175

IF OUR PRODUCTIVITY VALUE DOES NOT EQUAL OUR MARKET VALUE. THE PRICE LAND IS SELLING FOR, WE THEN HAVE TO ADD A PERCENTAGE FACTOR TO BRING IT UP TO MARKET. HERE IN SOUTH DAKOTA, ALL AG LAND IS SELLING MUCH HIGHER THAN THE PRODUCTIVE VALUE.

SOME OF THE PROBLEMS WITH THE USE OF THE SOIL SURVEY ARE, SMALL INCLUSIONS, USING SPOT SYMBOLS SUCH AS STONES. WET SPOTS. TERRACES,ESCARPMENTS, AND INACCESSIBILITY. 'THESE SITES HAVE TO BE FIELD INSPECTED AND IN SOME CASES A RATING AJUSTMENT IS MADE FOR THAT PARCEL. MOST OF THE MORE PRODUCTIVE SOILS IN WESTERN SOUTH DAKOTA ARE FOUND ON STREAM TERRACES. IF THE CHANNELED AREAS WERE NOT SEPERATED FROM THE REST OF THE TERRACE. IT CAUSES QUITE A PROBLEM BECAUSE OF THE HIGH PRODUCTIVE VALUE PLACED ON THE UNCROPPABLE. UNCROSSABLE CHANNEL. SOME OF THESE AREAS ARE SO SMALL THEY ARE INACCESSABLE WITH MODERN MACHINERY. WE ALSO HAVE SOME PROBLEMS ON COUNTY LINES WHEN LAND OWNERS OWS LAND IS TWO COUNTIES.

THE USE OF THE SOIL SURVEY COUPLED WITH PRODUCTIVITY TO FIND THE BASIC VALUE OF AC LAND IS THE FAIREST WAY. IT IS NOT INFLUENCED BY MANAGEMENT.

Soil Impacts on Solid Waste Facilities

Presented by Deborah Barton, Executive Director. South Dakota Solid Waste Management Association on May 20, 1996. Rapid City, SD

Thcrc are various types of solid waste facilities that arc impacted by soils and in turn can and do impact soils. A few definition of terms needs to be established before going into detail about soil impacts. First a solid waste facility in South Dakota is any facility dealing with solid waste in any form including hazardous liquid materials, recyclables requiring to be sorted or pulled from garbage (referred to as a material recovery facility or MRF), construction and demolition debris, petroleum contaminated soils, restricted use (a special type of inert solid waste site), whey disposal, waste tire storage, used appliance storage, and finally sanitary landfills. Most of these facilities require some form of permit to be constructed and operated within the state of South Dakota For tribal areas and other states, several of these types of facilities may exist, may require a permit or not, and in some cases, are not allowed Solid waste as defined for our use is any item discarded or can no longer be used for its original use. Some generic terms include trash. garbage, refuse, and litter.

Based on these very basic terms and understandings, soils can be a significant factor in siting, constructing. and operating a solid waste facility. For instance, when determining a solid waste facility is needed, a decision has to be reached on where to place the facility Some of you have heard of NIMBY (not in my backyard). NIMTOO (not in my term of office), and a few have heard of BANANA (build absolutely nothing anywhere near anybody). These three acronyms have the biggest nontechnical impact on decisions involving siting. From a technical point of view, however. an understanding of the soils and soil types at potential locations can be not only critical but pivotal in the decision making process. In addition, this knowledge can either be used in defense for or against the NIMBY, NIMTOO and BANANA.

Recycling centers typically do not need as detailed a look at soil types when under construction as they typically as a warehousing type of function - "clean" materials are brought to the site, processed and then shipped to other markets. Aluminum cans is the easiest to visual in this type of operation. However. for someone doing an environmental audit during financial discussions, a look at soil types should be done. For instance, my company, Wasteline, Inc. has been involved in several Phase I environmental audits and assessments for banks wanting to verify the level of risk they are taking. By checking the local soil survey maps. if available, in addition to historical usage of the site, proposed usage of the site, and existing conditions on the site. a recommendation can be made to the lending institution as to the level of potential risk and whether a phase 11 investigation is warranted A phase II typically requires well drillings to check actual soil types and contaminant levels in soils. In the case of old service stations, this can be important to determine whether soils have been contaminated with petroleum products. If the soils are contaminated or a tank is found to be leaking. the soils are removed and taken either for burial at a landfill or else to a soil treatment

the levIin.or burialm (the.)TiSoueumDakota well

90 to 95% of our drinking water in this state comes from groundwater. Groundwater contamination is a concern for us. And good tight soils give us better protection than sandy soils. In addition, with the concerns about the various aquifers which are not recharging as rapidly as they are being used, such as the Ogalala, the more we can protect the groundwater, the better.

Sanitary landfills, a type of oxymoron when you think in any depth about it, are required to do a better job of protecting the groundwater than their predecessors, the town dumps. In particular, on 9 October 1991, a day almost to be remembered in infamy - like Pearl Harbour, the United States Environmental Protection Agency. the EPA. enacted far reaching rule making that changed significantly the means we take to dispose of our solid waste, garbage or trash. Besides making consultants richer, some design standards were made more stringent. Among them was the requirement for a liner at the bottom of the landfill and another at the top that had to have a permeability of I $x 10^{-7}$ which is believed to be adequate to prevent the migration of leachate (garbage juice) from the landfill into the groundwater.

Liners can be of three types: 1) earthen (soil); 2) geosynthetic (polymer) and 3 composite. Earthen can bc either man-made (ie. recompacted or mechanically stabilized) and naturally occurring soil liners (like areas of Westcm South Dakota where the clay is actually exported to states needing soils low permeability). Geosynthetic liners arc materials used for soil applications from materials that are synthetically made. There arc four categories of geosynthetics: geotextiles, geogrids, geomembranes and geocomposites. Geomembranes arc believed to be the most impervious. Composite liners are a mixture of earthen with gwmembranes which arc also referred to as FMLs or flexible membrane liners. EPA prefers the composite liner, however, they allow approved states the latitude to accept alternative liner systems such as earthen liners that are proved to meet or exceed requirements for hydraulic conductivity, i.e. permeability.

The desirable characteristic of a liner used for solid waste includes at least three considerations:
1) low permeability - low hydraulic conductivity.
2) compatibility with the waste being deposited and the leachate produced ie. must be able to withstand the various chemicals that may be contained in leachate - acids, bases, organic fluids and who knows what - we call it the ethylmethlawful that gives you three legged, two headed calves chemicals.
3) attenuation capability or the ability to delay or decrease the rate of materials.

At this point one more acronym comes to mind, CATNIP - cheapest available technology not involving prosecution. Many concerned citizens believe that unless a fully geosynthetic liner is used, all a landfill will due is leak poisons into the groundwater and poison all the neighbors. In some cases this may be true, however, the use of geosynthetic member is not a guarantee either since a tiny hold in the liner could be enough to Ict out the poisons. Considerations to be given to earthen liners can be either naturally occurring soils within the immediate vicinity of the site, blended soils or soil mixtures, or amended or chemically stabilized soils. Because of the low permeability requirement, clay is the best naturally occurring soil to use in liner systems. However, not everyone is blessed, -- or cursed depending on your point of view -- with an abundance of Colony, Wyoming bentonite kitty litter clay soil on site.

As mentioned, the primary purpose of the liner system is to prevent or greatly reduce migration of pollutants into the groundwater. To this end, the use of soil liners can be improved by minimizing the permeability coefficient of the soil. Factors to be considered by engineers when designing for use of a soil liner is the soil particle size and particle size distribution, mineralogical composition, void ratio, degree of saturation, soil fabric and pore fluid chemistry. Decreased particle size, increased clay particles and their distribution in the soil, and well graded soils will decrease permeability and hence improve the overall effectiveness of soil liners. In addition, the compacting of the soil in place to include water content during compaction, clod sizes in the soil and type of compaction will also affect the permeability of the soil liner. Exposure of the liner to the elements, especially during freeze/thaw cycles can greatly change the permeability of the soil liners - most usually to the detriment of the liners and thus to the owner/operators of the facility who have just increased their liability exposure to a potential contaminant release into the ground water - or in some cases into surface water if the facility is next to a stream or other body of water.

During construction and operations, the facility owner/operator needs to ensure that periodic tests are being run on the liners to better ensure that adequate protection is being put into place to reduce liability risk. For those of us in the solid waste industry, our liability does not end when we close the gate and put a 2 foot layer of dirt or other liner system on top of the last garbage truck of trash dumped According to the current federal rules, the owner is liable for all monitoring of a landfill site for a minimum of 30 years and can be held liable in perpetuity, ic. forever or until the Lord returns, whichever occurs first. So the importance of a properly placed, maintained and operated liner system can not be emphasized enough. So some considerations to bc given when using soil liners, especially for larger sites includes protecting the liner from desiccation and freeze-thaw cycles by providing an insulating cover until waste is placed on the liner. Additional, staging the construction of the liners in deep holes by building the side walls incrementally to decrease expo 3 cm€ üàthe side018

BIGHORN NATIONAL FOREST

INTEGRATED RESOURCE INVENTORY

USING A PUBLISHED SOIL SURVEY

Kathleen A. Emerson, U.S Forest Service
Cody IRI Center, Shoshone National Forest
Cody, Wyoming

The Integrated Resource Inventory (IRI) is a system that spatially locates, vertically integrates, and describes land, water, and vegetation in a geographic information system (GIS). The goal is to provide one source of data for land management decisions based on resource information in a format common across Forest and Regional boundaries. The IRI is composed of three distinct themes: The Common Land Unit (CLU) combines geology, landform, soils, and potential natural vegetation, and represents ecological units that are stable over time. The Common Water Unit (CWU) contains information about stream, lake, and groundwater systems. The Common Vegetation Unit (CVU) includes both live and dead existing vegetation, reflecting disturbance history and successional status. The IRI process uses all reliable existing information together with photo interpretation to provide the spatial and attribute data for each layer. The layers are integrated within the 6th level watershed, at a 1:24000 scale, before being scanned and attributed in an electronic environment. The completed IRI information represents the Land Unit Level of the National Hierarchy of Ecological Units.

The Cody IRI team began gathering data concerning the Bighorn National Forest pilot project in the fall of 1995. The purpose was to gain an understanding of the entire inventory process and to allow the specialists from the Bighorn National Forest to see how their data was being integrated. The development of the Common Land unit (CLU) began with an evaluation of the soil survey, published in 1986. It was accurate in regard to soils and geology, but at an Order 3 level; and the granitic region was at an Order 4. Additional geologic information was obtained from the State of Wyoming Geological Survey and Iowa State University. They provided detailed as well as general geology information about the Bighorn Mountains. The general geology is a dome of granite encircled by beds of sedimentary material. The granitic area has had two periods of alpine glaciation. Iowa State University has a field station on the Bighorn Mountains where they study detailed geology and publish the data on topographic maps at a 1:24,000 scale.

Additional information was obtained from other sources. Landslide maps at a 1:24,000 scale were received from the State Geologist. These known areas of landslides will be added to the CLU. A detailed inventory of riparian areas was done by contract a few years ago; this data was available in digital form from the Forest. A general Land Type Association map was done by the soil scientist that completed the survey of the Bighorn National Forest.

Photo interpretation was used to refine the geomorphology of the soil survey map units. A national hierarchy involving geomorphic type, process, and landform was used to subdivide some of the map units that covered large areas. One of the most common areas subdivided was the two ages of alpine glaciation. The older glaciation has a gentler landscape with significantly different interpretation for timber harvest and regeneration than the potholes of the younger glaciation. The potential natural vegetation was obtained from the soil survey and field verified in undisturbed areas.

When the vegetation and water layers were compared to the land layer, areas of coincident lines were drafted on mylar as an independent layer to which all other layers were tied. This process allowed the team to see that the CW information, consisting of areas of open water and changes in valley segments, are tied closely with the soils and geomorphology. The vegetation information was also closely related to soils except were disturbances, such as timber harvest or fire, have occurred. A summary database was created in ARC/INFO with basic soil, vegetation, and water information.

The team did a demonstration for the specialists and managers of the Bighorn National Forest. With the mini-database, we were able to display many examples of basic interpretations. Some of them included maps of parent material, landform, and potential natural vegetation. This last map was compared to the existing vegetation map produced by the vegetation unit. Some areas of concern were noted regarding the number of types of vegetation units; the potential vegetation has fewer categories than the existing vegetation. There needs to be a careful coordination when making these comparisons, so that the data is correctly evaluated. This demonstration provided a chance for everyone to see the utility of entering existing data from many sources and at many scales into a common electronic environment.

As with many projects, there is a need for more funding and people than was originally planned to complete the project on time. Therefore, there are some compromises concerning the amount of information collected. In the Common Land Unit, only seven of the thirty-four map units in the survey will be refined with additional geomorphology data; most of these are the Order 4 units. There will also be a compromise on the amount of documentation and field verification. By carefully selecting the areas to sample, we can provide a high level of confidence in the additional mapping. Recorrelation of the soil survey will be completed at a later date by the Forest.

The integrated resource inventory process provides a means to collect and validate data from many sources and allows this data to be entered into an electronic environment.

NRCS

Soil Science
and
Resource Assessment
Organization Plan

The NRCS Structure for the Development, Evaluation and Delivery of Resources Technology Involves Three New Key Entities:

- **INSTITUTES**
  - **+ COOPERATING SCIENTISTS**
- **NATIONAL CENTERS**
- **INTERDISCIPLINARY RESOURCE TECHNICAL STAFFS**

The National Science & Technology Consortium

Consortium Functions:

1. Provide for consistency in the development and delivery of technical products and services.

2. Provide for communication and networking among consortium members.

3. Coordinate technical activities among all levels of the agency.

4. Coordinate networking among consortium members and external partners.

5. Ensure development of science and technology that is relevant to current and future agency priorities and customer needs.

INSTITUTES

Purpose:

- Maintain and enhance NRCS expertise in special emphasis areas where the agency has an interest in being recognized as a national leader.

Characteristics:

- Comprise a group of 6 to 14 Scientists/ Specialists
- Network with colleges, universities and other organizations
- Not necessarily be located in one place
- Focus technical expertise to support and assist field operations
- Responsible for training the first line technology transfer staff
- Established as long-lasting facilities

Institutes

1. Wetland Science
2. Soil Quality
3. Watershed Science
4. Social Sciences
5. Natural Resource Inventory and Assessment
6. Grazing Land Technology

Cooperating Scientists

1. Soil Erosion and Sedimentation
2. Air Quality
3. Agroforestry

NATIONAL CENTERS

Purpose:

- Produce a specific product or service that the NRCS is uniquely equipped and qualified to provide.

Characteristics:

- Include existing centers such as Soil Survey, Cartography and GIS, Water Supply Forecasting, NEDS, Climate Data and Plant Data Collection Center

- Staffing determined by mission

- Established as long-lasting facilities

National Centers

1. Soil Survey Center -Lincoln, NE

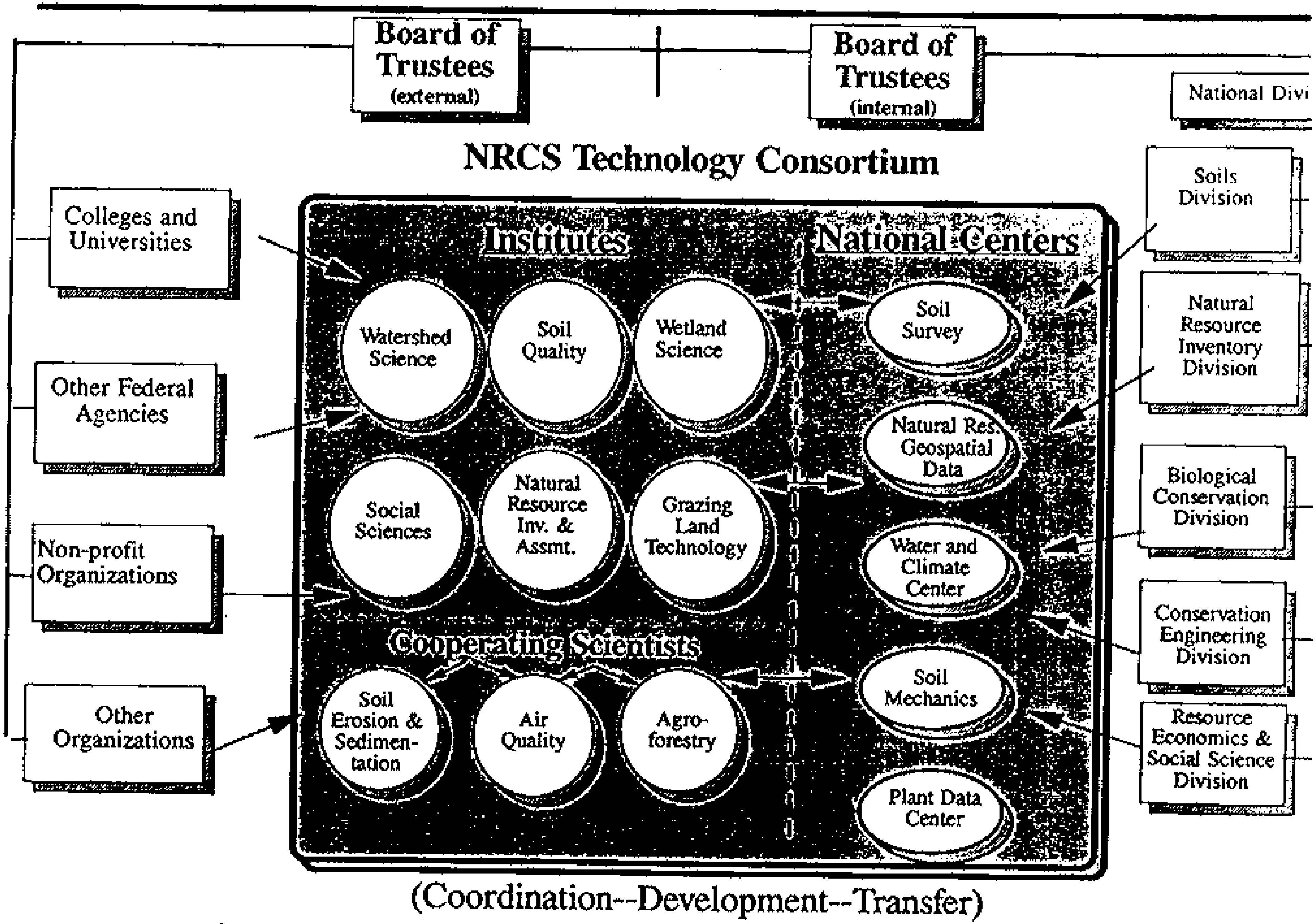
2. Natural Resource Geospatial Data
-Ft. Worth, TX

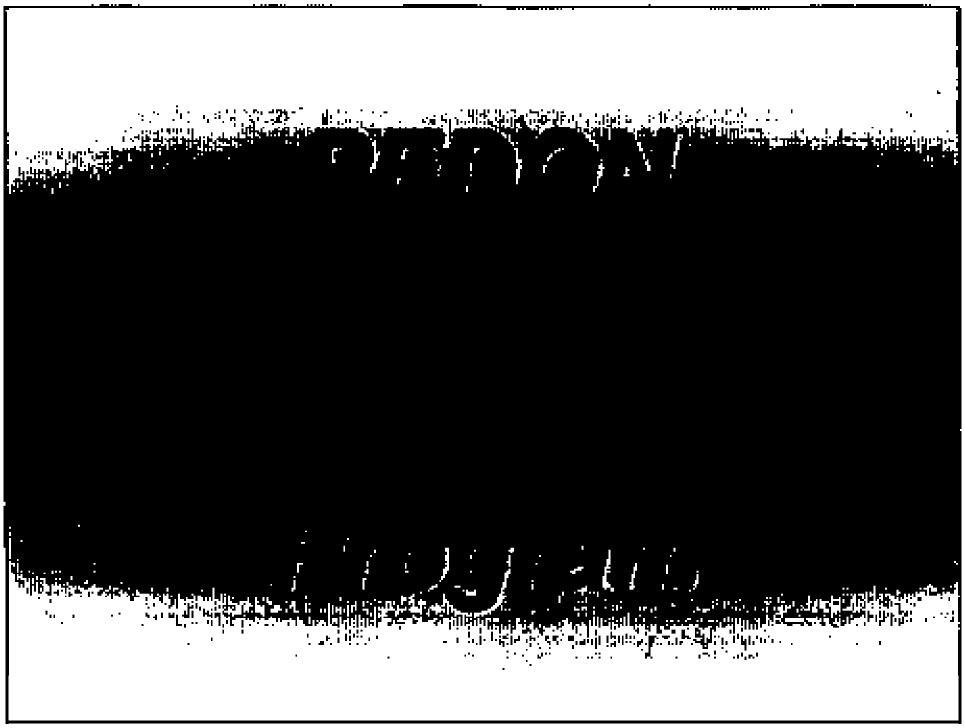
3 Water and Climate Center
-Portland, OR
—Beltsville, MD

4. Soil Mechanics -Lincoln, NE
-Ft. Worth, TX

5. Plant Data Center -Baton Rouge, LA

Deputy Chief for Soil Science and Resource Assessment





Sorry.

After being the PEDON program manager for six years, this slide is just force of habit.

Actually, my purpose today is two fold.

1- Introduce you do the U.S. Army Environmental Center

2- Give you a heads up on impacts the Sikes Act Amendments will have
Specifically, how the changes will provide opportunities to enter into cooperative agreements with the Army to map installations.

The United States Army Environmental Center, as an operating activity of the Army Staff, and under staff supervision of the Director of Environmental Programs, provides a broad range of military funded environmental program management and technical support services to Headquarters, Department of the Army, Major Commands, and installations.

The Army Environmental Center is the largest environmental unit in the three services.

AEC/NRCS Agreements

Memorandum of Understanding between the U.S. Army Environmental Center&the Natural Resources Conservation Service to establish watershed and environmental enhancement

- IAG - Assign a Resource Conservationist
- IAG Soil Surveys of Army Installations
- IAG - Assign a Soil Scientist
- IAG - Assign a Plant Materials Specialist

The Army Environmental Center has many agreements with federal agencies. These are the ones that are important to the Natural Resources Conservation Service.

The MOU serves as an umbrella agreement that allows for and encourages supplemental interagency agreements.

Soil Survey Activities

Fort Bliss. New Mexico and Texas : MOU

Fort Wainwright, Alaska: photography

Fort Hood, Texas: update of Bell County, Texas

Department of Army Installations Soil SurveY Status

- Develop a database of soil survey activity for major Army installations with significant training activity (DAISSYS).
- Coordinate the necessary activity between the two agencies to initiate appropriate levels of soil survey assistance

Sikes Act - Language

The Secretary of Defense **shall** carry out a program of planning for, and the development, maintenance, and coordination of, wildlife, fish, and game conservation and rehabilitation **on military installations. Under the program, the Secretary shall prepare and implement for each military installation in the United States an integrated natural resource management plan mutually agreed upon by the** Secretary of **Defense, the Secretary of the Interior, and the appropriate State agency designated by the State in which the** installation **was located, except that the Secretary (DoD) is not required to prepare such a plan for a military Installation if the Secretary determines that preparation of such a plan is not appropriate.**

The wording in bold are proposed changes to the current law.

Shall replaces 'is authorized to'

Integrated natural resources management plan replaces 'cooperative plan'.

The last emphasis gives the Secretary (DoD) some flexibility in determining which installations need plans.

Definition - Military Installation

- Any land or interest in land owned by the United States and administered by the Secretary of Defense or the head of military department; and
- Includes all public lands withdrawn from all forms of appropriation under public land laws and reserved for use by the Secretary of Defense or the head of a military department.

Definition - Integrated Natural Resource Management Plan

- An integrated plan based on ecosystem management that shows the interrelationships of individual components of natural resource management (e.g.., fish and wildlife, forestry, land management, public access) to mission requirements and other land use activities affecting an installation's natural resources.

Definition - Natural Resources

- All elements of nature and their environments of soil, air, and water. Which consist of the following two general types:
  - **Earth Resources:** Nonliving resources, such as minerals and soil components
  - **Biological Resources:** Living resources. such as plants and animals

Deadline - 36 Months

- Prepare and begin implementing the plans.
- For military installations where a plan was in effect on the day before the enactment of this Act, negotiate with the Secretary of the Interior and heads of appropriate State agencies regarding changes to the plan for compliance with reauthorization language.

Basically, what this means, is that there is no automatic Grandfather clause.

Initial studies have determined that most of the 'cooperative plans' are single species and are not integrated. These will not meet the requirements as set forth in other sections of the Sikes Act.

Impacts

- Every installation with more than 50 acres will need an INRMP
- In most cases, the level of existing natural resource inventory is not adequate.
- An order 2 survey is required.

Department of Defense Acreage

9,000,000 acres

16,000,000 acres

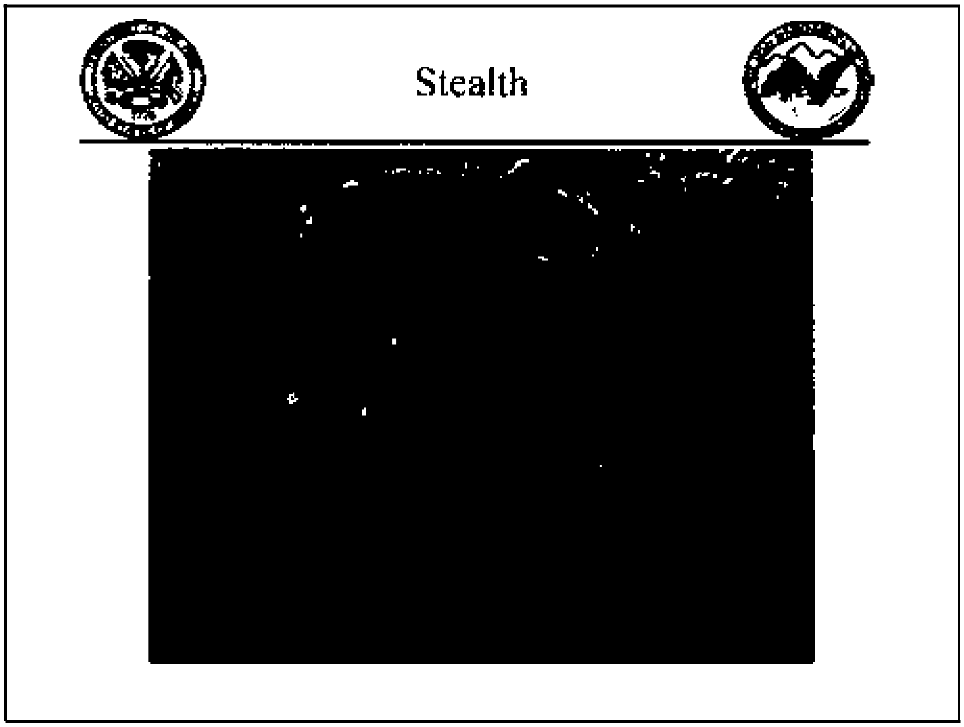
2,000,000 acres

25,000,000 acres

I have no information concerning specific Navy or Air Force installations. I do have a list, more or less complete, of Army installations.

The bottom line of the Sikes Act Amendment is that all of a sudden there are nearly 25 million acres of land that will need to be mapped sometime within the next 3 to 5 years. All of these acres will need to be at an order 2.

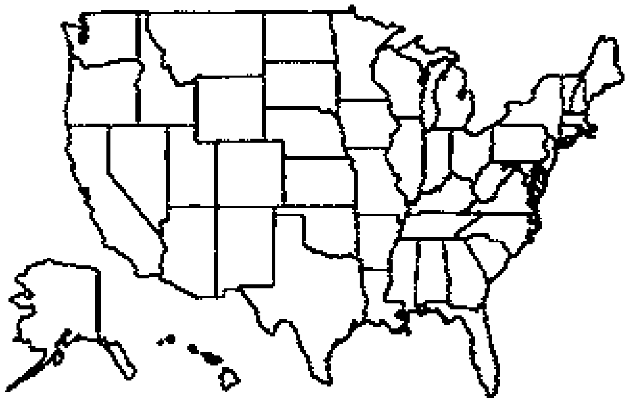
The real problem is not that there is 25 million acres to map. Neither is it the fact that there is only about 4 years in which to do this. For all practical purposes, the real problem is that they are stealth acres.



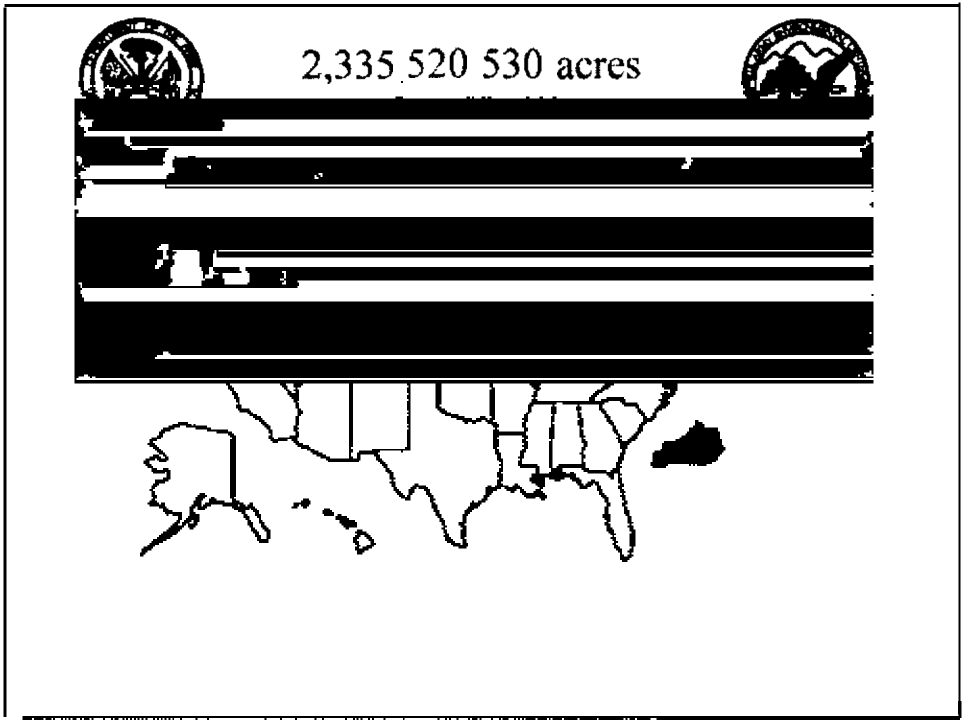
In all likelihood, you know exactly when your non-federal acres are scheduled to be mapped. That is, they show up on the the soil survey radar.

For the most part DoD land has been ignored and we only cared about it when installations came calling. Like the stealth fighter, by the time one sees it, it's too late to plan a reaction.

2,335,520,530 acres



The scenario could happen something like this. One day, NRCS National Headquarters knows that there are 2.3 billion acres in Soil Survey Schedule and that all are scheduled to be something (initiated, completed, published, etc.) by sometime (6/96, 12/99, 3/00, etc.).

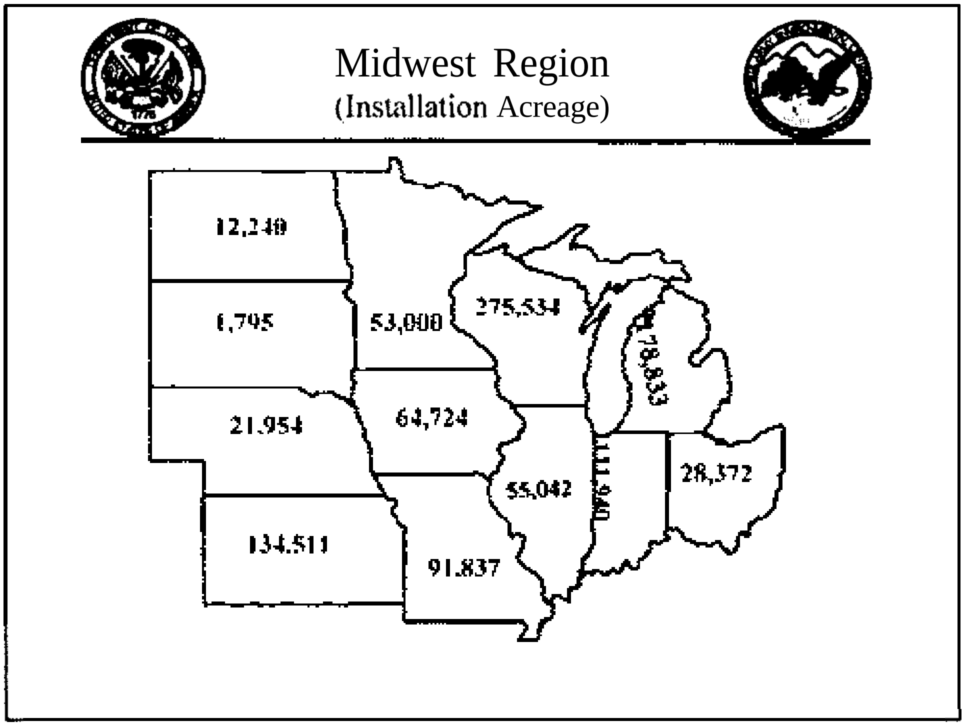


Then, the next day (after the Secretary of Defense calls and asks for soils data) there are still 2.3 billion acres in Schedule. However, there are 25 million that aren't scheduled for anything or need to be rescheduled, with a date of 1999.

That's like having another state the size of Kentucky show up with only some old mapping, some farm plan mapping, and some National Resource Inventory- Primary Sampling Unit's

In the past, most states were able to deal with these stealth acres because they had some soil scientists working in the area on survey's that didn't have mandated end dates. However, with current budgets, the states have turned to reimbursable agreements. This means that if a survey area doesn't get plugged into the planning process several years before it is time to do it, the states won't have the resources.

For example, Texas and New Mexico. They were told 30 September 1995, that Fort Bliss (1.2 million acres) needed to be mapped within the next 5 years, with several hundred thousand acres being mapped by 1998. Texas and New Mexico are going to staff the survey with new hires.



It has been determined that the acreage figures in this slide are valid for Army installations. If they err, it is on the low side. These figures do not include Air Force and Navy installations.

Spectrum Research, Inc.

49 I5 East Superior Street. Suite 100
Duluth, Minnesota 55804-2448
(218) 525.5322

1996 North Central Regional NCSS Work Planning Conference
Rapid City, SD **5/20/96**

Soil Survey Needs for the Next Decade

Presentation Title: **Licensed Professional Soil Scientists**

Presented by: James C. Balogh, Ph.D., CPSSc
Spectrum Research, Inc.
4915 E. Superior St., Suite 100
Duluth, MN 55804-2448
218-525-5322 E-Mail: 73233.3067@COMPUSERVE.COM

Qualifications: Director of Research & Development and CEO of Spectrum Research

Geoscience member of the Minnesota Board of Architecture, Engineering, Land Surveying, Landscape Architecture, Geoscience and Interior Design

Abstract

Professional opportunities for soil scientists have shifted in the last 15 years. As the number of positions shrink in universities, government and agronomic industries, employment is expanding for soil scientists in the private sector. Soil scientists are increasingly active in geotechnical consulting firms and contract research and development (R&D) companies.

Licensing of professional soil scientists is becoming a reality. Professional licenses require a combination of education, experience, and demonstrated competence. Once a license is obtained the professional must be (1) technically competent; (2) personally accountable for professional work; and (3) responsible for continually updating technical expertise.

Licensing also is advantageous to the professional soil scientist. These benefits include (1) professional recognition; (2) compensation commensurate with training and abilities; and (3) the ability to compete with other geotechnical professions.

A soil scientist working in either contract R&D or in private practice must possess a combination of fundamental knowledge and an understanding of problem solving processes. Updated soil survey information will become increasingly important for these professional soil scientists. However, the professional practice of soil science is more than soil mapping and classification, A licensed soil scientist must possess an integrated knowledge of all core areas of soil science.

Monday Afternoon - May 20, 1996

Presentations

1. Soil Survey Direction and the National Soil Survey Center

2. Bureau of Indian Affairs Agency Report

3. Forest Service Agency Report

Soil Survey Direction
and the
National Soil Survey Center

Soil Survey Staff

Presented by C. Steven Holzhey
North Central Regional NCSS Work Planning Conference

The National Cooperative Soil Survey (NCSS)

The soil (pedosphere) is the thin, critical interface between earth and atmosphere, supporting much of the terrestrial life of the planet, filtering much of the water we drink, and catalyzing many of the chemical transformations upon which we depend. Knowledge about characteristics of soils, and soil interactions with other factors, helps people predict and control the influences of human and natural phenomena as we seek to create a "Productive Nation in Harmony With a Healthy Land".

The NCSS helps people understand soils and their responses to a variety of natural and human influences. It accomplishes this through a multi-purpose science-based soil survey. NCSS products are:

(1) Information about the distribution and properties of soils, and of factors affecting the soil environment

(2) Predictions of soil behavior and of the natural systems of which they are a part, and,

(3) Guidance on how to apply the accumulated knowledge of soil survey.

A. Soil Survey Division Thrust Areas

1. Enhance Quality of Soil Survey Information.

a. Continue MLRA Approach to Soil Survey - Erase Political Fault Lines and Fill in Voids in Data.

b. Add Use Dependant and Temporal Soil Property Data for Soil Horizons.

c. Create One Soil Survey For All U.S. Lands

d. Create and hlaintain National Standards for Soil Survey.

2. **Accelerate Application of Soil Survey Information.**

   a. Develop Soil Survey Interpretations (R&D, NASIS, Training)

   b. Create Technical Soil Services Program - State Soil Scientists in 34 states.

   c. Provide Training to Develop Soils and Soil Survey Technical Skills of Field Office Staff.

   d. Digitize 2500 Soil Surveys by 2000.

   e. Re-engineer Publication Process.

   f. Develop NCSS Role in Soil Quality Assessment (Baseline Indicators and Soil Condition Index)

   g. Republish Soil Taxonomy.

3. **Create Easy Access to Soil Survey Information.**

   a. Provide a National and International Soil Data Access Facility (WWW/INTERNET).

   b. Provide a National and International Soil Data Capture and Standardization Software (Windows Pedon).

4. **Aggressively Apply New Technology in Soil Survey.**

   a. Develop Remote Sensing Techniques for Soil Survey - ERDAS.

   b. Develop GPS, GPR, etc. - Field Tools for Soil Survey.

   c. Develop GIS - Select/Query/Report Tools for Soil Survey.

B. **Supporting Processes**

1. **Create a NCSS Research And Development (R&D) Agenda.**

   a. Develop a Comprehensive Listing of R&D Needs for NRCS and Partners.

   b. Select and Prioritize NSSC R&D Activities from NCSS R&D Agenda.

   c. Leverage NCSS R&D Agenda to Increase and Strengthen Partnerships and Accomplishments.

2. Develop and Maintain a National Soil Information System (NASIS).

- **a.** Create NCSS **Software** Tools.
- b. Create a NRCS and NCSS **Networked** Information System.
- c. Integrate Data From Other Agencies and Institutions.
- d. Maintain and Manage 17 Integrated MLRA Natural Resource Data Bases

3. **Provide for Resource (Human and Financial) Development.**

- a. Develop Leadership, Project Management and Team Skills of NSSC, MLRA, State and **Field** Office Soils Staff.
- b. Increase Diversity Within Soil Science Discipline.
- c. Increase Funding for Mapping, Digitizing, Technical Soil Services and Soil Survey Laboratory **-** Investigate **sale** of products and services.

4. **Increase National and International Policy Influence.**

- a. Monitor Soil Resource Condition and Trends and Draft Policy Recommendations.
- b. Continue Active Outreach in International Organizations.
- c. Ensure that Soil Survey Staff Remain in International Demand.

5. **Ensure Political Support for Soil Survey.**

- a. Develop and Implement Continuous Customer Feedback Process.
- b. Actively Market Products and Services.

6. Ensure Scientific **Credibility of Soil Survey.**

- a. Graduate Studies of field staff
- b. Sabbaticals (national and international)

Soil Taxonom

Interpretations Group

. SHORT-TERM -- Work with states to develop a strategy to train state and field staff on how to develop interpretations criteria, and evaluate interpretations results for all interpretations (Urban, Grazing lands, Forest, Agronomic, etc...) Training should be coincident with the NASIS 3.0 Release of the Interpretations Module.

Implement new national interpretations.

Coordinate with Soil Quality, Wetlands Science, Grazing Lands, and to some extent other institutes to develop interpretations and support activities, for example the development of a soil condition index. Support national program needs and requests, for example soil data for CRP sign ups.

Develop and coordinate Soil and Ecological Science Standards.

. MID-TERM -- Work with states, institutes, NCSS and others to document interpretations needs, and develop strategies for developing these interpretations including coordination across political boundaries.

. LONG-TERM -- Examine the basic fundamentals of soil interpretations, including why interpretations are made, what is accomplished, etc...

Information Architecture Group

. SHORT-TERM -- Work with states to implement (distribute, train, support and procure hardware and software) NASIS 2.0. Coordinate with others programs such as FOCS on software, hardware and data needs.

Coordinate design of software for NASIS 3.0 and 4.0.

. MID-TERM -- Develop an action plan for integrating all soil information data collection, management and distribution (field, lab, etc) from all NCSS sources and develop a system lifecycle plan. Integrate this strategy with other NRCS activities.

Evaluate the effectiveness of the National Soil Information System.

. LONG-TERM -- Develop scenarios for next generation Soil Information Systems.

Analytical/Research Laboratory Group

. SHORT-TERM -- Eliminate backlog and establish a 3 month turn around for characterization projects and a 1 month turn around for reference projects. Dedicate no less than 50 percent of capacity to state driven demand. Acquire and implement a LIMS. Refurbish Basement. Learn about process mapping.

. MID-TERM -- Begin Laboratory Process Mapping --
- Cycle Times
- Workload Flows
  * Peak Demands
  * Staffing vs. Demand Function
  * Routine vs. Special Handling

Develop plan to implement results of process mapping and other ideas.
  * Establish Testing Criteria for "Good or Bad idea".

International - World Soil Resources, John Kimble

. SHORT-TERM -- Develop a strategy and funding for scientific exchanges. Evaluate and document what soil and soil survey assistance and expertise is needed for key target countries and develop a 5 year program for meeting those needs. Evaluate and document where expertise [subject area and scientist(s)] exists in other countries that will help advance the NRCS and Soil Survey Strategic Plan.

. MID-TERM -- Develop an action plan for establishing a world soil data access facility, including data acquisition plan.

Training - Earl Lockridge and Lea Ann Pytlik

. SHORT-TERM -- Work with states to develop a needs assessment and training strategy for state and field soil scientists. Work with State Soil Scientists and other principle state staff to develop a needs assessment and training strategy for field office staff in soil, soil survey and related topics.

. MID-TERM -- Investigate training methods. Evaluate effectiveness of current training methods.

Investigations Group

- SHORT-TERM -- Develop proposal for segmentation of time between;

  - Consultation/training - support to states and others
  - Research - defined by NCSS and NSSC research agenda
  - Support to NSSC functional groups and teams
  - Support to the Soil Survey Laboratory

. MID-TERM --Define the NSSC component of the NCSS R&D Agenda

Soil Survey Research and Development (R&D) at the NSSC

Soil Survey R&D contributes to the understanding of soils and allows people to betterS.044ibuteD (includilsgl

Concern | Driving Forces |
---|---|---

Climate Change	Soil information for carbon sequestration and and climate change models	-Impact of CRP -Inventory and maps of soil carbon -Methods to monitor soil climate -Predictions of soil impacts
Wetlands	Need to understand hydic soils	-Characterizing redox processes and water table regimes.
Soil Genesis/Landscape Evolution	Basic research needed to understand soil formation, processes and interactions as back stop for all NRCS programs.	-Soil Stratigraphic Studies -Andisol Studies -Hydrothermal Soils -Anthropogenic Soils -Soil Survey Project Questions -Use Dependant Temporal Properties
Soil Survey Lab and Field methods and Technology Development	Procedures and tools to help laboratory and field staff	-New Lab Characterization methods -Geophysical tool development -GIS tool development -Neuronetworking

Current and Future Research Topics

Soil Quality Indicators. The definition of soil quality is close to that of Larson and Pierce. Research by the NSSC provides methods for assessing inherent quality of the soil, and for assessing the soil condition relative to that inherent quality. Collaboration beyond the NCSS includes helping people understand soils, soil geography, soil processes, soil survey data, and application of soil survey data. It also includes the development of concepts and approaches to issues under the banners of soil quality, soil health, resiliency, and fragility.

Topics:

a. Properties that indicate quality
b. Data relationships to estimate properties that indicate quality.
c. Field procedures to measure properties that indicate quality.
d. Interpretations that indicate status of soil quality (are we sustaining the resource?)
e. Interpretations that imply status of other ecological components.

Soil Quality and Use Dependent Soil Properties. This encompasses those soil qualities that vary with use and that affect predictions of soil performance. Present emphasis is on survey and prediction of surface horizon crusting and sealing that affects water intake rates, water transmission, root penetration and seedling emergence, and erodibility. Plow pan formation is included. Future emphasis will include chemical changes through agricultural practices.

Water intake and transmission affect a wide array of interpretations. Use-dependent ranges are greater than ranges in soil permeability classes. Water management models, erosion prediction models, and a host of other present and future simulations to predict sustainability are dependent upon soil survey data as input.

Research on the physical qualities encompasses the development and testing of survey procedures, and procedures for populating the NASIS data base. This requires collaboration with scientists who are familiar with model requirements, and with practitioners who are developing applications dependent upon the soil survey data base. It encompasses literature reviews and consultations with experts to determine which procedures and qualities are practical predictors. It also encompasses consultative work with those who wish to use the soil survey to assess soil qualities, or to predict effects of alternate land uses.

Topics:

a. Identifying the important land uses in order to stratify the information.
b. Identifying important soil qualities.
c. Field measurements, including intake rates and hydraulic conductivities.
d. Procedures for creating and populating the data base.
e. Protocols for use with interpretations.

Future Research will encompass pH effects of fertilizers: and the accompanying changes in nutrient availability, toxicities, and hydraulic conducttvities. Research will include literature review, consultations, and testing of criteria for predicting susceptibility to change.

Soil Quality and Erodibility. This topic encompasses the methodologies and criteria for assessing and modelling (WEPP and WEPS) soil erodibility by wind and water. It is limited to collaborative work with scientists developing methodologies, and with practitioners applying predictive tools.

Topics:

a. Collaboration on setting up experiments to test soil erodibility.
b. Selection of soil properties to test for predictive value.
c. Selection of predictive criteria against known soil performance
d. Development of methods survey new predictive properties and populate the NASIS data base with new data elements.
e. Improvements in descriptive soil survey information to accommodate predictions, for example, developing ways to indicate locations of map unit components in the paths that water must take along a hillslope.

Water Quality and Soil Hydrology. This topic encompasses the understanding of water movement and storage in landscapes in order to understand soil patterns, and potential changes in soil patterns with natural or induced changes. Water movement contours most of the erosion/deposition in most landscapes. Water infiltration, percolation, and storage affects much of the biological activity and movement of chemicals both over and though the soil.

Current emphasis is on methods and partnerships to consolidate and incorporate our knowledge of soil hydrology into soil survey products and consultation with model developers and those who are applying the model.

Topics:

a. Landscape models showing edaphic, physiographic and ecological influences as the basis for predicting effects of potential change.
b. Methods for measuring hydraulic conductivities.
c. Methods for calculating hydraulic conductivities from soil properties.
d. Data and methods for predicting and measuring seasonal and annual variations in water states.

Water Quality and Chemicals in the environment. This topic encompasses the methodologies and criteria for assessing and modeling chemicals that have been added to the soil. It is limited to collaborative work with scientists developing methodologies and models to use soil survey data such as those in FOCS.

Topics;

a. Salinity
b. Heavy Metals
c. Nitrogen, Phosphorus, and Potassium
d. Pesticides

Climate Change This topic encompasses the soil data required to predict effects of greenhouse gases on global climate change, and the effects of man on greenhouse gases. It is limited primarily to the priorities of the USDA global change initiatives.

Topics:

a. Carbon sequestration in soils, including influences of man and climate.
b. Development of soil data bases at Long Term Ecological Research and other research locations.
c. Assistance to scientists in use of soil survey data to model global change.
d. Studies of soil climate and tests of predictive value of soil features in reconstructing past climate.
e. Documentation of current crop yields by soil and climate.
f. Preparation of North American and United States soil maps and characterization data for use in global change studies.

Wetlands and Hydric Soils. This includes research relating soil morphology to wetland regimes, and detailed studies of water tables in soil and landscapes.

Other Areas.

-Soil Genesis and Landscape Evolution
-Soil Survey Laboratory and Field Methods and Technology Development
-Soil Productivity Modeling
-Prescription Farming
-Soil Survey Reliability
-Soil Variability and Map Unit Composition (Statistical Approaches)
-Soils and Human Health

Bureau of Indian Affairs

Agency Report to the

1996 North Central Soil survey Conference

History

The Bureau of Indian Affairs is a unique agency in that it is set up to serve both people and land. When Columbus arrived in the new world there were about 1,000,000 American Indians in the country. Treaties were set up between the United States Congress and the native American tribes as the immigrants from Europe pushed westward. All of the Judicial Treaties were negotiated between 1778 and 1871. The Bureau of Indian Affairs, created in 1824, under the War Department was to handle the Indian issue. In 1830, Andrew Jackson, with the aid of the Indian Removal Act, moved over 70,000 Eastern Indians west of the Mississippi. This movement created what now is known as the "Trail of Tears". As a result of disease, and for the lack of a less harsh term, military actions, the American Indian population shrank to 500,000. In 1849, the Bureau of Indian Affairs came under the umbrella of the Department of the Interior, the guardian of the country's natural resources. The Allotment Act of 1887 opened up 389,000,000 acres to be divided amongst the various tribal members on the judicial treaty reservations. This act in itself did not shrink the reservation boundaries, but the results of loosing the recently assigned "allotted lands" through encumbrances, mineral discoveries, or outright sales, did. Tribal lends could not be sold.

Today

Today there are just under 2,000,000 American Indians, 40% of this population is under 20 years of age. Only half live on the reservation. There are 314 federally recognized reservations speaking 250 tribal languages.

Aberdeen Area Office GIS Soil Survey Use

All of the base themes on USGS quadrangle maps have been digitized for each reservation in the Aberdeen Area which includes Indian Trust Lands in North Dakota, South Dakota, and Nebraska, except contour lines. In addition, wetlands, range units, leases, dems, ownership, **surface cover types, landsat imagery** and soils coverage have been or are being created for most trust lands. Digitized soil surveys are available for Shannon, Bennett, Jackson, Rosebud, Lyman, Dewey, Zeibach, Corson, Moody, Charles Mix counties in South Dakota In North Dakota, Sioux, Mercer, Mountrail, Mclean, McKenzie, Dunn, and Rollette counties. In Nebraska, Thurston, Burt, and Knox counties. The Winnebago Tribe is using soil survey information to locate suitable housing sites, The Lower Brule Sioux Tribe is using it for landfill site selection. All BIA agency realty and land operation offices use the soil survey to determine rental rates and land purchase appraisals. The bureaus Natural Resources Inventory Survey includes a section on soils classification. With the aid of GIS, valid verifiable numbers will become a part of this report to Congress We look forward to working with all the agencies represented at this conference especially the NRCS.

WINNEBAGO TRIBE OF NEBRASKA

HOUSING TASK FORCE

SITE SELECTION PROJECT

ABSTRACT: The Winnebago Tribe of Nebraska has long recognized that one of the critical issues related to economic and social development of the Tribe is availability of suitable housing for its members. Beginning in 1994 a housing tank force was set up to develop both short and long term plans to address the needs. With the population of the Tribe expected to double within twenty years, the identification of suitable development sites was deemed to be crucial. It was determined that, for long range planning purposes, information needed to be generated which would allow the tribe to target its resources. The most efficient method for reservation wide analysis was through the use of GIS. Working with architectural engineers and geoscience professionals, as list of critical criteria was developed. There included such factors as depth to ground water, shrink-swell potential of the soil, and potential for surface water problems. Using information gathered by consultants for the tribe and found within various data bases, attachmenta were made to various GIS layers. The most critical of these was the soils layer, originally generated fmm soil surveys published by USDA. Graphics were generated from various manipulations of this information providing the decision makers valuable information for the targeting of limited resources.

1996 NCSS REGIONAL CONFERENCE - RAPID CITY, SD MAY, 1996

Forest Service Agency Report

Jerry Freeouf

USDA FOREST SERVICE

THE NATIONAL FOREST SYSTEM

- -155 NATIONAL FORESTS
- -20 NATIONAL GRASSLANDS
- -192 MILLION ACRES OF PUBLIC LANDS

WITHIN THE MIDWEST/NORTH CENTRAL REGION OF THE NCSS:

- -14 NATIONAL FORESTS
- -4 NATIONAL GRASSLANDS
- -13.4 MILLION ACRES OF PUBLIC LANDS

IN ADDITION TO THE NATIONAL FOREST SYSTEM, THE FOREST SERVICE ALSO HAS A RESEARCH BRANCH, A STATE & PRIVATE FORESTRY BRANCH, AND AN INTERNATIONAL FORESTRY BRANCH.

THE FOREST SERVICE IS COMMITTED TO AN "ECOLOGICAL APPROACH" TO MANAGING NATURAL RESOURCES.

AN ECOLOGICAL APPROACH MEANS BASICALLY THAT OUR MAIN FOCUS IS ON THE LONG-TERM CONDITION AND SUSTAINABILITY OF ECOSYSTEMS, RATHER THAN ON SINGLE RESOURCES, OR SHORT-TERN PRODUCTION OF GOODS AND SERVICES. We still produce goods & services - such as wood products, forage for animals, recreation use, minerals, wilderness experiences for people, etc.-- But each resource is not looked at individually, but together as a larger goal of ecosystem management.

To move us toward an Ecological approach, the Forest Service employs a multi-disciplinary work force, and strives toward working in an interdisciplinary fashion toward meeting our objectives.

This includes, as a basic element, an Interdisciplinary methodology for developing and displaying reliable information about characteristics, capabilities, use-management limitations, and behavioral predictions of ecosystems at different scales and/or levels of resolution. The basic tool for this methodology for the Forest Service is THE NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS.

The National Hierarchical Framework of Ecological Units is a regionalization, classification and mapping system for stratifying the earth into progressively smaller areas of increasingly uniform ecological potentials.

THE NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS (NHEU) is a structure to facilitate the mapping, display, and interpretation of Ecological Units at several different geographic scales, to respond to different scales of analysis, planning, and management needs. The component of the hierarchy includes the following levels:

ECOREGION:

DOMAIN - global scale - millions of square miles (1:30,000,000 or smaller)

DIVISION - continental scale 100,000s of square miles (1:30,000,000 to 1:7,500,000)

PROVINCE - 10,000s of square miles (1:15,000,000 to 1:5,000,000)

BCO-SWREGION:

SECTION - 1,000s to 100s Of square miles (1:7,500,000 to 1:3,500,000)

[redacted] - 100s to 10s of square miles (1:3,500,000 to 1:250,000)

LANDSCAPE :

-TYPE ASSOCIATION (LTA) -1,000s of acres (1:250,000 to 1:60,000)

LAND UNIT:

LAND TYPE (LT) 100s to 10s of acres (1:60,000 to 1:24,000)

-TYPE PHASE (LTP) 10s to Is of acres (1:24,000 or larger)

There is an INTERAGENCY MOU, Signed in November-December, 1995 by the NRCS, FS, BLM, NPS, FWS, NBS, USGS, and more recently by the EPA and ARS (9 agencies in all), to cooperate in developing a common Interagency Framework of Ecological Units. The ultimate goal is to unify, or at least fully coordinate (1) the National Hierarchical Framework used by the FS; (2) the MLRA Framework used by NRCS; and (3) the Ecological Region Framework used by the EPA.

ECOLOGICAL UNITS at all scales are based on an integration of Geomorphology, Geology, Climatic factors, Soils, and Potential Natural Vegetation.

LANDTYPE ASSOCIATIONS are at a comparable scale and based similar parameters to soil associations (STATSGO) units.

LANDTYPES are comparable to Order 3 soil surveys

LANDTYPE PHASES are comparable to Order 2 soil surveys.

We should be striving to coordinate our inventories of ecological units at these scales with soil surveys at the comparable scales. The ultimate is to coordinate them to the point that they are one and the same. We have achieved this in a number of places.

PROGRAM TRENDS

Virtually all Federal agencies are in a period of downsizing. Our soil scientist workforce (which makes up less than 1% of our total workforce) peaked at almost 300 in 1980, then slowly declined to about 175 in 1988, then increased to about 200 in 1993, and now is on a downward trend. our current workforce in soils is about 200, but with only about 175 to 180 doing soils work. With decreasing funding and staffing ceilings, there is increasing competition for scarce funds. Our only hope for survival is to integrate ourselves into ecological resource management programs, and continually DEMONSTRATE to managers the essential services that we provide.

OTHER ACTIVITIES:

Data base & Information Management

Continuing to develop interactive soil & Ecological Unit data base (SORIS - ECIMIS. Coordinating CSDS -- Common data elements with NASIS.

Involvement in Soil Quality and Ecosystem Health. - Need to develop Soil Quality concepts further for Forest and Rangelands.

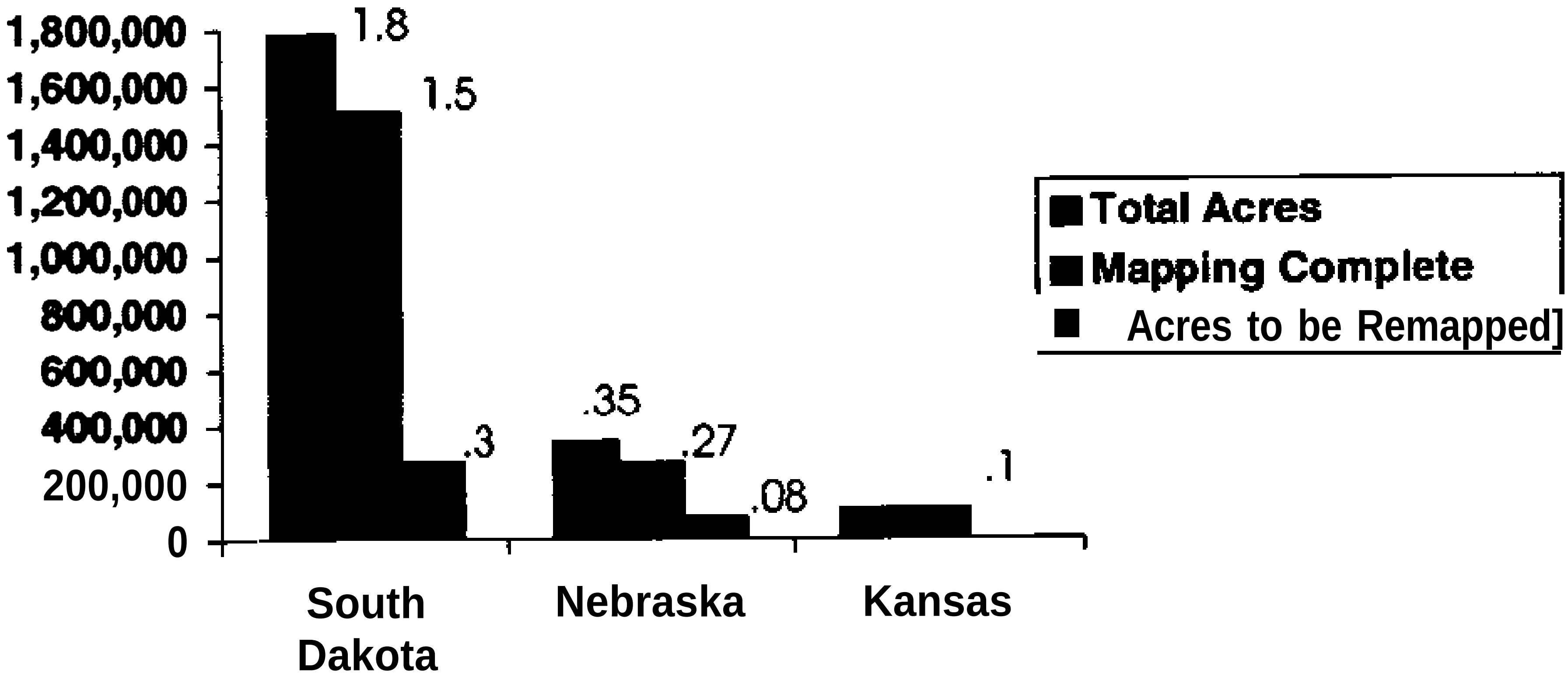
Long Term Soil Productivity study - Some preliminary results are beginning to emerge.

USDA Forest Service

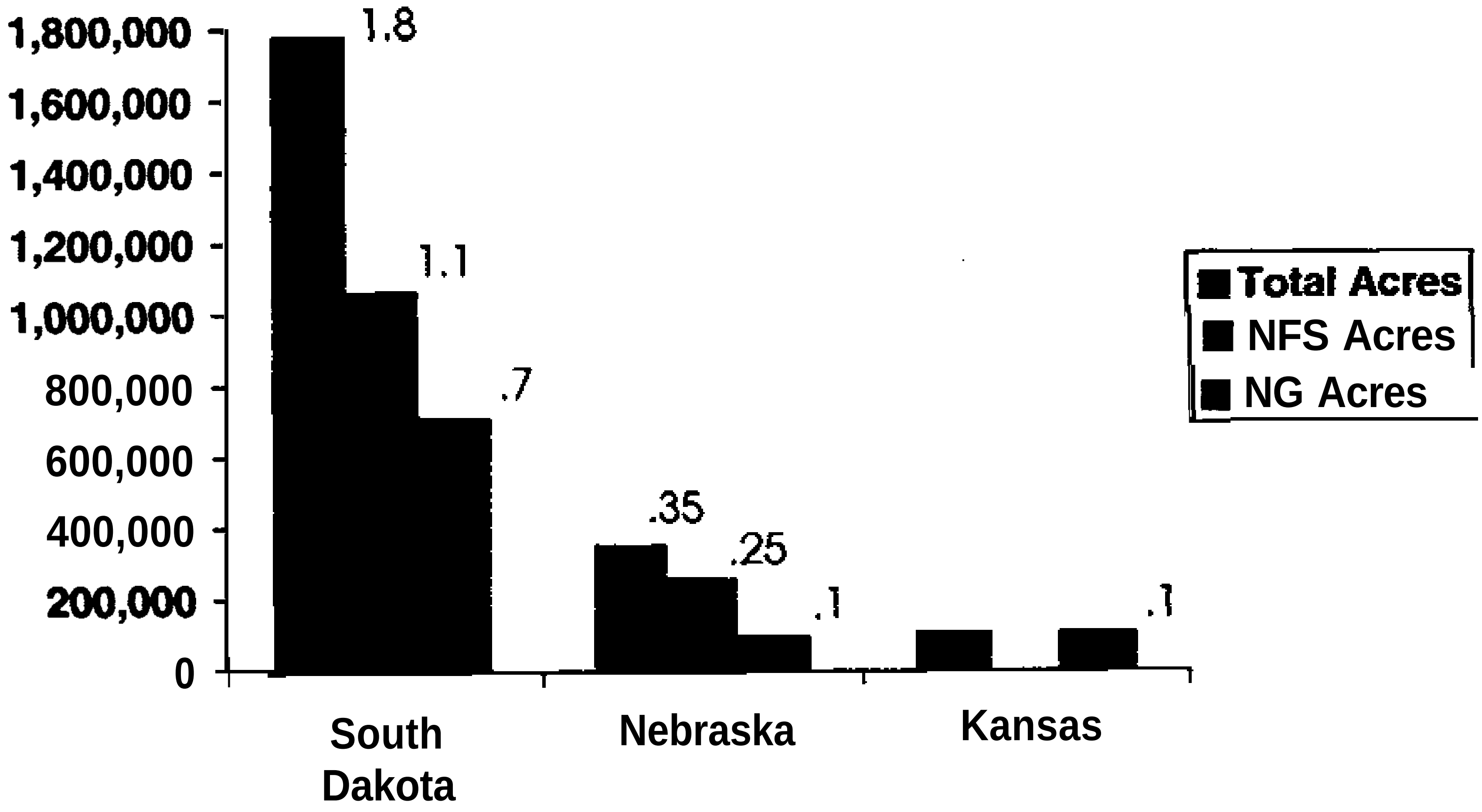
- The National Forest System
  - » 155 National Forests
- Within the Mid West Region of the NRCS
  - »

Summary of Soil Surveys for Mid -Western Area

Region 2



Summary of Soil Surveys for Mid-Western Area Region 2 - NFS and NG Acres



NATIONAL COOPERATIVE SOIL SURVEY REGIONAL CONFERENCE - RAPID CITY, SD
BRIEFING PAPER FOR JERRY FREEOUF
FOR
MARK TWAIN NATIONAL FOREST

The Mark Twain National Forest has been a participating member of the National Cooperative Soil Survey since the beginning of the NCSS. The soil survey program began on the Forest in the early 1960's and the mapping was completed in 1986. All soil surveys on the Forest were done at an Order 2 level and by NCSS standards. In the early days of the soil survey program, most of the mapping was done by FS Soil Scientists. Some soil survey reports were published cooperative reports and others were FS interim reports intended to provide basic soils information for the time until a formal published soil survey was available.

The Mark Twain National Forest has 1.5 million acres of National Forest lands in 29 counties in Missouri. Presently, 1,200,000 acres of NF lands in 21 counties have been soil surveyed and have a cooperative published report (or a report scheduled). National Forest lands in the other 8 counties containing 300,000 acres with older soil surveys are presently being upgraded to current taxonomic standards by a cooperative agreement with NRCS.

Plans for the future in Missouri soil surveys include second generation soil surveys to eliminate or reduce some of the inconsistencies in soil names and map units between counties due to surveys being made many years apart. A state-wide legend would also be a part of this effort.

In Missouri, we have always believed that National Cooperative Soil Survey efforts are the most efficient, economical, scientific, & professional means to accomplish the soil survey mission. We have seen the number of agencies in the NCSS grow from the early days when SCS, FS & the University of MO were the only members, to the present time with every land management agency in the State included.

We believe that in Missouri, we have the very best relationship and spirit of cooperation among all the NCSS agencies that exists on any Forest in any State in the Country.

Tuesday Morning - May 21, 1996

Presentations

1. NCR-3 Reports

2. Multimedia Soil Survey - In Perspective

3. NRCS Soils Information Available Through the Internet

4. Geology and Soils of the Black Hills

Illinois Report - NCR-3
K.R. Olson, May 1996

The 35,900,000 acres in Illinois have been mapped. Seven events, celebrating the start of the digital soil survey (3rd generation) and the completion of the field work for the modern soil survey (2nd generation), were held from July 1995 to March 1996. Cooperators were recognized on August 15, 1996 at the Illinois State Fair on Ag. Day. A re-union of over 100 Illinois soil mappers was held on March 22, 1996 at Bloomington. A series of articles related to the 93-year soil survey activity were prepared and used by the media.

Seventy-five counties have published reports with 27 waiting to be published. Twenty-one counties have a digital soil survey in progress. A number of soil scientists have been assigned to MLRA offices with additional soil scientists working on GIS since the 2nd generation of field soil mapping is completed.

I continue to represent the Illinois Agricultural Experiment Station at county soil survey field reviews, handle soil survey documentation, and participate in Soil Survey Conferences at the county, state, regional, and national levels. The University of Illinois is providing research data to assist field soil scientists in mapping eroded phases of Alfisols and Mollisols. The University continues to provide productivity index ratings for new soil types (396 in the last 17 years).

My research activity includes: soil productivity-erosion relationships, evaluation of conservation tillage systems for the restoration of productivity of previously eroded soils, crop yield prediction by soil, and quantification of erosion and sedimentation rate studies. I continue to teach Soils 304 (Soil Conservation and Management) on-campus and off-campus (as part of our Extramural M.S. program), the soils section of Ag. Econ. 312 (Land Appraisal) and the graduate level Soils 403 (Pedogenesis and Soil Taxonomy). This fall, I have been chosen to teach Introductory Soils (70 to 90 students per semester) with 3-1hr lectures and 5-3hr laboratory sections each week.

Our former Department of Agronomy was divided and re-named effective October 1995. The Crops group merged with Plant Pathology to become the Department of Crop Sciences. The Soils group merged with Horticulture, Forestry and Agricultural Entomology to become the Department of Natural Resources and Environmental Sciences.

Listed below are the journal articles published since the last NCR-3 meeting (June 1995 to May 1996):

Gennadiyev, A.N., K.R. Olson, and S.S. Chernyanskii. 1995. Soil science in the USA and V.V. Dokuchaev doctrine. Euroasian Soil Sci. Jour. 29:152-158.

Mokma, D.L., T.E. Fenton, and K.R. Olson. 1996. The effect of erosion on morphology and classification of soils in the North Central United States. Jour. Soil Water Conserv. 51:171-175.

REPORT TO NCR-3
Iowa Agriculture Experiment Station
T.E. Fenton
May 19-23, 1996

I. Iowa soil survey program

A.	Total number of counties	99
B.	Published	87
C.	In press	12
D.	In progress	4
E.	Waiting (update)	2

F. All of Iowa counties have been mapped at least one time and some counties have 3 surveys. There are 14 counties that have been designated as having out of date surveys. Total acreage is 36,016,200.

G. Our oldest published soil survey is Shelby County which was published in 1961. There are 3 additional counties that were published in the 1960's. They are included in the out of date surveys for which we used a 1974 publication date.

H. All updates of soil surveys will be on an MLRA basis using an orthophoto base with a scale of 1:12000. Most of the older surveys were made at a scale of 1:15840.

I. Most Iowa counties have digitized, georeferenced soil maps and county specific data bases available. Exceptions are those counties in which NRCS is in the process of digitizing recently completed surveys. These surveys will also be converted to the ISOIL format. The digitizing of all but the recently completed counties was done on a section by section basis and the sections were georeferenced using ARC-INFO and coordinates supplied by the Geological Survey. Joining of sections will be checked using ARC-INFO. The soil data can be used with the MS-DOS based ISOIL software or can be exported in various formats for use in a GIS. We have an updated version of ISOIL that is ready for release. It will be used by all NRCS District Offices that have the needed hardward. The cost for one county is $500 for the soil data and $100 for the software. A one time commercial fee of $500 is charged when appropriate. We plan to have all our data available on CD's.

J. A 3/4 time position for the Soil Characterization Laboratory is funded by the Division of Soil Conservation. Our work load will increase due to the MLRA updates and the associated increased requests for documentation.

II. Iowa soil survey personnel

A. NRCS field staff 9

B. NRCS Area Resource staff 7

C. NRCS state staff 2

III. IAES research activity related to soil survey

A. Erosion-Productivity project including soil quality.

B. Use of ground conductivity meters in soil survey.

C. Cooperative project with NRCS on stratigraphic relationships under loess-covered benches in Lucas County.

D. Cooperative project with NRCS on soils of the Savanna Terraces.

E. Landscape evolution on the Des Moines Lobe.

F. Hydric soil characteristics in Iowa.

G. Cooperative project with NRCS on water table studies of selected soils.

H. Soil sampling project cooperative with National Soil Survey Laboratory in southeast and northwestern Iowa.

I. Cooperative project with ISU Statistical Laboratory for developing improved procedures for updating soil surveys in Crawford and Woodbury Counties.

J. Use of soil survey data in precision farming and yield mapping.

REPORT TO NCR-3
Kansas Agricultural Experiment Station
M. D. Ransom
May 20 - 22, 1996

I. Kansas soil survey program

A.	Total number of counties	105
B.	Published	103 surveys, 105 counties
C.	In press	0
D.	In progress	1 county and 3 MLRA updates
E.	Waiting	3 (updates)

F. All of Kansas or 52,657,500 acres has been mapped in a "once over" soil survey that was completed in 1987.

G. Field work for the "modern survey" started in 1955. The oldest modern survey, Saline County, was published in 1959. An update was published in 1992.

H. Future updates of soil surveys will be done on a multi-county (MLRA) basis. Six MLRAs are currently targeted for revisions: the Central High Tableland (MLRA 72), Southern High Plains (MLRA 77), Central Rolling Red Prairie (MLRA 80A), Cross Timbers (MLRA 84A), Nebraska and Kansas Loess-Drift Hills (MLRA 106), and Iowa and Missouri Deep Loess Hills (MLRA 107). Updates are in progress in MLRA 72, 77, 106, and 107. The three county updates in waiting will be published on a 1:24,000 ortho-quad base. All other updating will be completed on a 1: 12,000 ortho-quad base. Most surveys in Kansas have been published at a scale of 1:20,000 and are not geo-referenced.

I. A joint project involving Agronomy, Geography, and SCS is digitizing all of the soil surveys in Kansas as part of an effort to develop a state-wide geographic information system. The project is funded by the Kansas Water Office and NRCS and will be completed in 1996 or early 1997. Existing soil map sheets are recompiled by NRCS onto Mylar overlays of USGS 7.5 minute quadrangles, which are then scan digitized. The scans are imported into PC-ArcInfo in order to build the data base. About 300 quads are digitized each year in the Geographic Information Systems Laboratory of the Geography Department. SCS provides a GS-11 Soil Scientist on-site to supervise work on compiling the Mylar overlays and to give final approval of the digitized soils data, which are archived by the Kansas Geological Survey.

J. A Soil Characterization Laboratory with a small budget provides analyses of grab samples for the soil survey program. Complete characterization data are currently available for only about 300 pedons that were analyzed by the National Soil Survey Laboratory.

II. Kansas soil survey personnel

A.	NRCS field staff	4
B.	NRCS area staff	10
C.	NRCS state staff	7
D.	Other	0

III. KAES research activities related to soil survey

A. Clay translocation and carbonate accumulation in the 16 - 26 inch rainfall zone of western Kansas. Project also includes a detailed examination of oriented clay features observed in thin sections.

B. Distribution and properties of clay minerals in Kansas soils with emphasis on applications to soil fertility.

C. Soil genesis and geomorphology on the Konza Prairie (Bluestem Hills), a long-term ecological research project site (LTER) of the National Science Foundation.

1. Soil mapping at a scale of 1:2000 and study of soil genesis for a 125 ha watershed.

2. Accumulation of carbonates, gypsum, and Na in polygenetic soils.

D. Parent material stratigraphy and genesis of soils developed in eolian materials in the Southern High Plains.

E. Development of a GIS that includes soils information, land use, soil suitability for crop land, and water resources for Finney County. We are using Landsat TM data to identify CRP land.

REPORT TO NCR-3
Michigan Agricultural Experiment Station
D. L. Mokma
May 20 - 21, 1996

I. Michigan soil survey program

A. Total number of counties 83
B. Published 59 surveys, 60 counties
C. In press 8
D. In progress 9
E. waiting 6
F. Field work for "modem soil surveys" in Michigan began in 1938. The field work for four surveys were completed prior to 1949. The oldest "modem soil survey", Muskegon County, was published in 1968. One soil survey was published during the past 12 months (September 1995). Several of the 59 published soil surveys are in need of updating to meet current needs. Updating will not have a high priority until all counties have a "modem soil survey". With reduced budgets, completion of "modem soil surveys" will be delayed. Several soil scientists were detailed to other states during the field season last year.
G. Updating of soil surveys will be done using the MLRA concept. The MLRA concept is underway or planned for the Superior Lake Plain (MLRA 92, with Wisconsin and Minnesota), the Huron-Erie Lake Plain (MLRA 99, with Ohio and Indiana), the Indiana and Ohio Till Plain (MLRA 111, with Ohio and Indiana) and the Northern Michigan and Wisconsin Sandy Drift (MLRA 94A). The MLRA concept is being used, where possible, to complete the "once-over" soil surveys. Seven soil surveys in progress and two completed surveys since the start of the project MLRA 94A are being handled as one soil survey area. The individual counties published as subsets.
H. Digitizing has been completed on 15 soil surveys; digitizing of another 32 surveys is complete but requires some editing or modifications to meet SSURGO standards. Digitizing of another 3 surveys is in progress.

II. Michigan soil survey personnel

A. SCS field soil scientists 23
B. SCS area resource soil scientists 5
C. scs state staff 2
D. MDA soil scientists 4
E. U.S. Forest Service 3

III. MAES research activities related to soil survey

A. Impact of accelerated erosion on soil properties and productivity
B. Soil absorption of septic tank effluent and sand filter effluent
C. Impact of cultivation on spodic horizon properties
D. Development of methods and guidelines for local wetland protection and related land use planning

REPORT TO NCR-3
Minnesota Agricultural Experiment Station
P. C. Robert
May 1996

1. Minnesota soil survey program (from the Minnesota State **Office)**

A. Total number of counties		87
B. Published		36
C. Awaiting publication		17
D. In progress	(initial)	07
	(update)	03
E Waiting		03
F. Out of date		21

G.There arc 17 counties where soil mapping is complete but not finished. Work required varies from map finishing , manuscript development, refinement of interpretations, to review of final report.

H.The MLRA approach will be used in updating soil surveys and completing all surveys in progress. (MO Region 10, staff of 8.5 with multistate responsibility including MN.)

II. Minnesota soil sarvey personnel

A	State Office:	3.5
B	Area staff	7
c:	Field staff	27

III MAES research activities

Anderson Jim.

- Detinition of agroregions in the Minnesota River based on Soil Atlas, land use, and climatic information to target practice implementation and education efforts.
- Evaluation of alternative individual sewage treatment systems on impacts of water table separation on loading rates and treatment.
- Installation of the pedon characterization data in a form (relational DBMS) and place (Department server) where it is accessible for analysis.

Bell Jay.

- Long term monitoring of piezometric surfaces, temperature. redox potential, and tensiometry to characterize soil moisture regimes and development of hydromorphic soil features.
- Development of an educational module explaining formation of hydromorphic soil features, hydric soil indicators, and an interactive exploration of selected information from the wet soil monitoring project to elucidate relationships among soil morphology, soil hydrology, and landscapes at a hillslope scale.
- Development of terrain classification for forest management purposes using terrain attributes derived from digital elevation models at various scales.
- Study, in collaboration with CSIRO Division of Soils, of soil property and terrain attributes derived for the Monavale watershed in New South Wales, Australia.

Cooper Terry.

- Phosphorus fertilization influence on golf turf, runoff, soil variability, for low and high P soils.

Grigal Dave.
- Development of "simplified" soil interpretations based on the county soil survey of Cass county. The objective is to create a turnkey system that integrates forest type, soil. ownership, etc. in a "point and click" format.
- **Study on mercury recycling in terrestrial watersheds.**

Nater Edward.
- Investigation of the distribution of relict aeolian sand deposits (linear sand stringers. sand sheets, etc.) and their relationship to the thick loess deposits to the east.
- Study measuring atmospheric and hydrologic fluxes of mercury to and through both the upland and peatland portions of northern forested landscapes.

Robert Pierre.
- Development of a model to estimate the percentage of crop yield lost as a result of erosion. Losses are related to a set of critical soil properties, climate, and agronomic management levels.
- Assessment of the effects of soil/site specific herbicide management on losses in surface runoff and leaching from mini-watersheds. Study of spatial patterns of soil properties that affect the fate and transport of herbicides.
- Study of the accuracy of mapping crop yields using a yield monitor and soil water using an electro magnetic sensor coupled with a GPS.
- Development of a computerized Farm*A*Syst (assessment of pollution risks) software to provide easy access to worksheets and factsheets, assist users in developing a plan of action, and perform queries on risk tanking. A prototype is in development for field assessment (cropland, pastureland, wetland, woodland).

IV. **Publications**

- Bell, J. C., J. A. Thompson, and C. A. Butler. 1995. Morphological indicators of seasonally-saturated soils for a hydrosequence in southeastern Minnesota. J. Minn. Aca. Sci. 59: 25-34.
- Bell, J. C., C. A. Butler. J. A. Thompson. 1995. Soil-terrain modeling for site-specific agricultural management. In P.C. Robert, R. H. Rust, and W. E. Larson (eds.) Site specific management for agricultural systems. Am. Soc. Agron., Madison. WI. pp. 209-228.
- Bierman, P.M., C.J. Rosen, P.R. Bloom, and E.A. Nater. 1995. Soil solution chemistry of sewage sludge incinerator ash and phosphate fertilizer amended soil. J. Environ. Qual. 24(2):279-285.
- Bouabid. R.. E.A. Nater. and P.R. Bloom. 1995. Characterization of the weathering status of feldspar minerals in sandy soils of Minnesota using SEM and EDX. Geoderma.(66) 137-149.
- Khakural, B.R.. P.C Robert, W.C. Koskinen. B.A. Sorenson, DD. Buhler, and D.L. Wyse. 1995. Test of the LEACHM-P for predicting atrazine movement in three Minnesota soils. J. of Env. Quality 24:644-655.
- Nater, E.A. 1995. Aluminium. The Encyclopedia of Analytical Science, Academic Press. Invited chapter.
- Petersen, G. W., J. C. Bell, D. McSweeney, G. A. Nielsen, and P. C. Robert. 1995. Geographic information systems in agronomy. In D. L. Sparrks (ed.) Advances in Agronomy, 55:68-1 11. Academic Press, New York.

NEBRASKA SOLL SURVEY
1996 REPORT TO NCR-3

Total number of counties	93
Counties with published modern soil surveys	86
Modem surveys in press	6
Updates in progress	6

Field Survey Activities

Nebraska is currently involved in the third generation of soil surveys. The first generation surveys were published before 1955 and covered 87 of the states 93 counties. The mapping phase of the second generation or modem soil survey program has been completed. Third generation or soil survey updates are in progress in 6 counties Deuel, Dundy, Cage, Hall, Saunders and Washington. Field activities have been completed in Dundy and Saunders counties. These updates are part of MLRA activities in MLRA 71, 72, 106 and 107.

Soil Survey Digitizing

The NRCS, Nebraska Natural Resources Commission and the Conservation and Survey Division have embarked on a project to digitize soils data for Nebraska. The Nebraska Natural Resources Commission is in the process of developing digital orthophoto quarter quads for the entire state that will serve as base maps for the soils digitiig project..

Soil Survey Personnel

Conservation and Survey Division IANR, UNL

Total - 6
- Research Soil Scientist - 5
- Data Base/ Digitizing Specialist - 1

USDA Natural Resources Conservation Service

Total - 16
- State Office - 2
- Liaison at NE Natural Resources Commission for soils digitization project - 1
- Field Soil Scientists - 9
- Cartographic Technician - 1

Regional Staff - 3 (former area soil scientists, deal mostly with NRCS program activities)

Research Related to Soil Survey

The effect of "forest" vs prairie on the morphology of a loess soils in eastern Nebraska.

The changes in the spectral reflectance of sediment, from loess soils, in water with increased concentrations of sediment.

The study of organic carbon, base saturation and pH data in Valentine and Valent soils to determine the validity of the separation of these soils.

The importance of taxoaomic variability in using soil maps to predict pesticide mobility.

Changes in soil properties in Moody, Hastings and Keith soils over the past thirty to forty years.

Tbe prediction of erosion in range land using the WEPPS Model and data on organic carbon in its various forms.

Development of a protocol to merge soils and groundwater data to indicate the vulnerability of groundwater to contamination by pesticides on a county basis.

The morphology of a pedoa that has been "covered" for about 80 years as related to a similar pedoa that has been "exposed" for the past 80 years.

Ohio Soil Characterization Data Base

Over the past 40-45 years more than 3,500 pedons have been described and sampled in Ohio in support of the progressive soil survey and soils research at Ohio State University, This translates into nearly 40,000 soil samples for which, routinely, particle-size, organic carbon, pH(water), calcium carbonate equivalent and CEC data are available. A large percentage of these pedons have additional data including but not limited to clay mineralogy, elemental analyses, bulk density, and COLE.

A searchable soil characterization database is being developed. Initial domain of the database will include 22 counties in northwestern Ohio. The final database will include all 88 Ohio counties. The database is relational and is composed of **four files:**

- Site data - soil series, location , slope, landuse, parent material. and physiography.
- Morphologic data - soil descriptions by horizon in standard NRCS format.
- Characterization data - particle size distribution, organic carbon, chemistry and clay mineralogy.
- Physical data - Bulk density, COLE, Atterburg Limits ,............... and AWC.

This database will be searchable in all fields. Using the benefits of a relational data base management system, searches can be efficient and logically constructed. For example, a search can be made for the number of poorly drained pedons that have <5% organic matter in the Ap horizon, existing on >2% slope, with Wisconsin Till as the parent material, Further limits can be placed as needed, such as a search by county, township, or all of Ohio: Query results can be exported into spreadsheet or statistics programs for further analysis. This database uses Claris FileMaker Pro 3.0, but can be exported into any system accepting .dbf extensions or that will open tab-delimited files. This particular program is usable on both Windows 95 and Macintosh computer operating systems. Future plans are to make the database available to interested researchers and to allow queries using a world wide web browser. The extknt of the queries is yet to be determined.

Databases are composed of files. A **database file** contains one or more **records.** Records are made up of **fields.** Each piece of information in a record is stored in a field. **Relational database management** systems allow you to use data from one file in another file without having to re-enter the data.

REPORT TO NCR-3
Purdue University
D. P. Franzmeier
May, 1996

All field work for the "once-over" soil survey has been completed for 10 years, but hvo counties reports are still not published. Most of these surveys are at a scale of 1: 15.840. Field work has been completed for five county update surveys. In each case, the entire county was re-mapped at a scale of 1:12,000. It has not been decided how the reports for those surveys will be published. Initial field work for a three-county update has recently been initiated.

Many computer-based models that predict how a soil will respond to some use have been develop, but few are used because we lack the specific soil information to run them, so many of the models sit on a shelf. We are in the process of developing a data base for each soil series in the state. It includes contents of coarse fragments, particle-size distribution, cation exchange capacity and base saturation. pH, carbon, nitrogen, carbonates, bulk density, water held at four suctions, and saturated hydraulic conductivity for the major horizons (usually 5 to 8 of them) down to a depth of 150 cm. From this we can derive subsets of data to run different models. One model we plan to use is CERES-Maize, a corn growth simulation model. It requires the upper and lower limit of water availability, and seems to be very sensitive to these limits, especially in dry years. We determine the protocol to use to derive field limits from laboratory suction measurements by comparing actual versus simulated yield on research plots. for some soils, the limits will be 33 kPa and 1500 kPa *suction*. For those in depressions with a shallow water table, they might be 10 to 1500 kPa, and for horizons that limit root growth, such as dense till and fragipans, the limits might be narrower than 33 and 1500 kPa. Once calibrated, we plan to run each soil through 25 years of actual weather data to get a more objective yield estimate than we now use.

Dense till is similar in morphology to fragipans. Both have very coarse prismatic structure with light gray coatings on prism faces. The prism interiors restrict water movement and root growth. the main difference is that till is calcareous and fragipans are acid. Some of the hardness of till appears to be due to weak cementation by silica compounds. Dense till horizons qualify for the proposed definitions of fragipans. Many of our fragipans are too deep to qualify, however. Now, Fragiudalfs are in the southern part of the state and Hapludalfs are in the north, but according to the proposed definition, they will be reversed.

We are monitoring water table level, and related characteristics, in toposequences in three areas of the state. We recently installed instruments on a sandy toposequence. and Jim Doolittle and Co. ran ground-penetrating radar and conductivity surveys. over the area. Radar seems to pick up water levels and bedding of sand very well.

REPORT TO NCR-3
South Dakota State University
South Dakota Agricultural Experiement Station
Plant Science Department - D.D. Malo
May 19-23, 1996

1. South Dakota Soil Survey Program.

A	Total number of counties	67
B.	Published reports	59
C	In press	14
D	Updates	2

E. All of South Dakota (48.6 million acres) has been mapped once (not all published) by a soil survey and that was completed in 1993.

F. Field work for modern soil surveys started in 1955. The oldest modern soil survey. Brookings County, was published in 1959. The field mapping for complete revisions of Brookings, Clay, and Minnehaha Counties were completed in 1995. Revisions for Spink and Codington Counties are in progress.

G Future updates of soil surveys (second edition) will be done on an MLRA (Major Land Resource Area) basis. All second edition soil surveys will use orthophotography as base maps. Soil surveys will be digitized through a cooperative effort of federal, state, and local agencies using stable base quad maps. During FY 1996 Memorandums of Understanding and a work plan to produce the second edition soil surveys for all MLRAs in SD should be completed.

H A joint project with the NRCS and SDAES is developing a data base of basic soils information for the series found in the state. Past theses, dissertations, journal articles, bulletins, NRCS files, soil surveys. and unpublished results are being catalogued. It is planned that a series of fact sheets or small bulletins highlighting the benchmark soils of the state will be prepared. Technical soil property (means. std. dev., ranges, confidence intervals) and soil genesis information will be presented.

I. The SDSU Pedology Lab analyzes NRCS soil samples (particle size, pH, SAR, EC, %C, %N, % $CaCO_3$, % aggregate stability, and other tests) as needed to assist in the cooperative soil survey program for the state. Last year 300+ different soil samples were analyzed.

2. South Dakota soil survey personnel (does not include soil conservationists or technicians)

		FTE
A.	NRCS field staff	8 (one less from 1995 report)
B.	NRCS area/regional staff	4
C.	NRCS state staff	5 lone less from 1995 report)
D.	SDAES staff	0.25
	Clerical	0.3
	Graduate Students	2 (one NRCS employee and one 112 time assistant)

3. **SDAES research activities related to the soil survey program and the pedology project (July 1995-May 1996).**

A. Developing with the NRCS a productivity index system for MLRAs 102B and 107 (southeastern South Dakota). The system uses crop and range information. Soil productivity ratings are being developed for Brookings and Deuel Counties.

B. A cooperative precision (site specific) farming project (SDAES, ARS, and NRCS) was initiated in 1995 to look at crop management (including chemical inputs) and soil differences on a watershed basis. Three 160 acre fields were selected. Detailed soils (electromagnetic conductivity meter (both EM31 and EM381 data, topo maps, fertility, soil characterization), weed, and insect data are being collected. The study is for three years. Treatments tested include: tillage (no till and conventionall, crops (continuous corn and corn/soybean rotation), different fertility levels, and various pesticide (both weed and insect) combinations. A GPS system is being used to locate sites in the field and to monitor yields. Detailed soil maps were prepared at a scale of 1:4000. The value of modern soil survey maps for precision farming will be evaluated. Various models will be tested to determine accuracy and error levels. Various sampling schemes are being tested (e.g. 100 ft grid, transects, and others).

Preliminary results indicate that EM 38 and EM 31 values are significantly related to insect infestations. yields, and various soil properties (e.g. soil landscape position, soil salinity, pH, lime content, soil mapping units, and soil moisture.

C. Cooperative project with the NRCS to: 1) evaluate the impact of irrigation on soil properties lpossible mapping unit separation) and 2) determine and evaluate the particle size data to separate very sandy (>85% sand) soil mapping units in Spink County.

D. Characterize research field soils and hydric soils appeals as requested by SDAES staff.

E. MS thesis projects:
   1. Parent material stratigraphy and soil genesis of soils developed in eolian materials along the Big Sioux River in Brookings County.
   2. Soil factors which affect EM 38 readings in eastern South Dakota soils.

F. Published: two book reviews, four Pedology reports, one lab manual for Introductory Soils, and two abstracts for presented papers. Copies available on request.

G. Published soil/water science research progress reports for 1995 activities. This publication highlights the soils research in the Department. Copies are available on request as long as supplies last.

H. Project coordinator for the development of a small land grant university in the North Yungas region (Carmen Pampa) of central Bolivia, South America. Involved in the planning and development of the curriculum and research efforts for this three-year old university. The University serves the Aymaran and Quetchua Indians of Bolivia.

Current address: D. Malo
Box 2140C, NPB 247C
Plant Science Department
South Dakota State University
Brookings, SD 57007.2141
605-688-4586 FAX 605-688-4452
email: filholmm@mg.sdstate.edu

CSREES REPRESENTATIVE'S REPORT

Dr. Berlie L. Schmidt
United States Department of Agriculture
Cooperative State Research, Education, and Extension Service
Washington, D.C.

The new Cooperative State Research, Education, and Extension Service (CSREES), which combines the research and extension activities of USDA of the former Cooperative State Research Service (CSRS) and Extension Service (ES), is now in place, with the research and extension professional staff merged and beginning to work together on joint programs. The Soil and Water Science areas, including Dn. Berlie Schmidt and Maurice Horton are now part of the Natural Resources and Environment (NRE) unit located in the Aerospace Center at 901 D Street, S.W. Other disciplines in tbis unit include the research and Extension program leaders in soil and water conservation, air and water quality, global change, forestry, fish and wildlife, waste management, and natural resources and environmental education. Dr. Ralph Otto, formerly an administrator in the natural resources section in Extension, Is the Deputy Administrator of the Natural Resources and Environment unit.

Dr. Bob Robinson, formerly Acting Administrator of the Economic Research Service, was recently appointed as the new CSREES Administrator, with Dr. Cohen Hefferan temporarily serving as Acting Associate Administrator.

Dr. Karl Stauber, the USDA Under Secretary for Research, Education, and Economics (REE), recently announced his resignation to become president of the Northwest Foundation in Minneapolis, and no successor has yet been named. Dr. Cathy Wotecki, formerly from the National Institutes of Health, has been named as the new Deputy Under Secretary for Research, Education, and Economics (REE). A brief revised outline of the current structure of CSREES is attached.

The restructuring of CSREES as part of the overall reorganization of USDA, has caused a number of changes in responsibilities for CSREES professional and support staff. As a result of a number of recent retirements of former CSRS program leaders, Drs. Schmidt and Horton have taken on new responsibilities for coordination of research programs and grants in air quality. global change, and others, in addition to their current soil and water programs. Extension counterparts are becoming more involved with research leaders in joint planning and activities in research, education and extension, and may assist in regional committee and program review activities. This new structure of CSREES should provide for closer coordination with the land-grant university partners on the continuum of research through technology transfer and application of new technologies.

Federal Budget

Significant changes in the federal budget are currently being debated in Congress and the White House, along with the reorganizations and downsizing of the Federal government. Fortunately, the 1996 USDA budget was passed by Congress and signed by President Clinton in October 1995 before the Federal government shutdowns, so USDA agencies, including the CSREES were able to continue operations without interruption Budget figures for CSREES for 1996 showed some decreases in funds for both research and extension, including decreases in special research grants and NRI competitive grants programs. These will affect the number and size of grants that will be able to be awarded in 1996. Although effects on the FY 1996 CSREES budget were not as significant as for many other USDA or other Federal agencies, it is unknown what future budget impacts may occur as a result of the major debates about the government budget currently underway.

Soil and Water Quality Research Grants Programs

Water Resources Assessment and Protection Program in the National Research Initiative Competitive Grants Program (NRI), with Dr. Berlie Schmidt as Program Dir&or will continue for FY 1996. but with somewhat reduced funding. This program encompasses the priority components research grants in water quality formerly included under the CSRS Water Quality Special Research Grants Program. The 1995 program, with Dr. James Schepers, ARS, Nebraska as Panel Manager, received 162 proposals, of which 18 awards were made for a total of $3.4 million. A publication of the Abstracts of all NRI giants is published annually, and is available upon request from CSREES. and can be accessed on the Internet through the CSREES Home Page (http://www.reeusda.gov).

The program descriptions for all NRI programs, including the Water Resources Assessment and Protection program, are published annually in late summer in the Federal Register and are also available on the CSREES Home Page. Dr. Thomas Doerge, Department of Soil, Water, and Environmental Science, University of Arizona, is assisting Dr. Schmidt as Panel Manager for the Water Resources program for 1996. Proposals are currently being reviewed by both external ad-hoc reviewers, and by a peer review panel for recommendations for funding. For information or questions on the Program contact Dr. Berlie Schmidt (phone: 202-401-4504, fax: 202-401-1706. or Email: bschmidt@reeusda.gov).

The Special Research Grants Program in Water Quality, with Drs. Maurice Horton and Berlie Schmidt as Program Managers, will continue to focus on funding research on the effects of integrated agricultural production systems on water qualify at a watershed or ecosystem scale. The 1995 Special Research Grants Program was again focused on multi-disciplinary, multi-institutional watershed-scale systems research on water quality. Three new grants were awarded for FY 1995. in addition to continued funding of the five Management Systems Evaluation Areas (MSEA) in the Midwest Initiative on Water Quality, for a total of $2.5 million. Congress continued to fund the Special Research Grants Program in Water Quality in 1996. No new awards were made in 1996, but funding was continued for the five Midwestern MSEA sites, plus the new MSEA sites funded at North Carolina State University with w-investigators in ARS in Georgia; Purdue University with co-investigators in Illinois and Texas; and Ohio State with co-investigators at Heidelberg College, Ohio.

New emerging research areas of national interest in soil and water science include: the impacts of agricultural practices and systems on soil, water, and air quality; site-specific or soil-specific management and precision farming; spatial and temporal variability of soils and landscapes and their effects on soil and crop management; waste management; and risk-assessment and management. CSREES programs already include many aspects of these areas of interest, but will develop further as future funding becomes available. In addition, new multi-disciplinary initiatives for possible future collaboration on these and other issues are currently being explored with EPA, the Department of Energy, and other agencies.

Research, Education, and Economics, USDA
Cooperative State Research, Educadon, and Extension Service

Office of the Administrator

Bob Robinson
Administrator
Email: brobinson@reeusda.gov
Phone: 202-720-4423
Fax: 202-720-5987

Colien Hefferan
Acting Associate Administrator
Email: chefferan@reeusda.gov
Phone: 720-7441
Fax: 720-8987

Betty Lou Gilliland
Assistant to Administrator
Email: bgilliland@reeusda.gov
Phone: 720-7441
FAX: 720-8987

Civil Rights

Curt Deville
[redacted]
Email: cdeville@reeusda.gov
Phone: 202-720-2700
Fax: 202-720-6956

Budget

Tina Buch
[redacted]
Email: tbuch@reeusda.gov
Phone: 202-720-2010
Fax: 202-720-2750

Legislative Affairs
(For REE Mission Area)

Maureen Kelly
Director
Email: mkelly@reeusda.gov
Phone: 202-720-3584
Fax: 202-690-2841

Plant and Animal Production, Protection, and Processing

Edward Wilson
Deputy Administrator
Email: ewilson@reeusda.gov
Phone: 202-401-4329
Fax: 202-401-4060

Natural Resources and Environment

Ralph Otto
Deputy Administrator
Email: rotto@reeusda.gov
Phone: 202-401-4555
Fax: 202-401-1706

Rural, Economic, and Social Development

Marvin Konyha
Acting Deputy Administrator
Email: mkonyha@reeusda.gov
Phone: 202-720-7940
Fax: 202-690-3162

Families, 4-H, and Nutrition

Alma Hobbs
Deputy Administrator
Email: ahobbs@reeusda.gov
Phone: 202-720-2908
Fax: 202-690-2469

Partnerships

George Cooper
Acting Deputy Administrator
Email: gcooper@reeusda.gov
Phone: 202-720-3381
Fax: 202-720-4924

Competitive Research Grants and Awards Management

Sally Rockey
Acting Deputy Administrator
Email: srockey@reeusda.gov
Phone: 202-401-1761
Fax: 202-401-4327

Science and Education Resources Development

Jane Coulter
Deputy Administrator
Email: jcoulter@reeusda.gov
Phone: 202-720-3377
Fax: 202-720-3945

Communications, Technology, and Distance Education

Barbara White
Acting Deputy Administrator
Email: bwhite@reeusda.gov
Phone: 202-720-4651
Fax: 202-690-0289

Multimedia Soil Survey -- In Perspective
summary of remarks presented by
Russ Kelsea, Information Architecture Group, National Soil Survey Center

Background

Multimedia soil survey means different things to different people. For some, it is any electronic means of presenting soil survey data. For others, it is distribution of data by a variety of methods including paper, diskette, compact disk, or world wide web. Whatever the manner of presentation, we have more opportunities and much greater flexibility in the delivery of soil survey information than ever before.

Until just recently, we were required to publish a soil survey in paper bound format as soon as possible following completion of field work and deliver copies to congressional representatives. Those specific requirements were eliminated in the current farm bill. We still need to disseminate soil survey information to the public 64 TrÂpþ8p88 8 8p88 888hÀs23 Tntil 6 T~ øx3 n|

included as static images. Complete documentation for creating this kind of report is available through the National Soil Survey Center.

Tom D'Avello and Bob McLeese, at the NRCS state office in Illinois, developed a Windows based, interactive soil survey format using both hypertext and GIS technologies. The manuscript text is in hypertext format, providing links between topics. But maps and tables are in GIS format, providing capability to view maps at different scales with orthophoto background and create themes based on soil survey data. A explanation of the interactive soil survey format is available at http://www.gis.uiuc.edu/nrcs/soils/p329.html. The first soil survey report converted to this format, JoDaviess County, will be delivered on CD-ROM in June.

Relationship to NASIS

The National Soil Information System (NASIS) is a long term project that will provide comprehensive, integrated information system tools for both data managers and data users. The need for this kind of system was recognized in the mid-1980's. Since that time, we have concentrated on tools essential for data managers and especially on those tools required for managing map unit data. The current release of NASIS software and the conversion from the State Soil Survey Database and SOIL-S/SOIL-6 technology to NASIS reflect this emphasis. Up to this point however, we have invested relatively little in NASIS to directly accommodate the users of soil survey data. The work done by Vrana, D'Avello and McLeese, and many others to define the future of soil survey for data users are excellent efforts that allow us to remove constraints from our thinking and ultimately produce better products for our data users.

NRCS Soils Information Available Through the Internet

The following is a list of Internet WWW addresses for NRCS soils information along with a brief description of the informarion available at each listed site. Through links from the main NRCS home page, most NRCS information can be reached. Other addresses are listed to provide a more direct link to specific information.

1. NRCS home page (http://www.ncg.nrcs.usda.gov/welcome.html)

This is the main page for information about the Natural Resources Conservation Service.

2. NASIS (http://www.itc.nrcs.usda.gov/nasis)

This page provides information on the National Soil Information System, currently being implemented for managing soil survey database information.

3. NRCS Node to NSDI (http://www.ncg.nrcs.usda.gov/nsdi_node.html)

This page contains information on various NRCS spatial and attribute data including the PLANTS database, hydrography. 1992 NRI, soils, and water and climate, plus other miscellaneous information.

4. NSDAF (http://www.statlab.iastate.edu/soils/nsdaf)

This page provides direct access to the soil survey attribute data [MUIR), official series descriptions (OSD), and national list of hydric soils, plus information on various other soils data.

5. PLANTS (http://plants.usda.gov)

This page provides direct access to the official USDA plants database.

Harvey P. Terpstra
Statistical Laboratory
Iowa State University
Ames, Iowa 50011

e-mail: hpterp@iastate.edu
phone :(515) 294-8177
fax : (515) 294-2456
office: 212 Snedecor Hall

GEOLOGY AND SOILS OF THE BLACK HILLS

by Ed Ensz for the NCCSS Mtg. 5/21/96

Illustration #1

From 550 to 74 million years ago the area of the Great Plains was covered with shallow seas. During this time the various layers of sediment were deposited on the bottom of this body of water. These layers comprise the geologic beds that are now exposed in the Black Hills region.

The seas were displaced by a slow uplift of the continent about 70 million years before present. A large dome (Black Hills Uplift) formed with the forces of the hot molten rock pushing upward. It was oblong in shape roughly 60 miles wide by 120 miles long. The elevation of the highest point was calculated to be around 13,000 feet above sea level.

Erosional forces continued to weather the dome removing as much as one mile of material. Hamey Peak, the highest in the Black Hills is now 7,242 feet above sea level.

Illustration #2

East - West cross-section of the Black Hills. This shows the three general categories of rocks the occur in the Hills. Sedimentary rocks which include limestone, sandstone, and shales. They generally have bedding planes or layers that can be separated. In the Black Hills they are fairly brightly colored, such as buff, tan, white, and red. They occur on the hogback, red valley, and high limestone plateau. Metamorphic rocks consist of the slates and schists that are dull gray in color. We will see these as vertically oriented fractured bedrock along our route tomorrow. They occur in the Pactola Lake and Hill City areas.

The Igneous rock we can take for granite. Most is pegmatite, which is a coarse grained rock in which the minerals are easily identified with the naked eye. For the most part it consists of feldspar, quartz, and mica.

Illustration #3

Major geologic formations of the Black Hills. Discuss the formations from the central core to the outer margins including the names of the formations.

Illustration #4

Block diagram of the Custer-Pennington Counties Portion of the Black Hills and related drainage systems

Illustration #5

Soil parent material cross-section. This is a transect through the peaks of Elk Mountain in Western Custer County and Hamey Peak in Pennington County. Discuss the soils related to the parent material and elevation (frigid, cryic temp regimes).

Illustration #6

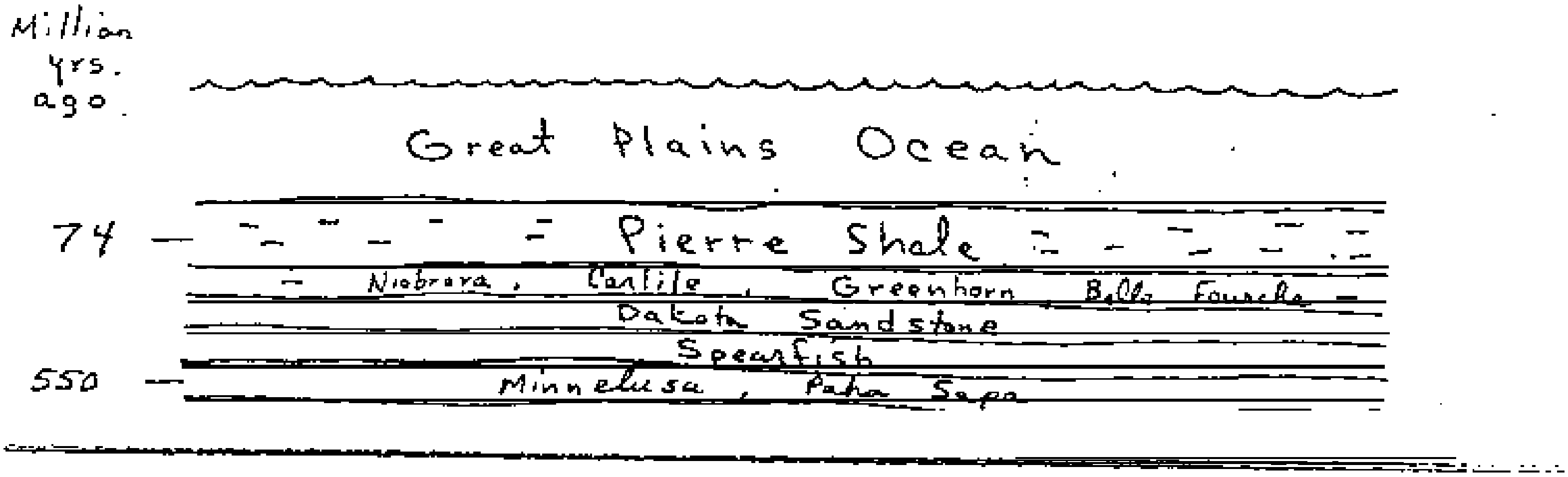
General Soils Map of Custer- Pennington Counties, Black Hills Portion. Discuss the various map units. #1 Canyon-Rockoa-Rock Outcrop Asso. on the Dakota Hogback. #2 Nevee-Gynevee-Rekop Asso. on the Red Valley. #3 Vanocker-Sawdust-Paunsaugunt Asso. on the lower limestone plateau. #4 Stovho-Trebor Asso. on the high limestone plateau. #5 Pactola-Rock Ourcrop-Virkula asso. on the Central Crystalline Area. #6 Buska-Mocmont-Rock Outcrop Asso. on the Central Crystalline Area. #7 Heely-Cordeston Asso. on the open prairies of the Central Crystalline Area. #8 Grummit-Arvada Asso. on the clayey shales of the prairie.

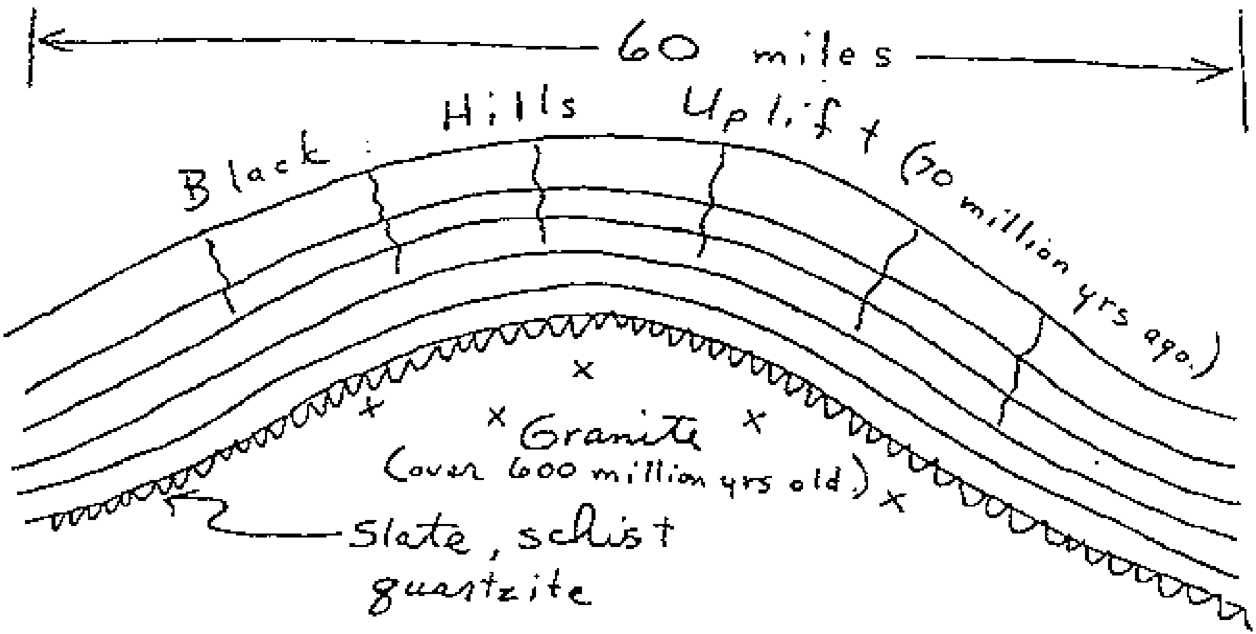
Illustration #7

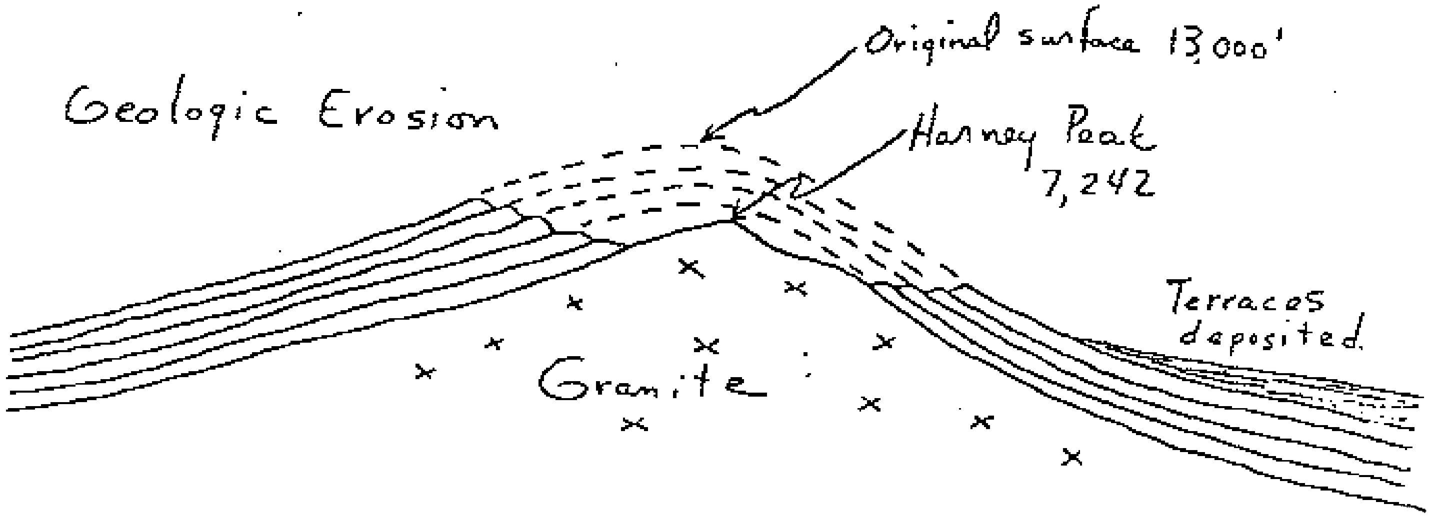
The relationship of the terraces in the Black Hills to the terraces in the Prairie along Rapid Creek, in regard to elevation.

Geology of the Black Hills

West side ← Cross-section showing development → East side

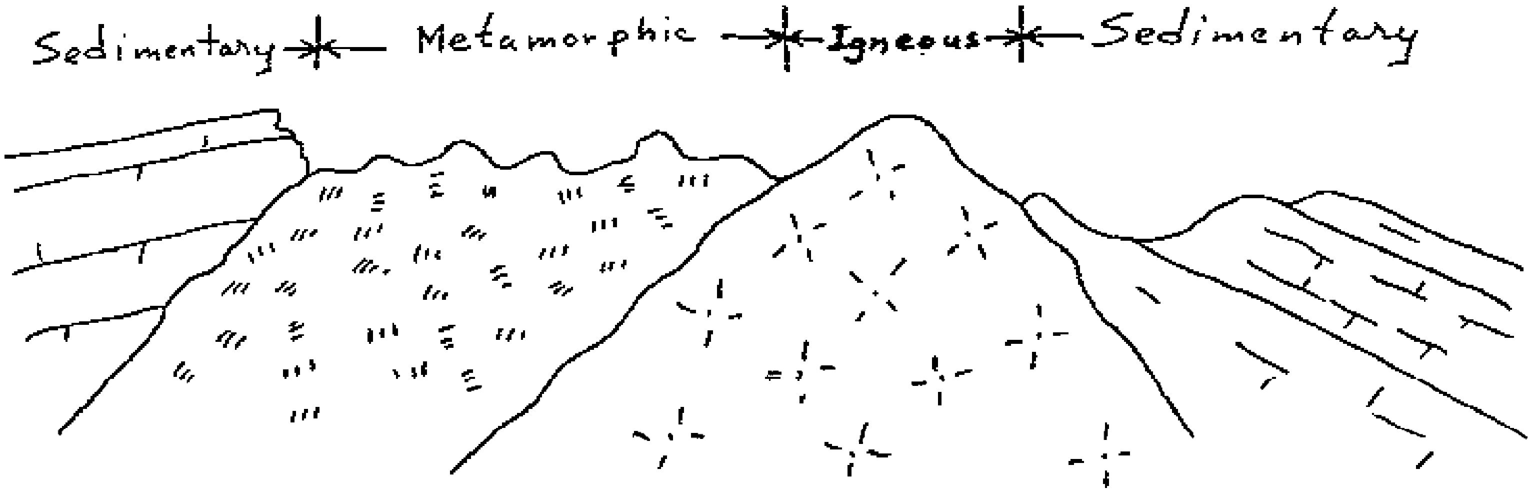






BE 6/89

East-West Cross-section of the Black Hills

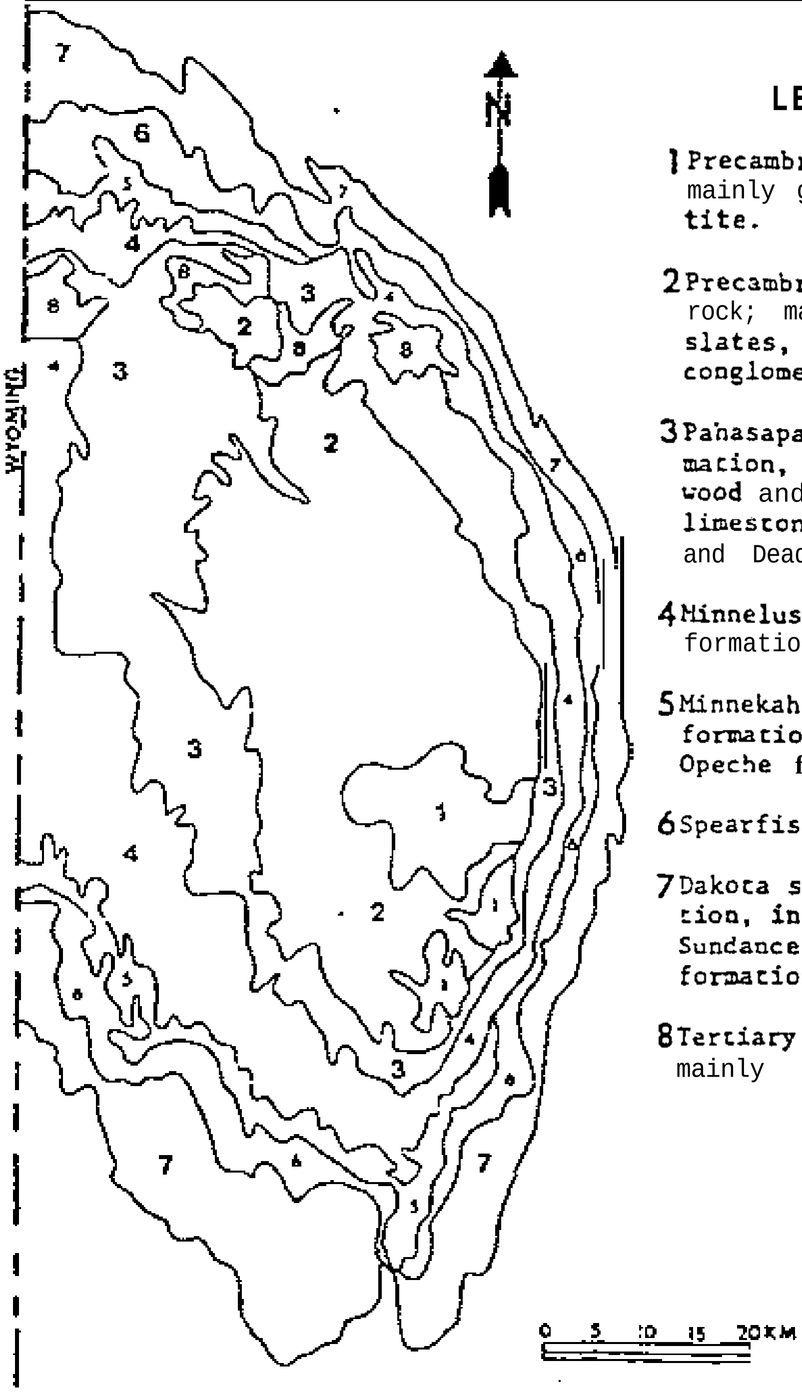


Types of rocks

1. Sedimentary - limestone, sandstone, shales
   bright colors - buff, tan, white, red
   fine grained
   occurrence: hogback, red valley, high limestone

2. Metamorphic - slate, schist
   dull gray colors
   uniform grained
   occurrence: Pactola lake area, Hill City area

3. Igneous - granite
   multi-colored - pink, white, black
   Coarse grained
   occurrence: Mt. Rushmore, Harney Peak.



LEGEND

1 Precambrian igneous rock: mainly granite and pegmatite.

2 Precambrian metamorphic rock; mainly schists, slates, quartzites, and conglomerates.

3 Pahasapa limestone formation, including Englewood and Whitewood limestone formations and Deadwood formation.

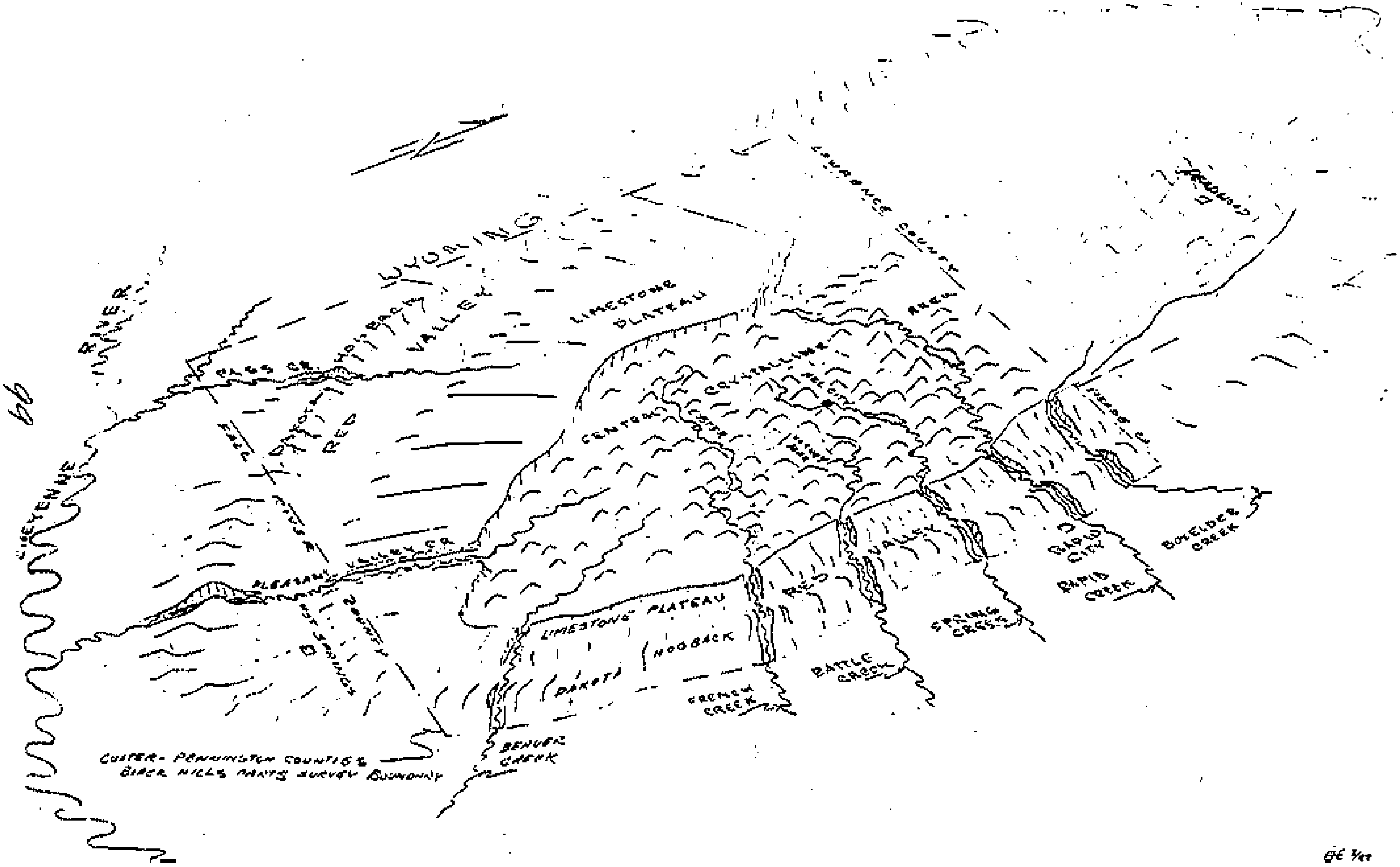
4 Minnelusa sandstone formation.

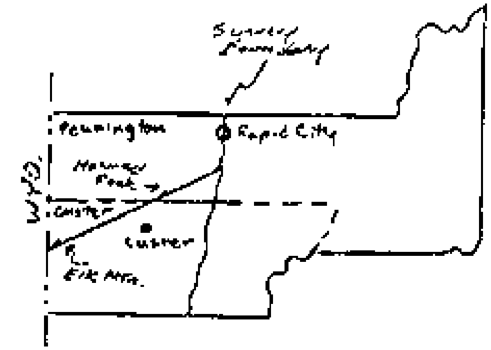
5 Minnekahta limestone formation, including Opeche formation.

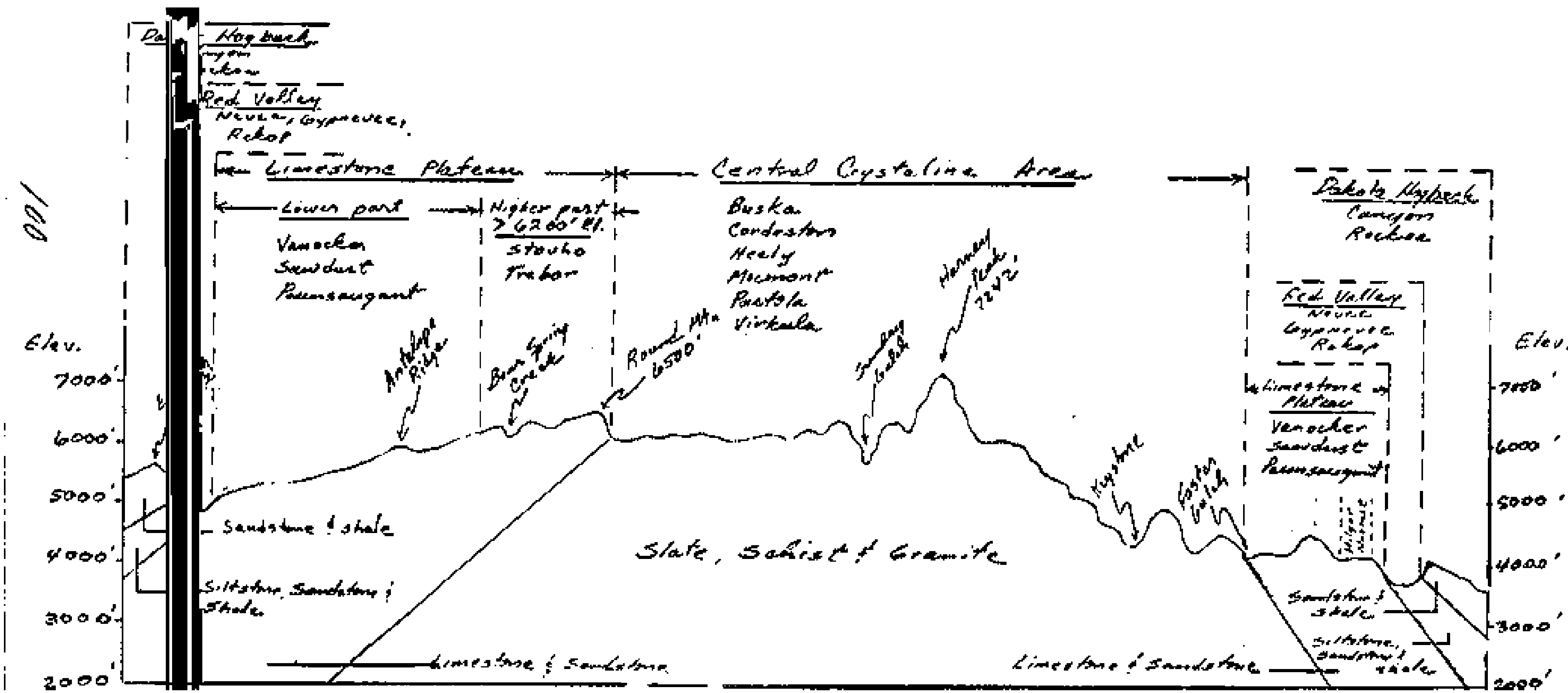
6 Spearfish formation.

7 Dakota sandstone formation, including Sundance and Morrison formations.

8 Tertiary igneous rock; mainly


WYOMING
LAWRENCE COUNTY
DEADWOOD
LIMESTONE PLATEAU
HOGBACK
VALLEY
RED
CRYSTALLINE AREA
CENTRAL
CUSTER
HILL CITY
KEYSTONE
BOXELDER CREEK
RAPID CITY
RAPID CREEK
SPRING CREEK
BATTLE CREEK
FRENCH CREEK
BEAVER CREEK
LIMESTONE PLATEAU
HOGBACK
DAKOTA
RED VALLEY
PASS CR.
FALL RIVER
PLEASANT VALLEY CR.
HOT SPRINGS
COUNTY
CHEYENNE RIVER
CUSTER-PENNINGTON COUNTIES
BLACK HILLS PARKS SURVEY BOUNDARY


Survey Boundary
Pennington
Rapid City
Harney Peak
Custer
Custer
Elk Mtn.
WYO.


Hogback
Red Valley
Limestone Plateau
Lower part
Vanocker
Sawdust
Higher part
> 6200' El.
Trebor
Central Crystaline Area
Buska
Cordeston
Heely
Pactola
Dakota Hogback
Red Valley
Limestone Plateau
Vanocker
Sawdust
Elev.
7000'
6000'
5000'
4000'
3000'
2000'
Antelope Ridge
Bear Spring Creek
Round Mtn 6500'
Harney Peak 7242'
Keystone
Sandstone & shale
Siltstone, Sandstone & Shale
Slate, Schist & Granite
Limestone & Sandstone
Limestone & Sandstone
Sandstone & shale

mile

JE 5/65

Tuesday - May 21, 1996

Posters, Abstracts, and Information

Resource Conservation Kit For Educators

by Henry Ferguson, Resource Soil Scientist
Macon County, Missouri

This soils education kit is designed to provide the educator with a source of materials for classroom use, as well as a means of previewing materials which are available for free, on loan or to be purchased.

The kit is provided for free to Soil and Water Conservation Districts. The districts then loan the kits to Natural Resources Conservation Service, Department of Conservation, Department of Natural Resources, and Extension Service personnel for use at conservation field days and classroom teaching. Kits are also loaned to teachers for a week or two at a time.

Each item in the kit is described and accompanied with enough background material to allow the educator to teach at a level from kindergarten to adult. The directions for making the items in the kit are included. The binder, Read Me First A Guide to the Resource Conservation Kit for Educators leads the educator through a short description of each item in the kit, and provides background material to give the educator more understanding and confidence in the material.

USE OF ELECTROMAGNETIC INDUCTION FOR SITE CHARACTERIZATION AND PRECISION FARMING

D. D. Malo, J.A. Schumacher, C.G. Carlson, D.E. Clay, T.E. Schumacher, and M. M. Ellsbury
Plant Science Department, South Dakota State University and
USDA-ARS Northern Grain Insect Laboratory

In 1995 a three-year study was initiated to examine the relationships between the fate of agrichemicals and water quality on a watershed basis, Three 65 hectare fields were selected in eastern South Dakota in Moody (Site I) and Rrookings (Sites 2 and 3) Counties. Sites were selected because of past and current management and different soil parent materials. Sites 1 and 2 have a corn-soybean rotation in no-till while Site 3 is a continuous corn with conventional tillage. The soils at all sites are either Haploborolls, Calciborolls. Calciaquolls, or Endoaquolls. Soil parent materials differ by site. Site l has loess over glacial till with some local alluvium. Site 2 has glacial till that is younger in age than Site 1. Site 3 has young glacial till and glacial outwash At each site the following soil measurements are being made: elevation, GPS location, N (NO,, NH, , total N), C (organic and inorganic), P. K, Zn, pH, EC, SAR, texture, percent water, electromagnetic induction (EM) readings (horizontal [h] and vertical [v]) using the EM 3 l(h=0-2.75 m, v=0-6 m) and EM 38 (h=0-.75 m, v=1.5 m) meters, and other tests as needed. The samples are being taken using both grid (33 m and 66 m) and transect methods at each site. In addition, insect infestations and weed monitoring are being assessed using a GPS referenced grid pattern. Different levels and types of management are being assessed to minimize agrichemical inputs on a watershed basis. Crop yields were measured in the field using a GPS system In 1996, two new EM studies examining the seasonal impacts on EM values and fertilizer impact on EM readings are being tested.

Preliminary results show that EM data is significantly related to soil moisture, soil pH, landscape position, texture on eastern South Dakota soils. Northern corn rootworm emergence was also significantly related to both EM 3 l and EM 38 data. Interactions between EM horizontal and vertical data for both EM 31 and EM 38 are being studied. EM data is closely related to soil mapping units and crop yields. Models are being developed to assist in management decisions based on EM and other data to improve the water quality in the soils and watersheds of eastern South Dakota.

Status of Global Change Projects
for the National Cooperative Soil Survey

Foreword'

Understanding the effects of agriculture and forestry on the global atmosphere composition of greenhouse gasses and the role that soils play in these processes is important. Identifying soil's contributions has been one major component of the USDA Global Change research and development program for the past six years.

The projects this report describes are examples of the types of research undertaken by the NRCS to help us understand terrestrial soil carbon and its interactions with the biochemical fluxes with the atmosphere. The resulting knowledge will enable future generations of general circulation modelers to more accurately describe, at the regional scale, the contributions of agriculture and forestry to the mitigation of greenhouse gas emissions, and to project the capability to adapt to these changes.

A very broad range of projects is being conducted by scientists in Soils Division, cooperating universities, and the Agriculture Research Service. Such free exchange of ideas allows others to understand what is going on in various projects and lets changes be made in existing projects. The information presented here will allow others to see what is being done and where we are headed.

The National Soil Survey Center in Lincoln, Nebraska has been the clearinghouse for both the approval and funding of Global Change projects in this report. We look forward to a continuation of this process. For more detailed information, request the following publication: Kimble, J.M.

Status of Global Change Projects
for the National Cooperative Soil Survey

Index of Projects

Soil Water and Soil Temperature Projects

Project: *Soil moisture and temperature models.*

Objectives: (1) To develop soil moisture and temperature maps using climatic information for the United States and the rest of the world. These maps will show soil moisture and temperature regime maps developed using computer models; and (2) To develop a data base which can be used in global circulation Models (GCM's).

Contact(s): H. Eswaran, Soil Scientist, USDA/NRCS, WSR, Washington, DC.

Status: Ongoing.

Project: *Impact of sea level rise on soil quality in coastal areas.*

Objectives: (1) To evaluate the impact of occasional tidal inundation on soil properties in upland soils along coastal fringe areas; (2) To determine the effects of inundation frequency on selected soil properties; (3) To develop chronofunctions which describe the changes in soil properties over time, in relation to rates of sea level rise.

Contact: M.C. Rabenhorst, Associate Professor, Department of Agronomy, University of Maryland at College Park, College Park, Maryland.

Status: Study is complete. A publication is available.

Project: *National soil moisture and temperature maps.*

Objectives: (1) To provide better correlation of moisture and temperature regimes between states; and (2) To improve the criteria on Soil Moisture and Soil Temperature in Soil Taxonomy.

Contact: H.R. Mount, Soil Scientist, National Soil Survey Center, NRCS, Federal Building, Room 152,100 Centennial Mall North, Lincoln, Nebraska 68508-3866.

Status: Complete. This effort included input from Soil Scientists in all 50 States. Roger Haberman (retired) coordinated most of this effort. Two publications with digital thematic maps have been distributed.

Status of Global Change Projects
for the National Cooperative Soil Survey

Project: *Soil moisture/temperature pilot project.*

Objectives: (1)To develop and test an automated system to collect near real time soil moisture and temperature measurements and associated climate information: and (2) To evaluate and test different sensors and methods of data collection.

Contact(s): G. Schaefer and D. Huffman from the NRCS in Portland, Oregon and R. Yeck, R. Paetzold, and H. Mount from the NSSC in Lincoln, Nebraska are the lead scientists working in conjunction with others from the states involved.

Status: This was a project set up to test different methods of data collection. It will continue for a couple more years. At present 21 sites are in place (New Mexico, Washington, Mississippi, Wyoming, Texas (2 sites), Florida (2 sites), Colorado, Wisconsin, Minnesota, Illinois, Kentucky, Georgia, Maryland, North Dakota, Nebraska, New York, Montana, Ohio, and North Carolina. New sites will not be added until existing ones are validated and all equipment tested along will development of procedures to process and supply data to users. New soil moisture sensors are being field tested.

Project: Climate study on *St. John Island (Lameshur Bay watershed), Virgin Islands.*

Objectives: (1) To obtain hard data on soil climatic parameters; (2) To develop soil climate maps for the NRCS Caribbean Area (3) To look at ground water saturation for flooding predictions.

Contacts: H.R. Mount and R.F. Paetzold, NSSC in cooperation with NRCS, USGS, and NPS Scientists in Puerto Rico and the Virgin Islands.

Status: Data collection in place and validated. Several publications are available upon request.

Project: *Soil water status monitoring in the Dunnigan Hills in northern California.*

Objectives: (1) To determine if some soil features, such as redoximorphic features, thick Bt horizons, duripans, and abrupt textural changes in soils on Pleistocene-age landforms relicts of previous climates; and (2) To determine if variation in ambient climate have a similar influence on soils with different properties.

Contact(s): R. Southard and J. Thomas, UC Davis, California.

Status: Project completed. A paper is being written.

Project: *Northern Wisconsin till study.*

Objective: To conduct a study of soil moisture movement and availability on soils with dense glacial till that occur in northern Wisconsin. There is a need for more measured permeability and available water capacity in till soils to realistically interpret the water movement and availability and its effects on soil and water quality.

Contact: R. Yeck, Lead Scientist at the NSSC in cooperation with other NSSC, scientists, USFS, and University Scientists in Wisconsin.

Status: All sites in operation, several being converted to automated data collection systems. Most conversions will be made in 1995.

Project: *Cinnamon Buy climate study.*

Objective: (1) To monitor climate from a remote site (north aspect) in the tropics. (2) To test telemetry technology as a means of collecting continuous climate data.; and (3) To compare the data with climate stations (south aspect) that are on the Lnmeshur Bay Watershed, St. John Island, Virgin Islands.

Contact: R. F. Paetzold, Research Soil Scientist, and H.R. Mount, Soil Scientist, National Soil Survey Center, NRCS, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, Nebraska 68508-3866.

Status: Station installed during November 1995 with assistance of NRCS personnel in Oregon and Puerto Rico and the National Biological Survey on St. John Island. A color brochure was prepared for Chief Johnson's visit to Puerto Rico during February 1996. Data review is ongoing.

Project: *Wet soils monitoring.*

Objectives: (1) To develop a better understanding of soil processes in wet lands and indicators which can be used to help identify wetlands; (2) To collect data on saturation, matric potential, redox potential, soil temperature plus reasonable companion data at several depths in one or more locations within a landform setting; (3) To determine bow long each year and at what depths the soils are saturated, tension saturated, and/or reduced, to include specific information on the

upper part of the soil that can be used in determinations of Hydric Soils; (4) To obtain complete site and pedon descriptions and associated characterization data at each monitoring site; (5) To study and comment on hydrologic and pedogenic relationships among monitoring sites on the landform where monitoring is established on a catena; and (6) To select sites in 1996 that will he sampled for biological/carbon movement which is being led by Dr. L. Wilding of Texas A&M University.

Contacts: W. Lynn, Research Soil Scientist at the NSSC, and NRCS and University Staffs in the respective states.

Status: Studies are being conducted in Alaska, Oregon, North Dakota, Minnesota, Illinois, Texas, Louisiana, New Hampshire, Kansas, and Kentucky. Plans are to continue project for 5 more years at a minimum. Report of summary meeting held in 1994 is being prepared. A data base at the National Soil Survey Laboratory to house monitoring data will provide numerical and graphic output for calendar year increments in a common format.

Organic Carbon Projects

Project: *Carbon sequestration in arid and send-arid environments - a case study of Texas.*

Objectives: (1) To develop a data base of content as kg $C/m^2/m$ of arid and semi-arid Texas; (2) To relate C content to land use and other land variables to evaluate the biogeochemical cycles and there by provide understanding needed for policy decisions; (3) to elucidate the pools of organic carbon sequestration and the processes involved in organic carbon decomposition in calcareous soils of arid and semi-arid regions of Texas; and (4) To develop working hypotheses on C sequestration and recommend research proposals for future study. It should be noted that similar studies on carbon pools were done in New York and Puerto Rico.

Contacts: C.T. Hallmark, L.P. Wilding, and D.A. Zuberer, Texas A&M University, College Station, Texas 77843-2474.

Status: Project completed in 1995. Suggestions for follow-up will be developed. Study will be expanded by looking at sites from wetland project.

Status of Global Change Projects
for the National Cooperative Soil Survey

Project: The role of phosphorus in carbon sequestration.

Objectives: (1) Determine the relationship between P activity and availability and carbon status of soils; (2) Estimate the buffer coefficients for a selected group of soils from Indonesia; (3) Estimate P requirements for this group of soils for two crops, one with high P requirements and one with low P requirements; and (4) Evaluated P data measured by the Mechlich 3, Olson, Bray procedures and to determine the relation ship to soil carbon.

Contact: Principal Investigator: Dr. Russell Yost, Department of Agronomy and Soils, Sherman Hall University of Hawaii, Honolulu 96822 and Dr. Hari Eswaran, WSR, USDA-NRCS, PO Box 2289, Washington, DC 20012.

Status: Project just funded in February of 1996. Work is under way using stored samples from selected field sites.

Project: Soil carbon in New Englandforests - analysis and modeling.

Objective: To develop a predicative model based on the integration of regional-specific factors(both physical and biotic/chemical) by which soil organic carbon content can be estimated. The model will be developed by relating soil organic carbon content to forest types and soil series as well as to other site parameters such as aspect, slope, soil depth, pH, etc. The model will provide resource professional with a technique for rapid field estimation of soil organic carbon content.

Contact: Kipen Kolesinskas, SSS, USDA-NRCS, 16 Professional Road, Storrs CT 06268-1299.

Status: Projected funded in January 1996. Work is under way on this two year study.

Project: Soil biological activity and the biological active carbon pool.

Objectives: (1) To determine the biological active pool of soil carbon in selected soils; (2) To look a the effect of Soil Carbon on Soil Quality; (3) TO set up a procedure to measure the biological component of the soil and the different carbon pools.

Contacts: John Kimble, Carol Franks, and Susan Samson, USDA-NRCS-NSSC,

Fed. Bldg. Rm. 152,100 Centennial Mall North, Lincoln, NE 68508-3866.

Status: Procedures for laboratory work be collected and evaluated, needed equipment be evaluated, visits to laboratories doing similar work underway. Some field samples collected and in cold storage. Inputs from other scientists related to biological needs being evaluated. We hope *to* be operational for a limited number of measurements in the summer of 1996.

Project: Carbon sequestration in soil - an international symposium

Objective: This international symposium which is joint organized by the USDA-NRCS, FS, ARS, and the Global Change Program Office, US-EPA and The Ohio State University and cosponsored by the Soil Science Society of America and the International Society of Soil Science with address the importance of world soils in carbon sequestration, define the relationship between soil quality and carbon sequestration, describe mechanisms and process of carbon sequestration in soil, identify cultural practices and policy issues to enhance soils capacity for carbon sequestration, and explain the role of conservation tillage and CRP in Carbon sequestration.

Contact: J.M. Kimble, USDA-NRCS-NSSC, Fed. Bldg. Rm. 152, 100 Centennial Mall North, Lincoln, NE 68508-3866.

Status: Conference will be held July 21-26, 1996 in Columbus, Ohio at The Ohio State University. More than 100 papers have been submitted for presentation from scientists from over 15 countries. Between 150 to 200 participants are expected to attend this symposium.

Project: *Soil-C storage within soil-profiles of the historical grasslands of the USA.*

Objectives: (1) To determine effects of precipitation and temperature gradients upon various soil-carbon pools within native, cropped, and CRP (>5 years) lands across the historical grasslands of the USA: (2) Evaluate long-term losses of soil carbon and the potential for using CRP to store C within various soil-C pools for representative soil profiles that are found along preeipitation and temperature transects within the historical grasslands of the USA: (3) From detailed soil-profile measurements and by careful use of the STATSGO or other data bases, make estimates of the carbon storage within soils of the historical grasslands of the USA and of the influence of management on regional losses or gains of C; and (4) To

determine effects of CRP on soil chemical and physical properties.

Contacts: R. Follett and E. Pruessner, ARS, Fort Collins, CO, and S. Samson and J.M. Kimble, NRCS, Lincoln, NE.

Status: Initial field sampling in fall of 1994 and 1995. Additional sampling to be done in 1996 in Minnesota and North Dakota. This data will be summarized and reported in 1995. Field treatments out in 1995 and a paper will be written in 1996. Follow-up sampling will be continued over the next several years.

Project: *Erosion effects on carbon redistribution and CO_2 flux.*

Objectives: (1) Determine the effect of landscape position on carbon distribution in the soil profile for give soil series: Canfield, Centerburg, Eldean, Glynwood, and Miamian; (2) Estimate the magnitude of past erosion by soil profile characteristics and ^{137}Cs analyses; (3) Monitor temporal changes in CO, flux for different landscape positions for paired mapping units; and (4) Determine the effect of carbon displaced by soil erosion on CO, flux.

Contacts: R. Lal, G. Hall, Ohio State University, NRCS Staff, Ohio, and J.M. Kimble, NSSC, Lincoln, NE.

Status: Graduate student in place in Ohio and project will be on going for two more years. Three papers drafted for the Ohio carbon meeting in July 1996 and one for the WICSO Conference in Germany in August 1996.

Project: *Factors controlling carbon sequestration in tropical soils.*

Objectives: (1) To evaluate the relationships between levels of soil organic matter and soil and other environmental parameters; (2) To identify soil properties and environmental factors that govern the accumulation of organic carbon in soils of different tropical ecosystems.

Contacts: F. Beinroth, L. Perez, M.V. Cartagena, University of Puerto Rico; C. Santiago, NRCS, Puerto Rico; and P. Reich, USDA/NRCS, WSR, Washington, DC.

Status: Completed.

Status of Global Change Projects
for the National Cooperative Soil Survey

Project: Organic carbon in the soils of St. John Island, United States Virgin Islands.

Objective: To compare the pools of soil organic carbon on a small tropical island using three methods; a) equal distribution, b) parent material, and c) physiographic area.

Contact: H.R. Mount, Soil Scientist, National Soil Survey Center, NRCS, Federal Building, Room 152,100 Centennial Mall North, Lincoln, Nebraska 68508-3866.

Status: Complete. Two publications are available including an article published in Soil Survey Horizons during 1994.

Project: *Soil organic carbon and associatedproperties on an aerial basis for global climate modelers - MLRA 106.*

Objectives: (1) To determine the soil organic carbon for soils in MLRA 106 by both sampling pedons and deep boring; (2) Link the data collected to the map units within the MLRA.

Contacts: R. Grossman and D. Harms and NRCS Staff at the NSSC and State Level.

Status: Initial field sampling in 1993 and 1994. This data is being evaluated and spatially related to map units in the MLRA. More deep coring completed in 1995. A paper is being written for presentation at the carbon meeting in Ohio in July 1996.

Project: *Soil carbon map of North America*

Objective: To develop a soil carbon map of north America (United States, Canada and Mexico) at a scale of 1:1,000,000 which can be used by modelers and others to look at the amounts and possible changes in the carbon storage in soils.

Contacts: S.W. Waltman, Soil Scientist at the NSSC, Norman Bliss, EDC USGS, Charles Tarnochi, Agriculture Canada, and Francisco Orosco, INEGI, Mexico

Status: Initial results presented at ISSS meeting in Mexico in 1994. All boundaries between Canada and the United States were matched in 1995. Pedon data is being added to the U.S. map units to complete the interpretation data now in the files. A draft map has been completed and is being checked.

Project: *Organic carbon data collection projectfor New England states.*

Objectives: (1) Improve the soil organic carbon data base for the New England States by correcting inconsistency, and or incorrect data elements; (2) Improve sampling of organic surface layers and the standing biomass; (3) Determine organic matter accumulations in the Bb and Bs horizons for Spodosols in the New England region.

Contact: L. Quandt, Soil Scientist at the NSSC working with NRCS and University Scientists in New York, Vermont, New Hampshire, and Maine.

Status: Field sampling completed in 1995. Samples undergoing analysis and evaluation.

Processes and Geospatial Data Projects

Project: *Field Experiments and ecosystem modeling.*

Objective: To develop modeling efforts useful for predicting soil and ecosystem properties under differing land use and climate scenarios.

Contact: E. Levine, Biospheric Sciences Branch, NASA / Goddard Space Flight Center, Greenbelt, Maryland 20771.

Status: This work is testing Neural Nets to estimate missing data which can then be used in models. R^2 values of 70-90 are being obtained. This work is ongoing with presentations being given at several meetings.

Project: *Arctic tundra LTER and high latitudes soils in Alaska and Russia.*

Objectives: (1) To map selected areas in the high arctic of Alaska and Russia and to develop a common mapping procedures and a legend for permafrost affected soils; (2) To provide soils data support to National Science Foundation projects related to gas fluxes from high arctic soils; (3) To obtain soil moisture and temperature data in

high arctic soils; (4) To develop better carbon estimates of soils at high latitudes; and (5) To allow estimation of many other soil properties from a G117 computer data base.

This work is also related to on going research by Agriculture Canada and an International Soil Science Society work group on Cryosols, with cooperation with the International Permafrost Association. A soil map at a scale of 1:10,000,000 is being developed by a team from the United States, Canada, and Russia. A test area will be completed in June 1996.

Contacts: J.M. Kimble, NSSC and C.L. Ping, U of Alaska, Lead Scientists working with a working group of about 20 scientists from Russia, Canada, Germany, Denmark, etc.

Status: Field sampling in 1992, 1993, 1994, and 1995. Work with NSF Arctic Systems project on gas flux will continue in 1995. Position set up in Alaska to coordinated international mapping efforts and development of common legend, will be filled in 1995 for a minimum of two years.

Project: *Order 1 soil survey on the Luquillo LTER, Caribbean National Forest, Puerto Rico.*

Objective: To develop better soils data to support the broad experimental work being conducted on this LTER. Over 800 papers have been published and a better understanding of soils is need to allow this important research work to be related to

and (5) Provide prototype ecosystem approach containing a strong soils component for use at other LTER sites.

Contacts: M. Petersen and A. Price, CO, NRCS; E. Kelly, C. Yonker and graduate students, CSU; C. Olson, NSSC.

Status: Project began in 1990 and should continue for at least 6 more years. Background literature for the site was compiled and topographic map analysis begun. An agriculture experiment station bulletin containing the order one soil survey is nearly complete and should be ready for final review and publication in fall 1994. This document is significant in that it will serve as the prototype for the types of soil information that can be made available at many other LTER sites when soil survey activities are included in research programs. It provides information to scientists whose backgrounds are removed from the science of soils and promotes and enhances an understanding of soil science.

A combination of research techniques including stable isotope characterization, geomorphic mapping and soil analytical work allowed for the following conclusions in a portion of the CPER, the upper Owl Creek watershed. Three soil-forming periods were identified in the Holocene: 10,000 to 8,000; 5,500 to 3,000; and 1,500 to present. Stable isotope chemistry indicates that climatic conditions were cooler than present in the early Holocene and warmer than present in the mid-Holocene. It was discovered that climatic-overprinting needs to be addressed in welded soils. Isotopic results from these compound soils are more difficult to interpret and require additional corroboration from other analytical techniques. The viability of reconstructing recent terrestrial environments using stable isotopic techniques under well-controlled field conditions has been shown to be effective here.

Project: *Panola mountain watershed, Georgia.*

Objectives: (1) To provide a detailed soil map unit from GPS systems that can be loaded into a GIS system spatially integrated previous, current and future research; (2) To sample representative soil profiles.

Contacts: H. Mount and W. Lynn NSSC, NRCS Staff in Georgia, and Scientists from the University of Georgia and USGS, Atlanta, Georgia.

Status: Field sampling and mapping completed in 1994. Work has continued into 1995. GIS analysis is ongoing.

under different climatic regimes.

Contacts: 0. Chadwick, JPL-NASA, E. Kelly, CSU, D. Hendrix, U of AK, C. Smith and R. Gavenda, NRCS, Hawaii; C. Olson, NSSC.

Status: Project began in 1992 and will continue for at least 4 more years. Analysis of data from the first traverse on a 150,000 YBP lava flow show that some soils currently in arid environments retain mineralogic and pedogenic characteristics of soils from wetter climates. Long-term rates of desilication increase by nearly an order of magnitude as time-weighted rainfall increases. Lack of smectite at low rainfall sites and the presence of carbonate suggest that low rainfall sites received much greater paleorainfall than our predictive paleorainfall model suggests.

A soil-climate process response model needs to be finalized on Hawaii. The currently predicted paleorainfall model needs further refinement. Additional very dry end climatic transect sampling and very wet end sampling will be completed in the next 2 years. Some of this activity may occur on other islands. Plans call for examining mass balance along climatic gradients in at least two more climatic regimes.

Several presentations have been given at professional meetings. Several manuscripts are in preparation and one has been published.

Project: *Earth hummock study.*

Objectives: (1) To document the morphology of the hummocks in three dimensions. Measurements documented on graphs, by photography, and by video tape; and (2) To gain an understanding of morphological processes associated with the morphology, specifically the effect of freezing on the morphology.

Contacts: W. Lynn, Research Soil Scientist at the NSSC in collaboration with Jay Bell at the University of Minnesota.

Status: Products completed or anticipated, or both:

1. **Poster paper at ASA in Seattle, 1995.**
2. **Entering graphs and measurements into a GIS system (Grass) at the National Soil Survey Center.**

Status of Global Change Projects
for the National Cooperative Soil Survey

Project: Soil properties sensitive to climatic change.

Objective(s): (1) To study trends in soil crop productivity and organic matter along climatic gradients in the Great Plains; (2) To use soil properties in predicting production and the effect of climatic change on soil productivity; and (3) To assist in long term monitoring of climatic changes on agriculture.

Contact(s): H. R. Sinclair, Jr. NSSC and Soil Scientists in 14 States (CO, IA, KS, LA, MN, MO, MT, NE, NM, ND, OK, SD, TX, and WY).

Status: Project has collected 4 years of data and will continue for 3 or 4 more years.

Project: *Bulk density methods for fragile surficial horizons*

Objective: Develop field methods for determination of bulk density of thin soil horizons not sufficiently coherent for displacement methods.

Contact: R. Grossman, Research Soil Scientist, National Soil Survey Center, Lincoln, Nebraska

Status: A draft procedure has been written and is being field tested. Results look very promising.

Project: Soil data base updates of classifications and site locations.

Objectives: (1) To georeference all of the pedons in the SSL data base; (2) To ensure all of the classifications are updated and correct for all pedons in the data base; and (3) To enter pedon descriptions for where not stored in the data base.

Contact: Dr. T. Reinsch and R. Engel. USDA-NRCS-NSSC, Fed. Bldg. Rm. 152, 100 Centennial Mall North, Lincoln, NE 68508-3866.

Status: Work has been going on the data base for the last 4 years about 50% of the pedons have checked classifications and georeferences. Activities will be focused on the states with the lowest percentage of completed files. One or two [illegible]

e

Why Can You Drink Water That Has Traveled Through The Soil (When Your Mom Will Not Let You Eat Food Off The Ground)?

[A 30-minute Hands-on Set of Lab Exercises for 4th and 5th Grade Students)

Tom Schumacher and Doug Malo, Plant Science Department

Listed below are the procedures and methods developed for a set of "hands-on" laboratory exercises for 4th and 5th grade students. These lab exercises explore the importance of soils to the water cycle. Students are introduced to science activities in a non-threatening, fun way. This lab requires more than one person if many groups are to be taught, one group after another.

1. Water cycle - Handout: Front side - Water Cycle and terms (Appendix).
   Back side - Directions and information.
   Listed on the handout - Station for each student (group and position).

   a. Students are given the handout and directed to their assigned station with help of a second person.
   b. Discuss the water cycle (Do not go into detail on water cycle if this is part of a Water Festival). Go directly to part of water cycle where water must go through. Specifics about Big Sioux Aquifer such as depth, texture, and other items are discussed.

2. Soil surface materials: Organic wastes (manure) in a bottle, decayed leaves, earthworms, burnt grass, soil, and other soil surface items of local interest.

   a. Ask class what water has to pass through or by to get to the aquifer. If they are slow to answer, prompt with examples given above. Conclude with manure to get a disgusted reaction. Then point out that the soil is important in making our water pure and safe to drink.

3. Soil Monoliths: Use three soil monoliths to represent the range of soil conditions present in the area. We use the Houdek, Lamoure, and Fordville soils. In addition, six buckets of aquifer (glacial outwash) material are distributed, one to each group of five students.

   a. Direct student attention to the Houdek soil. Point out that there are 565 soils in South Dakota. Point out Houdek as our State soil. Reference state flower, and state bird as other symbols important to South Dakota. Describe different parts of soil - topsoil, subsoil, and parent material. Show the Lamoure soil and how it differs from the

Houdek. Point out that the Fordville soil is a soil that is on top of an aquifer and that not all soils, including Houdek and Lamoure, have surficial aquifers. Have the students feel aquifer material in buckets placed in each group area.

4. Soil Columns: three Plexiglas columns (3-inch diameter and 15 to 18 inches long) are used, one with aquifer material, one with subsoil material, and one with topsoil from Fordville soil (the soil with the aquifer under it). The classroom needs a water source and a place for water disposal. Taped to the bottom of the soil columns are Buchner funnels with rubber tubing and clamps. Three 1000 ml beakers are placed under each column to collect water. A fourth 1000 ml beaker is used to pour water into the columns. Columns are filled 3/4 of the volume with soils. Do not put filter paper on the bottom of Buchner funnel (It slows water movement too much). Signs entitled "Aquifer Material", "Subsoil", and "Topsoil" are placed on each column. Columns are held with two ring clamps, a small one to hold funnel and a larger one on top to stabilize the column. Prepare one beaker (amount depends on the class size) with ammonium nitrate solution and a beaker with muddy water. Ask students which solution is safe to drink. In addition, a beaker of tap water should be prepared.

   a. Direct students' attention to the three columns. The topsoil and subsoil columns should be filled with water and the soil stirred before the group arrives and allowed to begin draining to give water for display. These two columns can be left running for a predetermined length of time (Use a timer). The second person can monitor to keep beakers from overflowing. Point out that the materials in the columns comes from the Fordville soil and that each part of the soil is important for supplying clean and abundant drinking water. Point out that topsoil, subsoil, and aquifer material is similar to that in the soil monolith. The topsoil and subsoil act as filters of water, compare solution from below with water on top of column to illustrate filtration of sediment materials. (Topsoil may be slightly yellow from organic matter compared to subsoil - point out the need for all parts of soil and a long soil column). Then turn on the aquifer column and ask "From which column does the water come out the fastest?". Have students record the results on the data sheet. Relate this to the ease of withdrawing water. The aquifer is good for storage and supply and not for filtering, while the subsoil and topsoil are good for filtering but not supplying water.

Leading into the next section hold up a solution of ammonium nitrate and ask if this looks good to drink. This solution is labeled the "Mystery Solution" and we will be testing this water to see if it is good to drink.

5. Ammonium and nitrate tests. Need Nessler's reagent (ammonia test kit for aquariums works well). One bottle of Nessler's reagent will work for about 150 students. Need nitrate test reagents [i.e. Hach test powder - Nitriver 3 (Potassium Pyrosulfate < 10%) and Nitriver 6 (Cadmium < 10 %)]. The capsules, one of each, are mixed together in sample bottle just prior to the lab exercise. [The naming of commercial products in this document does not imply endorsement by South Dakota State University . Products are named for information purposes and as examples which could be used to teach this lab.]

   a. Each group is labeled with a letter and the six stations within a group are numbered according to the steps in the experiment. Five cm diameter Buchner funnels are used to hold the test aquifer material. Each group needs four regular funnels (stations 1-4), two Buchner funnels (stations five and six), three ring stands, and three four-position funnel holders.
   b. Each group needs three round sample bottles (30 ml capacity) for the ammonium test and three square bottles (30 ml capacity) for the nitrate test.
   c. Two glass 25 ml graduated cylinders (stations two and four) are used to hold tap water (drinking water) to be used to determine if there is ammonium or nitrate ions present in the drinking water. Four plastic 25 ml graduated cylinders (stations one, three, five, and six) are used to hold the Mystery Solution (ammonium nitrate solution) for various tests.
   d. The ring stands and funnel holders are labeled "Ammonium Test (Drinking Water and Mystery Solution)" and "Nitrate Test (Drinking Water and Mystery Solution)", and 'Aquifer Material (Ammonium and Nitrate Tests)".
   e. At stations one, two, and five, round bottles are placed under the funnels for the ammonium test. The round bottles each have 8-10 drops of Nessler's reagent placed in them before the presentation.
   f. At stations three, four, and six, square bottles are placed under the funnels for the nitrate test. The square bottles each have the Nitriver 3 and the Nitriver 6 reagents added to them before the presentation.
   g. A stand with clay in Buchner funnels labeled as ammonium test and nitrate test is setup as a demonstration in a center area that is visible to the class. This setup is run before the presentation and will be used to compare to the aquifer material tested during the lab

exercises. The clay is prepared by sieving a low organic matter clay textured soil.

h. Small cups of about 10-20 ml are used to measure out the clay and sand. The sand and clay should be wetted with the ammonium nitrate solution. A filter paper (Whatman #1) is placed on the Buchner funnel and wetted before adding the clay or sand. Be sure to check the filter paper to make sure it does not limit the flow of the solution so much that the experiment does not get completed in the time frame available.

i. Approximately 15-20 ml of solution or water are added for each test. (At stations one, three, five, and six, 20 ml of Mystery Solution are placed in 25 ml plastic graduated cylinders. At stations two and four, 15-20 ml of drinking water are placed in glass 25 ml graduated cylinders. The graduated cylinders are filled prior to class using automatic pipettes.)

j. Once used the sand does not need to be replaced and can be used for the entire day of presentations. The clay is only run once prior to the first presentation and does not need to be replaced.

k. A set of indicator bottles to show a positive reaction for nitrate and ammonium is prepared so instructor can show the positive reaction during the presentation. This also allows the students to make comparisons to the known reactions.

l. Extra sets of round and square bottles are prepared for 30 students with indicators before the first presentation to get ready for the second presentation. The solutions are switched between presentations with fresh bottles. The second person then rinses these bottles in water and adds indicator for the third presentation and so on while the presentation is in progress.

6. Tell the students that everyone will be doing something in this next section. Ask station one students to hold the plastic graduated cylinder (briefly describe what it is and show one to them). Tell the students that the graduated cylinder has the Mystery Solution in it and that we are going to find out if the Mystery Solution contains ammonium ions. Show the round sample bottle and explain that an indicator was put into it so that if ammonium is present there will be a color change like the example shown earlier. Have them pour the water in the graduated cylinder into the round bottle (containing the Nessler's reagent) using the funnel setup (demonstrate and check to make sure they are pouring from the cylinder to the bottle and not vice-versa). Have them report their results verbally.

7. Ask the students at station two to pour the drinking water (glass cylinders) into the round bottle (containing the Nessler's reagent) using the funnel

setup. Tell them we are going to check if the drinking water has ammonium in it. Have them report their results verbally. Have the station one and station two students hold up their bottles for comparison. Discuss the harmful aspects of ammonium in the water. Reinforce that our drinking water is safe in terms of ammonium ions.

8. Next have the station three students take their plastic cylinders containing the Mystery Solution (ammonium nitrate solution) and pour into the prepared square bottle (containing nitrate test reagents). The color development is slow. A pink to red color develops. The intensity of the red is dependent on the amount of nitrate present. Ask about the color change and reinforce that this means nitrate is present in the solution. Explain why nitrate is harmful in our water.

9. Ask the station four students to take their glass cylinders containing the drinking water) and pour into the prepared square bottle (contains the nitrate testing reagents] using the funnel setup. Ask about no color change and reinforce that this means no nitrate is present in the solution. Have the station three and station four students hold up their bottles and compare the two. Reinforce that our drinking water is safe in terms of nitrate ions.

10. Next tell the class that we are going to test whether aquifer material or sand can take ammonium out of the Mystery Solution and later we will compare this to clay. Reinforce that clay is in the topsoil and subsoil of the Fordville soil. Have station five students carefully pour Mystery Solution from the plastic cylinder onto the sand or aquifer material in a Buchner funnel. Caution them to wait until water percolates through sand. Reinforce that results show that the sand did not do a good job of filtering out the ammonium ions. Have students record results on data sheet.

11. Next tell the class that we are going to test if aquifer material or sand will remove nitrate from the water. Have the student at station six carefully pour the Mystery Solution (ammonium nitrate solution) into the aquifer material or sand in the Buchner Funnel. Caution that if nitrate is present it will slowly turn pink and then gradually get red. Reinforce that sand or aquifer material allows nitrate to pass through it. Have the students at stations six and three compare results. Have students record results on data sheet.

12. Direct student attention to the center demonstration using clay with the Mystery Solution. Ask them to compare the color under the ammonium test of the aquifer material or sand and the clay. Reinforce that the clay is different because it removed most of the ammonium ions. Do the same

with the nitrate and reinforce that the clay and the sand both allowed nitrate through the soil. Have the students record results on the data sheet.

13. Ping-pong ball CEC model. You need two Styrofoam sheets - one labeled "clay" and the other labeled "sand". The clay has an abundance of velcro stickers on it (9) and the sand a very small number (2). The white ping-pong ball (represents + ion) has the complementary velcro on it to stick to the corresponding velcro on the simulated soil sheet. The colored ping-pong balls have the same velcro as the simulated soil materials. A bucket is placed below each sheet to hold the ping-pong balls that did not stick. A set (a positive and a negative ion) of ping-pong balls are placed at each station for each student.

    a. Have the students grab the ping-pong balls. Point out that these are models of ammonium nitrate molecules and that in water they come apart. Ask if they have studied magnets and/or electrical charges. Ask what happens when you have two like charges or poles facing each other and vice versa. On blackboard or chart have written:

Soil	negatively charged (-)
Ammonium	NH,+'
Nitrate	NO,"
Water	H_2O

    b. Go over charges on chemicals with them. Tell them that they are to figure out which of the ping-pong balls is ammonium and which is nitrate in the next exercise. Ask them to come forward and try to place the ping-pong balls on the sheets that represent clay and sand. If the ping-pong balls do not stick or there is no place for them then they go to the bucket below each sheet. Ask the students to return to their stations. Note that the white ping-pong balls stuck and ask them which of the chemicals on the board do they represent. Point out that in the sand a lot of the white ping-pong balls did not have a place to stick, while in the clay there were a lot of places for them to stick. Also point out that the colored ping-pong balls did not stick in either the clay or the sand. Relate this back to the experiment that they just conducted and to the difference between sand-clay and ammonium-nitrate.

14. Wrap up by reviewing the important points.

    a. Soil acts as a filter for sediment that we can see and if clay is present it will also filter out some types of chemicals with positive charges.

Soil does not do a good job of filtering and removing negative charged ions like nitrate. Have students complete the Part 4 in the data sheet.

b Inform students of some sources of nitrate: fertilizers, manure, burned grass, and in some cases even plowing the ground can produce a burst of nitrate. Let students know that we need to be careful when applying nitrate over an aquifer.

c. All parts of the Fordville soil (topsoil, subsoil, and aquifer) work together to supply us with clean and abundant drinking water.

d. Remind students that our drinking water in Eastern South Dakota comes from the Big Sioux Aquifer and review the meaning of aquifer again.

e. If time, talk about plants removing nitrate and ammonium from the soil before it gets to the aquifer.

15. Preparation for next group.

a. Immediately add new ammonium nitrate solution using automatic pipettes to all plastic graduated cylinders. (15-20 ml)

b. Add water to the glass graduated cylinders. (15-20 ml)

c. The second person should immediately switch the sample bottles with the previously prepared bottles containing indicators.

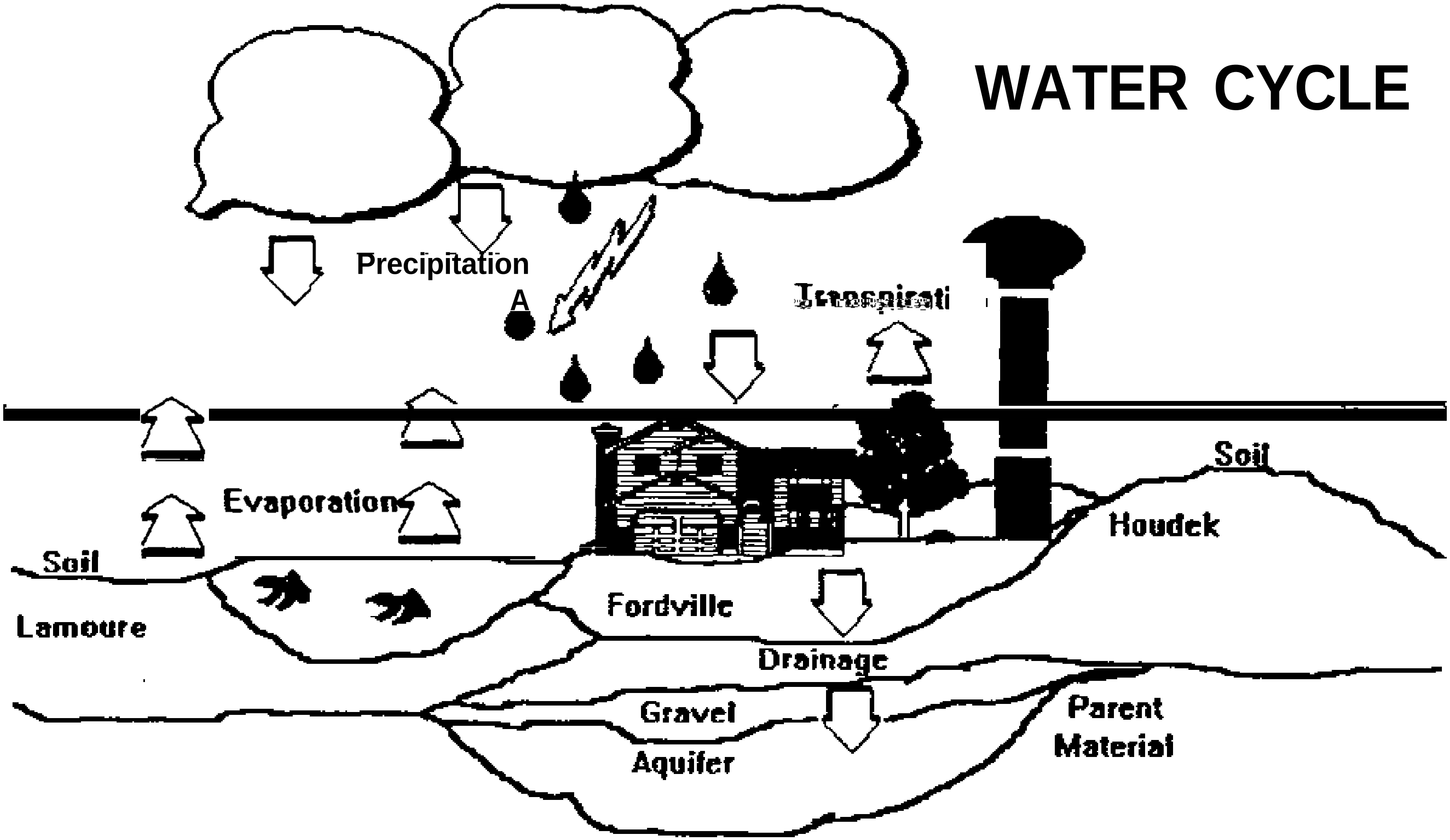
d. Put the ping-pong balls back together and arrange on the table at each station.

e. Add water to the columns and stir up soil on topsoil and subsoil columns. Clamp the drainage tubes for each column of soil used in the drainage test and add water.

f. Survey that everything is in place and get handouts in order for the next group.

g. Second person should begin rinsing bottles and preparing bottles with indicators for the next presentation.

WATER CYCLE



APPENDIX

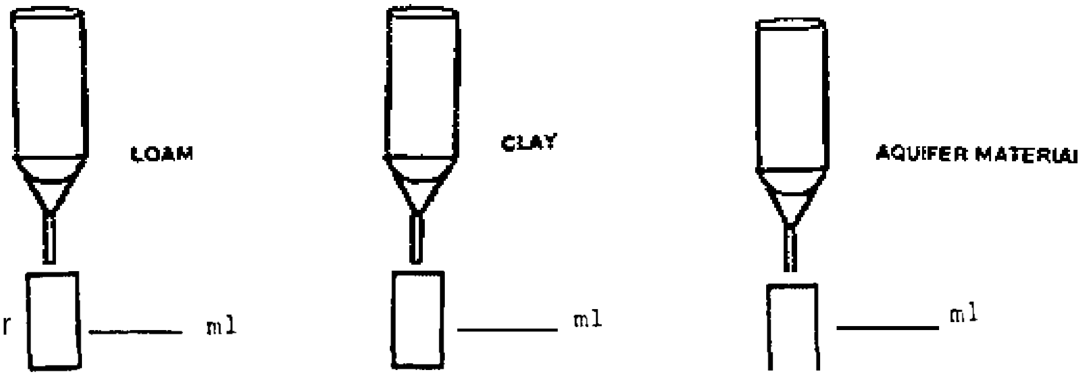
PART # 1

DO:
1. DISCUSS WATER CYCLE HANDOUT
2. OBSERVE MATERIALS FOUND ON THE SOIL SURFACE
3. FEEL AQUIFER MATERIAL - WHAT IS IT?
4. OBSERVE SOILS - LAMOURE, FORDVILLE, HOUDEK

PART # 2

OBSERVE WATER BEING POURED THROUGH A SOIL COLUMN. A TIMER WILL BE SET AND WE WILL COME BACK TO THIS STATION LATER.

DO: DRAW THE LEVEL OF WATER IN EACH SOIL COLUMN AFTER THE TIMER RINGS.



Volume of water ______ ml ______ ml ______ ml

PART # 3

1. A SOIL SOLUTION WILL BE COLLECTED AND TESTED FOR NITRATE AND AMMONIUM

ROUND BOTTLES - TEST FOR NITRATE
SQUARE BOTTLES - TEST FOR AMMONIUM

QUESTION: WHAT COLOR DID YOUR SOLUTION TURN?

NITRATE		AMMONIUM	
SAND	______	SAND	______
CLAY	______	CLAY	______

PART # 4

ACTIVITY: POSITIVE AND NEGATIVE IONS (CIRCLE ONE FOR EACH)

SOIL + OR -
AMMONIUM + OR -
NITRATE + OR -

PART # 5

SOIL ACTS LIKE A FILTER FOR MOST THINGS.
- POSITIVE IONS LIKE AMMONIUM STICK TO THE SOIL
- NEGATIVE IONS LIKE NITRATE PASS THROUGH THE SOIL

QUESTION: HOW CAN NITRATE BE REMOVED FROM THE SOIL?

ANSWER: NITRATE IONS ARE USED BY PLANTS. PLANTS CAN KEEP NITRATE FROM GETTING INTO OUR DRINKING WATER IF THERE IS NOT TOO MUCH NITRATE PRESENT.

Tuesday - May 21, 1996

Committee 1 - Activities and Recommendations

To: NCSS Committee 1
Subject: 1996 NCSS Regional Work Planning Conference, Committee 1, Soil Data Delivery Systems

Committee Chairs Pierre Robert (University of Minnesota1 and Nathan McCaleb (NRCS Lincoln, NE).

The committee charges for this group include the following:

1. How to get soil information in the hands of users, if soil surveys are not going to be published?

2. Soils information and the Internet.

3. Should there be a NCSS standard for electronic data entry? How should the data be certified?

4. What should be the requirements for storage and retrieval? Who should have access and/or responsibility for the data sets?

5. What are the benefits/disadvantages of using soil interpretations from MLRA data sets versus county specific data sets?

6. What level of data (field notes, complete description, lab sites, etc.) should be used for data aggregation?

The charges listed above are suggestions. Please feel free to make additions or recommendations for modification as you see fit.

We would like to develop a draft report prior to our committee meeting on Tuesday, May 21, 1996. If possible, please send your responses to Pierre Robert by May 10, 1996.

Pierre Robert
University of Minnesota
Dept of Soil Science
566 Borlaug Hall
1991 Upper Buford Cr
St Paul, MN 55108
612-625-3125
612-624-4223 FAX

COMMITTEE ONE
Soil Data Delivery Systems

NCR-3 Regional Work Planning
Conference

May 21,1996

Charge #1 How to get information in the hands of users, if soil surveys are not going to be published.

Recommendations

- CDs or equivalent should be explored as a medium to publish soil surveys.
- INTERNET should be used to distribute soils information
- Soil Surveys should still be published on hard copy, but in limited numbers.

Charge #1 (continued)

Other issues:

- All soil survey users should be considered
- Content of information in electronic medium should be reviewed
- Agencies and others should explore charging for special request services

Charge #2. Soils information and the INTERNET.

Recommendations

- INTERNET should be used as soon as possible for all soil survey related data.
- New data elements (landscape, soil, land use) could be developed to make commonly used data more accessible to users.

Charge 2 (continued)

Other issues

- Official data base in Searchable format (by state)
- Home Page system administration problems
- Only certified data should be used

Charge #3. Should there be a NCSS standard for electronic data entry? How should the data be certified?

Recommendations

- Some standards are already in place and should be considered in any certifications. (SSURGO, FOTG, etc.)
- Standards should NOT limit development of digital data.

Charge #3 (continued)

Issues:

- Federal Geographic Data Committee (FGDC)
- Metadata should contain as much information about the data as possible
- Robust enough to meet needs all users.

Charge 4 (1). What should be the requirements for storage and retrieval?

Recommendations

- Data distribution and queries should be from the archived database, not the live database.
- Databases should be updated regularly at a fixed schedule provided to users.
- CDs could be used for their capacity and stability.

Charge 4(2). Who should have access?

Recommendations

- All customers should have access to official data sets.
- Fees could be charged for special request.
- Access should be from many locations (NCGC, MO, field offices, etc.)

Charge 4(3). Who has responsibility for the data sets?

- Data sets or data bases should be the responsibility of the entity that produces it. i.e. NRCS is responsible for their data base, Forest Service is responsible for theirs, universities etc.

Charge 4 (continued)

- NRCS should set policy on data ownership and maintenance responsibilities for MO and state offices.

Charge 5. What are the benefits / disadvantages of using soil interpretations from MLRA data sets versus county specific data sets?

Advantages

- More consistent data, less local bias
- Larger population for analysis
- More uniform information

Disadvantages

- Less specific information
- Need more specific interpretations in some areas
- Not all MLRA subsets complete
- Differences in ages of subsets

Charge 6. What level of data (field notes, complete description, lab sites, etc.) should be used for data aggregation?

Issues

- All data are potentially useful, including field notes.
- The more site-specific information the better the data
- All levels as long as observed or measured. Some inferred data may be used as long as it is known to be inferred.
- Complete descriptions of lab sites should be included.

COMMITTEE ONE
Soil Data Delivery Systems
NCR-3 Regional Work Planning Conference
May 21, 1996

Charge **#1. How to get information in the hands of users, if soil surveys are not going to be published.**

Recommendations
- CD's or equivalent should be explored as a medium to publish soil surveys.
- INTERNET should be used to distribute soils information.
- Soil Surveys should still be published on hard copy, but in limited numbers.

Other issues:
- All soil survey users should be considered.
- Content of information in electronic medium should be reviewed.
- Agencies and others should explore charging for special request services.

Charge #2. Soils information and the INTERNET.

Recommendations
- INTERNET should be used as soon as possible for all soil survey related data.
- New data elements (landscape, soil, land use) could be developed to make commonly used data more accessible to users.

Other issues:
- Official data base in searchable for (by state).
- Home Page system administration problems.
- Only certified data should be used.

Charge #3. Should there be a NCSS standard for electronic drtr entry? How should be data be certified?

Recommendations
- Some standards are already in place and should be considered in any certifications (SSURGO, FOTG, etc.)
- Standards should NOT limit development of digital data.

Issues:
- Federal Geographic Data Committee (FGDC).
- Metadata should contain as much information about the data as possible
- Robust enough to meet needs all users.

Charge 4(1). What should be the requirements for storage and retrieval?

Recommendations
- Data distribution and queries should be from the archived database, not the live database
- Databases should be updated regularly at a fixed schedule provided to users.
- CDs could be used for their capacity and stability.

Recommendations
- All customers should have access to official data sets.
- Fees could be charged for special request.
- Access should be from many locations (NCGC, MO, field offices, etc.)

Charge 4(3). Who has responsibility for the data sets?

Data sets or data bases should be the responsibility of the entity that produces it. i.e. NRCS is responsible for their data base, Forest Service is responsible for theirs, universities etc.

- NRCS should set policy on data ownership and maintenance responsibilities for MO and state offices.

Charge 5. What are the benefits/disadvantages of using soil interpretntions from MLRA data sets versus county specific data sets?

Advantages
- More consistent data, less local bias
- Larger population for analysis
- More uniform information

Charge 6. What level of data (field notes, complete description, lab sites, etc.) Should he used for data aggregation?

Issues
- All data are potentially useful, including field notes.
- The more site-specific information the better the data.
- All levels as long as observed or measured. Some inferred data may be used as long as it is known to be inferred.
- Complete descriptions of lab sites should be included.

Tuesday - May 21, 1996

Committee 2 - Activities and Recommendations

NCSS North Central **Region Soil Survey Conference**
Rapid City, South Dakota
May 20-23, 1996

Report for Committee 2 - Soil Research Needs

Chair: Richard L. Schlepp, State Soil Scientist/MO **Leader,** Salina, KS

RMCkyirsRansom, Deprt mnti

Charge 1

The committee developed a consensus to edit Charge 1 as follows:

1. Identity NCSS soil research needs for the North Central Region and develop a mechanism to determine which partners (AES, USFS, BIA, BLM, USGS, state agencies, private consultants, or others) may be addressing or willing to address some of those needs.

We noted that a National Cooperative Research Committee was established at the National Cooperative Soil Survey Work Planning Conference in June 1995. We support the formation this committee which has the following composition:

1. One from each Agricultural Experiment Station region (total of 4)
2. One from the Forest Service
3. One from the Bureau of Land Management
4. One to six from the Natural Resources Conservation Service

Don Franzmeier moved to recommend the addition of one representative from USDA-Agriculture Research Service to this committee. The motion was seconded by Ron Yeck. Mickey Ransom asked for a voice vote, and the motion passed.

The committee then discussed the needs for similar committees working on a regional level. A consensus developed for each region to determine their own composition for such a committee.

Ron Yeck moved to establish a North Central Regional Cooperative Research Committee (NCRCRC) having the following composition:

1. One from the Forest Service
2. One from the Bureau of Indian Affairs
3. Three from the Agricultural Experiment Stations (NCR-3).
4. One from NRCS-National Soil Survey Center (this person serves as Liaison and Convenor of the committee)
5. Four from NRCS - two from MO's and two from NRCS State Offices
6. One from the Agricultural Research Service

The formation of this standing committee will be formally proposed as a recommendation to the Business Meeting of the North Central Soil Survey Work Planning Conference. Tom Schumacher seconded the motion. Mickey Ransom asked for a voice vote, and the motion passed.

Charee 2

This charge is an example of the type of issues that should be addressed by the NCRCRC.

Charge 3

The NCRCRC needs to address this charge

Charge 4

This charge does not seem appropriate for this committee or the NCRCRC. The committee did not suggest where Charge 4 belongs.

Additional Recommendation

The committee recommended that the Committee 2: Soil Research Needs be dissolved. Any remaining business should be handled by the NCRCRC.

There was no other business, and the meeting was adjourned

Respectively Submitted,
Mickey Ransom and Ray Sinclair
Co-Chairs

Tuesday - May 21, 1996

Committee 3 - Activities and Recommendations

ERODED SOILS AND CLASSIFICATION COMMITTEE
1996 NORTH CENTRAL SOIL SURVEY WORK PLANNING CONFERENCE
RAPID CITY, SOUTH DAKOTA
MAY 19-23, 1996

Committee Members: Al Giencke, Stanley Glaum, Bruce Kunze, Doug Malo, Joseph McCloskey, Ken Olson, Eugene Preston, Gregg Schellentrager, Neil Smeck, George Teachman, Michael Whited, Tom Fenton, Chair

The charges given by the Steering Committee are listed below:

1. Develop recommendation(s) to send to the NCSS for action based on the Eroded Soils Report from the 1995 NCSS Meeting in San Diego, CA.

2. Develop guidelines for mapping unit design and interpretations that could be used for eroded soils regardless of their classification.

3. Suggest diagnostic criteria of accelerated erosion; a quantification of accelerated erosion the Eroded Soils Report from the 1995 NCSS Meeting for your use.

Charge **1: Develop recommendation(s) to send to the NCSS for action based on the Eroded Soils** Report from the 1995 NCSS Meeting in San Diego, CA.

We considered the items discussed in San Diego report especially the sections toward the end entitled "Summary of items discussed in San Diego" and "Recommendations". We have a considerable number of publications and studies that document the importance of erosion on productivity. It seems rather ironic that many of the current topic of interest in soil quality, sustainability, world-wide carbon budget, climatic change, ecosystem differences, and natural resource inventory relate to organic matter content and associated properties. Organic matter changes in turn have long been related by soil scientists, at least in part, to accelerated erosion and erosion phases. In the preface to a 1994 Advances in Soil Science publication- Soil Biology: Effects on Soil Quality the editors describe characteristics of a high quality soil as follows-A high quality soil is thought to include the elements ofimproved soil aggregation, enhanced water holding capacity, rapid infiltration, increased nutrient availability, extensive rooting depth, increased soil organicmatter, reduced pesticide leaching, and resistance to compaction". Sustainability has a focus that includes soil quality but also includes use and management as well as environmental components.

Charge 2: Develop guidelines for mapping unit design **and interpretations that could be used for eroded soils regardless of their classification.**

We accept the guidelines as given in the Soil Survey Manual for definition of erosion classes and phases and many states have used these guidelines in field mapping. A conflict occurs when the phases are correlated. There is a major conflict between the philosophy used in the manual in the use of erosion phases and their relationship to uneroded phases and that used in Soil Taxonomy for classification criteria. Strict adherence to Soil Taxonomy with present classification criteria does not recognize accelerated erosion and thus destroys the genetic relationships that arc obvious in the field. In the foreword to Soil Taxonomy it is stated "The classification is designed to bring out these natural relationships and to enhance the predictions that pedologist in research, education, extension, and technical assistance can make about the behavior of a kind of soil from its relation to other kinds of soils for which we have knowledge from research or experience". The other question that was asked throughout the development of Taxonomy was "Do these grouping permit us to make precise predictions of soil behavior"? It may be that in the Midwest we have a unique combination of ecosystems that have influence the way we look at our soil resource. Most states have used erosion classes and phases to show the effects of accelerated erosion. Phases by definition are utilitarian groupings but without changes in Soil Taxonomy how do we maintain the utilitarian groupings?

Charge 3: Suggest diagnostic criteria of accelerated erosion; a quantification of accelerated erosion.

A previous committee developed the following list of properties associated with eroded conditions for all soils as

5. Has ten percent or more discernable masses of soil material that have color and texture similar to the subjacent horizon,

6. Has ten percent or more coarse fragments than the subjacent horizon.

7. Cs^{137} activity in the Ap horizon is <50 percent of the Cs^{137} activity of the surface horizon of a non-eroded reference pedon.

RECOMMENDATIONS:

Based on committee correspondence and discussions at the conference. it is the recommendation of the committee that the mapping and correlation of erosion phases should be continued in those States that utilize this information in their soil survey programs. Accelerated erosion is an important problem in many states and causes problems in classification in several soil order including Mollisols, Alfisols, Spodosols, and Ultisols. Erosion phases are important in the understanding and interpretation of ecosystems and other interpretations related to land use, maintaining a genetic link for soils, and in telling the story of the land. The following solutions to the classification problems related to the classification of those soils that have been affected by accelerated erosion proposed at this conference are listed below:

I. Add exception statements at appropriate places in Soil Taxonomy similar to (or artificial drainage) used to waive certain requirements for poorly drained soils. For example. in the thickness requirements of the mollic epipedon for Mollisols, (unless eroded) could be added and wed to waive the requirements for a specific category. The same procedure could be followed for other categories.

2. Accelerated erosion could be recognized as a diagnostic soil characteristic and defined in Soil Taxonomy under the section entitled "Other diagnostic soil characteristics". A listing of proposed diagnostic characteristics is given in a previous section of this report

3. Use the series name to link to eroded units but classify the soil based on existing properties. For example, an eroded Tama soil that did not meet the requirement for a mollic epipedon because of accelerated erosion would be named Tama, eroded to maintain the genetic link to the Tama series.

4. Modii Soil Taxonomy for the various categories that are affected by accelerated erosion. For example, for Mollisols, the requirements for the mollic epipedon could be changed. One possibility is to require mollic colors after mixing to a depth of 25 cm and delete other requirements such as the dependence of thickness of the mollic epipedon on solum thickness or depth to a lithic or paralithic contact.

Our committee will continue to explore these possibilities through the next National Conference. If the problems are

Responses to Charges for Eroded Soils and Classification Committee - K.R. Olson

Charge 1: Develop recommendation(s) to send to the NCSS for action based on the Eroded Soils Report from the 1995 NCSS Meeting in San Diego, CA.

Soil Taxonomy with a morphological emphasis seems to give more weight to soil forming processes that result in gains rather than soil degradational processes that result in losses.

Accelerated erosion should be recognized in **Keys to Soil Taxonomy in** either Chapter 2 (Horizons and Properties Diagnostic for the Higher Categories: Mineral Soils) in either of two subsections **Diagnostic Surface Horizons: the Epipedon or Other Diagnostic Soil Characteristics.** I would suggest a new term be developed **such as** an **anthroperodic epipedon** or **anthroperodic conditions. This** epipedon could be used for soils which have been truncated by human tillage activity and associated soil loss from the action of wind and water erosion. I believe this epipedon would be needed for soils in the Mollisol, Alfisol, Ultisol, Inceptisol, Spodosol, and perhaps Histosol orders. The properties listed on p. 6 of your summary could aid in the identification of **anthroperodic epipedons or anthroperodic conditions.**

If the new term is not accepted then the definition of mollic epipedon should be changed to have a minimum thickness of 7 inches (common depth of tillage) and meet all the requirements of a mollic epipedon except for thickness. This would at least keep moderately eroded soils the same soil order as slightly eroded soils. However, severely soils could still end up in a different soil order.

Charge 2. Develop guidelines for mapping unit design and interpretations that could be used for eroded soils regardless of their classification.

The eroded phases of soils should continue to be based on the eroded classes of soil as defined in the Soil Survey Manual. The only real problems are: (1) finding an uneroded soil original soil to compare eroded pedons with and (2) the morphological properties of the eroded and uneroded pedons could be classified into different soil orders.

Charge 3: Suggest diagnostic criteria of accelerated erosion; a quantification of accelerated erosion.

The suggested list of soil properties on p. 6 of your summary will aid in the identification of eroded conditions for all soils as compared to their uneroded counterparts. If my suggestion from charge 1 were accepted the term **anthroperodic epipedon or anthroperodic conditions** could be added to the list.

FROM NEIL SMECK

Concept of Taronomically-distinct Erosion Classes of Series

The problem of taxonomic changes due to accelerated erosion is not restricted to Mollisols but also occurs in Alfisols and Spodosols where diagnostic horizons are susceptible to removal by accelerated erosion.

Requirements to Implement

1) ability to recognize pedons in the field that have been impacted by accelerated erosion

2) ability to determine series used for pedons on comparable uneroded sites

3) creation of a taxonomic class below the series level for eroded soils

Advantages

1) classification of eroded pedon based on observable properties in field

2) linkage between eroded and uneroded pedons through series name (allows easy determination of taxonomic class of uneroded pedons and magnitude of changes attributable to erosion).

3) erosion class names will provide an obvious indication of man's impact on soil quality

4) distinguishes between soil properties resulting from long-term environmental influences and those due to short-term influence of accelerated erosion

Example from Ohio:

Miamian	fine, mixed, mesic Typic Hapludalf
Miamian eroded*	tine-loamy, mixed (calcareous), mesic Typic Hapludalf
Miamian severely eroded**	fine-loamy, mixed (calcareous), mesic Typic Udorthent

*Thrifton series now established for this situation

**Such pedons exist but not currently mapped (now considered inclusions in Thrifton)

United States Department of Agriculture

Natural Resources Conservation Service

760 South Broadway
Salina, Kansas
67401-4642
913-823-4500 / FAX 913-823-4540

April 23, 1996

Mr. Thomas E. Fenton
Professor of Agronomy
Iowa State University
2407 Agronomy
Ames, IA 50011

Dear Mr. Fenton:

SUBJECT: Charge for Eroded Soils and Classification Committee

I am pleased to see my name on the list for the eroded soils and classification committee. After reading the material you sent, it seems to be more complicated than I first perceived. Coming from the field, it was not a problem. We did not deal with a mollic that was an inch too thin and we dealt with erosion in the map unit. When it came time to classify, we classified the mollisol. Severe erosion was not a problem, because it went to an inceptisol or an entisol. The classification of these soils was fairly straightforward.

The problem occurs when a mollisol has an argillic. Here we have a thin surface over an argillic, or an argillic at the surface being incorporated into the plow layer. In mapping these were treated as inclusions in the map unit. They were not classified because there was nothing to classify them to, except as an alfisol. The interpretations were written to take care of use and management. Also in fields, the whole field was not always eroded; only parts of the field. There was always some mollic peds out there some place.

Argillics are a classification problem, also. By the definition of an argillic, we can find it at the surface of a partially truncated soil. This also was not a problem of classification because it was dealt with in the map unit.

If we are to reclassify eroded soils, then it seems best to me to come up with a new taxonomic order for eroded mollisols and alfisols that now do not classify (i.e., erodisols). I do not think we should be trying to fit soils that do not fit into

Tuesday - May 21, 1996

Committee 4 - Activities and Recommendations

Filholm. Mindv PltSci

From: jms
To: filholmm
cc: wjb
Subject: Committee 4 report
Date: Friday. June 21. 1996 3:23PM

COMMITTEE FOUR REPORT
NORTH CENTRAL WORK PLANNING CONFERENCE
RAPID CITY, SOUTH DAKOTA
MAY 19-23, 1996
DENNIS HEIL, CHAIRMAN

CHARGE 1: Is the current method of review and comment adequate for updates to Soil Taxonomy?

RECOMMENDATIONS: The committee felt that the overall review process was adequate and sufficiently detailed in the National Soil Survey Handbook (NSSH). However due to the recent reorganization there may be some clarification necessary. It is recommend
ed the National Soil Survey Center (NSSC) furnish a letter to State Offices and MO's reiterating and summarizing review and comment procedures. It is the responsibility of those offices to ensure cooperators and field soil scientists receive copies of th
e letter. It is also recommended that MO's establish a review process or team within each MO to ensure adequate review of proposals.

CHARGE 2: What standards and guidelines are needed for updating published soil surveys?

RECOMMENDATIONS: It is recognized that states and MO's have developed update standards and guidelines independently. These are on a state of MLRA bases. It is recommended the NSSC MO Coordinator consolidate and evaluate procedures used by states and M
O's and subsequently evaluate the need for national guidelines.

CHARGE 3: What are the benefits and/or disadvantages when changing classification of soils in existing published soil surveys and other publications.

RECOMMENDATIONS: The committee confirmed that series classification is to be updated as needed or as Soil Taxonomy is revised and that correlations of published surveys do not have to be amended because of changes in the classification of series. This
can be done when the survey is updated.

CHARGE 4: Prairie Alfisols in western Dakotas.

RECOMMENDATIONS: Classify the soils according to Soil Taxonomy. Make proposals to change Soil Taxonomy if the soils do not fit into the system properly.

CHARGE 5: Compatible mapping scales/interpretations between MO's within a state.

RECOMMENDATIONS: The committee had no specific recommendations. These issues are handled by input from the states and cooperators, the MLRA steering committees and defined in the MOU's.

CHARGE 6: Criteria for establishing series based on the O-150 cm control section. When are phases appropriate? What coordination between states and MOs is needed?

RECOMMENDATIONS: The committee had no specific recommendations. This is the responsibility of the MO with input from the states. Disputes or problem areas are handled by the steering committee.

It is recommended this committee be continued

Mindy, let me know if you receive this

Jerry

Charge 3. What are the benefits and/or disadvantages when changing classification of soils in existing published soil surveys and other publications.

It was generally agreed that changes in classification are needed to assure consistency in maps and interpretations and to maintain a credible series record. An undesirable aspect is that changes result in a large amount of work.

There are new opportunities for the review and approval of proposed changes in classification, due to the establishment of the 17 MLRA Offices. This committee should develop or recommend a process for developing guidelines or procedures for determining the need and feasibility of changes.

a. list advantages and disadvantages of making changes to soil classification.

b. a procedure for authorizing and processing changes

Charge 4. Prairie Alfisols in western Dakotas.

With the elimination of Aridisols from the western Dakotas, soils with argillic horizons that lack mollic epipedons will classify as Alfisols. These soils have developed under prairie vegetation. This committee needs to address the following issues.

a. should prairie Alfisols be recognized in the western Dakotas. This would not be a new concept. Alfisols under grassland-shrub vegetation are recognized in west Texas. Conversely, Mollisols occur under Douglas Fir in the Pacific Northwest.

b. if not, develop criteria that would keep these soils out of the

Charge 5. Compatible mapping scales/ interpretations between **MO's** within a state.

Some concern has been expressed that mapping philosophies may vary between MLRA soil survey regions. It was felt that changes in mapping philosophies should be limited to break along physiographic boundaries and differences need to be coordinated by MLRA steering bodies. A good assortment of disciplines need to be involved in this decision making process.

a. this committee should develop a recommendation for MO Offices to assure mapping consistency across MLRA's and states. This may involve someone with national coordination duties.

Charge 6. Criteria for **establishing series based on a O-150 cm** control section. When are phases appropriate? What coordination between states is needed.

As soil surveys are updated, new series can be developed for soils previously correlated as map unit phases. These phases have provided viable criteria for determining interpretations. We should not always have to depend on soil taxonomy to get correct interpretations. Criteria for using phases could be worked out by MLRA steering **committees.**

The distinction between series and phases has never been clear. Phases have been established using criteria both within and outside of the series control section. And in more intensely mapped areas, series differentia can be more subtle than in areas less intensively mapped.

This committee should address the following issues

a. the need for or development of criteria for classifying soils on a O-150 cm control section.

b. recommendations for using phases. Is it possible to develop criteria differentiating series and phases.

c. coordination between states and MO's.

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

P. 0. Box 1458
Bismarck, ND
58502.1458

DATE: April 4, 1996

TO: Committee Four Members
North Central Work Planning Conference

FROM: Dennis Heil, Chairman

SUBJECT: Committee Charges

Reference is made to the 1996 North Central Regional Cooperative Soil Survey Work Planning Conference scheduled for May 20-22, 1996, in Rapid City, South Dakota. You have been selected to serve on Committee Four - Soil Correlation and Classification. The following are the charges of the committee:

1. Is the current method of review and comment adequate for updates to Soil Taxonomy?
2. What standards and guidelines are needed for updating pubiished soil surveys?
3. What are the benefits and/or disadvantages when changing classification of soils in existing published soil surveys and other publications.
4. Prairie Alfisols in western Dakotas.
5. Compatible mapping scales/interpretations between MOs within a state.
6. Criteria for establishing series based on the O-l 50 cm control section. When are phases appropriate? What coordination between states and MOs is needed?

I ask that you provide written comments on these charges by Mav 1, 1996 (preferably in some electronic format), particularly if you will not attend. This will allow us to consolidate and efficiently address the comments at the conference.

These charges are suggestions. If there are more pressing concerns, please forward those along with your thoughts on resolving the charges. The charges/concerns will be addressed as time permits. It is not necessary to address charges you are not familiar with.

Questions can be directed to me or C.J. Heidt at (701) 250-4435 or FAX No. (701) 250-4778.

Responses to Committee Four. North Central Work Planning Conference

1. *Is the current method to review and comment adequate for updates to Soil Taxonomy?*

This has always been a good question. We have been circulating all proposals to the Soil Taxonomy committees as well as all state soil scientists and MO leaders. We leave it up to the individual state soil scientists to send copies to NRCS soil scientists and cooperators within the state. The number of comments we receive varies from a few to several. We are often surprised to hear people comment after changes appear in the "Keys to Soil Taxonomy" that they never had a chance to review the proposals or were unaware that any changes were being considered.

I am open to alternatives, if anyone can propose a better system for reviewing proposals to Soil Taxonomy.

2. What standards and guidelines are needed for updating published soil surveys?

We should use the standards that we have always used. If the question is really getting at standards and guidelines to use when determining priorities for updating soii surveys, I haven't a good answer.

3. *What are the benefits and/or disadvantages when changing classification of soils in* existing *published soil surveys and other publications?*

Updating the classifications of series allows *us* to make comparisons and keep track of all the series. Sometimes it's difficult and with all the recent changes to Soil *Taxonomy* it seems like a never ending job. The advantages include maintaining our soil series data base. The disadvantages are the hours of time required to reclassify soil series with so many other pressing obligations.

4. *Prairie Alfisols in western Dakotas.*

Of *course* the central concept of Mollisols is that they formed under grasslands and that Alfisols formed under trees. While these central concepts apply to some parts of the world, they don't apply everywhere. For example, we find Mollisols in some areas of the Pacific Northwest under Douglas Fir and in the Southwest under pinon-juniper. A large area of western Texas has Alfisols under grassland-shrub vegetation. so I guess I'm not shocked to find Alfisols in the grasslands of the western Dakotas.

There have been several attempts to modify the definition of the mollic epipedon, but no one has presented anything formally that appears feasible. The organic carbon in many of our ochric epipedons is comparable to that in many of the mollic epipedons. Color appears to be the criterion that really separates the two epipedons, but it's really properties like aggregate stability that make Mollisols such desirable soils. Maybe in the future we can develop criteria centered around properties such as aggregate stability.

5. Compatible mapping scales/interpretations among MO's *within a state.*

If history repeats itself, then each MO will, with time, develop a little different approach to certain things. We should discuss this at our meeting. One thing I think we could recommend is that for the sake of consistency we have a national correlator whose job is to maintain consistency and resolve any issues among MO's.

6. Criteria *for* establishing series on the O-150 cm control section. *When are phases appropriate? What coordination among* states and MO's *is needed?*

Clearly, properties outside of the series control section can be phase criteria. Properties within the series control section can be either series or phase criteria, but it has never been defined when series are appropriate and when phases are appropriate. This is largely due to the intensity of mapping. In areas that are more intensely mapped series differences often are more subtle than in areas with less intense investigations. This is the beauty of the system, yet at the same time it creates some headaches. So what I'm saying is that it would be very difficult to make a list of properties that should be considered phase criteria versus those that should be series criteria. Again, maybe we need a national correlator to help resolve some of these inconsistencies.

Subject: Responses to Committee 4, NCSS

To. Dennis M. Heil

Following are my responses to the charges proposed for Committee 4 of the NCSS meeting in Rapid City.

1. The current method of review for updates to Soil Taxonomy is adequate for major changes, however, a more streamlined (quicker) method is needed for minor changes. For example, splitting a Leptic Vertic subgroup from a subgroup that was previously just Vertic should not take as much time to review as some of the major changes. Possibly, National Soil Taxonomy Handbook Issues could come out more often in order to incorporate minor changes into the system.

2. Any guidelines that are used to update published soil surveys should be uniform throughout the MLRA. Whenever soil surveys are changed, some type of metadata should accompany the new product stating the vintage of the product and the types of changes made.

3. Changing classification of soils in published soil surveys.

Advantages:

-Improve the credibility of the product by providing the user with perfect matches between surveys.

-All surveys would have uniform classifications.

-Some computer generated interpretations use the soil classification as rating criteria, therefore, the same soil should be classified the same in all surveys to get consistent interpretations. Example- The soil rating for plant growth (SRPG) program uses soil classification to rate some categories.

-Provide the user with the most current information.

Disadvantages:

-Need to update Official Series Descriptions.

-Should publish some type of amended classification table.

-Need to amend the original correlation document.

4. With the elimination of Aridisols from the western Dakotas, argillic soils that do not have a mollic epipedon classify as Alfisols. Most of these Alfisols have developed in residual material under grassland vegetation. The traditional concept of Alfisols having been developed under forest vegetation could be misleading to some users. This committee should explore the possibility of developing criteria that would keep these soils out of the Alfisol order.

5. Some concern has been expressed from states that have more than one MLRA office that mapping philosophies between the different MO's will be so different that mapping will not be consistent across the state. If there are different mapping philosophies, they should break or change along physiographic boundaries. Most of these differences should be worked out by the MLRA steering committees. Care should be taken to get a good assortment of disciplines involved with the steering committee to insure mapping consistency across states.

6. As soil survey subsets are updated, new soils can be established for those soils that were previously mapped as phases as needed. Phases are very viable criteria for determining interpretations. We should not have to depend upon Soil Taxonomy to get accurate interpretations. Criteria for using phases can be worked out by the MLRA steering committees.

Wayne Bachman

UNITED STATES DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

DATE: April 25, 1996

TO: Dennis Heil, Chairman Committee Four
North Central Work Planning Conference

FROM: Jim Millar

SUBJECT: Comments on the charges for committee four

1. I feel the procedures for reviewing and commenting on updates to Soil Taxonomy is adequate, but I would stress that all soil scientist working in the area (i.e. permafrost criteria) affected by the proposed changes in taxonomy have adequate time to comment.

2. We need to have some rough standards and guidelines for updating published soil surveys to maintain consistency. Because the current quality of each published soil survey is different (date of publication), the extent of the work needed to update the soil survey to today's standards is different. The update procedures set up in North Dakota by Mike Ulmer and C.J. Heidt is a good starting point. Photo interpretation is an outstanding tool for updating published soil surveys, but it is not equivalent to being out in the field. Give me 2 or 3 years of good photos for interpretation purposes and a 4X4 ATV to verify the photo interpretation and I can give you an excellent updated soil survey.

3. Changes in classification are inevitable and they are comparable to setting up new series that should have been mapped in counties already published. The only major problem I have with changes in a soils classification is when they are dictated by somebody in Lincoln, NE who got a wild hair and decided to change classification (i.e. Vertisols). There are no major disadvantages of changing a soil's classification unless it changes the interpretations and if the soil is being mapped differently today than in published soil surveys. Our customers are not terrible interested in a soil's classification, but they are concerned about the interpretations.

4. I am not familiar enough with Prairie Alfisols in the western Dakotas 'to comment.

5. I feel it is very important to have compatible mapping scales/interpretations between MOs within a state.

The natural break in mapping scales in South Dakota would be the Missouri River (1:12000 east river and 1:24000 west river). *This* would also eliminate the mismatch problems created by different mapping scales.

6. I am not *aware* of the possibility of changing the *control section to O-150* cm. My only comment is that if it is not broken don't fix it.

I am looking forward *to meeting you* and working with you on committee four of the North Central Work Planning Conference in the Black Hills.

Jim Millar

Jim Millar

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
25 1/2 West 6th Ave.
Redfield, S.D 57469

DATE: April 25, 1996

TO: Dennis Heil, Chairman Committee Four
North Central Work Planning Conference

FROM: Steve Winter
USDA-NRCS
25 1/2 W 6th Ave
Redfield, SD 57469

SUBJECT: Comments on the charges for committee four

1. The current method of review and comment is adequate for updates to Soil Taxonomy.

2. We need to have some standards and guidelines for updating published soil surveys. If there are no guidelines you have no consistency.

3. The benefits or disadvantages depend on how much the classification is changed. Some changes in classification were needed for some series. Other changes inclassification may change how the series was used in the soil survey.

4. Prairie Alfisols - no comment, I am not familiar enough with this.

5. We need to have compatible mapping scales / interpretations between MOs within a state. We need to keep consistency within the state.

6. Why does the control section need to be changed? What will the control section change do to the series that are already established?

I am looking forward to the work planning conference in May.

Steve Winter

Thursday - May 23, 1996

1. NCR-3 Minutes

2. NRCS Minutes

3. NCSS Minutes

NCR-3 (SOIL SURVEY)
Annual Meeting, May 19-21, 1996
Howard Johnson Motel
Rapid City, South Dakota

Present

*Tom Fenton	Iowa State University
*Don Franzmeier	Purdue University
Al Giencke	NRCS, Major Land Resource Area Office (MO), St. Paul, MN
George Ham	Administrative Advisor (Kansas State)
Steve Holzhey	NRCS, National Soil Survey Center, Lincoln, NE
*Mark Kuzila	University of Nebraska
*Doug Malo	South Dakota State University
Nathan McCaleb	NRCS, State Soil Scientist, Lincoln, NE
*Del Mokma	Michigan State University
*Ken Olson	University of Illinois
*Mickey Ransom	Kansas State University
Tom Reinsch	NRCS, National Soil Survey Center (Laboratory), Lincoln, NE
*Pierre Robert	University of Minnesota
*Neil Smeck	Ohio State University

Absent

*Randy Miles	University of Missouri
*Dave Hopkins	North Dakota State University
*Kevin McSweeney	University of Wisconsin

* State NCR-3 representative

NCR-3 met with the North Central Regional Soil Survey Work Planning Conference on May 19-23, 1996, at Rapid City, SD. NCR-3 committee member Doug Ma10 served on the steering committee and was co-host of this conference. All NCR-3 committee members participated in the working committees of the conference. These committees make recommendations to the National Cooperative Soil Survey (NCSS) which provides scientific leadership and sets policies and procedures for the NCSS. These working committees include the following: 1) Soil Data Delivery Systems; 2) Soil Research Needs (chaired by NCR-3 committee member Mickey Ransom); 3) Eroded Soils (chaired by NCR-3 committee member Tom Fenton); and 4) Soil Correlation and Classification. Federal agencies represented at the meeting included Forest Service, Natural Resources Conservation Service, Agricultural Research Service, Bureau of Land Management, Bureau of Indian Affairs, and National Park Service. Separate committee meetings of NCR-3 occurred on May 19, 20, and 21, 1996.

The NCR-3 meeting was called to order by Chair Ken Olson at 8:00 p.m. on Sunday, May 19, 1966. Members and guests introduced themselves. Since the reorganization of soil survey within the USDA Natural Resources Conservation Service (NRCS), it was not clear who the official representative of NRCS should be. It was the consensus that the leader of the Major Land

Resource Area Office (MO) in the area in which the meeting is held, and any other interested NRCS people, should be invited.

The minutes of the 1995 meeting, that were previously distributed, were approved.

Olson reported that several members of NCR-3, Olson (NCSS Steering Committee), Malo (NCR-3 Representative, and Fenton (Eroded soils committee chair), attended the National Soil Survey Conference in San Diego, CA, July 10-14, 1995. Malo distributed the Report from NCR-3 that he presented to the conference. NCR-3 members had significant input in the areas of Site Specific Soil Surveys, Hydric Soils, and Eroded Soils.

Olson and Fenton will serve as a nominating committee to select a candidate for the election of a new secretary.

Olson distributed a list of NCR-3 meeting places and chairs beginning in 1934; it is attached to these minutes. A list of NC Soil Survey Conference locations and hosts, projected to the year 2000 was also distributed.

George Ham, Administrative Advisor of NCR-3, reported that the NCR-3 Project Revision was approved to the year 2000. He distributed a copy of the revision and the comments of the NCA-1 Committee (administration) evaluation. It was very favorable. This committee suggested that we should continue to keep the users of soil survey information in mind, and that more specifics on research output would be helpful to NCA-1. Much or the work of NCR-3 on use of soil survey is done through the Regional Soil Survey Conference, and this should be documented in our mid-term review. Several NCR-3 representatives also serve on other NC committees which helps to remind other soil scientists of the role that soil **survey** information might play in. The committee thanked Olson for his efforts in preparing the revision.

Berlie Schmidt, Cooperative State Research, Education, and Extension Service (CSREES) representative, could not attend this meeting,but he forwarded written comments to George Ham, and George distributed them. CSREES is a new federal agency that combines research and extension activities. Some emerging research areas that Berlie listed are closely related to soil survey: the impacts of practices and systems on soil quality, soil-specific management, and spatial and temporal variability of soils and landscapes.

Al Giencke, NRCS, St. Paul. summarized the recent reorganization of the soil survey within NRCS. There are six Administrative Regions and 17 Major Land Resource Area (MLRA) offices (MOs) for soil survey in the U. S. The MOs will have responsibility for all planning and quality control of soil surveys. The 12-state North Central Region lies in two NRCS Regions, and most of the NCR is in the MLRAs administered from Bismarck, St. Paul, Indianapolis, and Salina, but some is in other MO areas. In some states, MO soil scientists are supervised by the MO leader, and in other states they are supervised by the local state soil scientist.

Tom Reinsch is in the National Soil Survey Center in Lincoln, and is the liaison with the four major MOs in the NC Region. He suggests how resources at the Center should be allocated.

Nathan McCaleb, NRCS, explained that the Regional offices are for administration and the MOs are for technical leadership.

The meeting was recessed at 9:25 p.m. and was reconvened at 2:45 p.m. on May 20 for the presentation of committee reports.

Soil Taxonomy Committee. NCR-3 agreed that its representation on various committees within the NC region should be from the eastern (MI, IL, IN, OH), central (MN, WI, IA, MO), and western (ND, SD, NE, KS) parts of the region. The current representatives (and the year their term ends) on the Soil Taxonomy Committee are Hopkins, ND (97); Mokma, MI (96), and Olson, IL (98). It was decided that Randy Miles (MO) should replace Mokma for a three-year term on this committee. It was suggested that the future representatives on the Taxonomy committee be from MN, SD. and N. This committee is active periodically, but there was little activity since the last NCR-3 meeting.

Eroded Soil Committee. The work of this committee was deferred to the NC Soil Survey Conference committee on the same topic. Both are chaired by Tom Fenton.

National Soil Survev Center Advisory Committee, Neil Smeck, NCR-3 representative There was no activity since the last NCR-3 meeting, probably because of the reorganization within NRCS.

National Soil Survev Standards Committee, Mickey Ransom, NCR-3 representative. No activity for the same reason.

Soil Survey Standards, Pierre Robert, NCR-3 representative. There is a Regional Research Committee on this topic, and Pierre represents soil survey interests on it. The relation between yield maps determined during harvest and soil maps is complicated by the map unit inclusions, Maps at a scale of about 1:5,000 may be needed. Farmers are also looking at our yield estimates more critically than they were before the advent of this technology. We might need to improve these estimates.

National Cooperative Soil Survey Research and Development Agenda Committee, presented by Steve Holzhey. This is a new committee proposed by the National Soil Survey Conference, which suggested that regional committees also be formed. This conference will discuss the formation of a regional committee later in the week. NCR-3 unanimously passed a resolution favoring the formation of a regional committee.

The meeting was recessed at 3:40 p.m. and was reconvened at 8:00 a.m. on May 21, 8:00 a.m. when the NCR-3 committee representatives present briefly summarized research in their states before the entire conference. Written reports from these states were distributed. Some highlights are summarized below:

Illinois: Developing methods to study soil erosion using fly ash from coal-fired locomotives and steam engines as profile markers.

Indiana: Creating a data base that can be used to support various models such as CERES-Maize that can simulate long-term corn yields, Also, several wet soils monitoring projects are underway.

Iowa: Developing improved methods for updating soil surveys using sample sites that are selected by the statistical laboratory and found on the ground using geopositioning systems

Kansas: Conducting a long-term study of soil genesis and geomorphology in the Konza Prairie that includes detailed soil mapping and a study of accumulation of carbonates, gypsum, and Na.

Michigan: Studying innovative on-site waste disposal systems in some slowly permeable soils, including the use of sand filters.

Minnesota: Developing landscape models to explain soil hydrology, evaluating site-specific soil management techniques, and several other projects.

Nebraska: Comparing properties of soils under forest and prairie vegetation; studying mobility of pesticides in soils and how to predict it using soil maps

Ohio: Placing data from 3500 pedons analyzed at Ohio State in a relational database management system (FileMaker Pro). It will allow searching by a combination of properties.

South Dakota: Established a site specific farming project, in cooperation with several agencies, that includes surveys with an electromagnetic conductivity meter and GPS instrumentation.

The meeting was recessed at 9: 10 a.m. and was reconvened at 4:00 p.m., May 21 to hear more committee reports and general discussion and to elect officers.

Regional Soil Map, Tom Fenton. All lines are in place. NRCS will digitize the map. Map and legend will be distributed in a few weeks.

Other items: 1) Methods of making site-specific soil surveys are being studied.

2) There is a great need to work with consulting soil scientists and with certified crop advisors.

3) A possible NCR-3 project is the development of a handbook to help describe soil landscapes.

Dave Hopkins was elected secretary for 1996-97. Don Franzmeier, past secretary, will serve as chair.

The next NCR-3 meeting will be in Indianapolis the second or third week of June, 1997, from mid-day Monday to mid-day Tuesday. Franzmeier will make the arrangements.

The next National Soil Survey Conference will be in Baton Rouge, LA, in July, 1997. Doug Malo was selected to serve on the steering committee, and Randy Miles was selected to present the report for NCR-3 at the conference.

NCR-3 will have three representatives on the North Central Region Research and Development Agenda Committee (pending its final approval by this conference) each serving a three year term, with one of the three serving on the national committee. The following were selected:

East (MI, IL, IN, OH): Smeck, I year term and national representative.
Central (MN, WI, IA, MO) Fenton, 2-year term
West (ND, SD, NE, KS): Kuzilla, 3-year term.

The meeting was adjourned at 5:00 p. m.

Respectfully submitted,

Donald P. Franzmeier
Donald P. Franzmeier
Chair, NCR-3

Approved,

George E. Ham
George E. Ham
Administrative Advisor, NCR-3

Request for Continuation of NCR-3

I. NCR-3 Soil Survey

II. Duration: October 1, 1996 to September 30, 2000

III. Justification for Continuation of NCR-3 Committee:

The National Cooperative Soil Survey (NCSS) is composed of the many federal, state, university and local partners with a public mandate related to the identification, inventory, use and management of soil resources. These partners include university pedologists from each agricultural experiment station (ASS) in the nation together with representatives from the USDA, Natural Resources Conservation Service (NRCS); USDI, Bureau of Land Management; USDA, Forest Service; Cooperative States Research, Education, and Extension Service (CSREES) as well as various state and local agriculture and/or natural resource agencies. The NCR-3 committee provides an essential component for coordination of National cooperative Soil Survey (NCSS) activities in the North Central Region (NCR).

The NCR-3 committee is composed of pedologists from each North Central AES, representatives from the USDA, NRCS and CSREES and a" administrative advisor. The university representatives are responsible for coordinating AES responsibilities in the NCSS in their representative states. This committee has provided a" important forum for designing, reviewing, and testing procedures and practices for developing soil survey information (SSI). Emphasis on particular facets of soil survey by the NCR-3 has changed in response to emerging issues and accomplishment of various goals of NCSS. As outlined below, the completion of most of the soil mapping in the NCR now offers the opportunity to focus more effort on refining and adapting the assembled SSI to meet the natural resource planning and management needs of the 1990s and beyond. This will require continued cooperation among the various partners on the NCSS. University pedologists will need to broaden university cooperation in the NCSS by engaging the expertise of university colleagues in allied subdisciplines of soil science who can contribute to improving the scientific foundation for soil interpretations.

SSI is the most detailed and comprehensive natural resource information available in the United States. SSI is used for a" increasingly diverse array of applications that go well beyond its traditional use as a tool for agricultural planning and management. The increased interest in SSI reflects the diverse and sometimes competing options that are proposed or implemented for use of natural resources. This debate is increasingly defined in terms of broad societal concerns about overlapping issues such as resource sustainability, global climate change, soil quality, biodiversity, and environmental protection. SSI should therefore be formulated in a sufficiently robust and reliable manner to meet existing and emerging applications.

Soil Taxonomy which supports development of SSI, is a comprehensive soil classification system designed to accommodate all soils of the world. It serves as the primary classification system in most other countries to identify soils on which research is conducted. As such, it is a" important vehicle for technology transfer, which is being continuously refined as improved knowledge about soils is obtained.

In the NCR much of the forest land and rangeland as well as all cropland were mapped by 1990. Therefore, the NCSS is placing more emphasis on improving the scientific basis and extrapolative utility of soil interpretations, and development of improved systems for storage, retrieval, analysis, and display/dissemination of SSI, and procedures for modernizing outdated soil surveys. These areas of emphasis draw heavily on the scientific and technical expertise that university cooperators can provide to the NCSS. Examples that committee members have begun to address are:

First, use of geographic information systems (GIS) and allied technologies for organizing existing SSI and for facilitating soil surveys and updates has emerged as a powerful tool for soil survey. However, much of the current SSI has been prepared over a spa" of 50 years. Differences in scale, cartographic technology, landscape concepts, land use interpretations, and classification systems have occurred during this time. This poses both technical problems and concerns about data quality that need to be addressed before data can be reliably incorporated into automated systems. Automated technologies also provide a means for improving the detail and quality of information contained in soil maps through application of spatial, analytical, and display techniques. Paralleling the technical issues are decisions that will need to be made concerning the scope and format of soil survey modernization. Current plans are directed towards using

Major Land Resource Areas (MLRAs) as primary entities for these activities. However, the extent of additional field work necessary to accomplish modernization is likely to vary across the region and within specific MLRAs. The Location of MLRA boundaries, which invariably cross state lines, will need to be evaluated by considering crop and climatic data in addition to soils. NCR-3 members are in a position to interact with colleagues to access and provide this information. There is a need for NCR-3 members to become more involved in helping provide state-of-the-art SSI in a GIS format to help: (i) maintain the integrity and accuracy of the original survey, (ii) eliminate duplication and waste in developing single use soil data bases, and (iii) facilitate the transfer of soil data layers between different computer systems.

Second, there is a need to collect crop yield data for benchmark and/or extensive soils to support yield estimates provided in soil survey reports and to test crop growth models that predict yield. Additional modeling work may be required for a more accurate prediction of crop yields for NCR soils. Many counties in NCR use these crop yield estimates in land appraisal and assessment work. These counties which use an income capitalization approach to land value have become leaders in use of digitized soil data for tax assessment. However, failure to maintain the integrity and accuracy can result in legal challenge,

NCR-3 meets annually. On alternate years it meets with all NCSS members in the NCR to identify and coordinate research needs that support development of soil survey. Information on pertinent research being conducted at participating AES is exchanged among NCR-3 members. Three members of the NCR-3 committee serve on the Regional Soil Taxonomy review committee which reviews all proposed modifications to Soil Taxonomy including those developed by international working committees. Representatives from NCR-3 serve on NCSS work planning boards and national committees. These various committee linkages provide a network for evaluating soil survey technology in terms of its suitability for use in solution of current and anticipated land use problems. SSI is a major mechanism for technology transfer of research findings developed at AES and other research facilities in the NCR. Policies of NCSS are evaluated by the NCR-3 with respect to their impact on land users and AES within the region.

In summary, NCR-3 provides a forum for contributing to the scientific foundation that guide collection of SSI and its interpretation and extrapolation. It provides a mechanism for evaluating and refining NCSS directives to suit local and state needs within NCR, which is facilitated by participation of committee members on national committees of the NCSS. NCR-3, through its three members on the Soil Taxonomy committee, contributes to the evaluation of all proposed modifications to Soil Taxonomy. If Soil Taxonomy is going to remain an important vehicle for technology transfer, then it must be refined and updated continually as new knowledge about world soils is obtained. Finally, NCR-3 provides an essential mechanism for development of cooperative research initiatives among the various states and timely dissemination of soil survey-related research findings from individual participants.

IV. Committee objectives:

1. Publish the NC regional soil map.

All state maps and legends are complete and the joins between states have been resolved. A cost estimate is being determined and permission to publish will be sought from the appropriate Regional Research Committee. Data bases will be tied to the regional soil map.

2. Develop hydric soil identification procedures for the NCR.

NCR-3 has developed a proposed definition of hydric soils in the NCR. It is anticipated that regional rather than national field indicators of hydric soils would be more useful and appropriate for the identification of hydric soils and wetlands.

3. Develop standards and criteria for using soil maps for site specific soil surveys for multiple uses including precision farming.

A subcommittee of NCR-3 has been established on needs and standards for using site specific soil survey maps. Committees of both the NCR and NCSS Conferences have been working on scale (approximately 1:4800 to 1:7200), legend, standards and procedures for detailed site specific soil survey. On-site investigations can be used for many purposes including: precision farming, tax assessment, soil quality, soil ecological mapping and urban development. The roles of the public and private soil scientists will need to be addressed.

4. Develop outreach methodology for disseminating soil survey information.

Pedological modules will be developed and put on the world-wide-web (internet) permitting easy access by the public and various users. Other outreach activities will be daveloped to inform users of the next generation of the soil survey.

Committee goals include:
1. Create the critical mass necessary for scientists at the various AES to have an impact of quality control and formulation of policy and direction for the NCSS program on both a regional and national basis.
2. Identify specific soil and land-use research needs that will benefit from a regional or sub-regional approach that can either build upon existing initiatives in individual states or address a timely emerging need.
3. Coordinate official NCR representation on national NCSS and Soil Taxonomy committees and relay/evaluate national recommendations and initiatives to pertinent groups throughout the region.
4. Develop and coordinate extension and educational activities related to NCSS.

V. NCR-3 participants:
Illinois (Dr. K. Olson), Indiana (Dr. D. Franzmeier), Iowa (Dr. T. Fenton), Kansas (Dr. M. Ransom), Michigan (Dr. D. Mokma), Minnesota (Dr. P. Robert), Missouri (Dr. R. Miles), Nebraska (Dr. M. Kuzila), North Dakota (Mr. D. Hopkins), Ohio (Dr. N. Smeck), South Dakota (Dr. D. Malo), Wisconsin (Dr. K. McSweeney), "SDA,NRCS (Mr. J. McCloskey), USDA,CSREES (Dr. B. Schmidt), Administrative Advisor (Dr. G. Ham)

"I. Highlights of Committee **activities and accomplishments since last approval:**
1. NCR-3 initiated action to address the classification of eroded soils. This initiative resulted *in* the convening of a regional workshop on eroded soils that focused future efforts on two tasks: 1) an improved definition of accelerated erosion and 2) modifications to Soil Taxonomy to appropriately classify soils that have been subjected to accelerated erosion. A committee was formed to address each task. Each Committee reported progress at the 1995 NCSS Conference and solicited additional input. Deliberations will continue at the 1996 Regional Soil Survey Conference. Such refinements in the NCSS are essential to continued improvement in our soils data base.
2. NCR-3 members continue to play an important role in developing plans for a variety of soil survey updates in the region. These will be conducted within the divisions of Major Land Resource Areas (MLRAs), most of which transgress state boundaries.
3. NCR-3 has completed a draft of an updated regional soils map with an interpretative legend.
4. Co-hosted the 1994 joint West-Midwest Soil Survey Conference in Coeur d'Alene, Idaho. This conference was organized to transfer soils knowledge between regions. The 1996 NCR Soil Survey Conference will be held in Rapid City, South Dakota.
5. NCR-3 has developed a draft document proposing a definition of hydric soils in the North Central Region. This document was used by both the Chairman of the Hydric Soils committee of the 1995 NCSS conference and the NRCS who are developing "Field Indicators of Hydric soils of the United States".
6. NCR-3 continues to provide official representatives to the following:
   - National Soil Survey Technical Center Advisory Committee
   - "Needs and Standards for Using Soil Survey Maps in Precision Farming" sub-committee of the NCR-3
   - NCSS Standards Committee
   - Midwest Soil Taxonomy committee
   - National Soil Database committee

"II. Recommendation from NCA-1:
See attached letter.

VIII. Required Signatures:

Kenneth R. Olson — 11/30/95
Kenneth R. Olson, Chair, NCR-3 — Date

George E. Ham — 12/27/95
George E. Ham, Administrative Advisor — Date

Eldon Ortman, Chair, NCRA — Date

Record of North Central Soil Survey Conference

Year	Location	Host Agency	Chairman
1955	Missouri	Joint	Ableiter, Aandahl
1956	Michigan	Joint	Westin
1957	Illinois	Joint	Bartelli
1958	Wisconsin	Joint	Bidwell
1959	Kansas	Joint	Rogers
1960	Indiana	Joint	Elder
1961	North Dakota	Joint	Engberg
1962	Ohio	Joint	Riecken
1964	Nebraska	Federal	Nelson
1966	Iowa	State	Ulrich
1968	Minnesota	Federal	Mitchell
1970	Illinois	State	Fehrenbacher
1972	South Dakota	Federal	Bannister
1974	Missouri	State	Scrivner
1976	Michigan	Federal	Harner
1978	Wisconsin	State	Hole
1980	Indiana	Federal	Sinclair
1982	North Dakota	State	Patterson
1984	Kansas	Federal	Roth
1986	Ohio	State	Smeck
1988	Nebraska	Federal	Culver
1990	Iowa	State	Fenton
1992	Minnesota	Federal	Giencke
1994	Idaho (Illinois)	State (Joint)	Ypsilantis, Olson
1996	South Dakota	Federal	Schaar
1998	(Missouri)	State	(Miles)
2000	(Michigan)	Federal	( )

updated 5/16/96 by K. R. Olson

Meetings and Officers of NCR-3

Date	Place of Meeting	Chairman	Secretary
1934	?	(Committee just organized)	
June 1949	Urbana, Illinois	H. H. Krusekopf	---
? 1950	?	F. F. Riecken	---
June 1951	Brookings, South Dakota	F. F. Riecken	E. P. Whiteside
June 1952	Columbia, Missouri	E. P. Whiteside	F. C. Westin
May 1953	Wooster, Ohio	E. P. Whiteside	F. C. Westin
Feb. 1954	Madison, Wisconsin	F. C. Westin	N. Holowaychuk
June 1954	Lincoln, Nebraska	F. C. Westin	N. Holowaychuk
Nov. 1954	Chicago, Illinois	N. Holowaychuk	R. T. Odell
Jan. 1955	Columbia, Missouri	N. Holowaychuk	R. T. Odell
Jan. 1956	East Lansing, Michigan	R. T. Odell	F. D. Hole
June 1956	Ames, Iowa	N. Holowaychuk	R. T. Ode11
Jan. 1957	Monticello, Illinois	R. T. Ode11	F. D. Hole
June 1957	No meeting held	F. D. Hole	H. P. Ulrich
Jan. 1958	Madison, Wisconsin	F. D. Hole	H. P. Ulrich
June 1958	No meeting held	H. P. Ulrich	H. F. Arneman
Jan. 1959	Manhattan, Kansas	H. P. Ulrich	H. F. Ameman
Jan. 1960	Lafayette, Indiana	H. F. Ameman	0. W. Bidwell
Jan. 1961	Fargo, North Dakota	0. W. Bidwell	H. W. Omodt
March 1962	Columbus, Ohio	H. W. Omodt	J. A. Elder

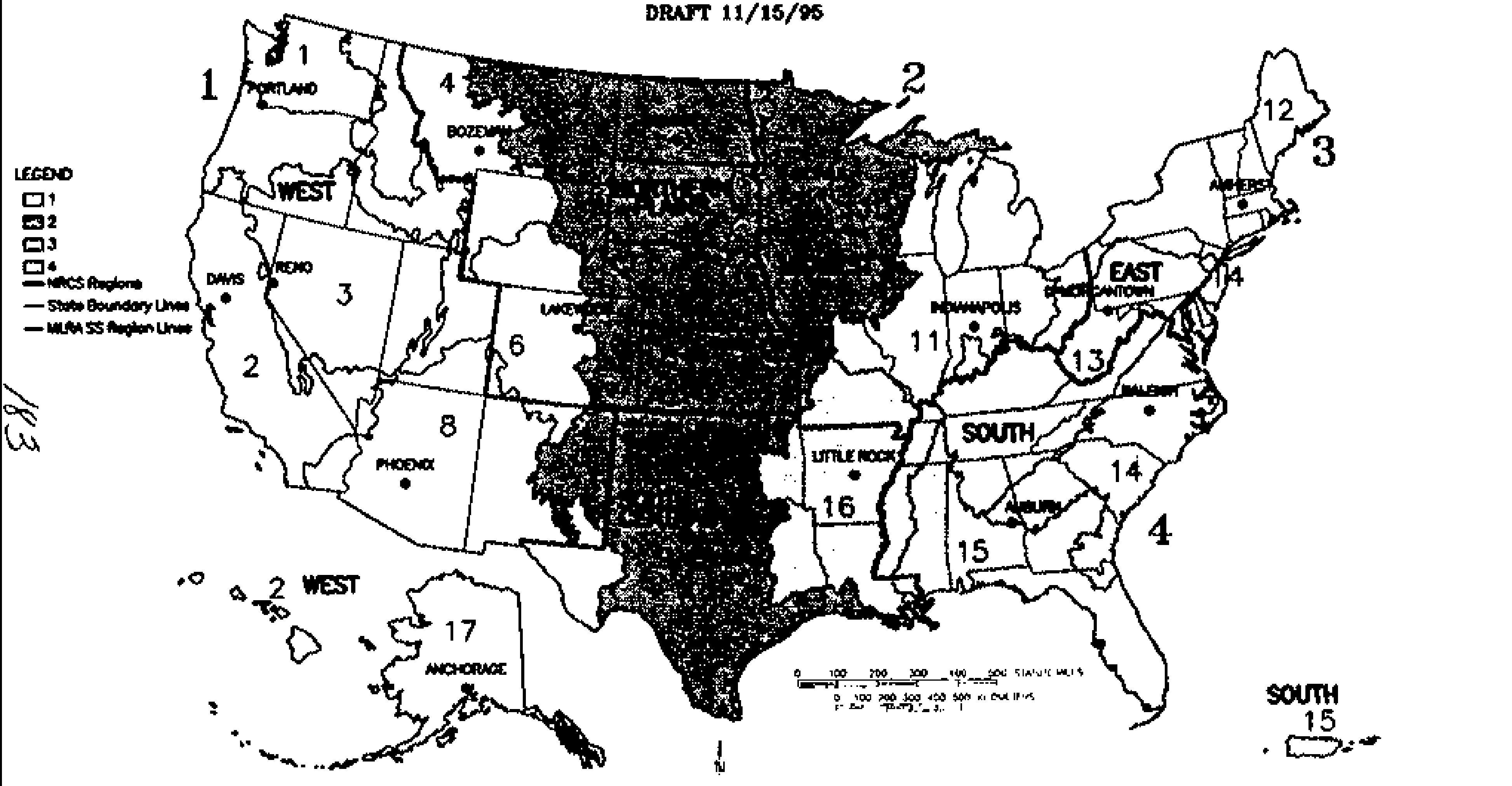
Date	Place of Meeting	Chairman	Secretary
Dec. 1962	Minneapolis, Minnesota	J. A. Elder	C. L. Scrivner
June 1963	East Lansing, Michigan	C. L. Scrivner	F. C. Westin
Jan. 1964	Lincoln, Nebraska	C. L. Scrivner	F. C. Westin
Jan. 1965	Chicago, Illinois	F. C. Westin	F. F. Riecken
Mar. 1966	Ames, Iowa	F. F. Riecken	G. A. Johnsgard
Jan, 9, 10, 1967	O'Hare Inn, Des Plaines, IL	G. A. Johnsgard	E. P. Whiteside
Mar. 18, 19, 1968	St. Paul, Minnesota	E. P. Whiteside	N. Holowaychuk
Mar. 17, 18, 1969	Chicago, IL	N. Holowaychuk	F. D. Hole
Mar. 2, 1970	Champaign, IL	F. D. Hole	R. H. Rust F. C. Westin, Acting
Apr. 22, 23, 1971	Ramada (O'Hare) Inn, Schiller Park, IL	R. H. Rust	0. W. Bidwell
Apr. 18, 1972	Rapid City, South Dakota	0. W. Bidwell	D. P. Franzmeier
Nov. 28, 1973	U. of Wisc., Madison, WI	D. P. Franzmeier	Hollis W. Omodt
Apr. 9, 1974	Osage Beach, MO	Hollis W. Omodt	T. E. Fenton
Nov. 18, 19, 1975	Chicago (O'Hare) Holiday Inn, Schiller Park, IL	T. E. Fenton	J. B. Fehrenbacher
May 6, 1976	Traverse City, MI	J. B. Fehrenbacher	F. C. Westin D. Malo, Acting
Oct. 25, 1977	St. Louis, MO	F. C. Westin	N. Smeck
Feb. 2, 1978	Madison, WI	N. E. Smeck	G. B. Lee
Oct. 17, 1979	Holiday Inn, NE Lincoln, NB	G. B. Lee	Del Mokma
May 21, 1980	Lafayette, IN	Del Mokma	Dave Lewis

Date	Place of Meeting	Chairman	Secretary
Nov. 11, 1981	St. Louis, MO	Dave Lewis	Dick Rust
May 5, 1982	Fargo, ND	Dick Rust	O.W. Bidwell
Nov. 2-3, 1983	Omaha, NE	O.W. Bidwell	Ken Olson
Apr. 1984	Manhattan, KS	Ivan Jansen	Don Franzmeier
Oct. 30-31, 1985	St. Paul, MN	Don Franzmeier	Don Patterson
June 19, 1986	Columbus, OH	Don Patterson	Tom Fenton
Oct. 28-29, 1987	St. Louis, MO	Tom Fenton	Randy Miles
June 22, 1988	North Platte, NE	Randy Miles	Gary Lemme
June 19-20, 1989	Indianapolis, IN	Gary Lemme	Neil Smeck
June 7, 1990	Ames, IA	Neil Smeck	Mark Kuzila
June 11-12, 1991	Omaha, NE	Mark Kuzila	Kevin McSweeney
June 15-18, 1992	St. Paul, MN	Kevin McSweeney	Del Mokma
June 7-9, 1993	Mitchell, IN	Del Mokma	Pierre Robert
June 12-17, 1994	Coeur d'Alene, ID	Pierre Robert	Mickey Ransom
June 12-13, 1995	Kansas City, MO	Mickey Ransom	Ken Olson
May 19-23, 1996	Rapid City, SD	Ken Olson	Don Franzmeier
1997		Don Franzmeier	

update 5/16/96 by K.R. Olson

NATIONAL SOIL SURVEY CENTER (NSSC)
SERVICE REGIONS

DRAFT 11/15/95



Minutes of the 1996 North Central Regional NCSS Work Planning Conference
Rapid City, South Dakota

Thursday May 23. 19%

The Conference Business meeting was held on the completion of the conference commitee reports. The meeting was called to order by Greg Schellentrager, Chairman.

Jerry Schaar thanked Mindy Filholm and Barb Hall for all of their help in making the meeting arrangements. He thanked Deanna Reyher and Kent Cooley for an excellent tour, and he thanked Pat Kearns and Wayne Bachman for organizing the meeting.

Greg asked for a motion to accept the proposals of all committees. The motion was made. seconded, and passed.

A motion was made to disband committee #2, and to continue committees 1.3, and 4. The motion was seconded and the motion carried.

A motion was made to establish a Regional Cooperative Research and Development Committee. Each NCSS Region would determine their own composition). The North Central Regional Cooperative Research and Development Committee would consist of the following:

1) One member from the Forest Service
2) One member from the Bureau of Indian Affairs
3) One member from the Agricultural Research Service
4) Three members from the Agricultural Experiment Stations from (NCR-3)
5) Liasion from NSSC - Serves as convenor
6) Four members fmm the Natural Resources Conservation Service (State Soil Scientists, Major Land Resource Area Leaders, etc.)

The motion was seconded and carried

A motion was made to ajdourn, it was seconded and passed.

NATIONAL COOPERATIVE SOIL SURVEY

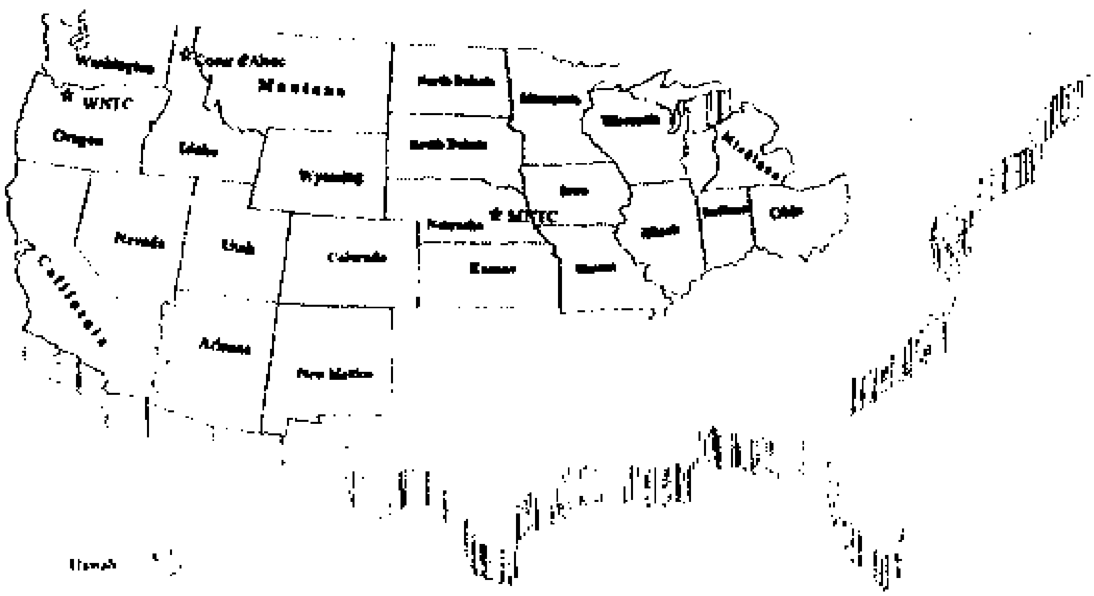
Western/Midwestern Soil Survey Conference Proceedings

Coeur d'Alene, Idaho
June 12-17, 1994

Soil, Water, Air, Plants, Animals

PROCEEDINGS

Western/Midwestern Regional Cooperative Soil Survey Conference



BUILDING ALLIANCES FOR ENVIRONMENTAL HARMONY

WESTERN/MIDWESTERN REGIONAL COOPERATIVE
SOIL SURVEY CONFERENCE

Soil Survey in Ecosystem Management

Sponsored by

Bureau of Land Management
Idaho Soil Scientist Association
Soil Conservation Service

Special Assistance from

Bureau of Reclamation
Midwestern Region Agricultural Experimental stations
Pintlar Corporation
University of Idaho
U.S. Forest Service
Washington society Professional Soil Scientists
Washington state University
Western Region Agricultural Experimental stations

Other Contributing Organizations

American Excelsior Co.
Coeur d'Alene Tribe
Decagon Devices
Earth Info Inc.
Electronic Data Solutions
Idaho Conservation League
Idaho Department of Health and Welfare
Idaho Department of Parks and Recreation
Intermountain Resources
National Society of Consulting Soil Scientists
North American Green
Oregon state University
Panhandle Health District
Plum Creek Timber

Holiday Inn Convention Center
Coeur d'Alene, Idaho
June 12 to June 27, 199~~2~~4

1994 NCSS REGISTRATION LIST

Aho, Terry - Soil Conservation Service, Spokane, WA
Allen, Robert - Bureau of Land Management, Reno, NV
Amen, Alan - Bureau of Land Management, Lakewood, CO
Arnold, Richard - Soil Conservation Service, Washington, D.C.
Bachman, Wayne - Soil Conservation Service, Huron, SD
Bare, Scott - Idaho Soil Conservation Commission, Coeur d'Alene, ID
Bargsten, Tom - Bureau of Land Management, Grand Junction, CO
Bautz, Gregory - Bureau of Land Management, Lander, WY
Belohlavy, Francis - University of Nebraska, Lincoln, NE
Benedict, Paul - Soil Conservation Service, Pocatello, ID
Bessinger, Glenn - Bureau of Land Management, Denver, CO
Boettinger, Janis - Utah State University, Logan, UT
Bordenave, Pierre - National Society of Consulting Soil Scientists, Sandpoint, ID
Botsford, Bruce - Bureau of Land Management, Dillon, MT
Brincken, Edward - Soil Conservation Service, Pasco, WA
Brockmann, Lester - Soil Conservation Service, Lincoln, NE
Busacca, Alan - Washington State University, Pullman, WA
Campbell, Steven - Soil Conservation Service, Spokane, WA
Chugg, Jack - Bureau of Land Management, Coeur d'Alene, ID
Clark, Ronnie - Bureau of Land Management, Lakewood, CO
Collins, Thomas - U.S. Forest Service, Ogden, UT
Condron, Margaret - Office of Surface Mining, Denver, CO
Conway, Stan - U.S. Bureau of Reclamation, Denver, CO
Culver, Jim - Soil Conservation Service, Lincoln, NE
Daugherty, LeRoy - New Mexico State University, Las Cruces, NM
DAversa, Mary - Bureau of Land Management, Prineville, OR
Davis, Phil - American Excelsior Company, Yakima, WA
Davis, Scott - Bureau of Land Management, Lakewood, CO
Dean, David - Electronic Data Solutions, Jerome, ID
DesLauriers, Lynn - Soil Conservation Service, Eagan, MN
Dollarhide, Bill - Soil Conservation Service, Reno, NV
Duncan, Bradley - Soil Conservation Service, Okanogan, WA
Engel, Robert - Soil Conservation Service, Lincoln, NE

Fenton, Thomas - Iowa State University, Ames, IA
Folsche, Dick - Soil Conservation Service, Ft. Worth, TX
Fortner, Jim - Soil Conservation Service, Lincoln, NE
Fosberg, Maynard - University of Idaho-Retired, Moscow, ID
Foster, Rick - U.S. Forest Service, Anchorage, AX
Francis, Jim - Bureau of Land Management, Sacramento, CA
Franks, Carol - Soil Conservation Service, Phoenix, AZ
Franzmeier, Don - Purdue University, W. Lafayette, IN
Frederick, William - Soil Conservation Service, Grand Lodge, MI
Freeouf, Jerry - U.S. Forest Service, Lakewood, CO
Gardner, Brian - Idaho Soil Conservation Commission, Orofino, ID
Gareis, Gerhard - Bureau of Land Management, Burns, OR
Garner, Eddie - Bureau of Land Management, Las Vegas, NV
Gehring, Richard - Soil Conservation Service, Columbus, OH
Geller, Alice - Missouri Dept. of Nat. Res., Jefferson City, MO
Gentry, Herman - Soil Conservation Service, Ellensburg, WA
Gerber, Tim - Ohio Dept. of Natural Resources, Columbus, OH
Gerken, Jonathan - Soil Conservation Service, Columbus, OH
Gordon, Chuck - Soil Conservation Service, Bozeman, MT
Greene, Annie - U.S. Forest Service, Dillon, MT
Gross, Renee - Soil Conservation Service, Lincoln, NE
Haagen, Ed - Soil conservation Service, Moscow, ID
Ham, George - Kansas State University, Manhattan, KS
Handler, John - Soil Conservation Service, St. Paul, MN
Harris, Grant - Decagon Devices, Pullman, WA
Haupt, Jon - Bureau of Land Management, Boise, ID
Heidt, C. J. - Soil Conservation Service, Bismarck, ND
Heil, Dennis - Soil Conservation Service, Portland, OR
Hendricks, David - University of Arizona, Tucson, AZ
Hipple, Karl - Soil Conservation Service, Spokane, WA
Hoffmann, Glenn - Soil Conservation Service, Orofino, ID
Hopkins, David - North Dakota State University, Fargo, ND
Hovland, Dwight - Bureau of Land Management, Anchorage, AK
Huntington, Gordon - University of California, Davis, CA
Ikawa, H. - University of Hawaii, Honolulu, HI
Indorante, Sam - Soil Conservation Service, Belleville, IL

Janeway, Mark - North American Green Inc., Evansville, IN
Jeppesen, Darwin - Bureau of Land Management, Idaho Falls, ID
Kehne, Jay - Soil Conservation Service, Ephrata, WA
Kelly, Gene - Colorado State University, Fort Collins, CO
Klink, Robert - Bureau of Indian Affairs, Portland, OR
Krapf, Russell - Bureau of Land Management, Phoenix, AZ
Kukachka, Bob - Soil Conservation Service, Soda Springs, ID
Kuzila, Mark - University of Nebraska, Lincoln, NE
Lammers, Duane - U.S. Forest Service, Corvallis, OR
Langridge, Russ - Soil Conservation Service, Portland, OR
Linnel, Lyle - Bureau of Land Management-Retired, Coeur d'Alene, ID
Lockridge, Earl - Soil Conservation Service, Lincoln, NE
Loerch, Cameron - Soil Conservation Service, Lincoln, NE
Lubich, Kenneth - Soil Conservation Service, Madison, WI
Madenford, Gary - Bureau of Land Management, Boise, ID
Maurer, Dave - Bureau of Land Management, Medford, OR
Maxwell, Harold - Soil Conservation Service, Boise, ID
Maynard, Catherine - U.S. Forest Service, Helena, MT
McCaleb, Nathan - Soil Conservation Service, Lincoln, NE
McCloskey, Joe - Soil Conservation Service, St. Paul, MN
McDaniel, Paul - University of Idaho, Moscow, ID
McGrath, Chad - Soil Conservation Service, Boise, ID
McVey, Shawn - Soil Conservation Service, Preston, ID
Meurisse, Robert - U.S. Forest Service, Portland, OR
Miles, Scott - U.S. Forest Service, Redding, CA
Miller, Chris - Soil Conservation Service, Selah, WA
Miller, K. Ed - Ohio Dept. of Nat. Res., Columbus, OH
Mitchell, Robert - Bureau of Land Management, Miles City, MT
Mokma, Delbert - Michigan State University, East Lansing, MI
Monger, Curtis - New Mexico State University, Las Cruces, NM
Moore, Joe - Soil Conservation Service, Anchorage, AK
Muckel, Gary - Soil Conservation Service, Lincoln, NE
Murphy, Dennis - Bureau of Land Management, Montrose, CO
Natsuhara, Charles - Soil Conservation Service, Olympia, WA
Nesser, John - U.S. Forest Service, Missoula, MT
Nielsen, Gerald - Montana State University, Bozeman, MT

Oelmann, Douglas - Soil Conservation Service, Des Moines, IA
Olson, Dale - Soil Consultant, Pasco, WA
Olson, Kenneth - University of Illinois, Urbana, IL
Page, Richard - Bureau of Land Management, Salt Lake City, UT
Page-Dumroese, Debbie - U.S. Forest Service, Moscow, ID
Parham, Tommie - Soil Conservation Service, Albuquerque, NM
Peterson, Neil - Soil Conservation Service, Boise, ID
Radek, Kenneth - U.S. Forest Service, Okanogan, WA
Raney, Ronald - Soil Conservation Service, Okanogan, WA
Ransom, Mickey - Kansas State University, Manhattan, KS
Reedy, Thomas - Soil Conservation Service, Lincoln, NE
Renthal, Jim - Bureau of Land Management, Phoenix, AZ
Robbie, Wayne - U.S. Forest Service, Albuquerque, NM
Robert, Pierre - University of Minnesota, St. Paul, MN
Rolph, Steven - Bureau of Indian Affairs, Nespelem, WA
Schaar, Jerome - Soil Conservation Service, Huron, SD
Scheffe, Ken - Soil Conservation Service, Albuquerque, NM
Schellentrager, Gregg - Soil Conservation Service, Des Moines, IL
Schlepp, Richard - Soil Conservation Service, Salina, KS
Schroeder, Darrell - Soil Conservation Service, Casper, WY
Schuler, Rick - Bureau of Land Management, Cheyenne, WY
Shetron, Stephen - Michigan Tech University, Houghton, MI
Sinclair, Ray - Soil Conservation Service, Lincoln, NE
Smeck, Neil - Ohio State University, Columbus, OH
Smith, Chris - Soil Conservation Service, Honolulu, HI
Smith, Dave - Soil Conservation Service, Davis, CA
Sobecki, Terry - Soil Conservation Service, Portland, OR
Swenson, Hal - Soil Conservation Service, Boise, ID
Thiele, James - Soil Conservation Service, Bismarck, SD
Thompson, Bruce - Soil Conservation Service, Columbia, MO
Tugel, Arlene - Soil Conservation Service, Portland, OR
Vogt, Kenneth - Soil Conservation Service, Columbia, MO
Waite, Don - Bureau of Land Management, Reston, VA
Walters, Alan - Soil Conservation Service, Naches, WA
Weisel, Charles - Soil Conservation Service, Coeur d'Alene, ID
Wettstein, Carol - Soil Conservation Service, Lakewood, CO

White, Dean - Soil Conservation Service, Waterville, WA
Winward, Rulon - Soil Conservation Service, Rexburg, ID
Ypsilantis, Bill - Bureau of Land Management, Coeur d'Alene, ID

Monday, June 13

8:00 - 9:00	Registration - Bay 1, Convention Center, Holiday Inn
8:00-3:30	Exhibitor's Session - Foyer of Convention Center/Lobby, Holiday Inn
9:00 - 9:15	Opening Remarks - Bill Ypsilantis, Conference Chairperson, Bureau of Land Management, Coeur d'Alene, ID
9:15 - 9:30	Welcome by Bureau of Land Management - Del Vail, State Director, Boise, ID
9:30 - 9:45	Welcome by Soil Conservation Service - Ed Burton, Deputy State Conservationist, Spokane, WA
9:45 - 10:00	Welcome by Forest Service - John Nesser, Region 1 Soil Scientist, Hissoula, MT - David Jolly, Regional Forester, Missoula, MT
10:00 - 10:30	Break
10:30 - 10:45	Welcome by University of Idaho - Dr. David Lineback, Dean, College of Agriculture, Moscow, ID
	Agency reports:
10:45 - 11:00	Soil Conservation Service - Dr. Richard Arnold, Director, Soil Survey Division, Washington, D.C.
11:00 - 11:15	Bureau of Land Management - Glenn Bessinger, Soil Program Lead, Washington, D.C.
11:15 - 11:30	Forest Service - Wayne Robbie, Region 3 Soil Scientist, Albuquerque, NM
11:30 - 1:00	Lunch
1:00 - 1:15	Western Region Agricultural Experimental Stations - Dr. Gene Kelly, Colorado State University, Fort Collins, CO
1:15 - 1:30	Midwestern Region Agricultural Experimental Stations - Dr. Pierre Robert, University of Minnesota, St. Paul, MN
1:30 - 2:00	The Great Flood - Brian Rowder, Farragutt State Park, ID
2:00 - 2:30	Geological and Pedologio History of the Palouse

- Dr. Alan Busacca, Washington State University

2:30 - 3:00 **Volcanic Ash Influenced Soils of Idaho**
- Dr. Paul McDaniel, University of Idaho

3:00 - 3:30 **Break**

3:30 - 4:15 **Agency Meetings**

Soil Conservation Service, Western/Midwestern Regions
- Bay 2, Convention Center, Holiday Inn

Agricultural Experimental Stations, Western/Midwestern Regions
- Boardroom, Holiday Inn

US Forest Service
- Conference Room, Comfort Inn

Bureau of Land Hanagament
- Coeur d'Alene Room, Shilo Inns

4:15 - 5:00 Soil Conservation Service, Western Region
- Bay 2, Convention Center, Holiday Inn

Soil Conservation Service, Midwestern Region
- Bay 1, Convention Center, Holiday Inn

Agricultural Experimental Stations, NCR4
- Small Conference Room, Shilo Inns

Agricultural Experimental Stations, WRCC-30
- Boardroom, Holiday Inn

US Forest Service (continuation)
- conference Room, Comfort Inn

Bureau of Land Management (continuation)
- Coeur d'Alene Room, Shilo Inns

6:30 - 7:00 Boarding time for cruise boat.

7:00 - 9:00 **Conference reception on the Coeur d'Alene cruise boat.** Eric Thomson, BLM, Coeur d'Alene, ID will provide commentary at points of interest about BLX management on the lakeshore. spouses welcome! (cruise departure at 7 p.m. sharp)

Tuesday, June 14

9:00 - 3:30 Exhibitor's Session
- Foyer of Convention Center/Lobby, Holiday Inn

8:00 - 8:20 Ecosystem Management Overview / Forest Health Assessment
- John Nesser, USFS, Missoula, MT

8:20 - 8:40 Soil Relationships to Ecosystem Uanagement
- Robert Meurisse, USFS, Portland, OR

8:40 - 9:00 Ecosystem Basis for Soil Survey
- Jim Culver, SCS, Lincoln, NE

9:00 - 9:10 Field trip orientation

9:10 - 10:10 Poster sessions
- Foxies Lounge area, Holiday Inn

Special Use Soil Survey for Desert Tortoise
- Eddie Garner, BLN, Las Vegas, NV

Soil Survey Enhancement and Ecological Site Correlation
- Al Amen, BLH, Denver, CO

Slashburn Effects on a Spodosol in the Rain Forest of the Humid Tropics
- Arlene Tugel and John Kimble, SCS, Portland, OR

Analysis Based on Ecosystem Happing Hierarchies
- Cathy Maynard, USFS, Helena, MT

Special Soil Surveys and Pigmy Rabbit
- Jay Kehne, SCS, Spokane, WA

Riparian Area Management to Range Reform 94
- Ronnie Clark, BLH, Lakewood, CO

Seasonal Occurrence of Perched Water Tables in the Eastern Palouse Region
- Rod Gabhart, University of Idaho, Moscow, ID

Procedures for Proposing Changes to Soil Taxonomy
- Robert Engel, Robert Ahrens and John Witty, SCS, Lincoln, NE

Biological Control of Noxious Weeds
- Robert Mitchell, BLH, Miles City, MT

10:10 - 10:40	**Break**
10:40 - 12:00	**Committee Meetings**

The Role of NCSS in Sits Specific Soil Surveys
- Bay 1, Convention Center, Holiday Inn

Drastically Disturbed Soils
- Coeur d'Alene Room, Shile Inns

Ecosystem Based Soil Surveys for Resource Planning
- Bay 2, Convention Center, Holiday Inn

Distribution and Access to Soil Survey Data
- Small Conference Room, Shilo Inns

Redefining the Cooperative Role in NCSS
- Boardroom, Holiday Inn

New Ways of Making Soil Survey Interpretations
- Conference Room, Comfort Inn

12:oo - 1:15	**Lunch**
1:15 - 3:oo	**committee Meetings**

The Role of NCSS in Site Specific Soil Surveys
- Bay 1, Convention Center, Holiday Inn

Drastically Disturbed Soils
- Coeur d'Alene Room, Shilo Inns

Ecosystem Based Soil Surveys for Resource Planning
- Bay 2, Convention Center, Holiday Inn

Distribution and Access to Soil Survey Data
- Small Conference Room, Shilo Inns

Redefining the Cooperative Role in NCSS
- Boardroom, Holiday Inn

New Ways of Making Soil Survey Interpretations
- Conference Room, Comfort Inn

3:oo - 3:30	**Break**
3:30 - 4:45	**committee Meetings**

The Role of NCSS in Site Specific Soil Surveys
- Bay 1, Convention Center, Holiday Inn

Drastically Disturbed Soils
- Coeur d'Alene Room, Shilo Inns

Ecosystem Based Soil Surveys for Resource Planning
- Bay 2, Convention Center, Holiday Inn

Distribution and Access to Soil Survey Data
- Small Conference Room, Shilo Inns

	Redefining the Cooperative Role in NCSS - Boardroom, Holiday Inn
	New Ways of Making Soil Survey Interpretations - Conference Room, Comfort Inn
7:00 - 8:30	NCR3 Nesting - Coeur d'Alene Room, Shilo Inns
7:30-8:30	Idaho Soil Scientist Association Meeting - Bay 1, convention center, Holiday Inn

Wednesday, June 15

Conference Field Tour

Busses Depart from Holiday Inn parking lot at 7:00 a.m.

stop 1 - Patterned Ground/Channeled Scabland Soil - Miller Ranch, Washington (arrive 8:05, depart 9:05)

stop 2 - Palouse Paleosols - Ewan, Washington (arrive 9:25, depart 10:20)

stop 3 - Lunch stop - Steptoe Butte, Washington (arrive 11:20, depart 12:20)

stop 4 - Loess Soil on Forest Site Converted to Cropland - Setters, Idaho [arrive 1:45, depart 2:45)

stop 5 - Volcanic Ash Soil - Fourth of July Pass, Idaho (arrive 3:30 depart 4:30)

Busses Arrive at Holiday Inn parking lot at 5:00 p.m.

Thursday, June 16

8:00 - 8:20	An Integrated Landscape Resource Analysis Approach to Comprehensive Watershed Management - Al Amen, BLH, Denver, CO
8:20 - 8:40	Variation of Surface Soil Salinity on Steep Wancos Shale Ecosystems - Dennis Murphy, BLH, Montrose, CO
8:40 - 9:00	Long Term Soil Productivity and Volcanic Ash Soils - Debbie Page-Dumroese, USFS, Moscow, ID
9:oo -9:20	Ecosystem Mapping Hierarchies; Aquatic and Terrestrial - Cathy Maynard, USFS, Helena, MT
9:20 - 9:40	overview of Forest Ecosystems - Dr. David Perry, Oregon State University, Corvallis, OR
9:40- 1o:oo	Soil Invertebrates in a Forest Ecosystem - Dr. Andy Moldenke, Oregon State University, Corvallis, OR
1o:oo -10:30	Break
10:30 - 10:50	SWAPA - Nathan McCaleb, SCS, Lincoln, NE
10:50 - 11:10	Restoring Riparian Ecosystems - Wayne Elmore, BLW, Prineville, OR
11:10 - 11:30	Water Quality - Terry Sobecki, SCS, Portland, OR
11:30 - l:oo	Lunch
l:oo - 1:20	Conservation Efforts along the Coeur d'Alene River - Frank Frutchey, Kootenai County, Coeur d'Alene, ID
1:20 - 1:40	Wetland Delineations - Arlene Tugel, SCS, Portland, OR
1:40 - 2:oo	Water Quality Issues and Related Soil Information Needs in the Clark Fork-Pend Oreille Watershed - Ruth Watkins, Tri-State Implementation Council, Sandpoint, ID
2:oo - 2:20	Incorporation of Soil Information into Cumulative Effects Analysis in Idaho - Brian Sugden, Plum Creek Timber, Columbia Falls, MT
2:20 - 2:40	NASIS - Harold Maxwell, SCS, Boise, ID
2:40 - 3:20	Break

3:20 - 3:40 PM-10
- Jim Carley, SCS (retired), Spokane, WA

3140 - 4:00 The Role of the Soil Scientist in Land Use Planning - A Consultant's Perspective
- Pierre Bordenave, InterMountain Resources, Sandpoint, ID

4:00 - 4:30 A century Minus Five ---- and Counting
- Dr. Richard Arnold, SCS, Washington, D.C.

Friday, June 17

8:00 - 8:20	**National Ecological Hierarchy** - Tom Collins, USFS, Ogden, UT
8:20 - 8:40	**Use of Soil Information for Assessing Ecosystem Health** - Phil Cernera, Coeur d'Alene Tribe, Plummer, ID
8:40 - 9:00	**A Political Perspective on Ecosystem Management and Its Consequences to Idaho** - Senator Mary Lou Reed, Idaho state Senate, Boise, ID
	Committee report5
9:00 - 9:20	**Role of NCSS in Site Specific Soil Surveys** - Del Mokma, Michigan State University, East Lansing, MI
9:20 - 9:40	**Drastically Disturbed Soils** - Sam Indorante, SCS, Illinois
9:40 - 10:00	**Ecosystem Based Soil Surveys for Resource Planning** - Robert Meurisse, USFS, Portland, OR
10:00 - 10:30	**Break**
10:30 - 10:50	**Distribution and Access to Soil Survey Data** - Scott Davis, BLM, Lakewood, CO
10:50 - 11:10	**Redefining the Cooperative Role in NCSS** - Paul McDaniel, University of Idaho
11:10 - 11:30	**New Ways of Making Soil Survey Interpretations** - Arlene Tugel, SCS, Portland, OR
11:00 - 12:00	**West Region business meeting** - Bay 2, Convention Center, Holiday Inn - Dennis Heil, SCS, Portland, OR
	Midwest Region business meeting - Bay 1, Convention Center, Holiday Inn - Nathan McCaleb, SCS, Lincoln, NE
12:00	**Adjourn**
1:00 - 3:00	Steering committee meeting - Coeur d'Alene Room. Shilo Inns

FACILITATORS

Monday, June 13

morning	Bill Ypsilantis, BLM, Coeur d'Alene, ID
afternoon	Russ Xrapf, BLM, Phoenix, AZ

Tuesday, June 14

morning	Tommie Parham, SCS, Albuquerque, NM

Thursday. June 16

morning	Annie Greene, USFS, Dillon, MT
afternoon	Mary Davarsa, BLM, Prineville, OR

Fridav, June 17

morning	Dennis Heil, SCS, Portland, OR

Exhibitor's Session

American Excelsior Company
Phil Davis, sales
609 S. Front Street
Yakima, WA 98901
206-462-7263

Decagon Devices
Grant Harris, Sales
AgVision Sales Department
P.O. Box 835
Pullman, WA 99163
509-332-2756

Electronic Data Solutions
David Dean, Sales
P.O. BOX 31
Jerome, ID 83338
208-324-8006

National Society of Consulting Soil Scientists
Pierre Bordenave, President
111 Cedar Street, Suite 8
P.O. Box 1724
Sandpoint, ID 83864
208-263-9391

North American Green
Mark Janeway, Sales
313 NE 81st Street
Seattle, WA 98115
206-524-1273

Western/Midwestern Regional Cooperative Soil Survey Conference

Soil Survey in *Ecosystem Management*

Conference Steering Committee

Dennis M. Heil, Permanent Chair
Soil Conservation Service
West National Technical Center
511 N.W. Broadway, P.m. 248
Portland, OR 97209-3489
(503) 326-2851

Alan Busacca, Professor
Dept. of Agronomy & Soils
Washington State University
Pullman, WA 99164
(509) 335-2381

Tom Collins, Soil Scientist
Forest Service
Federal Building
324 25th Street
Ogden, UT 84401
(801) 625-5357

Robert Klink
Bureau of Indian Affairs
911 N.E. 11th Ave.
Portland, OR 97232-4169
(503) 231-6751 ext. 313

Harold Maxwell, State Soil Scientist
Soil Conservation Service
3244 Elder Street, Rm. 124
Boise, ID 83705
(208) 334-1348

Paul McDaniel, *Professor*
Dept. of Plants, Soils, &
Entomological Sciences
University *of* Idaho
Moscow, ID 83843
(208)885-7012

Ken **Olson,** Professor
Agronomy Dept.
University of Illinois, Urbana
1102 S. Goodwin Ave.
Turner Hall, Rm. W401C
Urbana, IL 61801
(217) 333-9639

Bill **Ypsilantis,** Conference Chair
Bureau of Land Management
1808 N. 3rd St.
Coeur d'Alene, ID 83814
(208) 769-5025

James **Carley,** State Soil Scientist
Soil Conservation Service
Rock Point Tower II, Suite 450
W. 316 Boone Ave.
Spokane, WA 99201-2349
(509) 353-2339

Bruce Frazier, Professor
Crop Soil Science
Washington State University
Pullman, WA 99164
(509) 335-2381

Lyle **Linnell,** Conference Secretary
Bureau *of* Land Hgmt. (retired)
E. 5305 French Gulch Road
Coeur d'Alene, ID 838144
(208) 664-2961

Nathan **McCaleb,** Permanent Chair
Soil Conservation Service
Midwest National Technical Center
Federal Building, Rm. 152
100 Centennial Mall North
Lincoln, NE 68508-3866
(402) 437-5315

John **Nesser, Soil** scientist
Forest Service
P.O. 80x 7669
Missoula, MT 59807
(406) 329-3412

Wayne **Robbie,** Former **Conference** [illegible]

Welcoming Remarks

1994 Western/Midwestern Regional Cooperative Soil Survey Conference

June 12-17, 1994

Del Vail

State Director

Bureau of Land Management

Boise, Idaho

I'm very happy to have this opportunity to welcome you to The Gem State - Idaho. Idaho is truly the "Gem of the West" with the deepest canyon on the North American continent, many of the west's great untamed rivers, majestic mountain ranges, and immense wilderness areas. Dramatic elevation ranges in the state are illustrated by Mt. Borah at over 12,000 feet and the inland seaport of Lewiston at a mere 750 feet above sea level.

The uncompromising beauty of this state is reflected in the clear waters of its over 2,000 lakes. In fact, Idaho has the greatest concentration of lakes of any western state. These lakes are a fisherman's paradise. A few months ago, a local fisherman caught a record setting 43 pound Mackinaw out of Lake Pend Oreille, the largest lake in the state located just 18 miles north of Coeur d'Alene. And later today, you will have an opportunity to enjoy a cruise on Lake Coeur d'Alene which was rated as one of the five most beautiful lakes in North America by National Geographic.

Idaho is a large, uncrowded state. With almost 53 million acres of land, it is the nation's 11th largest state yet only ranks 40th in population. Even though it is one of the fastest growing states in the U.S., its population just recently surpassed one million people. In fact, there are more sheep and cattle in Idaho than people.

Idaho has a rich historical heritage. The Lewis and Clark expedition crossed the Bitterroot Range at Lola Pass and followed the Selway and Clear-water Rivers to the Snake River in 1805.

Between 1842 and 1860, three hundred thousand emigrants traveled west along the Oregon Trail. One hundred fifty years later, wagon ruts are still visible along the 580 miles of the trail crossing southern Idaho. The 150th anniversary of the trail was celebrated in 1993 through the successful cooperation of BLM and numerous other organizations.

In 1846, Idaho was acquired by the United States as part of the American territory agreed to in the Webster-Ashburton Treaty with Great Britain. Idaho Territory was created in 1863. It included Montana until 1864, and most of Wyoming until 1868. On July 3, 1890, Idaho became the 43rd state.

Almost two-thirds of Idaho is federally owned. The Bureau of Land Management administers nearly 12 million acres or about 22 percent of the land in the state. This land encompasses a wealth of natural and historic resources.

Public land administration has come a long way since the passage of the Taylor Grazing Act of 1934 and the inception of the BLM in 1946. Demands on the resources are continually increasing and becoming more diverse. Laws and regulations that guide our management are infinitely more complex than they were just a few years ago. The challenges that face us are considerable, but the Bureau of Land Management in Idaho is ready to meet those challenges in a professional manner and forge ahead into new frontiers of land stewardship thru Ecosystem Based Management.

To provide you with an idea of the scope of the task facing BLM, let me acquaint you briefly with some of the unique resources in our care and some of the critical issues we are tackling. BLM administers almost 1,800 miles of spawning and rearing habitat in the Pacific Northwest: 70 percent of which occurs in Idaho. Sockeye salmon were listed as an endangered species in November 1991 and three races of Chinook salmon were listed as threatened in May 1992. Listing requires federal agencies to avoid any further losses and undertake actions to recover the species. Section 7 of the Endangered Species Act requires federal agencies to consult with the National Marine Fisheries Service to determine if proposed actions comply with the act. BLM has reviewed all ongoing actions, including livestock grazing, recreation, mining, timber harvest, and road construction and maintenance to determine which activities "may affect" the listed salmon species. Hundreds of biological evaluations and assessments have been prepared and consultation is proceeding. This is a tremendous workload which greatly influences how these traditional public land activities are conducted. I can assure you the BLM is committed to protecting the habitat of these listed species.

The Snake River Birds of Prey Area, located just outside Boise, has the highest known nesting density of raptors in North America. Over 700 nesting pairs of 15 different species of eagles and hawks occur within this area, most of which is managed by BLM.

Major populations of deer, elk, moose, and Rocky Mountain bighorn sheep winter on BLM land. Approximately 95 percent of the California bighorns, 80 percent of the antelope and 80 percent of the sage grouse populations in the state are dependent upon BLM land for habitat.

Threatened and endangered plants also are important components of the ecosystem on public lands. The Coeur d'Alene District has developed a recovery plan for MacFarlane's Four O'clock, Idaho's only endangered plant species.

A 119-miles stretch of the South Fork of the Snake River in eastern Idaho has been identified by the U.S. Fish and Wildlife Service as Idaho's most important cottonwood riparian ecosystem. It is also one of the most significant bald eagle nesting areas in the United States, producing about one-half of the bald eagles born in Idaho.

BLM is cooperating with the Idaho Department of Fish and Game, Ducks Unlimited, and the Idaho Nature Conservancy to conserve and improve fish and wildlife habitat in the Thousand Springs/Chilly Slough areas. These areas contain a wide diversity of wildlife as well as a highly productive trout fishery, and public recreational opportunities.

Recreational use of public lands has mushroomed in recent years. The river management program involving the Lower Salmon, Bruneau/Jarbridge, and Owyhee Rivers has received national recognition. New programs, such as watchable wildlife, cave management and management of BLM's Back Country Byways, are rapidly expanding. Tourism is the fastest growing industry in Idaho and BLM provides recreation sites and unspoiled lands that draw travellers from around the world.

Range Reform and changes in the mining claim fee structure have had a profound impact on the workload of the BLM in Idaho and elsewhere. Thousands of public inquiries have had to be answered regarding these complex, ongoing issues. Just last Wednesday, over 50 formal hearings were jointly held with the USFS throughout the west to obtain public comments on the administration's Range Reform 94 proposals, The Clean Water Act amendment of 1987 placed additional emphasis on nonpoint source pollution control by requiring BLM to meet the requirements of the State of Idaho Nonpoint Source Management Program and the Idaho Antidegredation Regulations.

Third-order soil surveys have been completed on approximately 97 percent of the public lands in Idaho, with Butte County the last major mapping effort in the state. The soil surveys are being correlated with the range sites and habitat types. New soil initiatives will center on the assessment of ecosystem health.

Management of various programs, such as soil, water, range, wildlife, forestry, minerals, lands, recreation, and others, has been the traditional means of administering the wide array of resources and uses of the lands the BLM administers. However, the emphasis is shifting towards Ecosystem Based management of the entire state.

Idaho BLM is at the leading edge of this conversion to ecosystem-based management. The State of Idaho has been divided into four ecoregions: the Upper Columbia River, Salmon/Clearwater Rivers, Lower Snake River and the Upper Snake River. These ecoregions have been further subdivided into ecosystem management areas. At the present time, 10 ecosystem management areas have been designated. Additional ecosystem management areas will be designated as the process continues.

The ecosystem management process within BLM will rely strongly on interdisciplinary teams to develop and implement on-the-ground management. Cooperation between federal and state agencies, user interest groups and conservation groups will be essential to the success of ecosystem based management. Ecosystems do not conform to political and agency boundaries and they must be managed, to the greatest extent possible, without regard to traditional administrative lines on maps. However, that doesn't infer that management of private land will be dictated by federal agencies.

Hopefully, we can work together with private landowners to build partnerships and develop a consensus about making good land stewardship decisions that will benefit all interested parties.

Soil has been described as the "Placenta of the Ecosystem" since it nourishes all the other components of that system. Protection of that placenta is critical to the preservation of health, function, and inherent productive capability of the ecosystem. Mush of the species richness and diversity of ecosystems is encompassed in the soil mantle. Thousands of microbial and macro-invertebrate species and associations of these species are present in surprisingly small volumes of soil. We need to discover more about how our management of the land impacts these and other components of the soil. Our prosperity, and ultimately our very survival, may depend upon the answers to these questions.

I know you have a full and informative agenda for your sessions this week. I hope you can tackle some of the critical issues facing all of us as we move into ecosystem based management.

Again, I want to sincerely welcome you to Idaho.

Welcoming Remarks

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

Ed Burton

Deputy State Conservationist

Soil Conservation Service

Spokane, Washington

Welcome to the West/Midwest Regional Work Planning Conference. We extend a special welcome to our friends/colleagues from the Midwest region and to the field and area soil scientists who are able to be here this week. We extend special thanks to the Coeur d'Alene division of the Bureau of Land Management for their effort to host this conference. We are anxious to show our geographic area to you and to team up with our cooperators during this conference to discuss ideas and strategies to take us into the future. There are many new challenges for each of us with downsizing, reinvention/reorganization efforts and new and increased requests to meet our customer's needs.

We have a beautiful, unique area which provides the classroom/laboratory for this workshop. Continental and alpine glaciation created the U-shaped valleys and the lakes of Worth Idaho and Northeastern Washington. The numerous failures of Glacial Lake Missoula created the Channeled Scablands of Eastern Washington and the volcanoes of the Cascade Mountain Range have provided the unique parent materials for the Andisols of this area. Your Wednesday field trip will provide you the opportunity to see much of this first hand.

There are about 360 million acres of Federal land and about 400 million acres of nonfederal land in the West. It is often intermingled in complex patterns which provides unique opportunities to partnership in our soil survey efforts. There are numerous opportunities for resource inventory and management, for developing and improving interpretations and transferring technical data to our customers. With the computer hardware/software technology that now exists and our needs as partners, it is important that our data bases are accessible by ALL cooperators in the National

Cooperative Soil Survey (NCSS) program. In Washington, the Forest Ecosystem Management Assessment Team (FEMAT) and the East Side Forest Assessment Project are examples of new opportunities for cooperation among agencies in the NCSS.

Not only is land use varied in the West, traditional uses such as timber production, recreation, irrigated and dryland crop production, and livestock grazing are now impacted by new pressures and expectations, especially at the urban/agriculture interface. This provides soil scientists with new customers, new challenges and the need for innovative resource management systems to protect these resources. Water quality programs of some form are being required or considered by all levels of government. Land owners and users need current, accurate soils information to make natural resource planning and implementation decisions.

There are about 127 active soil surveys in the west. Ninety-five are on nonfederal lands and 32 are on Federal lands. There are about 220 million acres yet to be mapped in the West. For example, Washington State has about 700,000 acres of nonfederal lands not yet mapped for a "once over". However, we have another 4 million acres that need to be updated/remapped to meet customer needs. Several million acres of other lands have the need to be updated or make soil surveys to meet the NCSS standard level.

The lands of the West are varied and access is often limited because of the ruggedness of the resource we are attempting to inventory/manage. Landscape, climate, geology, and plant community diversity also dictates the number of soil series that are mapped and the number of soil interpretation records needed to provide interpretations for our customers. Of the approximately 16,000 soil series recognized in the U.S., roughly 10,500, or 60 percent, have been proposed and are used in the West. About 70 percent of the 30,000 soil interpretation records (SCS-SOI-5s) are used in the west. Again, this generates a lot of data to store, manipulate and access. There is also a demand for new data from our customers which needs to be supported by ADEQUATE field and laboratory observations so that the data provided are reliable and can be certified. There is no substitute for quality data in any program.

The West, particularly AK, CA, ID, OR, and WA, have most of the soils now recognized as Andisols. The need to properly inventory these soils has created a tremendous workload for the reclassification effort and a large workload exists to quantify and quality the soil properties that need to be entered into soil databases so that the data can be

Welcoming Remarks

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

David F. Jolly

Regional Forester

Forest Service

Northern Region

On behalf of the Forest Service, let me welcome all of you to Coeur d'Alene in beautiful northern Idaho. I appreciate this opportunity to share some thoughts with you concerning Ecosystem Management and the role of the National Cooperative Soil Survey.

The Forest Service has managed ecosystems since its inception; so have many other Federal and State agencies. That management has often focused on selected parts of ecosystems rather than on whole ecosystems or on the processes that keep ecological systems healthy, diverse, and productive. Our knowledge and thinking have evolved. We are now embarked on a course of managing ecosystems to sustain both their diversity and productivity while at the same time laying the foundation for sound multiple-use, sustained-yield management. I want to offer some thoughts on what is different about management today as compared to the past, define Ecosystem Management, and suggest some principles for Ecosystem Management.

First, what is different today than in the past? Today we find that:

1. people need and want a wider variety of uses, values, products, and services from the land:

2. new information and a better understanding of ecological processes emphasizes the role of biological diversity as a factor in sustaining the health and productivity of ecosystems and the need for integrated ecological inventories at various scales to support ecosystem management;

3. people outside the Forest Service and other Agencies want more direct involvement in the decision-making process: and

4. the complexity and uncertainty of natural resources management calls for stronger teamwork between scientists and resource managers in all Agencies.

An ecosystem is a community of organisms and its environment that functions as an integrated unit Ecosystems occur at many different scales and change over time. They do not have natural boundaries: they grade into others and are nested within a matrix of larger ecosystems.

Ecosystem Management means the use of skill and care in handling organisms and their environments. It implies that the system is the context for management rather than its individual parts. It is the means to an end, not an end in itself. We do not manage ecosystems just for the sake of managing them. We manage them for specific purposes such as producing, restoring, or sustaining certain ecological conditions: desired resources uses and products: and aesthetic, cultural, or spiritual values. Put another way, ecosystem management means to product desired resource values, uses, products, or services in ways that also sustain the diversity and productivity of ecosystems.

What them, are some key principles for Ecosystem Management? I would suggest these:

1. Manage for diversity and sustainability: Multiple-use, sustained-yield management depends on sustaining the diversity and productivity of ecosystems at multiple geographic scales.

2. Recognize that ecosystems are dynamic and complex: Future conditions are not perfectly predictable and any ecosystem offers many options for uses, values, products, and services which can change over time.

3. Define desired future conditions: Descriptions of desired future conditions for ecosystems should integrate ecological, economic, and social considerations into practical statements that can guide management activities.

4. Management must be coordinated: Ecosystem connections at various scales and across ownerships make coordination of goals and plans essential. Landscape and regional scales are increasingly important in analyses and management guidelines. However, this does not translate into a right to regulate private property rights or dictate the actions

of other landowners. We are partners and cooperators in ecosystem management, not regulators.

5. Data needs to be integrated: *In* order to support integrated management of lands and resources, inventories and data should be integrated. This is one area in which the National Cooperative Soil Survey can play a key role.

6. Management and Research should be integrated: Monitoring and research should be integrated with management to continually improve the scientific basis of ecosystem management.

In conclusion, let me state that the knowledge and understanding of soils has always been and will continue to be integral to our understanding of ecosystems and how they function. Scientific, integrated inventories are key to the further development of our knowledge base.

Once again, welcome to Idaho. I wish you an enjoyable and productive conference.

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

Agency Report

Richard Arnold

Director, Soil Survey Division

Soil Conservation Service

Washington, D.C.

Country-wide Forums. There are 2 kinds. One deals with ideas for the 95 Farm Bill. What changes may be desirable or needed? Conservation Reserve Program receives a lot of attention as contracts are completed and land may go back into production. Interest in soil and water quality, as discussed in the recent National Research Council report, addressed the importance of maintaining and improving the quality of soil and water resources.

Another set of forums, we call then the Chief's Forums, are concerned with how best to serve the needs of the country. Should the mission be modified? Is a natural resource conservation service, NRCS, an appropriate mechanism?

It is an opportunity for everyone to have a say. We are interested in your comments, your suggestions, your concerns. There will be meetings all across the country. Tell us what you think. It is for employees of SCS, FS, BLM, BIA, NPS and all other agencies. It is for university folks, special interest groups. It is for individuals - farmers, ranchers, foresters, wildlife specialists, energy, conservation, production, protection, stewardship, urban folks, rural folks, everyone who cares. Please take part; in person, in writing, on the hotline, and encourage others.

Restructuring of USDA. Secretary Espy is waiting for Congress to give its approval to re-organize the USDA, to go from about 40 offices and agencies to something in the 20's, to downsize even further, to close some offices and combine others, to make USDA more responsive and efficient. Things are somewhat on hold. After the buyout (about 1,000 of 13,000 employees), it is necessary to re-think how to cope with our responsibilities. State realignments are occurring. Will SCS have another buyout? I don't know - if so it likely will be a directed effort to protect certain job series and encourage others to leave. No definite word as yet. Most everyone is on an interim staffing plan; a consolidation process, a time of re-evaluation, and thinking about what we likely can do and cannot do. NHQ will probably be re-aligned but not right away. Chief Johnson wants to hear more of the "heartbeat" of America - then make a move.

Budgets. Well, I've already told you the good news. The bad news is the frustration of adapting to unwanted changes. A subcommittee of the House did a mark-up of 95 budget - OUCH! Do Wetland6 but we'll cut out other activities. For example, greatly reduce river basin and watershed activities. Soil survey is looking at a 1993-like budget - no pay increase, no inflation, no $2.5 M for digitizing, no $6 M for orthophotoqraphy. If that is to be our budget, we will have to juggle priorities more than anticipated. We fare better than some other SCS programs, but that makes us a higher percent of the budget and that means covering more off-set for the agency.

Soil Survey. We report to the Deputy Chief for Technology, Richard Duesterhaus. Rich was previously the Assistant Chief for the Northeast. He's a fine person and will very capably lead us through the transition. The Soil Survey Steering Team is functioning fairly well. A lot of tough decisions now because of budgets, re-thinking of SCS priorities, little stumbling blocks and the like. But they are getting better all the time and we have a strong commitment to a total Soil Survey program.

Based on your comments, suggestions, and criticisms, we have started to flush out the Soil Survey Program Plan into a real strategic plan that tells us our objectives, where we are now, where we want to be, what we are doing to get us there, and how we measure our progress. We currently have 5 strategic issues and 24 specific objectives. It is a flexible document. It begins to meet the national performance policies of the U.S. Government.

The Future. Our strategic issue number 3 is to provide a basic inventory of soil information for the entire country that is produced according to NCSS standards and procedures. We really believe this. The people of the U.S. deserve the best information possible that is consistent and relevant. How should we achieve this? Are there things we could be doing that we aren't doing now? The Federal Geographic Data

Committee (FGDC) is charged with making geographic data meet standards and be readily available. This sounds OK but the implications are staggering - how to get U.S. soil surveys in a coordinated, integrated database that everybody can tap into - a big job - tough to comply with these new regulations.

Please consider ways to do the right things for the right reasons. Should USDA efforts in soil inventory be combined? Only the mapping and GIS? Whole reports? What about data application - technical soil services - keep separate or handle jointly? Lots of unanswered questions - but some truly interesting opportunities to serve the needs of society.

What about coordinating surveys for the whole U.S.? All private and all public lands. Would Congress entertain such a request - do the people of the U.S. desire efficiency and effectiveness for their tax dollars?

Think about it - talk about it - let us know. Go to the Forums, write letters, get active, get involved. It's your Soil Survey - where do you want it to go? Where should we be in the 21st Century? How can we best serve the best interests of the folks of the U.S.?

We have proposed a number of alternatives for the SCS top staff and our Assistant Secretary to consider - they are doing that and will offer us their opinions soon. The next century will surely be exciting - no matter which path we follow.

Thanks.

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

Agency Report

Glenn Bessinqer

Soil Program Lead

Bureau of Land Management

Washington, D.C.

Ecosystem Management and Soil Surveys in the BLM

In the Bureau of Land Management, we're working towards implementation of ecosystem management. And, like many other agencies, our concept of ecosystem management is not yet solid. There seems to be many ideas and perceptions on how to approach the concept and, just possibly, we may never adopt a single approach.

To better accommodate ecosystem management, we are going through some significant changes in the BLM. Our organizational structure, at all levels, is being revised. And, probably of greater significant, our budget process is changing from program specific to a project basis - a very positive change in regard to our ability to manage the soil resources on the public lands.

The common ecosystem management buzz terms I consistently hear are capability, sustainability, diversity, and health. And, the definitions for these terms are found, to a very large degree, in the soil ecosystem.

As a result, I believe that ecosystem management provides the soil profession an excellent opportunity to assume a leadership role in public land management. Our knowledge, and the analysis and application of soil information, is a prerequisite to virtually all land use decisions; a fact that becomes more and more apparent to managers and other resource specialists as we begin to manage ecosystems and not uses such as mining, grazing, and the like.

As all of you know, the traditional soil survey is the premier process for identifying ecological baselines. The survey provides more than just soil information. It provides the ecological setting for the landscapes we manage.

But, it seems to me, that the use of the information is relatively limited. And, I'm not sure exactly why. Maybe it's because we haven't adequately demonstrated and nor sold it's utility to management and others. Is it because we've been too focused on the collection of the data itself and not the interpretation and on-the-ground applications?

Whatever the reasons, it is becoming more and more difficult for us to get the priority and budget we need for soil surveys. To help mitigate this situation, the soil survey strategy being developed is that:

1. New soil surveys will be conducted only as part of an interdisciplinary efforts to gather and apply ecological information - ecological inventories vs. soil surveys:

2. Priority for ecological inventories within the BLM will be based on more immediate management needs, consistent with planning schedules, budgets, and other measures. We cannot afford what I call a "blanket" goal like, "100% coverage by a specific date." It just will *not ever* happen: and,

3. Established project management tools and techniques will be used to plan and control inventories. We must:
- Have direct management involvement;
- Meet our schedules and budgets; and,
- Get the type and quality of information we need.

Other objectives that we are working towards that will help us meet our goal for soil resource management in the BLM includes:

- Modernization of our business systems, especially through automation. Our information must be automated and the professionals highly computer literate.

- Human Resource Development through training and recruitment of a work force that is culturally diverse and have new ideas. Knowledge and background in system ecology must be stressed in training and recruitment.

- Outreach activities to increase internal and external cooperation and coordination through education and direct participation.

- New Science centered around soil ecological systems. We need to go way beyond the relatively well known physical and chemical aspects of the soil and increase our capability in understanding the biological systems of soils.

The bottom line, as I see it, is that soil resource management will be even more critical with ecosystem management. Soil surveys will become true ecological inventories. The soil scientists will work in interdisciplinary teams oriented towards total ecosystems. We will conduct our work in a much more structured and business-like manner to help assure our success. And, the work environment will be more collaborative, modern and automated.

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

Agency Report

Wayne A. Robbie

Soil Scientist

Forest Service

Albuquerque, New Mexico

The Forest Service is pleased to participate in this conference. Our agency has a long history of involvement to the National Cooperative Soil Survey and looks forward to maintain this involvement. The Forest Service is very active in promoting the concept and principles of Ecosystem Management. Therefore, the theme is most appropriate and timely. Some of the activities that we, as an agency, are currently involved in that relate to ecosystem management include the development of the National Hierarchical Framework for Ecological Units, continued advancement in the design of a database structure for pedon and site information and supporting environmental research with emphasis on forest and rangeland ecosystems as related to soil quality.

The National Hierarchical Framework of Ecological Units is a product that assigned by the ECOMAP steering committee at the Washington Office. It's development had the involvement of many soil scientists within the National Forest Systems, Forest Service Research and other Federal Agencies. The purpose of the framework is to organize a multiscale approach to the classification and mapping of terrestrial ecosystems. This framework will be presented later in the conference. The Forest Service will utilize this framework for analysis, planning and research when considering multiple factors in assessing ecosystem composition, structure and function along with the frequency, magnitude and extent of ecosystem processes.

The Forest Service has developed a database to store and retrieve pedon and site information. SORIS (Soil Resource Information System) is an Oracle application in a relational format. It is currently being reviewed by our Regional Soil Scientists. The design of its structure, and data elements and definitions are believed to be compatible with other agencies efforts in database development. It is designed to have portable features to ensure data transfer and exchange.

Concurrently, with the development of SORIS, there is an ongoing effort to develop system-generated applications to provide analysis and interpretations. This effort involves the design and testing of models that process site or pedon data. As this effort continues to evolve, additional applications will be recognized and added.

The soils program of the National Forest Systems in cooperation with Forest Service Research are continuing the National Long-Term Soil Productivity Study. While primarily focused on forest ecosystems and the types of management activities associated with this environment, it is now being proposed to expand this study to rangelands which would include desert, grassland and Pinyon-Juniper woodland ecosystems. Specific attention would focus upon the types and effects of cultural activities and management practices that include recreation, grazing and fuel wood harvesting. These ecosystems occupy large areas of the landscape and are significant with respect to production of products and contain inherent values to local communities.

In closing, the Forest Service is advancing rapidly in gaining knowledge, organizing our knowledge and distributing our understanding about ecosystems and their management. Our role within the National Cooperative Soil Survey will continue to share information and contribute to the advancement of soil science.

WESTERN REGION EXPERIMENT STATION REPORT AT NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE, BURLINGTON, VT.
(This Report Compiled by E.F. Kelly)

A brief summary of the Soil Survey activities in the western region was presented. This summary was compiled from responses to a questionnaire submitted to each of the Agriculture experiment station cooperators. Reports by individual states follow the questionnaire summary.

1. Principle research activities at present:

Much of the focus of the applied research in the western region relates to the environmental aspects and application of soils information to water resources. Major areas of research within the region include: 1) Wet soils research, 2) Water quality of runoff from agricultural land, 3) Soil vulnerability to ground water contamination, 4) Erosion control, and 5) Grazing impacts on soils and the environment.

Basic Pedology research in the region related to the use of soils in Climate Change and Global Change Research. Specific projects include: 1) Changes in Soil Chemistry induced by different plant communities, 2) Loess stratigraphy and landscape evolution, 3) Geochemical mass balance, 4) Host of mineralogical investigations, 5) Global Change, 6) Soils & Paleoclimate, 7) Soil Response to changing C02, 8) Soil Climate studies, 9) Land use Changes on soil biogeochemistry.

2. Principle sources of funding for your research:

Experiment station cooperators are under a considerable amount of pressure to generate research dollars due to reductions in Hatch Formula funds. Many cooperators receive minimal support from the university to be directly involved in NCSS activities other than travel to and from regional workshops. The majority of money received comes from contracts and grants with subject areas and funding sources aligned as follows:

Water Quality	Global Change	Other
SCS	DOE EGG	TNC
EPA	NASA	Dept of Defense
DEQ	NSF	
Dept of AG		
Water resources		
USDA		

3. Number of graduate students:

Based on responses graduate students in the region were listed as follows: MS = 19, PhD = 12. It would be interesting to see how other regions compared. Funding constraints again seem to limit the number of graduate students in individual programs.

4. Principle teaching Activities:

A re-orientation of the pedology positions outside of traditional agricultural applications requires the experiment station cooperators to develope and teach courses outside of the traditional soil genesis, classification and survey and related courses.

Traditional Courses

Introductory soils
Soil Morphology and Survey
Soil Genesis and Classification
Mineralogy
Soil Judging

New courses (Non-Traditional)

Biology of the Soil Environment
Agroecology
Environmental Applications of Soil Science

Environmental soil science
Wetland Science
Soil Ecology

5. What changes have you made in your curriculum or courses in recent years that you feel meet the changing needs of the soil science community ?

Many of the Universities are now designing curriculum which addresses issues outside of the agricultural applications of soils. Many cooperators indicated that emphasis is now being placed on issues such as Global change, environmental application of soils information and ecological applications of soil science.

6. Involvement in Soil Survey activities:

Many of the cooperators indicated limited involvement in field soil survey activities (Field Reviews) due to time constraints and budget limitations that influence travel. Cooperation in soil survey activities is now directed toward areas that require little travel away from the university and where university facilities and expertise can be utilized. These activities include: 1) Education sessions, 2) Training Sessions, 3) Workshops, 4) Consultation on issues and Policy, 5) work planning conferences, 6) conduct lab analyses for survey, 7) Respond to information requests

7. What limits the extent of your involvement in NCSS:

Major limitations in NCSS activities as noted by respondents were 1) Drastic cuts in Ag Experiment station budgets, 2) No time for field reviews or manuscript review, 3) Little credit given for service activities (This is how the NCSS activities are perceived by higher administration), 4) heavy emphasis on external funding (now salaries are being included), 5) Publish or perish, 6) lack of active surveys nearby

8. Other general comments:

Many University cooperators indicated that budget cuts have left little time to participate in NCSS activities. Most Universities are now at a critical mass in terms of personnel involved in NCSS and related activities. Under ideal circumstances some cooperators noted that each university could use another pedologist for service activities. At many universities extension and research positions are being cut as retirements occur. Clearly our involvement will be based on creative ways to conduct basic pedology research, this will be the direction of NCSS experiment station cooperators in years to come. Many cooperators believe that increased cooperation with NCSS could help strengthen develop new directions in soils research.

Most cooperators agreed that the time is right for a re-thinking of how the NCSS can become a highly publicized and successful government program.

ARIZONA

Dr. David Hendricks

Research projects are as follows: 1) concerned with comparing the nature of soils on forested northern slopes with grass covered southern slopes of Green's Peak, a high elevation cinder cone, 2) A study is of the Andisols and related soils of the San Francisco Volcanic Field near Flagstaff, 3) A study of soils along a climosequence on the island of Hawaii in cooperation with the Jet Propulsion Laboratory, CSU, the SCS and others, 4) Research concerning the geomorphology, and genesis of soils formed on a sequence of marine terraces near the Mendocino triple junction.

Served as co-chair for the Western Regional Soil Survey Conference and led the field trip for the conference held in Flagstaff in 1992. Occasionally participate in field reviews.

Teaching responsibilities included: Soil Chemistry, Soil and Environmental Chemical Analysis, and Soil Genesis.

CALIFORNIA (U.C. Berkeley)

Dr. Ronald Amundson

Research activities center on the following: 1) use of Stable C and O isotope research on soil and plant carbonates and their relationship to climate, 2) Processes controlling ^{14}C in soils, 3) Use of paleosols in environmental reconstruction. In terms of direct soil survey activities I have served as an Informal collaborator on genesis of soils as related to Fresno County soil survey.

Teaching Responsibilities included: Soil Genesis (lectures and field trips), Summer field course, Graduate Seminar. Actively involved in training of graduate students in Isotope geochemical analyses of soil organic matter, minerals and plants.

CALIFORNIA (U.C. Riverside)

Dr. Robert Graham

Research activities are as follows: 1) Weathered granitic rock: hydraulic properties, plant utilization, genesis, geomorphic distribution, and pedologic processes, 2) Decade-scale genesis in a biosequence of native plants at the San Dimas Experimental Forest lysimeter installation, 3) Climatic gradient (457-2795 mm MAP) of mesic serpentinitic soils in the Klamath Mountains, California, 4) Use of near- and mid-IR for mineral identification across a plutonic contact in Baja California, 5) Pedologic and geomorphic processes on a marine terrace sequence in central

coast California. NCSS activity limited by the lack of active soil surveys in area.
Teaching responsibilities included: Soils of Southern California (each year), Soil Mineralogy (odd-numbered years), Soil Mineralogy Lab (odd-numbered years), Pedology (even-numbered years).

Department also created a viable soil science option in our environmental science undergraduate program and established an introductory soil science course with a choice of two labs, one of which emphasizes soil survey reports and land-use planning; the other emphasizes the fundamental subdisciplines of soil science. A new course titled, "Biology of the Soil Environment" has been added. It emphasizes biogeochemical cycling, bioremediation, and other soil-plant-microbe relations not targeted by traditional soils courses.

COLORADO

Dr. Eugene Kelly

Research Activities Centered on the following: 1) the use of stable C and 0 isotopes in soils research, 2) Holocene Paleosols of the central Great Plains and their use as proxies for paleoclimate, 3) Paleoclimate of the Pacific NW (with WSU-Busacca), 4) Organic matter dynamics in Great Plains and tropical environments, 5) Climosequence on the Island of Hawaii (develop isotopic characterization of silicate clays w/JPL, UA, CASE WESTERN RESERVE, SCS), 6) Isotopic composition of soil water (JPL-Chadwick) an its utility in modeling the hydrologic regime of arid and semi-arid ecosystems.

Soils survey activities are now limited to the publication of "Soil Survey of CPER", workshops, work planning conferences, and conducting analyses for NCSS of Colorado. There may be an opportunity to provide some basic pedological research and technical support for the Soil Survey of Rocky Mountain national Park. Past Chairman of WRCC-93, Currently serving on Technical Advisory Committee to NSSC.

Teaching Activities included: Soil Genesis and Survey (fall), Forest and Rangeland Soils (fall), Advanced Soil Genesis (w/Univ of WY class is taught spring), Wetland Science (team taught by hydrologist, ecologist, pedologist), Environmental Soil Science (team taught), Soil Judging. Most courses now focus on the environmental applications of soil science.

Department has decided to change name from Agronomy to Dept of Soil and Crop Science. Department now offers an under graduate concentration "Environmental Soil Science".

HAWAII

Dr. H. Ikawa

Research Activities included: 1) Determine tree performance (native koa, loblolly and Caribbean pines) in a three-elevational transect on island of Maui, 2) evaluate tree performance (native koa) as related to chemical and biological properties of Andisols, Oxisols, and Ultisols on the islands of Hawaii and Oahu. Participate in the soil survey of the island of Hawaii being conducted by the SCS--field review, sample collection for selected laboratory characterization (15 & 1/3 bar water, mineralogy). Update the classification of Andisols, Oxisols, and Ultisols of Hawaii.
Hawaii State Governor's Agricultural Coordinating Committee, McIntire-Stennis funds, Hatch funds, State funds, U.S. Forest Service, U.S. Fish and Wildlife Service

Teaching Responsibilities: Introductory soil science (4 cr.); soil formation and classification (4 cr.) Teaching now has more emphasis on environmental awareness

IDAHO

Dr. Paul McDaniel

Research Activities include the following: 1) Influence of eolian parent materials on genesis, classification, and properties of Idaho soils, 2) Epiaquic conditions in fragipan-dominated landscapes, 3) Genesis of E horizons in ash-influenced forest soils, 4) Changes in soil chemistry induced by successional plant communities in the Grand Fir Mosaic Ecosystem (We are studying the effects of bracken fern/coneflower communities on soil pH and potential Al^{+3} toxicity in clearcut areas of central and northern Idaho), 5) Aggradational and erosional history of the Radioactive Waste Management Complex, Idaho National Engineering Laboratory. Attend a limited number of field reviews and work-planning conferences and have helped with organization of recent NCSS-related field trips. University laboratory has also provided a few analyses and chemicals to assist some of the active surveys. I do not actively participate in review of materials such as soil survey manuscript, proposals for new series, and other technical documents, although these materials are circulated to me for comment. New Chairman WRCC-93.

Teaching Responsibilities include: Soil Judging, Soil Development and classification, Advanced Soil Genesis, Soil Mineralogy (team-taught).

Recently changed our curriculum to offer 3 options under the Soil Science B.S. degree: 1) Agroecosystem Management, 2) Environmental Science, 3) Land Resources. We currently offer a soils course entitled 'Pesticides in the Environment' and will soon offer one entitled 'Solute Transport in Porous Media'.

NEW MEXICO

Dr. Curtis Monger

Research Activities focus on Soil-geomorphic response to climate change in the now arid regions of the Southwest. Act as the Liaison to New Mexico National Cooperative Soil Survey.

Teaching responsibilities include: Soil Morphology and Classification, Soils-Land Use, and the Environment, Soil Genesis,
Introductory Soils

We have modified the Soils and Land Use course to emphasize the environmental aspects of soil science

OREGON

Dr. Herb Huddleston

Research activities: 1) Wet Soils Research (we're one of the national sites for monitoring of water tables), 2) Ponded Hydric Soils Research (determine the distribution of ponded areas in farm fields and their correlation with geomorphic surfaces and hydric soils), 3) Evaluation of Soil Vulnerability to Groundwater Contamination by Pesticides, 4) Environmental Applications of STATSGO Maps and Databases - we're using STATSGO, in conjunction with a comprehensive database on pesticide uses on crops in Oregon, to prepare generalized maps of the distribution of uses of specific chemicals. We're also using STATSGO to prepare maps of hydric soils in Oregon, maps of soil-pesticide vulnerability ratings, and perhaps to show the distribution of ponded soils, 5) Water Quality of Runoff from agricultural land.

Soil Survey Activities include an occasional field review, providing Leadership for education session for introducing new soil survey reports, Participation in SCS soil scientist training sessions and workshops, Communication and consultation with State office staff on issues and policies, Participation in annual work planning conferences.

Teaching Responsibilities Include: Soil Morphology and survey, Soil genesis and classification, Environmental Applications of Soil Science, Soil Judging workshops, Each year we prepare students for competition in the regional contest in the fall, then use the winter term to prepare for national competition, which then occurs in the spring term. This year Oregon State hosted the national soil judging contest.

We have made an attempt to integrate our teaching of soil physics, soil chemistry, and soil biology, into a 3-term sequence: Properties of Soil Ecosystems (Fall term), Soil Ecosystem Processes (Winter term), and Soil Ecosystem Modeling (Spring term).

UTAH

Dr. Janis Boettinger

Research Activities include: 1) Soil genesis and soil chronofunctions related to Pleistocene glacial chronology of the north slope of the Uinta Mountains, 2) Mechanisms controlling concentrated flow erosion in gypsiferous soils: A pedologic approach (collaboration with L.D. Norton, USDA-ARS), 3) Soil characteristics and relation to on-site and remotely sensed soil moisture, vegetation type and cover, and evapotranspiration in a typical Great Basin valley, 4) Zeolite occurrence and stability in soils (collaboration with R.C. Graham, Univ. Calif., Riverside), 5) Ammonium absorption characteristics of a clinoptilolite (zeolite) from northern Utah (collaboration with L. M. Dudley, P.T. Kolesar, USU).

Hosted the 1992 FY Utah Cooperative Soil Survey Planning Conference and Field Trip, St. George, UT,. Involved National Cooperative Soil Survey personnel and objectives in my research program. Also respond to information requests, try to find students for temporary jobs and student coops, etc. WRCC-93 representative to the NCSS Standards Committee.

Teaching responsibilities include: Soil identification and interpretation (name change soon to be in effect: Soil Genesis, Morphology and Classification), General Soils, Pedology.

Developing a new undergraduate curriculum in soil and water sciences. The new major, called "Environmental Soil-Water Science" is designed to replace part of the old "Plant and Soil Sciences" major. This major is designed to give students a strong background in basic sciences and math; an understanding of the physical, chemical and biological processes and interactions in the soil-water zone at the earth's surface; and a choice of specializing in soil, water, or an integration of soil and water.

WASHINGTON

Dr. Alan Busacca

Research Activities Include: 1) Stratigraphy and interpretation of paleosols in loess, 2) dust entrainment and human health 3) soil-landscape survey

Minimal involvement in NCSS activities. Provided some soil geomorphology assistance and NSSL lab sampling; state generalized soil map

Teaching Responsibilities Include: Soil genesis and morphology (undergrad and grad), World agricultural systems. Our Department added an option in "Environmental Soil Science" to the B.S. in soils.

WYOMING

Dr. Larry Munn

Research Activities include: 1) Influence of soil properties on forest productivity, 2) Vulnerability of groundwater to pollution from nitrate and pesticides, 3) Use of RUSLE to estimate erosion.

Soil Survey activities involved coordination the distribution of STATTSGO to GIS users at UW.

Teaching Responsibilities Include: Introductory Soils (Spring semester), Soil Morphology, Genesis and Classification (Fall semester), Advanced Soil Genesis and Classification (Spring, alternate years), Agroecology (Introductory) (Spring, team taught)

Dropped our undergraduate soil science major. We dropped undergraduate degrees in Soils, Crops and Entomology and replaced them with a degree in Agroecology. We have recently added courses in Soils in Environmental Quality and Chemistry of Reclamation Materials and Soils. We have hired a Soil Physicist starting in August 1993 to emphasize soil water. We still offer a program whereby a student can qualify as a Soil Scientist on the federal register.

MIDWESTERN REGION AGRICULTURAL EXPERIMENT STATIONS

REPORT

Dr. Pierre C. Robert, University of Minnesota

I. SOIL SURVEY PROGRAM STATUS. JUNE 1994.

Current status of state soil surveys compiled from NCR-3 reports:

	IL	IN	IA	KS	MI	MN	MO	NE	ND	OH	SD	WI
No. Counties	102	92	99	105	83	87		93	53	88	66	
Published	72	87	85	105	57	56		85	36	75	54	
In Press (Update)	25	2	13	· (2)	10	18		7	14	3 (1)	12	
In Progress (Update)	5 (3)	(4)	4 (3)	(4)	9	10 (3)		1 (5)	3 (2)	(7)	(4)	
Waiting (Update)	·		(1)	(0)	7	3				10 (4)		

II. SOIL SURVEY DIGITIZATION STATUS

IL.
- Three out of 102 counties are digitized
- One Survey was digitized by the IL Geo. Survey and another one by Lake County. Both used hand digitizing, rubber sheeting, and DLG-3 file format.
- The third survey was digitized by the county by re-compiling 1:12,000 maps on ortho 1/4 quads, scanning, and storing in DLG3 format.
- SCS use the same procedure for 8 watersheds (about 100,000 ac.)

IN.
- No coordinated system
- Counties or parts of counties are digitized by various agencies and various systems.

IA.
- Most counties by July 1994.
- Georeferenced soil maps by sections (USGS coordinates)
- ISOIL software or export to GIS
- Internet project

KS. • Statewide project W/ Agronomy, Geography, and SCS
• Completion by 1995
• Recompilation on USGS 7.5 quads, scan digitization
• SCS soil scientist for quality control
• Archival by Kansas Geological Survey

MI. • Nine soil surveys digitized
• Recompilation of 6 additional soil surveys
• Contracts W/ MI Dep. Natural Resources
• Nineteen digitized but need some editing to meet mapping standards

MN • Forty two surveys (Ag counties) are digitized in SSIS raster format
• Capability to georeference and use standard GIS formats

NE. • Recompilation on 7.5 quads of 2 nd generation surveys
• Digitization by NE Natural Resources Commission
• Updated survey (3 rd generation) at 1:12,0000 scale on ortho base digitize by Conservation & Survey Division.

ND. • SCS digitizing center in Fargo has completed digitizing two county soil surveys

OH. • Forty eight surveys are digitized in OCAP raster format
• Digitization by the OH Capability Analysis Program (OCAP) of OH Dep. Natural Resources

SD. • Currently, there are 7 digitized county surveys available.
• Six additional county surveys are in process of editing
• Two surveys are in process of digitization and 3 are being recompiled
• Files are exported from GRASS to DLG3 format. Survey fomat is 7.5 min quads in UTM

III. RESEARCH ACTIVITIES RELATED TO SOIL SURVEY

Illinois. Ken Olson

• Soil productivity-erosion relationship.
• Evaluation of conservation tillage systems for the restoration of productivity of previously eroded soils.
• Crop yield prediction by soil.
• Quantification of erosion and sedimentation rates.
• New (about 230) and revised soil productivity indexes.

Indiana. Donald Franzmeier

- Monitoring water table depth, reduction, and water movement in several toposequences. This is part of the SCS global change initiative.
- Compaction and cementation in C horizons of soils formed in glacial till.
- Soil formation in barrens (prairie remnants) within hardwood forest areas.
- Detection and quantification of the amount of residue cover on fields using remote sensing (AVIRIS) data.
- Geomorphology of the Flatwoods area of southern Indiana.

Iowa. Tom Fenton

- Erosion-productivity project including soil quality.
- Use of electrical conductivity in soil survey.
- Cooperative project with SC'S on stratigraphic relationships under loess-covered benches in Lucas County.
- Cooperative project with SCS on soils of the Savan Terraces.
- Landscape evolution of the Des Moines Lobe.
- Hydric soil characteristics in Iowa.
- Cooperative project with SCS on water table of selected soils.

Kansas. Michael Ransom

- Clay translocation and carbonate accumulation in the 16-26 inch rainfall zone of western Kansas.
- Distribution and properties of clay minerals in Kansas soils with emphasis on application to soil fertility.
- Soil genesis and geomorphology on the Konza Prairie (LTER). Soil mapping at a scale of 1:2,000, study of genesis for a 125 ha watershed, and accumulation of carbonates, gypsum, and Na in polygenetic soils,
- Parent material stratigraphy and genesis of soils developed in eolian materials in the Southern High Plains.
- Cooperative project with SCS on the hydrology and genesis of soils in playas in southwestern Kansas.

Michigan. Del Mokma

- Impact of accelerated erosion on soil properties and productivity.
- Soil absorption of septic tank effluent and sand filter effluent.
- Impact of cultivation on spodic horizon properties.

Minnesota. Pierre Robert

- Landscape evolution in southeastern Minnesota (E. Nater)
- Wet soil monitoring (J. Bell)

- Soil-terrain modeling (J. Bell)
- Relationship of turf quality to management practices (T. Cooper)
- Describing soil and crop variability on a sand-plain landscape with surface-collected data (J. Anderson)
- Method for the prediction and quantification of soil property variability using GIS technologies (P. Robert)
- Forest productivity index (D. Grigal)
- Soil productivity modeling of agricultural land (P. Robert)
- Soil7 GIS (I'. Robert)
- Precision farming (P. Robert).

Nebraska. Mark Kuzila

- Comparison of sampling methods to determine map unit composition.
- Relationship of spectral reflectance to turbidity generated by the erosion of common soil types.
- Carbon tetrachloride retention by modern and buried A horizons.
- Determination of the impact of landuse on soil organic matter in the Sand Hills of Nebraska.
- Morphological and chemical changes in Moody and Hastings soils after 30-35 years of cultivation.
- Utilization of the soil survey database to predict pesticide mobility.
- Use of video camera to determine in situ soil color.

Ohio Neil Smeck

- Permeability and water movement in sediments, dominantly colluvium, on a forested slope in southeastern Ohio In situ permeabilities were measured using an amozemeter.
- Examination of the properties of colluvial deposits in eastern and southeastern Ohio.
- Study of fractures in glacial till deposits with particular interest in the hydrology of till around land fill sites in northern Ohio.
- Comparison between properties of silt deposits on the upland and lower landscape positions along an abandoned valley in central Ohio.

North Dakota. Dave Hopkins

- Water movement in landscapes, wetland hydrology, and geochemistry
- Wet soil indicators and their reliability in terms of identifying hydric soils
- Organic matter/aggregate stability study of western ND agricultural soils.

South Dakota. Doug Ma10

- Technology transfer of applied/basic soils information for the agriculture and environment of South Dakota:
    - C sequestration in SD soils using lab data of the past 50 years;
    - Data base of all soil series (lab and morphology data);
    - Resampling of sites (1920 & 1937) for impact of cultivation and the environment on C, N, P, Ph, etc.;
    - Evaluation of various computer models used to define and manage sensitive aquifer areas;
    - Revise bulletins on soil classification, soil productivity, etc.
- In cooperation with SCS, testing of hydric soil indicators, gathering of basic soil data, and soil productivity ratings for several MLRAs.
- Spatial distribution of soil selenium in south-central SD. (J. Doohttle)
- Erosion impacts on soil productivity and soil properties (T. Schumacher)
- Hydric soil identification and characterization in prairie potholes (D. Rickerl)
- Site-specific farming (G. Carlson)
- Differences in herbicide adsorption/desorption rates on different soil series (S. Clay)
- Influence of soil parent materials on fertilizer and other chemical movement (D. Clay).

fluence subsequent episodes of soil development. Differences in the degree of geologic and pedologic overlap can cause large spatial variation in morphologic propenies of soils across landscapes. Knowledge of the spatial variation resulting from differential sediment influx is crucial in estimating the duration of soil formation tephras. however, indicate that at least two distinct buried soils formed at some sites within the same interval of time in which only one soil profile was formed throughout most of the Scabland and Palouse. In addition, the degree of soil development of each of the two buried Washtucna Soils is about the same as that of the single Washtucna Soil profile, suggesting that rates of soil formation were accelerated at the dual-soil site relative to the single Washtucna Soil site. In this paper, we propose a simple model for the interaction between loess deposition and the formation of superimposed calcic soils and discuss the effect of this interaction on soil stratigraphy and rates of soil formation.

The Palouse loess

Loess in the Channeled Scabland and on the eastern Columbia Plateau beyond the margin of the Channeled Scabland is known informally as the Palouse loess (Fig. 1). The Palouse loess, which covers more than 10,000 km^2 and in places is up to 75 m thick (Ringe, 1970), forms the deepest and most continuous loess deposit in the northwestern U.S.A. In the western and drier parts of its occurrence where present-day mean annual precipitation is less than about 450 mm, the deposit contains dozens of buried soils, sheets of unaltered loess, and numerous volcanic ash layers in vertical sequence (Busacca, 1990). Buried soils consist of cambic horizons and horizons of pedogenic accumulations of calcium and magnesium carbonates (hereafter referred to as carbonates) and silica. Paleomagnetic measurements indicate that the geologic record in the loess spans at least the last 1 million years (Packer, 1979; Kukla and Opdyke, 1980; Foley, 1982). Recent research has demonstrated that the loess adjacent to Scabland Coulees contains a record of multiple episodes of giant glacial-outburst floods that coursed through the Channeled Scabland during Pleistocene glacial maxima (McDonald and Busacca, 1988). Repeating stratigraphic sequences within the loess consist of flood-cut unconformities, loess layers, and buried soils: these sequences suggest that episodes of Scabland flooding triggered some periods of loess deposition, which were followed by periods of soil formation (McDonald, 1987; McDonald and Busacca, 1988; Busacca, 1990). A thick Cordilleran Ice Sheet extending into southern Canada or the northern U.S. is required to generate these large-scale floods, so the stratigraphic record in the loess may be one of the best terrestrial proxy records of glacial-climatic cycles in North America.

The primary minerals in the loess are quartz, feldspars, and micas (Rieger, 1952; McCreery, 1954). The initial source of carbonate in the buried soils is considered to be principally detrital, derived from eolian redistribution of weakly calcareous slackwater sediments that accumulated in basins and valleys to the southwest of the Palouse and Scabland during episodes of glacial-outburst flooding (Fig. 1). Detrital carbonate in unaltered loess ranges from 2 to 5 percent (0.03-O. 10 g/cm’). Lack of measurable carbonate in the upper part of most surface soils indicates that the detrital carbonate has been leached and reprecipitated in the subsoil horizons.

The study area

The four road-cut exposures described here are located in loess deposits in the southcentral part of the Channeled Scabland (Fig. 1). The road-cuts are oriented normal to the long axes of hills of loess.

The present-day climate is semi-arid due to the rain shadow of the Cascade Mountains that lie to the west of the Channeled Scabland. Because of the semi-arid climate and sagebrush-steppe vegetation, most of the surface soils that have formed *in loess* in the area that we discuss are Mollisols (Soil Survey Staff, 1975). Aridisols occur in areas of the Scabland that receive less than 225 mm of mean annual precipitation.

56

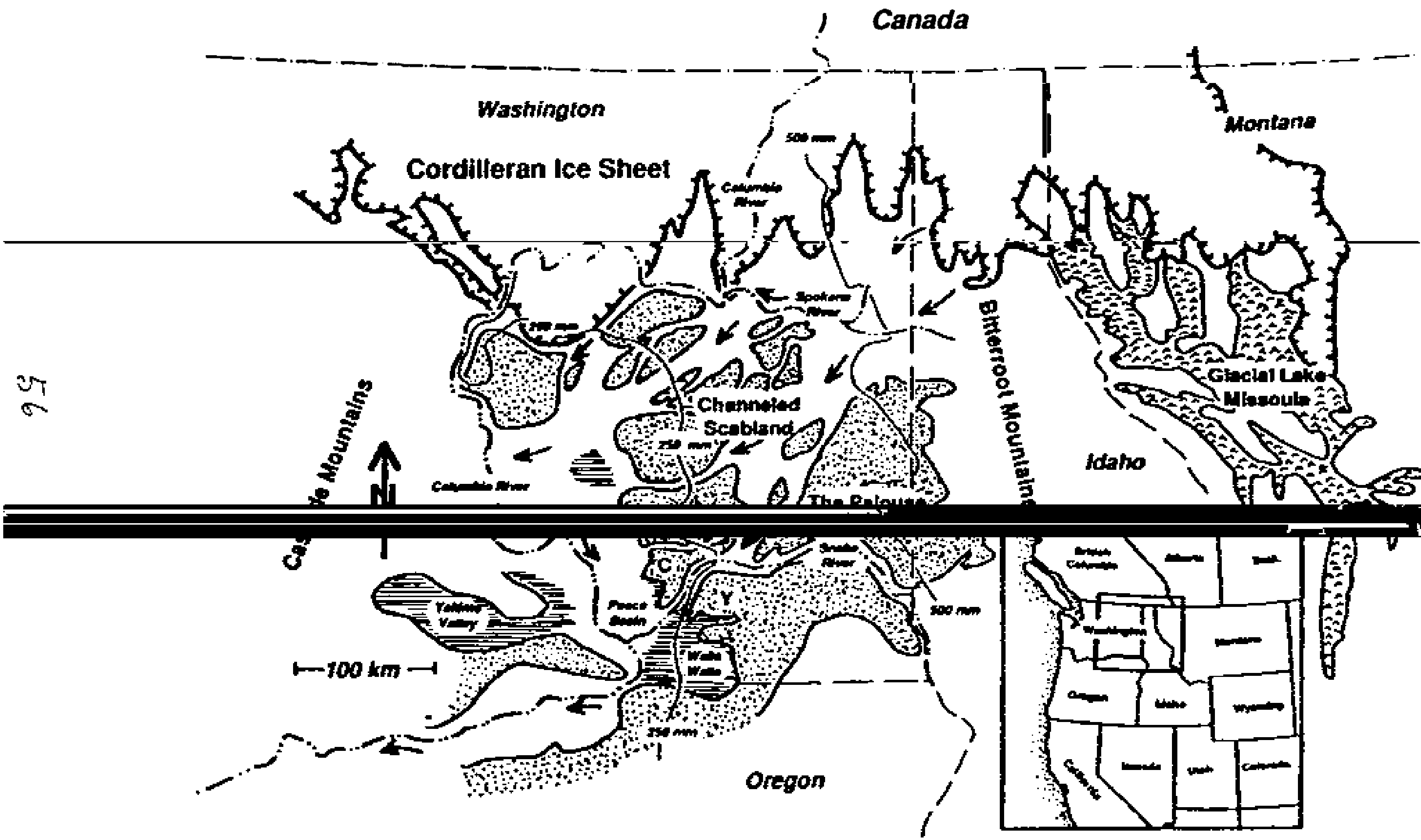


Fig. 1. Map of the western United States (inset) and generalized map of the Lake Missoula–Channeled Scabland system that also shows locations of the study sites. Cordilleran Ice Sheet shown at its late Wisconsin maximum by the heavy hachured line. Arrows show major pathways of water through the Channeled Scabland. Stipple pattern shows areas of deep loess cover in the Channeled Scabland and the Palouse. Horizontal lines show major areas of slackwater sediments in the Pasco Basin and Walla Walla Valley. Small pockets of slackwater sediments deposited in adjoining valleys not shown. Study sites are Washtucna (W), Connel (C), and Clyde (Y). Site locations are WA-5: 46°46′24″N, 118°21′22″W; CON-1: 46°37′16″N 118°42′42″W; CLY-1: 46°16′15″N, 118°29′42″W; CLY-2: 46°16′20″N, 118°29′42″W. Isohyets of [redacted]

Stratigraphic descriptions were made from hand-dug trenches in road-cuts. Buried soils and loess layers were described and sampled using standard methods for soils (Soil Survey Staff, 1981).

The Washtucna soil-stratigraphic unit

The Washtucna Soil is a well-developed soil that contains a weakly to strongly cemented perrocalcic horizon (Fig. 2, Table 1). The petrocalcic horizon, which is continuously cemented and has a thin laminar cap, has the general character of weak Stage IV morphology (Gile et al., 1966); however. the petrocalcic horizon lacks strong K fabric. The Washtucna Soil throughout the Channeled Scabland is stratigraphically bracketed by two distinct volcanic ash layers erupted from Mount St. Helens (Fig. 2, *MSH*). Correlations between the tephras and the reference samples from the volcano are based on analysis of major elements in volcanic glass and in ilmenite and magnetite phenocrysts. and on phenocryst mineralogy (Foley, 1982; Nelstead. 1988). The soil is underlain by the MSH set C tephra (Fig. 2), which has been radiocarbon dated at the volcano at approximately 36.000 yr B.P.

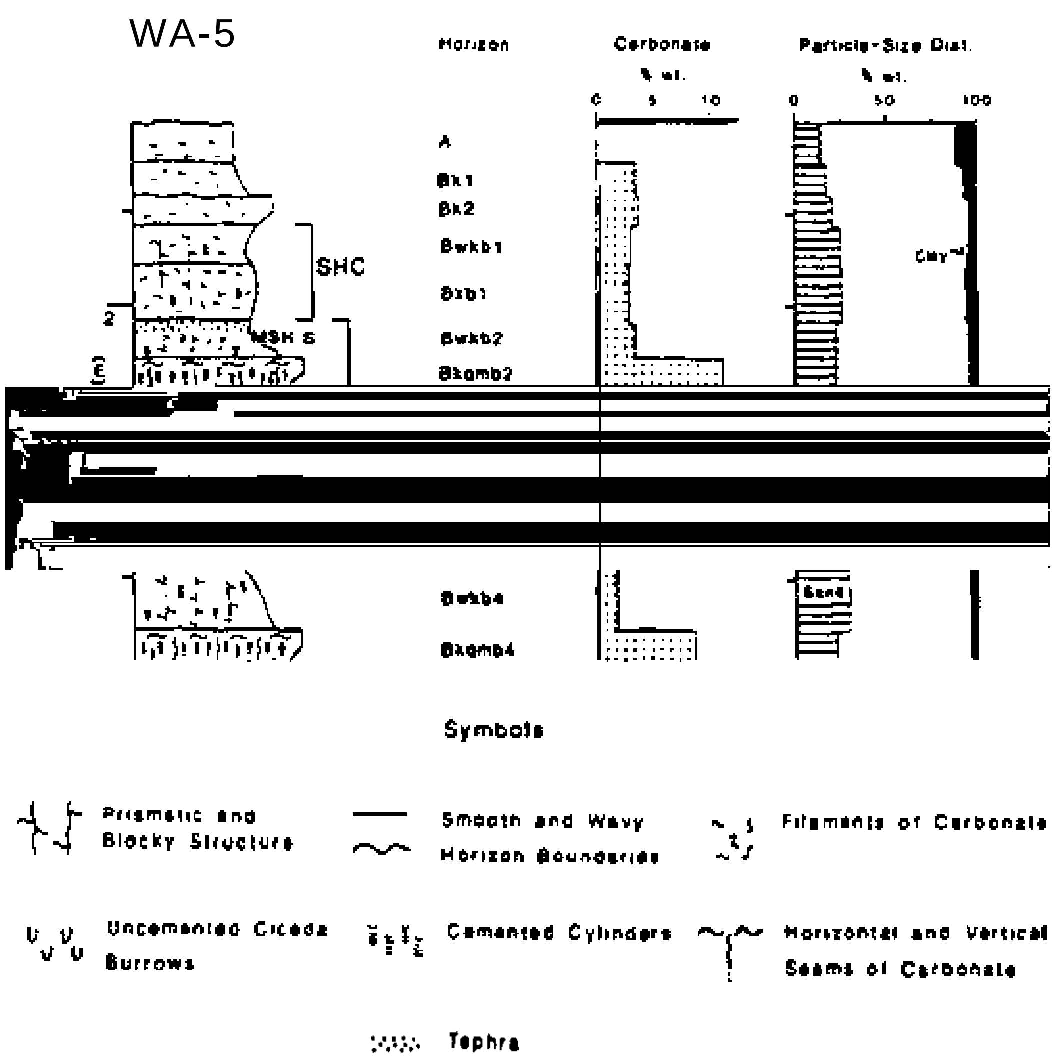


Fig. 2. Schematic

TABLE I

Selected morphology of the Washtucna Soil(s)

Site	Depth (cm)	Horizon[a]	Dry color	Structure'	DC[b]	Cyl[c] (vol%)	Carbonate morphology'	Total mass* carbonate (g/cm²)
WA-5	218-259	Bwkb2	10YR 6/3	Icpr: lcsbk				
	259-295	Bkqmb2	10YR 7/2	m				
			10YR 6/3[f]					
			10YR 7/2	2csbk				
			10YR 7/2					
CON-I								
CLY-2								
CLY-1								

m

(Mullineaux. 1986). The soil is overlain by the MSH set S tephra. which has been radiocarbon dated at Mount St. Helens at approximately 13,000 yr B.P. (Mullineaux, 1986).

The Washtucna Soil and the loess layer in which it formed represent an interval of time before the end of the Late Wisconsin episode of giant floods in the Channeled Scabland, which occurred between about 17,000 and 12,000 yr B.P. (Waitt, 1985; Atwater, 1986), but after the next older episode of Scabland flooding. Radiocarbon ages of the MSH set C tephra at Mount St. Helens and charcoal from Scabland flood deposits that yields a radiocarbon age of about 40,000 yr B.P., and the age of Late Pleistocene stratigraphy in the Canadian Prairies (Fenton, 1984) suggest that this older episode of flooding is early or middle Wisconsin in age and occurred between 75 and 40 ka (McDonald and Busacca, 1988, 1990). Stratigraphic and sedimentologic evidence suggest that the sand- and silt-rich slackwater sediments left by this episode of older floods formed the primary eolian source for the loess layer in which the Washtucna Soil formed (McDonald and Busacca, 1990).

Spatial variability of the Washtucna Soil

Washtucna

The Washtucna Soil as it is exposed in roadcuts across much of the Channeled Scabland has the morphology of a single buried soil. We use the Washtucna Soil at the WA-5 site near the town of Washtucna, Washington (Fig. 1) to represent the properties of the single buried soil (Fig. 2, Table 1).

The top of the Washtucna Soil at the WA-5 site is defined by the position of the MSH set S tephra. The horizon that contains the tephra in its upper part seems to have formed the original A and Bw (cambic) horizon of the buried soil (Bwkb2, Fig. 2). The typical dark coloration of the A horizon caused by the humified organic matter is conspicuously absent from the Washtucna Soil and other buried soils in the Channeled Scabland. We attribute this to oxidation of organic matter after burial of the soil by younger loess. Because of the absence of organic matter and because of overprinting by later pedogenesis, former A horizons throughout the loess now have a similar appearance to that of cambic or calcic horizons; therefore, we label former A horizons as B horizons because that is their appearance today.

The cambic horizon (and former A horizon) of the Washtucna Soil has a slightly higher chroma and less pedogenic carbonate than do buried soil horizons above and below it, and has a weak to moderate blocky structure. Pedogenic carbonates are common in the cambic horizon of the Washtucna Soil (and nearly all buried soil cambic horizons in the Scabland) but are not generally present in cambic horizons of the presently forming surface soils; therefore, we attribute pedogenic carbonate in buried cambic horizons to be due largely to the overlapping of subsequent pedogenesis. Buried cambic horizons containing pedogenic carbonates are designated with "k".

The dominant feature of the Washtucna Soil is its light-gray petrocalcic horizon (Bkqmb2. Fig. 2, Table 1) that has weak Stage IV morphology (Gile et al., 1966). The petrocalcic horizon at the WA-5 site is weakly to strongly cemented, is about 35 cm thick, contains 12% carbonate (0.17 g/cm'), and has vertical and horizontal seams of carbonate and abundant cemented cylindrical nodules (insect burrows). The nodules make up about 90% of the horizon volume. Thin (<2 mm) vertical seams of carbonate define polygons that are 50 to 100 cm wide. Horizontal seams of carbonate form a weakly developed laminar cap at the top of the petrocalcic horizon.

Cylindrical nodules are a conspicuous feature of most buried soils formed in the loess. Nodules can range from 1 to 3 cm in diameter and are weakly to strongly cemented by pedogenic carbonate. Cementation of the nodules is also enhanced by small amounts of silica such that the nodules do not completely break down when soaked in hydrochloric acid. The nodules originated as the burrows of soil fauna such as cicadas. Burrowing apparently occurred within the A and cambic zone of the loessial soils early in a cycle of soil development. The burrows have become cemented at a later time after continued loess deposition caused the zone of precipitation of carbonates to move upward into the position of A and cambic horizons.

It is important to emphasize here the almost universal presence of cemented cicada burrows within carbonate-cemented zones in paleosols formed in loess in the arid parts of eastern Washington. Because the burrowing of the sediment by cicadas is a near-surface process in uncemented loess (Hugie and Passey, 1963), the precipitation of carbonates within the burrowed zone must occur at a later time in a deeper relative profile position after the land surface has moved up. Most petrocalcic horizons in soils such as the Wasbtucna Soil must have formed during two phases of soil development: The first phase forms the burrowed zone and the second phase cements it. These two phases may occur somewhat simultaneously during times of low rates of loess deposition as the rising landscape causes carbonate to precipitate in the deepest part of the early formed burrowed zone; the remainder of the burrowed zone is then progressively engulfed by the rising zone of accumulation of carbonate.

There are two transitional horizons below the petrocalcic horizon of the Washtucna Soil. The Bkqb2 (Fig. 2) has discontinuous vertical seams of carbonate and 40% cemented cylindrical nodules that have nearly continuous coatings of carbonate. The nodules are in a matrix of soft calcareous loess. The BCb2 horizon (Fig. 2) is structureless and has only a few percent cemented nodules and filamentous carbonate in former root channels.

Connell

The morphology of the Washtucna Soil at the CON-I site (Fig. 1) near the town of Connell. Washington represents soil formation in thicker loess. The loess between the MSH S and C tephras thickens from about 2 m at the WA-5 site to over 7 m at sites much nearer principal source areas for the loess. which were in the Walla Walla Valley and Pasco Basin (Figs. 1, 3). Because of its intermediate location between these extremes (Fig. 1), loess is almost 3 m thick between these ash markers at the Connell site (Figs. 3b, 4).

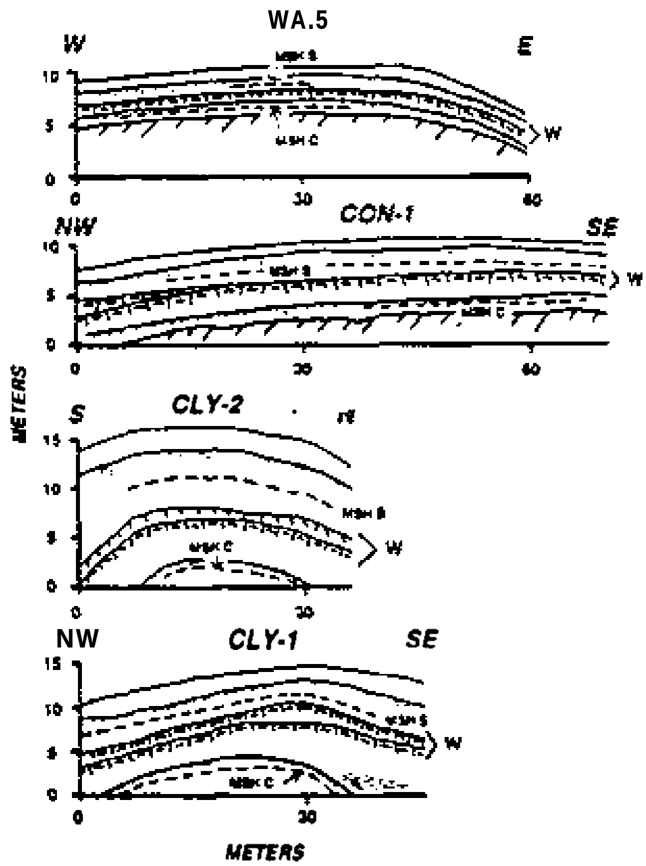


Fig. 3. Scbemrtic cross-sectional diagrams of road-cut exposures for the four study sites: WA-S. CON-I. CLY-2. CLY-I. Position of the Wasbtucna Soil (*W*) shorn by symbols for horizontal and vertical seams of carbonate (Fig. 2). The position of the Sand Hills Coulee and Old Maid Coulee soil-stratigraphic units shorn by line and stipple pattern. Position of tephras MSH set S (*MSH S*) and MSH set C (*MSH C*) shown by heavy dashed lines. diagonal hachure. Uneven parts of the WA-5 and CON-I exposures not considered here.

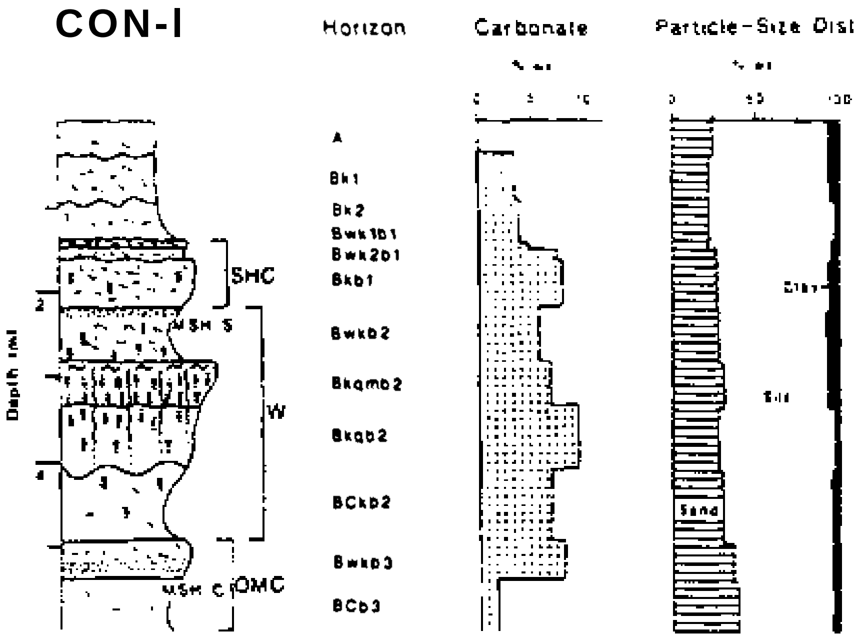


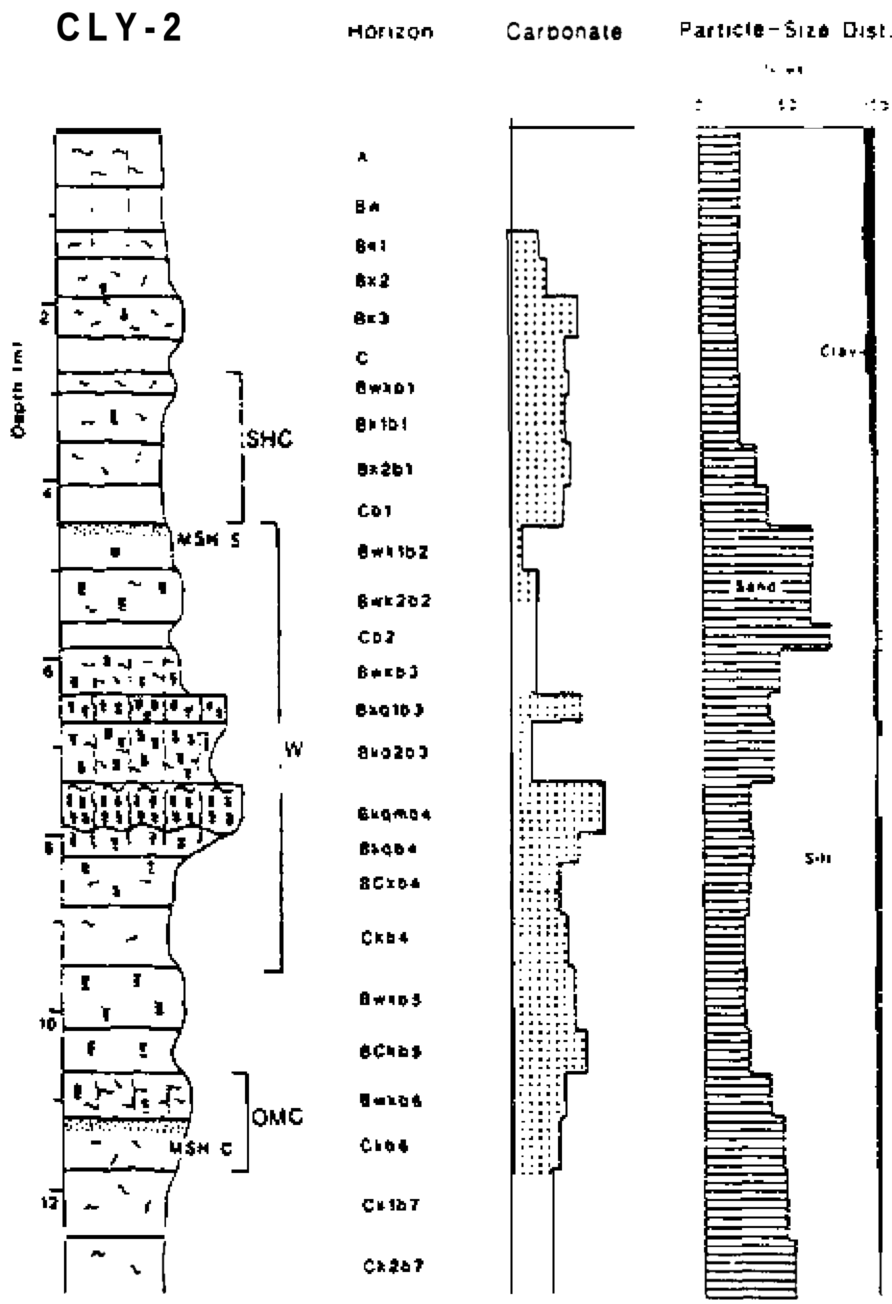
Fig. 4. Schematic stratigraphic column for the CON-I sire. Symbols used are defined in Fig. 2.

The Washtucna Soil at the CON-I site (Fig. 4) is generally similar to that at the WA-5 site, except that corresponding horizons at the CON-1 site are thicker than at WA-5 site because of the slightly greater loess thickness.

The combined effect of greater loess thickness and landscape position on soil formation is shown by soil-stratigraphic relationships on the outer flanks of the CON-I exposure where layer thickness increases from about 3 m to more than 4 m (Fig. 3b). There, the single petrocalcic horizon bifurcates into two separate petrocalcic horizons. Each petrocalcic horizon is 30 to 40 cm thick, separated by a Bkq horizon that is 40 to 60 cm thick and has 30 to 50% cylindrical nodules in a soft loess matrix. It was at sites like this that we first began to suspect that the genesis of tbe Wasbtucna Soil could be complex and consist of more than one period of soil formation.

Clyde

Two road-cut exposures, CLY-I and CLY-2, are located about 30 km south-southeast of the Connell sites (Fig. 1), near Clyde, Washington. These two sites are very close to the sediment source and as a result, the loess at these two sites is 5 to 7 m thick between the MSH S and C ash markers. Both sites have a dramatically different sequence of buried soils between the markers than we saw at the


CLY-2
Horizon
Carbonate
Particle-Size Dist.
Depth (m)
A
Bw
Bk1
Bk2
Bk3
C
Bwkb1
Bk1b1
Bk2b1
Cb1
Bwk1b2
Bwk2b2
Cb2
Bwkb3
Bkq1b3
Bkq2b3
Bkqmb4
Bkqb4
BCkb4
Ckb4
Bwkb5
BCkb5
Bwkb6
Ckb6
Ck1b7
Ck2b7
SHC
MSH S
W
OMC
MSH C
Clay
Sand
Silt

derlying soil. This layer is recognized by a sharp increase in the sand content. The second soil has Stage III morphology and is less developed than the underlying soil. The Bkq1b3 horizon (Fig. 5) is an incipient petrocalcic horizon that has about 6% carbonate (0.08 g/cm^3) and vertical seams of carbonate (2-3 mm thick) that form large polygons similar to those in the underlying petrocalcic horizon. Cemented cylindrical nodules that have a nearly continuous coating of carbonate form 80 to 90% of the horizon volume. Although much of the horizon consists of cemented nodules, the nodules have not been continuously cemented together to form a petrocalcic horizon. The overlying horizon (Bwkb3, Fig. 5) has weak blocky structure and scattered cylindrical nodules and is considered to have been the original A and cambic horizons of this soil.

The uppermost soil of the sequence is a weakly developed soil that has formed in a third layer of sandy loess (—b2, Fig. 5, Table 1). This layer also is recognized by its much higher content of sand. This soil consists of two structureless cambic horizons that have a slightly higher chroma than horizons above or below, and scattered cylindrical nodules and filaments ofcarbonate. The lowest horizon is a C horizon that separates the upper soil (- b2) from the middle soil (—b3). The MSH set S tephra lies at the top of the Bwk1 b2 horizon.

The Washtucna Soil at the CLY-1 site is subdivided into at least two soil profiles (Figs. 3, 6). The lower of the two soils (—b4: Fig. 6, Table 1) contains a strongly cemented petrocalcic horizon that has weak Stage IV morphology (Bkqmb4). The petrocalcic horizon varies in thickness from 70 to 110 cm and has 11% carbonate (0.15 g/cm^3). Cemented cylindrical nodules that have a continuous coating of carbonate make up about 90% of the horizon volume. Vertical seams of carbonate 2 to 5 mm thick define large 50 to 150 cm polygons. Horizontal seams of carbonate 1 to 2 mm thick form a weak laminar cap. The petrocalcic grades downward into a transitional horizon that has just a few percent nodules and filaments of carbonate (BCkb4, Fig. 6). The original A and cambic horizons of this soil have been overlapped by the upper soil profile of the subdivided Washtucna Soil (Bwkqmb3, Bwkqb3, Fig. 6).

The upper soil profile (—b3: Fig. 6, Table 1) that forms the subdivided Washtucna Soil at the CLY-2 site also has a petrocalcic horizon with weak Stage IV morphology (Bwkqmb3). The morphology of the upper petrocalcic is similar to that of the morphology of the lower one except the upper is thinner, ranging from 50 to 80 cm thick, and has only 6% carbonate (0.08 g/cm^3). The original A and cambic horizons for the soil are the Bwkb2, Bwkb3, and the Bwkqb3 horizons which appear to be cumulic (Fig. 6). The interval between the upper and lower petrocalcic horizons ranges from 40 to 150 cm across the CLY-I exposure (Fig. 3).

The thick zone of cambic horizons (Bwkb2, Bwkb3, Bwkqb3) above the upper petrocalcic horizon may also form part of a third subdivided profile, similar to the uppermost profile at the CLY-2 site (Fig. 5).

Geomorphic control on loess layer thickness

The bifurcation of the Washtucna Soil into two well-developed soils primarily reflects the impact of variable rates of loess deposition and, secondarily, geomorphic position. The interval of loess in which the Washtucna Soil formed, as defined by the stratigraphic position of the MSH set S and C tephras, is significantly thicker at the two Clyde sites than at the CON-1 and WA-5 sites. The greater thickness of the loess at the Clyde sites indicates that the rate of loess accumulation at those sites was much greater than the rate of accumulation at the CON-1 and WA-5 sites during the same interval of time. The presence of two or three buried soils in proximal sites resulted from a series of pulses of deposition during which the landscape surface moved up too rapidly for

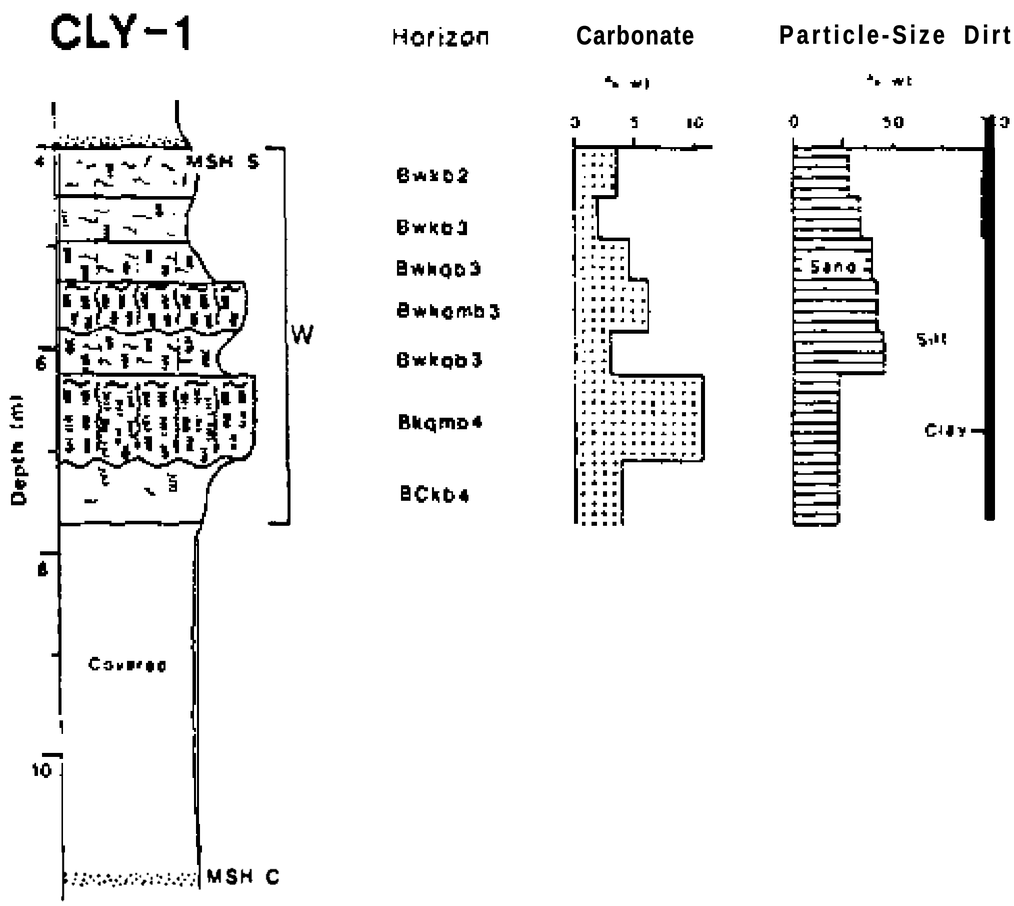


Fig. 6. Schematic stratigraphic column for the CLY-I site. Symbols used are defined in Fig. 2.

soils to form, separated by periods of lower rates of deposition and relative landscape stability during which the multiple Washtucna Soils formed. These discrete pulses of sedimentation apparently did not occur at distal sites.

Dispersal of eolian material by wind from sediment source areas produces regional patterns in the sedimentologic properties of loess deposits. Regional transects of loess in the central U.S. have shown that there is a general thinning of loess layers away from source areas due to a decrease in the concentration and size of windblown particles (Frazee et al., 1970; Kleiss, 1973; Ruhe, 1983; Fehrenbachet et al.. 1986). The thickest (and coarsest) loess in the central U.S. is found immediately downwind of major river valleys. Thicker loess layers at the Clyde site are due to the proximity of the sites to the principal source areas for the loess.

The CLY-I and CLY-2 sites are located immediately downwind of nearby areas of Scabland flood slackwater sediments. The flood sediments are thick sequences of mostly sand and silt that were deposited in the Walla Walla Valley, Pasco Basin, and adjoining low-lying valleys (Fig. 1) where cataclysmic flood waters pondcd before draining to the Pacific Ocean (Brett, 1969; Baker and Bunker, 1985). The Clyde sites are virtually surrounded by valleys that were backflooded during the largest events of scabland flooding; several tens of meters of slackwater sediments were deposited in these adjacent valleys. Regional stratigraphic correlations among exposures of Late Pleistocene loess indicate that loess layers associated with Late Quaternary episodes of flooding thin and fine with distance to the northeast of areas of slackwater sediments due to eolian redistribution by prevailing winds (McDonald, 1987;

Busacca. 1990). The distal positions of the CON-1 and WA-5 sites have thinner loess layers than those at the proximal sites because the distal sites are located many kilometers downwind from the major areas of slackwater deposits.

Hillslope position may also have had an impact on accumulation of thick loess layers. The two Clyde sites are excavated into hills that lie below the crest and on the north (lee) side of a major loessial ridge. **Loess**

Loess deposition and initial pedogenesis in proximal sites

The cycle of loess deposition in which the lower Washtucna Soil formed was triggered by an episode of glacial-outburst flooding that occurred during the early or middle Wisconsin (McDonald, 1987; McDonald and Busacca, 1990).

Rates of deposition generally exceeded minimum rates of soil formation during the time that the first 5 to 7 m of loess were deposited in proximal sites like CLY-1 and CLY-2. This is because most of this thickness is only very weakly altered, although at least one slightly reddened cambic soil named the Old Maid Coulee Soil (McDonald and Busacca, 1990) formed (Fig. 7a).

The first phase of soil development for the lower Washtucna Soil at proximal sites began when the influx rate of sediment slowed, which in turn caused a slower rise of the land surface and of the zone of active soil formation. During this period of relative landscape stability, soil-forming processes began to dominate over those of loess deposition. We conclude a slowing of loess deposition rates occurred because this would allow organisms such as cicadas to more thoroughly burrow a given volume of sediment. Buried soils in the loess that have petrocalcic horizons, such as the Washtucna Soil, commonly have fossil burrows in more than 90% of their volume, whereas unaltered loess (see, e.g., Fig. 7a) that we think must have been deposited relatively rapidly generally has less than 5% burrows. The soil that formed in the uppermost part of the loess during this first phase of Washtucna Soil formation consisted of burrowed A and cambic horizons and a weak calcic horizon (Fig. 1b).

We do not know why or when the slowing of loess deposition began that led to the onset of development of the Washtucna Soil. One possible explanation may be that the supply of eolian sediment from slackwater deposits decreased because of substantial depletion of the flood deposits by fluvial erosion and eolian redistribution.

Formation *of the* petrocalcic *horizon*

The formation of the petrocalcic horizon in the lower Washtucna Soil at proximal sites is a direct result of a renewed rapid rate of loess deposition that forced the land surface and the zone of accumulation of secondary carbonates to move upward into the position of the A and cambic horizons that had been heavily burrowed by cicadas (Fig. 7c). This added layer of loess at the CLY-2 site was coarser than the loess it covered having almost 15% more sand (Fig. 5); this added layer at the CLY-1 site is also coarser than the underlying loess with sand content doubling to almost 50%. Micromorphology of calcic and petrocalcic horizons (E. McDonald, unpubl. data) indicates that the interiors of individual cicada burrows were tint cemented with pedogenic carbonate to form the cemented cylindrical nodules. Cementation probably began when the burrows were initially engulfed by the rising zone of carbonate accumulation. As the accumulation of pedogenic carbonate continued, carbonate was then preferentially precipitated as nearly continuous coatings on the exterior surfaces of the cylindrical nodules. Vertical seams formed by accumulation of pedogenic carbonate along prismatic ped faces. The transfer of much of the carbonate downward along prismatic ped faces appears to have been instrumental in forming petrocalcic horizons because the degree of carbonate cementation decreases away from the vertical seams. The petrocalcic horizon was completed when the abundant cylindrical nodules became cemented together. A weak laminar cap of thin horizontal seams formed over the top of the now-impermeable horizon. During the formation of the petrocalcic horizon, new A and cambic horizons with prismatic and blocky soil structure and cicada burrows were forming in the overlying loess (Fig. 7c).

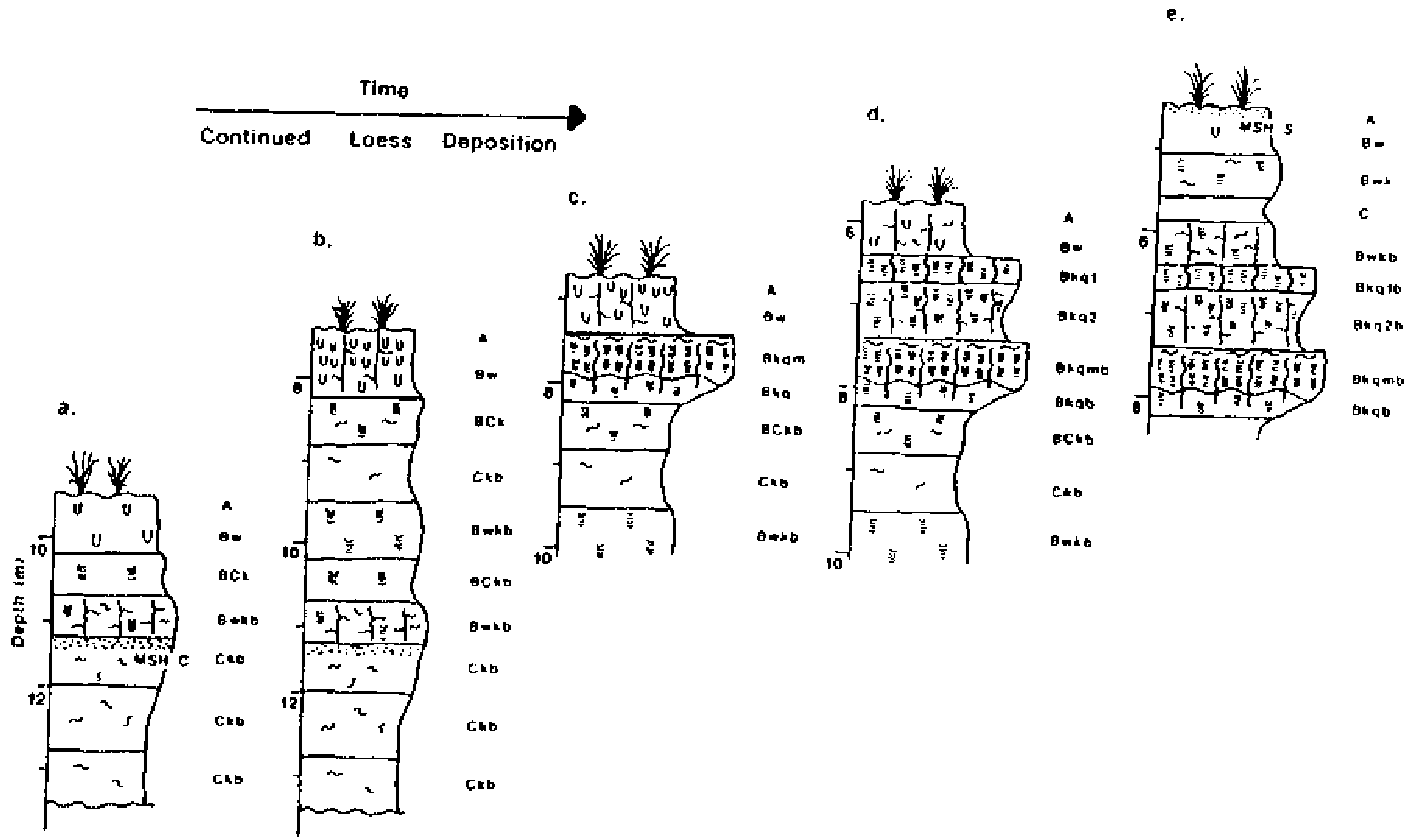


Fig. 7. Schematic diagram showing sequence of five phases of soil development and continued loess deposition that formed the soil stratigraphy at the CLY-2 site. Symbols used are defined in Fig. 2.

At distal sites such as WA-5 (Fig. 2) and indeed over the majority of the loess area that receives less than 400 mm of annual precipitation today (Fig. 1), only a single Washtucaa Soil is seen, and it has a morphology and carbonate content much like that of the lower Washtucna Soil in proximal sites.

Bifurcation of the Washtucna Soil

One or more additional cycles of loess deposition occurred during and after the formation of the lower Washtucaa Soil at the proximal sites but apparently did not occur at more distal sites such as WA-5. Renewed deposition of sand-rich loess buried the A and cambic horizons that formed with the petrocalcic horizoo of the lower Washtucaa Soil. As a result. this cicada burrowed zone of the A and cambic horizons was also engulfed by the zone of carbonates (Fig. 7d). Cicada burrows in the former A and cambic horizons of the lower soil first became cemented to form cylindrical nodules, then carbonate preferentially precip itated along the exteriors of the burrows. Development of seams of carbonate completed superimposition of the upper Washtucna Soil over the older A and cambic horizons of the lower Washtucna soil. A petrocalcic horizon formed as part of the upper Washtucaa Soil at the CLY-1 site, whereas at the CLY-2 site, the soil only has an incipient petrocalcic horizon. Exposures of the upper Washtucna Soil at other proximal sites indicate that the upper soil often contains a petrocaicic horizon.

Continued deposition of sand-rich loess caused the landscape to rise once again, resulting in the formation of a third, very weakly developed soil. At the CLY-2 site, the third soil formed within a meter of very sandy loess (> 65% sand, Fig. 5). The MSH set S tephra occurs in the loess that overlies this uppermost Washtucaa Soil (Fig. 7e), providing a minimum age estimate of 13,000 yr B.P. for the last phase of development of the Washtucna Soil.

Timing of soil formation

Determining the age of the Washtucaa Soil(s), and in turn, the rates of pedogenesis. is problematic because of a lack of numerical age control for the onset of soil formation and because regional stratigraphic relationships among exposures of Late Quaternary loess suggest different lengths of time for the formatioa of the Washtucna Soils.

Development of the Washtucaa Soils may have occurred during much of the time interval after the early or middle Wisconsin episode of flooding (75,000 to 40,000 yr B.P.) and before the end of the Late Wisconsin episode of flooding (17,000 to 13,000 yr B.P.). An iaitial period of relatively rapid loess deposition and formation of the weakly developed Old Maid Coulee Soil prevailed for perhaps 5000 to 10,000 years following the older episode of flooding. The remaining balance of time would provide as much as 57,000 or as little as 13.000) years for the periods of landscape stability that led to the development of the Washtucaa Soils, depending on whether the older episode of flooding occurred during the early or middle Wisconsin. If formation of the Washtucaa Soils was constrained to this period of relative landscape stability, it is unclear what caused additional cycles of loess deposition at the proximal sites.

An important question is what was the origin of the pulses of sandy loess at the Clyde sites that are associated with the dual Washtucaa soil in proximal locations. Development of the superimposed soil profiles resulted from major influxes of sand-rich loess sometime during Washtucna-Soil time to force the single soil of more distal sites to separate into two or more at proximal sites. The combination of an increase in the coarseness of the loess and the pulses of renewed deposition indicate that a significant change occurred regarding landscape stability and processes controlling loess deposition.

Different possible origins of these sediments

68.

in a few thousand years would provide one explanation for these observations.

An alternative hypothesis for the origin of the coarse loess layers is that they were triggered by changes in climate or vegetation that affected landscape stability and the supply of eolian sediment at the onset of Late Wisconsin glaciation in the Pacific Nonhwest. A pollen record from Carp Lake in south-central Washington suggests that the Columbia Plateau was colder and more arid between 2 1,000 and 8 500 yrs B.P. These changes at the start of late Wisconsin glaciation may have caused a decrease in the vegetative cover on loess deposits across the plateau, and in turn triggered the initial cycle of eolian deposition. Additional increments of sandy loess may have been added by eolian redistribution of late Wisconsin flood sediments beginning at about 17,000 to 16,000 yr B.P. This interpretation also requires rapid rates of soil formation, although it does allow more time for the formation of the Washtucna Soil at distal sites between the onset of degrading climate and the end of the late Wisconsin Scabland flooding. This interpretation also would provide for continued loess deposition for the bifurcation of the Washtucna Soils. Although it is plausible that cycles of deposition of sandy loess that are incorporated in the Washtucna Soils resulted from vegetative or climatic changes, this linkage remains to be documented in the Scabland loess deposits.

Other hypotheses may explain the origin of the pulses of sand-rich loess and provide different constraints on the timing on the development of the Washtucna Soil; however, the scenarios presented here best explain our current knowledge of linkages among flooding, loess deposition, and soil formation in the Channeled Scabland. We are testing the proposed time intervals for the formation of the Washtucna Soil by (1) applying a model that estimates the accumulation of pedogenic carbonate (Mayer et al., 1988), and (2) numerical dating by the thermoluminescence method of the loess in which the soils formed.

Implications and conclusions

Rates of soil development

The stratigraphic relationships of the Washtucna Soil among the sites discussed in this paper indicate that in areas of deep loess accumulation, two well-developed soil profiles were formed during the same time interval in which only a single soil profile was being formed throughout the rest of the Channeled Scabland. Evidence for this is the consistent stratigraphic position among the Washtucna Soil(s) and the two MSH tephras at all sites. This indicates that the base of the Washtucna Soil where it consists of two soil profiles is not time-transgressive to the degree that soil development began much earlier in areas of thick loess and continued for a period of time significantly longer than in areas where only one soil profile was formed. In addition. it seems unlikely that a longer period of landscape stability and soil development would occur in areas close to the loess source area where loess accumulation is very rapid and deeper than in areas of thin loess at greater distances.

The formation of two well-developed soils in proximal areas during the same time interval in which only one well-developed soil was formed in distal areas indicates that, at the least, rates of soil formation were much different between distal and proximal sites. The differences in the rates of soil development perhaps can best be explained through the concept of pedologic thresholds. The development of the Washtucna Soils represents the combined effects of extrinsic and intrinsic thresholds (Schumm, 1979). An extrinsic pedologic threshold was created when an external event caused pulses of eolian sedimentation that forced the landscape to rise, which led to the formation of overlapping soil profiles. An intrinsic threshold was crossed when the rising zone of carbonate accumulation engulfed former A and cambic horizons of the previous, now-buried soil that had been profusely burrowed by cicadas, leading to rapid formation of the petrocalcic horizon. The initial translocation of carbonate resulted in the cementation of the cicada burrows. Continued translocation of carbonate caused the carbonate to be preferentially precipitated on burrow exteriors: because of their great abundance, the burrows, in turn, quickly became cemented together, forming a petrocalcic horizon.

An imponant aspect of the development of the cemented cylindrical nodules is that they decreased the surface area-to-volume ratio in the horizon, therefore decreasing the quantity of pedogenic carbonate required to cement the horizon together. Evidence for this is the small amount of carbonate measured in the petrocalcic horizons (generally only 6 to 12%). Carbonate content for the Washtucna Soils is nearly two to six times lower than the carbonate content in soils described in the southwest U.S. that have Stage III or IV morphology (Machette, 1985). The small quantity of translocated carbonate in the petrocalcic horizons of the Washtucna Soils is consistent with our suggestion that they formed in a very short time.

The role of cylindrical nodules in the formation of soils in the loess is similar to that of gravel in coarse-textured soils, where the gravel decreases the amount of carbonate required to cement the interstitial matrix. Gile et al. (1966) have suggested that the pedogenic accumulation of carbonate proceeds at a faster rate in coarse-textured soils than it does in fine-textured soils.

It has been disturbing to us that the single Washtucna Soil at distal sites is only about as strongly developed as one of the two Washtucna Soils at proximal sites, sometimes even less so (compare Figs. 2, 5, 6), even though the single soil would have been forming on the land surface for about the same period of time as the dual soil. We think that the threshold concept applies to explain this as well. At the distal sites, only one burrowed zone was engulfed to trigger the formation of the single petrocalcic horizon. At the proximal sites during this same time interval. deposition of additional loess caused a second zone of cicada burrows to be engulfed. The translocation of carbonate from this new sediment allowed the second Washtucna Soil to quickly form at proximal sites; conversely, the absence or additions of only small amounts of sediment at distal sites added little more carbonate to the Washtucna Soil in those areas away from the sediment source.

Impact on soil stratigraphy

The different and perhaps rapid rates of pedogenesis exhibited by the bifurcated Washtucna Soil has important implications for the Paiouse loess as well as for soil-stratigraphic studies in general.

Soil formation during periods of glacial climate is important to soil-stratigraphic studies because of the widespread belief that conditions favorable for rapid soil development occur only during ioterglaciations (cf. Birkeland and Shroba, 1974; Morrison, 1978). An interesting hypothesis first proposed by Foley (1982) was that at least some of the buried soils in the Palouse loess may have been formed during glacial stages. Stratigraphic relationships suggest that the Washtucna Soil may have developed during the late Wisconsin, or a time of glacial climate. Recognition of other soils that may have formed during glacial periods would provide a powerful tool for linking the Palouse stratigraphy to the deep-sea oxygen isotope curve. That the Washtucna Soil and others in the loess may have formed during times of glacial climate is in opposition to the concept of soil-forming intervals (Morrison, 1967), which holds that soil-forming processes are relatively inactive during times of glaciation and that unique and optimal climate conditions during the brief times of interglaciations are responsible for the bulk of soil formation.

Soils that can form very rapidly if a pedologic threshold is exceeded could lead to very incorrect estimates of the age of that soil and of its geomorphic surface, or in incorrect soil-stratigraphic correlations. For example, calcic soils in the southwestern U.S. that have Stage III to Stage IV morphology are generally found on surfaces thought to be Middle to Late Pleistocene or older than 100,000 yr B.P. (Gile et al.. 1966; Machette, 1985). The ages of these soils. however, are poorly constrained. The weak Stage IV morphology of the Washtucna Soil has formed in a considerably shorter time. We are not suggesting that all calcic soils formed this fast; however, there is still a great deal we do not know about rates of accumulation of pedogenic carbonate and of soil formation. especially once threshold conditions are established. The results reported here do suggest. however, that extreme caution is required when estimating ages of geomorphic surfaces based on the stage of carbonate morphology because of the possibility that rates of soil formation can be very different under different circumstances. The concept of pedologic thresholds is not new (Birkeland, 1984: Busacca, 1987), but little is known about what types of geologic and pedologic environments can be conductive to promoting rapid soil formation.

Many soils form in dynamic environments where, as a result of episodic sedimentation, the morphologic propenies of a pre-existing soil may have an important impact on a subsequent period of soil development. The development of a zone of cicada burrows in one phase of soil development that was subsequently engulfed by pedogenic carbonate under a rising landsurface, along with the rapid development of gravel-like cemented cicada burrows. seems to have greatly accelerated the development of petrocalcic horizons. Recognition of the effects of overlapping periods of soil development is always a concern in stratigraphic investigations of buried soils: however, continued eolian additions to surface soils are more difficult to detect and evaluate.

Acknowledgements

We acknowledge the grant support of the National Science Foundation (EAR 8318909 and EAR 8707527).

nary Non-Glacial Geology of the Conterminous United States. Geology of Nonh Amenca. K-2. Geol. Soc. Am.. I" press.

Busacca. A.J.. McCool. D.K.. Papendick. R.I. and Young. D.L.. 1985. Dynamic impacts of erosion processes on productivity of soils in the Palouse. In: Erosion and Soil Productivity. Proc. Natl. Symp. on Erosion and Soil

Geoderma, 45 (1989) 105–122
Elsevier Science Publishers B.V., Amsterdam – Printed in The Netherlands

Long Quaternary Record in Eastern Washington, U.S.A., Interpreted from Multiple Buried Paleosols in Loess

ALAN J. BUSACCA

Department of Agronomy and Soils, and Department of Geology, Washington State University, Pullman, WA 99164-6420 (U.S.A.)

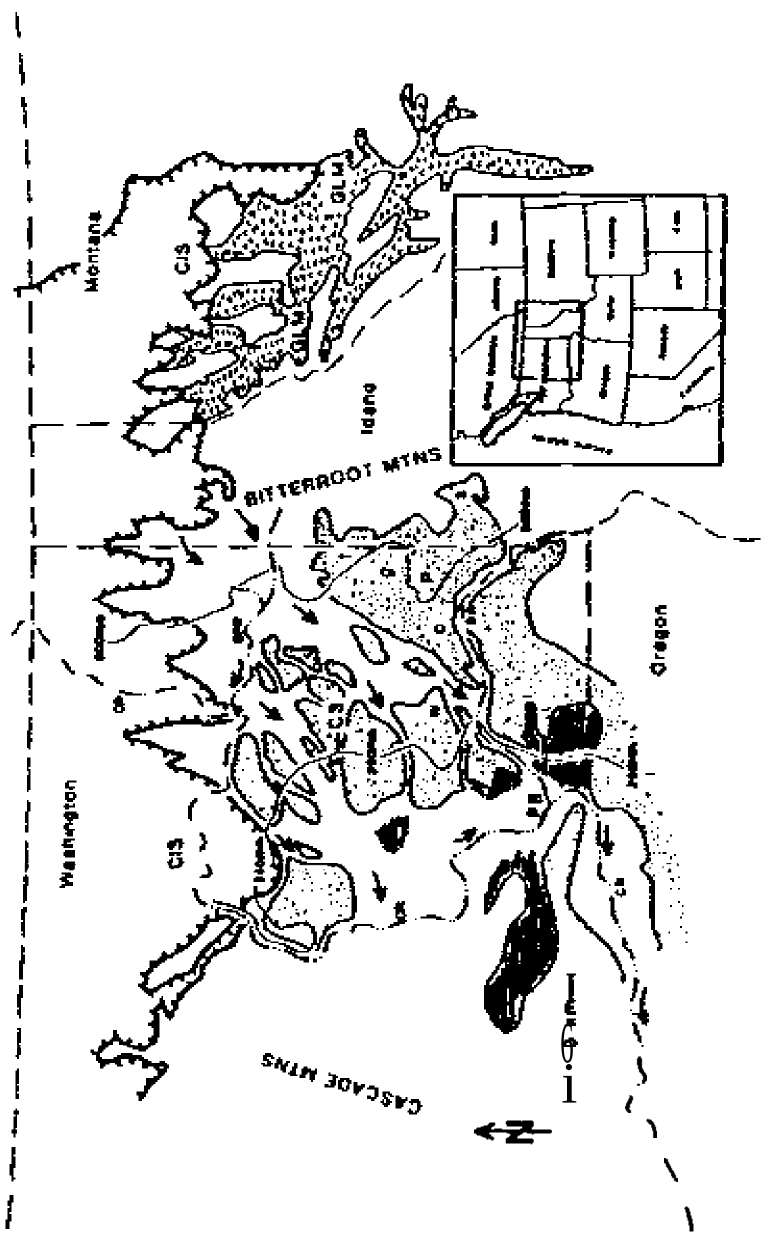
(Accepted for publication July 10, 1989)

ABSTRACT

Busacca, A.J., 1989. Long Quaternary record in eastern Washington, U.S.A., interpreted from multiple buried paleosols in loess. Geoderma, 45: 105–122.

Loess that is from a few meters to 75 m thick covers an area of more than 20,000 km² on the Columbia Plateau in Washington, Idaho and Oregon. The region of deepest loess is in eastern Washington and is called "The Palouse". The Palouse is downwind of the Channeled Scabland, through which massive outburst floods from Glacial Lake Missoula flowed repeatedly during glacial stages of the Pleistocene. The deepest stratigraphic section yet studied is in a remnant of the once continuous loess cover that is surrounded by Scabland channels. A normal-over-reverse magnetic polarity zonation in this section supports an age of more than 790,000 yr, but 15–35 m of loess may be present beneath this section, so a total of 1.5–2 million yr is possible. Upward fining of texture in some layers in the loess at this site and stratigraphic evidence at nearby sites suggest that at least some pulses of loess deposition were triggered by episodes of cataclysmic floods. Nineteen or more individual paleosols can be recognized in 26 m of section based on field morphology, physical and chemical properties, and micromorphology. The paleosols consist of calcic, petrocalcic and duripan horizons, many of which are associated with cambic horizons. Less strongly developed soils in this and other sections have been obscured by partial overlap of soil development in an episodically rising loess landscape. Paleosols in the loess at other sites reflect a dry-to-moist climatic gradient from west to east across the region during the Pleistocene that was grossly similar to today's. Accumulation of pedogenic carbonates and silica dominates in a western zone where the present-day mean annual precipitation is less than about 450 mm. Translocation of silicate clays and leaching of carbonates dominate in a central steppe zone where precipitation is between 450 and about 700 mm. Fragipans are common in an eastern zone along the steppe–forest transition at present-day precipitation of over 700 mm. Reconnaissance study suggests that these climatic–pedogenic zones have been somewhat stable during many of the episodes of soil development preserved in the loess, although some paleosols have different features from the majority of the paleosols in that zone, e.g., paleosols with fragipans in a sequence of paleosols with argillic horizons, which suggests that some episodes of soil development took place under different climatic conditions.

0016-7061/89/$03.50



INTRODUCTION

The deepest and most continuous **loess** deposits in **the northwestern** U.S.A. **are** centered on eastern Washington **state** in **a** region **called** "The **Palouse**". The **Palouse loess** may help us lo belter understand **the Quaternary** history **of** North America **because**

Fig. 1. Location map of the Palouse (*P*) and Channeled Scabland area (*CS*) with a schematic representation of Quaternary features discussed in text. Maximum extent of the Cordilleran Ice Sheet (*CIS*) during the late Wisconsin is shown by the heavy hatchured line; maximally developed Glacial Lake Missoula (*GLM*) during the late Wisconsin shown by patterned area in western Montana. Areas of thick loess are shown by the stipple pattern; the Palouse is the roughly triangular area on the Idaho–Washington border. Major pathways of glacial outburst floods illustrated by arrows, significant deposits of quiet-water silt and sand from floods are shown by pattern of closely spaced horizontal lines. Pasco Basin (*PB*), Columbia River (*CR*), Snake River (*SR*), and Spokane River (*SPR*) also shown. *W* denotes the location of the Washtucna site, *O* the Oliphant site, *T* the Thatuna site; *S* the Santa site, *G* the town of Garfield. The Washtucna stratigraphic exposure is 46°46'00"N 118°20'50"W, elevation 500 m, the Oliphant pedon is 46°42'32"N 117°46'45"W, elevation 550 m; the Thatuna pedon is 47°13'31"N 117°6'37"W, elevation 880 m, and the Santa pedon is 46°50'N 116°36'45"W, elevation 915 m. Isohyets of 250 mm and 500 mm of present-day mean annual precipitation plotted for the Palouse and Scabland areas only.

excellent indicators of pad climates (see. for example. Liu. 1985), can he wed as stratigraphic markers for regional correlations (e.g. Ruhe, 1976), and, in a few cases, paleosol-and-loess sequences have been used to reconstruct glacial-interglacial cyclical patterns (e.g. Kukla. 1975. 1977; Kukla et al.. 1988), so further work on the loess of the Palouse is clearly warranted.

A new phase of march on the history and origins of loess and paleosols in the Palouse region has been underway for several years, and a picture is beginning to take shape of the nature of the paleosols in the loess and theirclimatic and stratigraphic significance. The purpose of this paper is to show some of the results of this recent work and to discuss new ideas and hypotheses.

METHODS

Stratigraphic and soil descriptions

One deep stratigraphic exposure in the drier part of the region and thm surface pedons from progressively wetter zones were studied and are discussed below. The large section was selected because it is one of the deepest excavations in the loess. The description was made from a hand-dug. stepped trench in a roadcut 3.3 km northwest of the town of Washtucna, Washington (W in Fig. I). The site is at the crest of a north-south trending hill at an elevation of 490 m. The roadcut exposes the upper 26 m of section. The hill is part of a "loess island", a remnant of the deep loess cover that is surrounded by channels of the Scabland system. The trenching extended 0.5-1.5 m back from the face of the roadcut to expose fresh material. Individual loess strata and paleosol horizons were described using standard methods for soils (Soil Survey Staff, 1981) that were supplemented with additional terms to describe sedimentological features, tephra layers and unusual morphologic features that resulted from bioturbation.

Pedons of the surface soils discussed below were selected to illustrate the great changes in pedogenic character across the Palouse region. They were described from freshly ● xcwMed backhoe pits. The soils were described using standard methods for soils (Soil Survey Staff, 1981). The Oliphant, Thatuna and Santa sites are 45 km east, 113 km east-northeast, and 137 km east of the Washtucna site, respectively (Fii. I). Each of the three sites was on the convex upper part of a loess hill with southwesterly (Oliphant series), northeasterly (Thatuna) and westerly (Santa) aspects and slops of less than seven degrees The three sites are all within the main body of the Palouse loess geographically and are therefore not near any Scabland channels.

Sampling and analysis

Bulk samples of each soil and paleosol horizon and loess layer were collected for analysis. Sampling intervals at the Washtucna and other sites ranged from

10 to 100 cm. Oriented undisturbed blocks of paleosols and loess layers were collected from the Washtucna site. These were impregnated with resin and thin sections were made and then examined with a petrographic microscope. Pedogenic calcium and magnesium carbonates were analyzed by treating samples for 30 min with a sodium acetate buffer solution (0.5 *M* NaOAc in 13% HOAc) heated lo 90°C; the calcium and magnesium were analyzed by atomic absorption spectroscopy. Samples for the determination of particle-size distribution were pretreated twice using the same procedure as above to remove carbonate

RESULTS AND DISCUSSION

Washtucna deep stratigraphic exposure

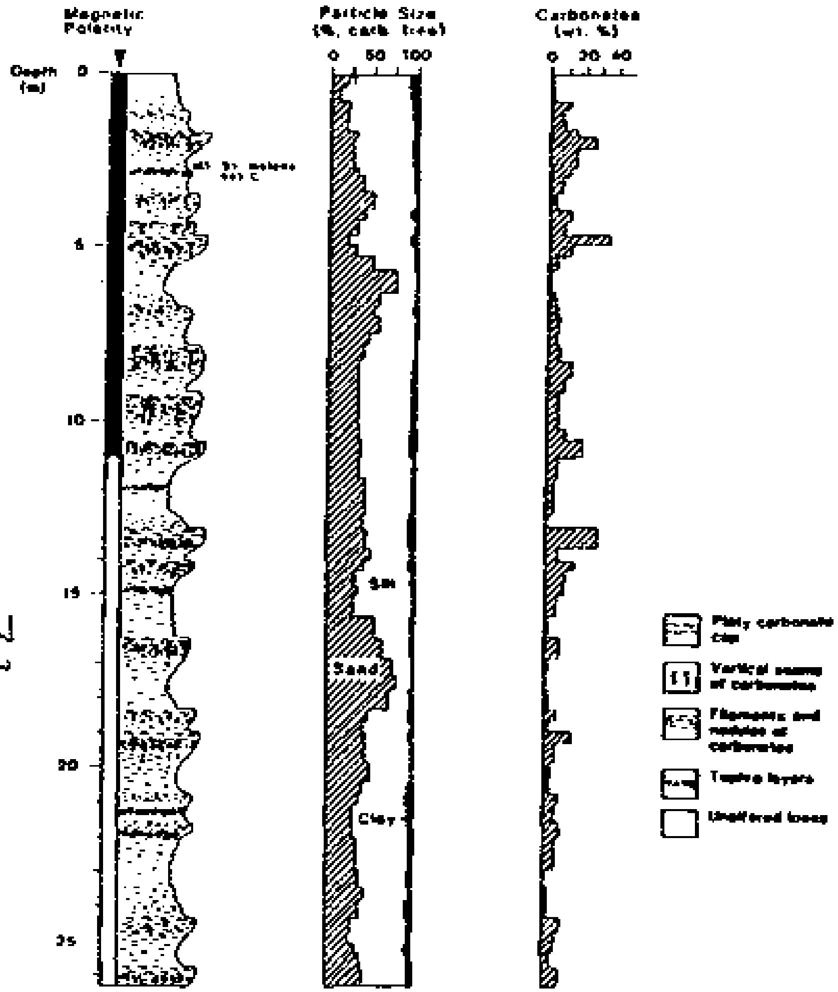


Fig. 2. Stratigraphic-pedologic reconstruction of the deep exposure at Washtucna, Washington. Magnetostratigraphy of the section is shown at left; black is normal magnetic polarity and white is reversed magnetic polarity. Paleosols are shown in schematic form in which closer spacing of symbols and greater distance out from the origin represent greater degree of soil development. Symbols show morphologic features resulting from accumulation of carbonates and silica

cicada), horizontal laminar caps and vertical seams. Several forms can occur together in individual paleosols.

Secondary silica contributes significantly to the cementation of some of the

paleosols at Washtucna and other sites in the semiarid part of the Palouse even though amounts rarely exceed 1.5% on a carbonate-free basis (S.A. Feldman and A.J. Busacca, unpublished data). Strongly developed paleosols can have dominantly carbonate cements, both carbonates and silica. or in a few cases. dominantly silica. The paleosol at 24 m. for example (Fig. 2), has low carbonale content yet apparently because of silica cementation is one of the most strongly cemented paleosols in the exposure.

Camhic horizons are present above about one-half of the calcic and petrocalcic horizons and duripans. Cambic horizons have higher color chromas than do horizons above and below them; in thin section, they exhibit greater weathering of primary minerals and more secondary imn oxide coatings. Cambic horizons also have slightly higher amounts of dithionite-extractable iron than do non-cambic horizons (about 0.6% versus about 0.3%. on a carbonate-free basis). Even though the amounts are small. the relationship between Fe., and csmbii horizons is consistent enough that it is probably the result of pedogenesis in most cases. Although there are variations in clay content with depth (Fig. 2), field morphology and study of thin sections suggest argillic horizons in this stratigraphic section only for the paleosols at 13 and 24 m. The variations in clay content. therefore, are due principally to depositional processes, perhaps with some contribution by in-place weathering in some horizons.

Zones darkened by humified organic matter or other buried plant remains are not found at this site. and in fact are extremely rare even in the areas of higher precipitation to the east. There is evidence al some sites that A and cnmbic horizons

(Morrison, 1978) and superimposed soil (Busacca et al., 1965) have been proposed for various forms that overlap can take in specific geologic and pedogenic settings.

Soil structure formed hy burrowing organisms such as earthworms and cicadas is very common in paleosols throughout the semiarid and arid climatic zones of the Palouse and Scabland. The most heavily burrowed horizons, which I describe as having a "cylindrical" soil structure, would seem to delineate the positions of former A and cambic horizons because of the known life habits of these organisms (Hugie and Passey, 1963), but they are almost invariably also part of the moat strongly cemented horizons in the paleosols. Root casts of grasses and shrubs that are now strongly cemented by carbonates are also common. These observations are consistent with a complex genesis of the soils in which the A and cambic horizons of a soil are eventually engulfed by carbonate and silica cements as the zone of precipitation of carbonates and silica rises in an episodically accreting loess landscape. As individual loess beds thin to the north and east of source areas in the Pasco Basin and environs (McDonald. 1987; Busacca, 1969). the overlap becomes more severe and the problem of distinguishing individual paleosols becomes more severe. Much remains unknown about the

Paleoclimatic significance of the Palouse loess

nelopmcnlns

adequate numbers of exposures at present to take full advantage of the possi-

part of the bunchgrass zone, and the high-precipitation forest zone, respectively.
soil has a mollic epipedon

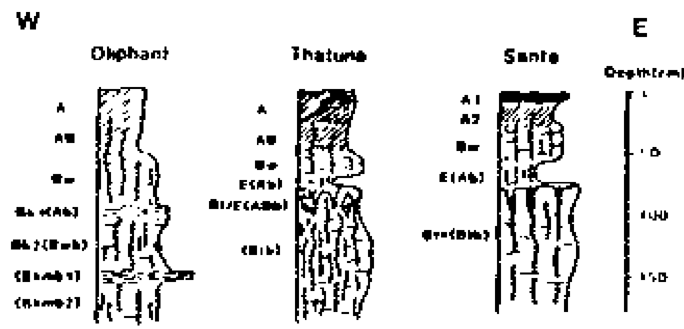


Fig. 3. Schematic diagrams of the Oliphant, Thatuna, and Santa pedons. Horizon nomenclature is from Soil Survey Staff, 1981.

TABLE I

Environmental, physical, and chemical data for the Oliphant, Thatuna and Santa series soils

Soil series, great group	Horizon	Basal depth (cm)	MAP*1 (mm)	MAT*1 (°C)	Native vegetation*2	Particle size*3 (%) sand	silt	clay	Fe$_d$*4 (%)	Carbonate content (%)	Organic carbon (%)
Oliphant, Haploxeroll	A	33	360	10.0	B	18	71	13	1.0	0	1.1
	AB	51				16	71	13	1.0	0	0.8
	Bw	94				15	78	9	0.9	0	0.5
	Bk1(Ab)*5	112				21	70	9	0.5	23	0.5
	Bk2(Bwb)	147				18	76	6	0.7	5	0.5
	(Bkmb1)	152				27	68	5	0.3	30	0.3
	(Bkmb2)	162				19	78	3	0.3	21	0.2
Thatuna, Argixeroll	A	38	560	8.9	B,S	6	71	23	1.0	0	2.0
	AB	54				6	70	24	1.0	0	1.0
	Bw	72				7	71	22	1.0	0	0.7
	E(Ab)	83				8	79	13	0.8	0	0.4
	Bt/E(ABb)	117				6	66	28	1.2	0	0.3
	(BtB)	178				3	66	31	1.0	0	0.2
Santa, Fragixeralf	A1	13	720	6.5	C	10	73	17	nd.*6	0	4.0
	A2	23				6	74	18	nd.	0	0.8
	Bw	53				8	74	18	nd.	0	0.5
	E(Ab)	74				8	79	13	nd.	0	0.3
	Btx(Btb)	168				7	65	28	nd.	0	0.2

*1MAP = mean annual precipitation; MAT = mean annual air temperature; climate estimates from Donaldson (1980) and Barker (1981); all sites have xeric moisture regimes.
*2B, perennial bunchgrass; B,S bunchgrass and mesophytic shrubs; C, conifer forest.
*3Calculated on a carbonate-free basis.
*4Fe$_d$ = dithionite extractable iron.
*5Horizon designations in parentheses are interpretations of paleosol horizon types before Holocene episode of loess deposition and soil development (see text).
*6nd. = not determined.

15,000 yr apparently is insufficient lime to form a" argillic horizon in the Holocene loess under a xeric climate. although the cambic horizon shows macro- and micromorphologic evidence in the form of weak argillans and interstitial pore fillings that clay transformation and translocation are taking place in the material.

A strong albic and argillic horizon sequence underlies the young loess in the Thatuna soil. The albic horizon has been formed by lateral water flow over the upper surface of the less permeable argillic horizon (Rieger and Smith. 1955). The argillic horizon has thick or prominent argillans on ped faces and lining tubular pores. Imn-manganese concretions up to several millimeters in diameter are common in the albic and argillic horizons. Translocation of extractable iron as well as clay is evident from a comparison of the albic and paleosol argillic horizons (Table I). The albic and argillic horizons are good examples of the welding process (Ruhe and Olson, 1980) because contemporary processes associated with the modern land surface have extended into what probably was the former A horizon of the paleosol to form the albic (Fig. 3). Degradation of the upper part of the argillic horizon (Fig. 3) and possibly clay translocation appear also to be contemporary processes.

The Santa series soil has an ochric epipedon because it has been formed under a mixed conifer canopy instead of under perennial grasses. It is an Alfisol (Fragixeralf) that is part of a belt of Alfisols and Inceptisols that formed in forest near the forest-steppe boundary in the distal part of the loess field. The ochric epipedon and cambic horizon have been formed in young loess. They overlie a strong albic horizon and an argillic horizon of a paleosol. The albic nnd fragipan horizons apparently formed during the Holocene as a" overprint on the A and argillic horizons, respectively, of the paleosol. The albic and fragipan horizons serve lo "weld" the paleosol to the surface soil. They have im" mottles and manganese concretions, indicating alternating conditions of oxidation and reduction in these horizons.

Fragipans are dense. brittle. reversibly cemented subsoil horizons (Grossman and Carlisle, 1969; Soil Survey Staff, 1975). In northern Idaho, as elsewhere, fragipans have a distinct morphology but a poorly understood genesis. Here they occur in a zone only about 20 km wide (Barker, 1981) that is approximately parallel to precipitation isohyets, temperature isotherms, and astride a particular forest habitat type. The steppe-forest transition zone may have been coincident with the zone of fragipans during the driest phases of the Holocene ?!:W:

of the paleosol units? That is, for example, have all of the soils in the stratigraphic sequence of the Palouse loess formed under similar climates during interglacial stages or might some of the soils have formed under very different climates during glacial stages? One way to address questions such as these would be to determine whether the geographic position of the key pedogenic transition zones stayed the same or changed between episodes of soil development, as recorded in the properties of paleosols in the stratigraphic sequence of the loess. Two examples fmm the Palouse will serve lo illustrate this point.

A reconnaissance of roadcuts across the zone of fragipans showed as many as seven buried paleosol fragipans in vertical sequence, with more of them likely to be preserved beneath the deepest level of the roadcuts. This observalion points lo a recurrence across a narrow geographic zone, through al least a part of the Pleistocene, of a rather specific though unknown set of pedogenic or environmental conditions during episodes of soil development. A backhoe trench near the town of Garfield, Washington exposed a paleosol fragipan nearly 20 km west of the zone of fragipans delineated during soil survey (Barker, 1981), which would be the fragipans developed during the Holocene. Given the large gradients of moisture, temperature, and elevation on the eastern edge of the Palouse, this would represent a large shift in the location of the steppe-forest boundary during al least one episode of soil

CONCLUSIONS AND IMPLICATIONS

tion is reversely magnetized below 12 m (Fig. 2). I tentatively interpret this entire normally magnetized section as having been deposited during the Brunhes Normal Polarity Chron. At best, the section in only partially correlative with that at Washtucna. Because of the great thickness of normally magnetized loess at this second section compared to that at Washtucna, a further implication is that the normally magnetized part of the Washtucna section may have subtle disconformities and that an unknown portion of the geologic

ACKNOWLEDGEMENTS

REFERENCES

Atwater, B.F., 1986. Pleistocene glacial lake deposits of the Sanpoil River Valley, northeastern Washington. U.S. Geol. Survey Bull., 1661, 39 pp.

Baker, V.R. and Bunker, R.C., 1985. Cataclysmic Late Pleistocene flooding from Glacial Lake Missoula: a review. Quat. Sci. Rev., 5: 1-41.
Barker, R.J., 1981. Soil Survey of Latah County Area, Idaho. U.S. Dept. Agric., Soil Conservation Service, U.S. Govt. Print. Off., Washington, D.C., 166 pp.
Busacca, A.J., 1989. Loess deposits and soils of the Palouse and vicinity. In: V.R. Baker et al., Ch. 3, the Columbia Plateau. In: R.B. Morrison (Editor), Quaternary Non-glacial Geology of the Conterminous United States. Geol. Soc. Am., Geology of North America, v. K-2. In press.
Busacca, A.J. and Feldman, S.A., 1985. Genesis and significance of Quaternary buried paleosols in loess in eastern Washington. (Abstr.). Agron. Abstr., 1985 Annu. Mtg., Am. Soc. Agron., p. 189.
Busacca, A.J., Aniku, J.R. and Singer, M.J., 1984. Dispersion of soils by an ultrasonic method that eliminates probe contact. Soil Sci. Soc. Am. J., 48: 1125-1129.
Busacca, A.J., McCool, D.K., Papendick, R.I. and Young, D.L., 1985. Dynamic impacts of erosion processes on productivity of soils in the Palouse. In: Erosion and Soil Productivity. Proc. Natl. Symp. Erosion and Soil Productivity, New Orleans, Louisiana, 10-11 December, 1984. Amer. Soc. Agric. Eng., St. Joseph, Mich., pp. 152-169.
Daubenmire, R., 1970. Steppe vegetation of Washington. Tech. Bull. 62, Wash. State Agric. Exp. Sta., Wash. State Univ., Pullman, 131 pp.
Dodonov, A.E., 1979. Stratigraphy of the upper Pliocene-Quaternary deposits of Tajikistan (Soviet central Asia). Acta Geol. Acad. Sci. Hung., 22(1-4): 63-73.
Dodonov, A.E., 1986. Stratigraphy and paleogeography of loess in middle Asia. Ann. Univ. Mariae Curie Sklodowska Lublin-Polonia (Geol. Inst. USSR Acad. Sci.), 41(1): 1-14.
Donaldson, N.C., 1980. Soil Survey of Whitman County, Washington. U.S. Dept. Agric. Soil Conservation Service, U.S. Govt. Print. Off., Washington, D.C., 185 pp.
Foley, L.L., 1982. Quaternary Chronology of the Palouse Loess near Washtucna, Eastern Washington. M.S. Thesis, Western Wash. Univ., Bellingham, 137 pp.
Frazee, C.J., Fehrenbacher, J.B. and Krumbein, W.C., 1970. Loess distribution from a source. Soil Sci. Soc. Am. Proc., 34: 296-301.
Fryxell, R., Neff, G.E. and Trimble, D.E., 1965. Scabland tracts, loess, soils, and human prehistory. In: D.B. Schultz and H.T.U. Smith (Editors), Guidebook for INQUA Field Conference E. Nebraska Academy of Sciences, Lincoln, Nebr., pp. 79-89.
Grossman, R.B. and Carlisle, F.J., 1969. Fragipans in soils of the eastern United States. Adv. Agron., 21: 237-279.
Hugie, V.K. and Passey, H.B., 1963. Cicadas and their effect upon soil genesis in certain soils in southern Idaho, northern Utah, and northern Nevada. Soil Sci. Soc. Am. Proc., 27: 78-82.
Jackson, M.L., 1975. Soil Chemical Analysis-Advanced Course. Published by the author, Madison, Wisc., 2nd ed., 895 pp.
Johnson, R.G., 1982. Brunhes-Matuyama magnetic reversal dated at 790,000 yr B.P. by marine-astronomical correlations. Quat. Res., 17: 135-147.
Kocurek, G. and Nielson, J., 1986. Conditions favourable for the formation of warm-climate aeolian sand sheets. Sedimentology, 33: 795-816.
Kukla, G.J., 1975. Loess stratigraphy of central Europe. In: K.W. Butzer and G.L. Isaac (Editors), After the Australopithecines. Mouton, The Hague, pp. 99-188.
Kukla, G.J., 1977. Pleistocene land-sea correlations, I. Europe. Earth Sci. Rev., 13: 307-374.
Kukla, G.J. and Opdyke, N.D., 1980. Matuyama loess at Columbia Plateau, Washington (Abstr.). Am. Quat. Assoc., Abstr. Progr., p. 122.
Kukla, G., Heller, F., Liu, X.M., Xu, T.C., Liu, T.S. and An, Z.S., 1988. Pleistocene climates in China dated by magnetic susceptibility. Geology, 16: 811-814.
Liu, T.S., Editor, 1985. Loess and the Environment. China Ocean Press, Beijing, 251 pp.
McDonald, E.V., 1987. Correlation and Interpretation of the Stratigraphy of the Palouse Loess of Eastern Washington. M.S. Thesis, Wash. State Univ., Pullman, 218 pp.

onald, E.V. and Busacca, A.J., 1987. Use of paleosols for correlation and interpretation of aternary geologic events in the Palouse region of eastern Washington (Abstr.). INQUA XII ngr., 31 July 9 August, 1987, Ottawa, p. 223.

onald, E.V. and Busacca, A.J., 1988. Record of pre late Wisconsin floods in the Channeled bland interpreted from loess deposits. Geology, 16: 728-731.

onald, E.V. and Busacca, A.J., 1989. Stratigraphy of late Quaternary loess in the Channeled bland of Washington State. Quat. Res. In press.

son, R.H., 1978. Quaternary soil stratigraphy — concepts, methods, and problems. In: W.C. haney (Editor), Quaternary Soils. Geo Abstracts, Norwich, pp. 77-108.

eaux, D.R., 1991. Summary of pre 1980 tephra fall deposits erupted from Mount St. Helens, shington State, U.S.A. Bull. Volcanol., 48: 17-26.

ad, K.T., 1988. Correlation of Tephra Layers in the Palouse Loess. M.S. Thesis, Wash. State iv., Pullman, 80 pp.

, D.R., 1979. Paleomagnetism and age dating of the Ringold Formation and loess deposits he State of Washington. Ore. Geol., 41: 119-132.

, P.C. and Baker, V.R., 1978. New evidence for pre Wisconsin flooding in the Channeled bland of eastern Washington. Geology, 6: 567-571.

ond, G.M., Fryxell, R., Neff, C.E. and Weis, P.L., 1965. The Cordilleran Ice Sheet of the thern Rocky Mountains and related Quaternary history of the Columbia Plateau. In: H.E. ight, Jr. and D.G. Frey (Editors), The Quaternary of the United States. Princeton Univer Press, Princeton, N.J., pp. 231-242.

S. and Smith, H.W., 1955. Soils of the Palouse Loess. II. Development of the A2 horizon Sci., 79: 301-319.

G.H.J., 1983. Periglacial eolian evenly laminated sandy deposits in the Late Pleistocene of Europe, a facies unrecorded in modern sedimentological handbooks. In: M.E. Brookfield T.S. Ahlbrandt (Editors), Eolian Sediments and Processes. Developments in Sedimen gy, 38. Elsevier, Amsterdam, pp. 455-482.

R.V., 1976. Stratigraphy of mid-Continent loess, U.S.A. In: W.C. Mahaney (Editor), Qua ary Stratigraphy of North America. Dowden, Hutchinson, and Ross, Stroudsberg, Penn 197-211.

R.V. and Olson, C.G., 1980. Soil welding. Soil Sci., 130: 132-139.

n, J., 1988. The structure and genesis of early Weichselian to early Holocene sand sheets in tern Europe. Sediment. Geol., 55: 197-232.

rvey Staff, 1975. Soil Taxonomy: A Basic System of Soil Classification for Making and rpreting Soil Surveys. U.S. Dept. Agric. Handb. No. 436, 754 pp.

rvey Staff, 1981. Soil Survey Manual (draft). U.S. Dept. Agric., Soil Conservation Service.

rvey Staff, 1984. Procedures for Collecting Soil Samples and Methods of Analysis for Soil ey. U.S. Dept. Agric., Soil Conservation Service, Soil Survey Investigations Report 1, 68

R.B., 1985. Case for periodic, colossal jökulhlaups from Pleistocene glacial Lake Missoula Soc. Am. Bull., 96: 1271-1286.

P. A. McDaniel, Soil Science Division, University of Idaho, Moscow, Idaho 83844-2339

K. E. Houston, U.S. Forest Service, Cody, Wyoming 82414-2140

M. A. Fosberg, Soil Science Division, University of Idaho, Moscow, Idaho 83844-2339

and

A. L. Falen, Soil Science Division, University of Idaho, Moscow, Idaho 83844-2339

Soil-Plant Community Relationships in the Selkirk Mountains of Northern Idaho

Abstract

Soils and the native plant communities they support often exhibit a strong mutual dependence within geographically similar areas. In mid- to high-elevation forests of northern Idaho, volcanic ash is an important soil parent material and has had a major impact on soil properties and the distribution of vegetation. As a result, there are several well-expressed soil-plant community type associations within this region. This study compares the properties and classification of soils and plant communities along a south-facing elevational gradient in the Selkirk Mountains of northern Idaho. Cold, moist soils of the higher elevations, corresponding to the *Abies lasiocarpa* (subalpine fir) series, are strongly influenced by volcanic ash. These soils have undergone intense podzolization and are classified as Spodosols. The intermediate moisture and temperature conditions associated with the middle elevations support plant communities of the *Tsuga heterophylla* (western hemlock) series. Associated soils exhibit progressively less influence of volcanic ash with decreasing elevation. Accordingly, soils of the upper end of the western hemlock zone are classified as Andisols and those of the lower end are classified as intergrades to the Andisols. At relatively low elevations, the warmest and driest soils of the climatic gradient support communities of the *Pseudotsuga menziesii* (Douglas-fir) series. These soils contain little or no volcanic ash and are classified as non andic Inceptisols and Entisols. Results from this study indicate that increased sensitivity of Soil Taxonomy to ash-influenced soils helps distinguish several of the important soil-vegetation interactions that have been operative in this region. As a result, interrelationships between soils, their classification, and associated plant communities can be clearly demonstrated for these and, presumably, similar forested ecosystems of the Pacific Northwest.

Introduction

Interrelationships between soils and the vegetation they support are often observed by field soil scientists and plant ecologists. In recognizing the close relationship between plant communities and soil-forming processes, Jenny (1941) included organisms (primarily vegetation) as one of the five soil-forming factors in his widely used model of soil genesis. Major (1951) used a similar set of independent variables to define a climax plant community. Thus soil- and climax plant communities can both be thought of as products of the same set of environmental variables – climate, organisms, relief, parent material, and time – and an interdependence therefore exists between a specific soil body and its climax vegetation (Hironaka *et al.* 1991). Considerable research in forests and rangelands of the western U.S. has been directed at identifying and even attempting to quantify the relationships between soils and the native climax communities they support (Daubenmire 1970; Steele *et al.* 1981; Hironaka *et al.* 1983; Tisdale and Bramble-Brodahl 1983; Cooper *et* al. 1991).

The habitat type (h.t.) approach to classification of land areas was first introduced by Daubenmire (1952) and is based on identification of potential climax plant communities. This system has been widely used to stratify and classify forest lands in the western U.S. (Pfister *et al.* 1977; Steele *et al.* 1981; Cooper *et al.* 1991). Habitat types represent a "type" rather than "continuum" approach to classification – they are identified by a specified combination of indicator plant species that reflect a modal type. Soil classification also represents a "type" approach. Soil taxa are defined in Soil Taxonomy by a discrete set of diagnostic chemical, physical, and morphological properties, many of which influence or are a product of the native vegetation (Soil Survey Staff 1975).

Given these similarities between soil and habitat type classification schemes, soil classification should be related to a habitat type classification within a given environmental setting. However, efforts to correlate soil and habitat type classifications have not been entirely successful. Potkin (1991) found that many soil properties which are important to plant community distributions in

84

high-elevation environments are not utilized by Soil Taxonomy for classification purposes. Neiman (1986) examined 89 forested sites throughout northern Idaho and found little quantitative relationship between h.t.'s and soil physical properties and taxonomic classes. These studies suggest that within some environmental settings, soil classification does not emphasize or consider characteristics that are important to the distribution of plant communities. Furthermore. Hironaka et al. (1991) have cautioned that at any scale beyond a very localized application. a universal correlation does not exist between soil properties and vegetation attributes.

In northern Idaho. volcanic ash has had a significant impact on many soil properties and is believed to strongly influence the distribution of vegetation (Steele *et* al. 1981). Recent changes in Soil Taxonomy (Soil Survey Staff 1975) have placed more importance on the unique properties of ash-influenced soils. Once ash has been deposited across a region, it is exposed to various soil weathering environments and surficial processes such as erosion. As a result, the impact of the ash on soil properties may be quite variable within a relatively small geographic region. Accordingly. the Andisol order has been added along with Andic and Vitrandic intergrades of other orders to better reflect a range in ash-influenced soil properties (Soil Survey Staff 1992).

Given the importance of volcanic ash as a soil parent material in many forested areas of the Pacific Northwest and the increased taxonomic sensitivity to ash-influenced soils, the objective of this study is to illustrate some of the interrelationships that exist between soils and plant communities in this region. Specifically, this paper compares the properties and classification of soils and vegetation along a south-facing elevational gradient in the Selkirk Mountains of northern Idaho.

Methods And Materials

Study Area

The study area is located in the Trout Creek drainage of the Selkirk Mountains in northern Idaho (Figure 1). Trout Creek flows from Pyramid Lake to the Kootenai River, dropping approximately 1300 m in elevation over a distance 0120 km. The general topography of the drainage becomes steeper at lower elevations as Trout Creek has incised more deeply into the underlying substrate. Two contrasting geologic substrates occur in this area of the Selkirks. Steeply dipping Precambrian metasediments flank the range on the east side and granitic rocks of the Kaniksu Batholith make up the core of the range (Conners 19761. Pleistocene glacial deposits overlie both substrates and thus constitute one of the major soil parent materials of the area. During the Holocene. large quantities of volcanic ash from the cataclysmic eruption of Mount Mazama (approximately 6700.6800 yrs BP) were deposited throughout the region (Fryxell 1965: Fosberg *et* al. 1979; Bacon 1983). Some of this ash has been retained in modern soils either as a relatively undisturbed surficial mantle or as an admixture with coarser-textured granitic

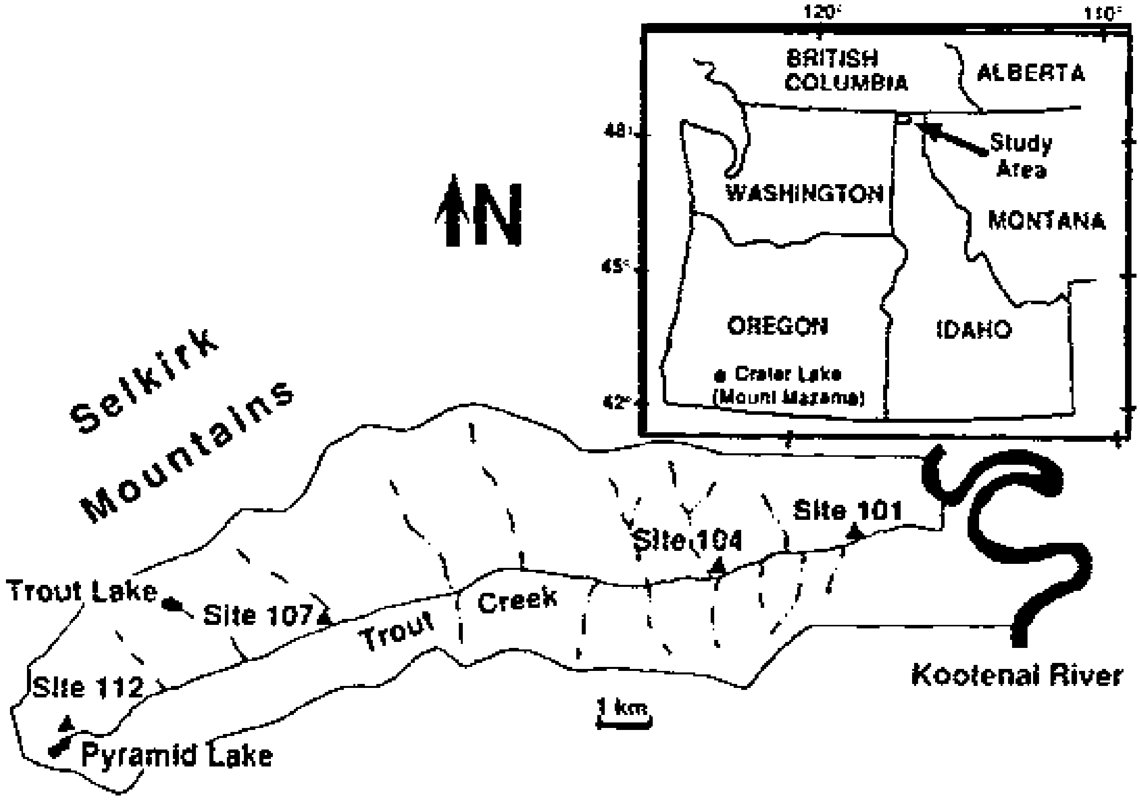


Figure 1. Map showing location of study area (inset) and sampling sites within the Trout Creek drainage.

hand-dug pits to determine representative morphological characteristics. A sampling pit was then located near the center of the plant community and dug to a depth of approximately 1 m. Soil profiles were described using standard horizon designations and descriptions (Soil Conservation Service 1984; Soil Survey Staff 1992). Soils were sampled by genetic horizons and classified to the family level according to Soil Taxonomy (Soil Survey Staff 1992) using appropriate laboratory and soil climate data. Samples were air dried and crushed with a rubber-tipped pestle to pass a 2-mm sieve. Laboratory analyses were performed using the following methods: particle-size analysis by pipette and centrifugation procedures (Jackson 1975; Gee and Bauder 1986); water retention at 1.5 MPa of soil moisture tension using pressure-plate extraction (Klute 1986); organic carbon by rapid dichromate oxidation (Nelson and Sommers 1982); pH (1:1 soil:water) and NaF pH using a combination glass electrode (Soil Conservation Service 1984); P retention by colorimetry (Blakemore *et al.* 1981); and Fe and Al contained in short-range order minerals by extraction with acid ammonium oxalate (Soil Conservation Service 1972). Glass contents were determined on very fine sand fractions by counting between 100 and 200 grains using a petrographic microscope.

Vegetation

A 375m² circular vegetation plot was established at each soil sampling location. All vascular plant species present within this area were identified according to Hitchcock and Cronquist (1973) and their abundance recorded by canopy coverage class (Cooper *et al.* 1991) (Table 1). Habitat types and phases were identified using a forest habitat type guide for northern Idaho (Cooper *et al.* 1991).

Results and Discussion

The distribution of soil and forest climax community classifications along the Trout Creek climatic gradient are summarized in Figure 2. The approximate ranges of soil moisture and temperature regimes are also given. These regimes are based on data collected at the sites (Fosberg, unpublished data) and related studies in northern Idaho by Schauer (1976). Cryic and frigid soil temperature

86

TABLE 1. Species list and coverage classes[1] for Trout Creek sites.

	Site 112	Site 107	Site 104	Site 101
Trees				
Pinus ponderosa	0	0	0	2
Pseudotsuga menziesii	0	T	T	3
Larix occidentalis	0	T	0	0
Pinus monticola	0	T	0	0
Thuja plicata	0	3	4	0
Tsuga heterophylla	0	1	3	0
Picea engelmannii	2	1	0	0
Abies lasiocarpa	3	2	0	0
Pinus albicaulis	3	0	0	0
Shrubs				
Holodiscus discolor	0	0	0	3
Physocarpus malvaceous	0	0	0	4
Philadelphus lewisii	0	0	0	2
Spirea betulifolia	0	0	0	T
Symphoricarpus albus	0	0	0	2
Berberis repens	0	0	T	3
Amelanchier alnifolia	0	0	T	1
Rosa gymnocarpa	0	0	0	1
Acer glabrum	0	0	1	
Vaccinium myrtillus	0	0	T	
Pachistima myrsinites	0	1	1	
Lonicera utahensis	0	1	T	
Linnaea borealis	0	1	T	
Vaccinium globulare	3		0	
Sorbus scopulina	T	0	0	
Rhododendron albiflorum	5	0	0	
Forbs				
Aralia nudicaulis	0	0	T	
Disporum hookeri	0	T	T	
Smilacina stellata	0	T	T	
Achillea millefolium	0	0	0	
Smilacina racemosa	0	0	T	
Hieracium albiflorum	0	0	0	
Goodyera oblongifolia	0	T	T	
Chimaphila umbellata	0	0	T	
Trillium ovatum	0	0	T	
Pyrola secunda	0	T	T	
Clintonia uniflora	0	T	T	
Chimaphila menziesii	0	T	0	
Tiarella trifoliata	0	T	0	
Osmorhiza chilensis	0	0	T	
Viola orbiculata	0	T	T	
Mitella breweri	T	0	0	
Xerophyllum tenax	1	0	0	
Graminoids				
Agropyron spicatum	0	0	0	
Calamagrostis rubescens	0	0	0	
Carex geyeri	0	0	0	
Bromus vulgaris	0	T	0	
Luzula hitchcockii	3	0	0	

[1] 0 = not present, T = 0-1% canopy coverage, 1 = 1-5%; 2 = 5-25%, 3 = 25-50%; 4 = 50-75%; 5 = 75-95%, 6 = 95-100%

87

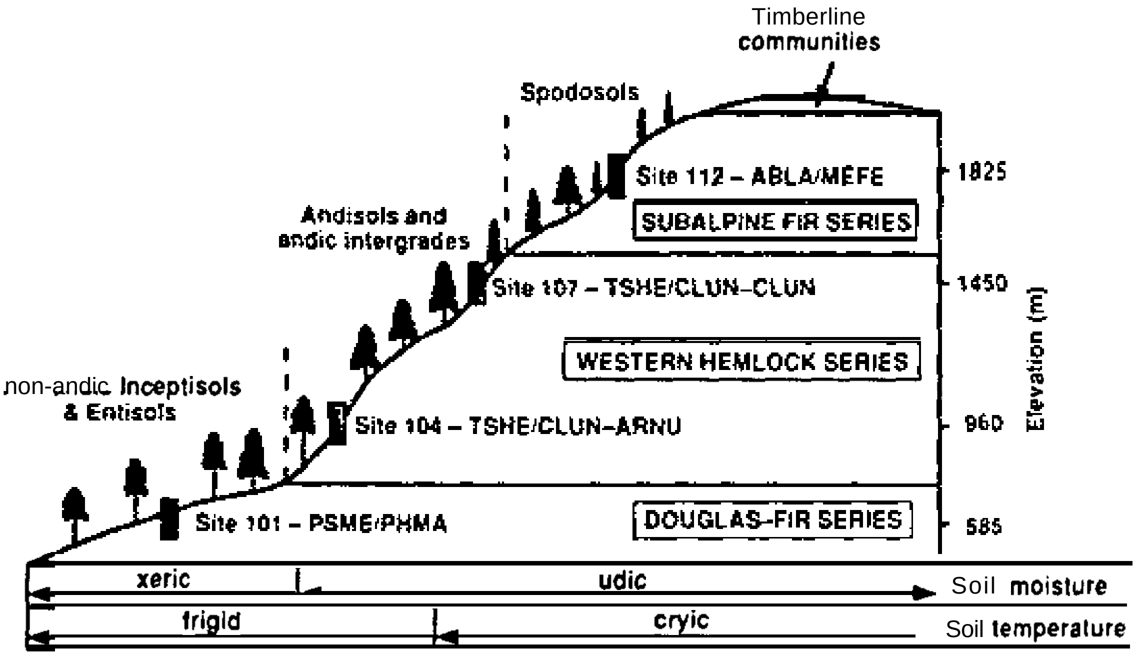


Figure 2. Generalized soil-plant community relationships on a south-facing slope in the Trout Creek drainage. Abbreviations: ABLA/MEFE = *Abies lasiocarpa/Menziesia ferruginea* h.t.; TSHE/CLUN-CLUN = *Tsuga heterophylla/Clintonia uniflora* h.t., *Clintonia uniflora* phase; TSHE/CLUN-ARNU = *Tsuga heterophylla/Clintonia uniflora* h.t., *Aralia nudicaulis* phase; PSME/PHMA = *Pseudotsuga menziesii/Physocarpus malvaceus* h.t.

regimes are both characterized by a mean annual soil temperature $<8°C$, but the cryic regime has cooler summer temperatures (Soil Survey Staff 1992). Udic and xeric soil moisture regimes differ in the length of time that the soil is dry during the summer months—xeric soils are subject to longer periods of dry conditions than are udic soils (Soil Survey Staff 1992). In the Trout Creek drainage, the change from cryic to frigid temperature regimes occurs somewhere within the *Tsuga heterophylla* zone. The change from the udic to xeric moisture regime appears to coincide with the change from the *T. heterophylla* series to the *Pseudotsuga menziesii* series.

The highest elevation sampling location, Site 112, is located at an elevation of 1830 m on a 10% slope and represents the coldest and moistest end of the climatic gradient. Climax vegetation is classified as an *Abies lasiocarpa-Menziesia ferruginea* (fool's huckleberry) h.t., *Luzula hitchcockii* (smooth woodrush) phase. The soil has formed in a mantle of Mazama ash overlying coarse-textured glacial drift (Figure 3). The dominant feature of this soil is the morphological evidence of podzolization. In the podzolization process Fe and Al move as soluble metal-organic and inorganic complexes, giving rise to a light-colored E horizon which overlies a brown to reddish-brown Bs (or Bhs) horizon. Sufficient quantities of Fe and Al have been translocated at Site 112 to form an albic (E)–spodic (Bs) horizon sequence (Figure 3; Table 2). Accordingly, this soil is now classified as a Spodosol, which is defined in Soil Taxonomy as a soil in which substantial quantities of amorphous Al and Fe (oxalate extractable) have accumulated beneath an albic E horizon (Soil Survey Staff 1992). Previously this soil had been classified as an Andisol (Soil Survey Staff 1990) and an Andept (Soil Survey Staff 1975).

In the Trout Creek drainage, we have observed the E-Bs horizon sequence (and Spodosols) only in association with the subalpine fir series. Similar associations have been reported elsewhere in the Pacific Northwest (Smith *et al.* 1968; Hunter 1988; Dahlgren and Ugolini 1991). This soil-plant community association exists because the conditions required for subalpine fir climax are also conducive for podzolization. The vegetation and climate interact in a manner to provide soluble organic chelating compounds and relatively large quantities of soil moisture that cause downward

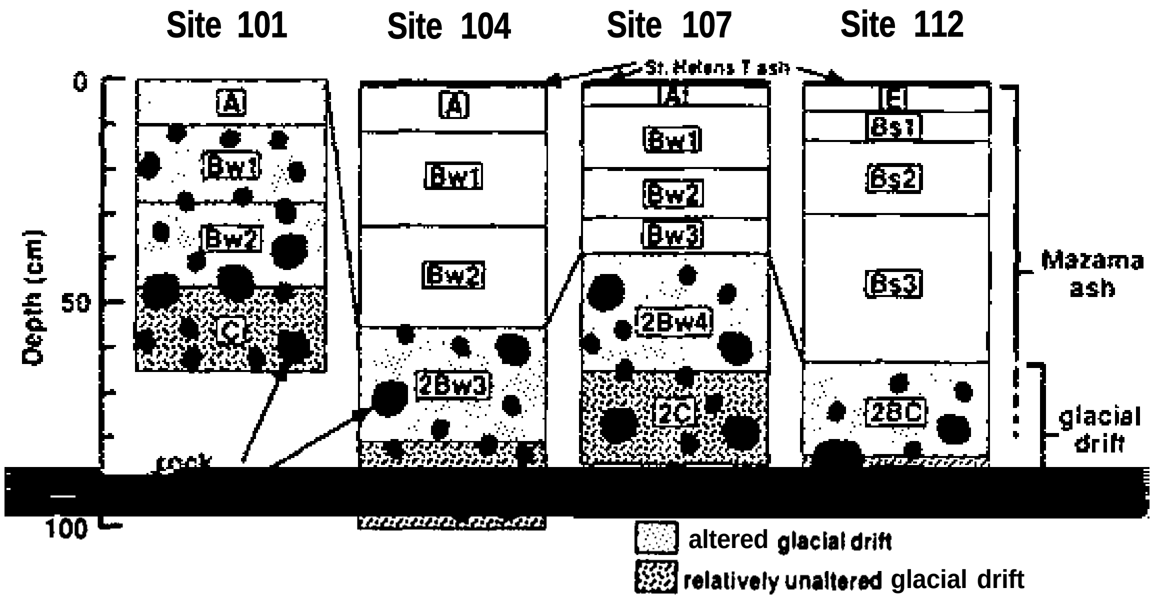


Figure 3. Comparison of parent material and horizon sequences in Trout Creek soils sampled along a bioclimatic gradient

migration of organic and inorganic metal complexes.

The Site 112 soil is the most strongly arid and contains the largest quantities of organic matter of any of the soils in this study (Table 21. NaF pH values >10, high P retention, and comparatively high glass contents in the very tine sand fractions all indicate a strong volcanic ash influence and result in classification of this Haplocryod as an Andic intergrade. Relatively large quantities of oxalate-extractable Fe and Al in the Bs horizons reflect the greater intensity of weathering and podzolization processes in this soil compared to those of the other sites.

Site 107 is located on a 35% slope at an elevation of 1450 m. Vegetation fits the *T. heterophylla-Clintonia uniflora* (queencup beadlily) h.t., *Clintonia uniflora* phase. The presence of *Abies lasiocarpa* and *Picea engelmannii* (Engelmann spruce) at this site suggest it occupies the cooler, moister end of the *T. heterophylla* series. The soil has formed in similar parent materials to those at Site 112, as high NaF pH values, high P retention, and comparatively high glass content all indicate a strong volcanic ash influence (Figure 3, Table 2). The major morphological difference is that podzolization processes have not been sufficient to produce an E-Bs horizon sequence. The Bw horizons do, however, exhibit sufficient development to meet the requirements of a cambic diagnostic horizon. The strong influence of volcanic ash and the lack of a spodic horizon result in classification of this soil as an Andisol (Soil Survey Staff 1992). This soil had previously been classified as an Andept (Soil Survey Staff 1975) and was therefore not distinguished from the Site 112 soil at the higher levels of Soil Taxonomy despite major differences in soil-forming processes.

Site 104 is located on a 55% slope at an ele- [redacted] (1991) described this as the warmest and generally moistest phase of this habitat type, but also observed relatively dry stands that are barely able to support the moist-site species. Even though this site has the same h.t. classification as Site 107, the absence of *A. lasiocarpa* and *Picea engelmannii* indicates comparatively warmer and drier conditions. The sandy textures and relatively low water content at 1.5 MPa of soil moisture tension further suggest that this is a droughty site (Table 2). We feel the *A. nudicaulis* phase at Site 104 represents a warmer, drier environment than does the *C. uniflora* phase at Site 107. Cooper *et al.* (1991), however, describe the *C. uniflora* phase as the driest and warmest phase of the *T. heterophylla-C. uniflora* h.t.

TABLE 2. Selected morphological, chemical, and physical properties of Trout Creek soils described in this study

Horizon	Depth (cm)	Color moist	Color dry	Sand	Silt	Clay	pH H_2O	pH NaF	Organic carbon	1.5 MPa H_2O	P retention	Oxalate-extractable Fe	Oxalate-extractable Al	Glass vfs*
				-----	%					....	..%..			
Site 112 medial over loamy-skeletal Andic Haplocryod														
Oi, Or	5.0													
C	0-1	2.5Y 5/2	10YR 7/2 (St. Helens T ash)											
E	1-6	10YR 4/2	10YR 6/1	38.3	56.2	5.5	3.7	7.3	4.8	14.6	20.1	<0.1	0.1	38
Bs1	6-13	7.5YR 4/5	10YR 5/5	39.3	54.5	6.2	4.7	10.8	4.2	18.5	96.4	1.3	2.1	24
Bs2	13-29	7.5YR 4/5	10YR 6/5	39.1	55.6	5.4	5.4	10.9	2.7	13.2	95.9	0.7	1.8	28
Bs3	29-62	10YR 4/5	10YR 6/5	45.0	51.0	4.0	5.2	10.8	1.4	8.7	86.6	0.5	1.2	22
2BC	62-83	2.5Y 4/4	2.5Y 7/4	51.7	45.1	3.2	5.3	10.6	0.7	6.2	55.3	0.2	0.6	2
2Cd	83-95+	2.5Y 4/2	2.5Y 5/2	68.0	29.3	2.7	4.9	10.3	0.6	5.1	30.5	0.1	0.3	1
Site 107 ashy over sandy-skeletal, mixed Typic Vitricryand														
Oi, Oe	5.0													
C	0-1	2.5Y 5/2	10YR 7/2 (St. Helens T ash)											
A	1-5	7.5YR 3/4	10YR 4/4	64.8	31.0	4.1	5.0	10.4	2.9	6.5	54.2	0.5	1.2	31
Bw1	5-18	7.5YR 3/4	10YR 4/4	62.0	34.6	3.5	5.2	10.6	2.8	7.2	70.9	0.6	1.5	32
Bw2	18-30	10YR 3/5	10YR 5/5	65.6	31.2	3.2	5.2	10.5	1.8	4.4	64.1	0.4	1.4	32
Bw3	30-38	10YR 4/5	10YR 5/5	69.9	27.8	2.3	5.2	10.5	1.3	4.6	62.8	0.4	1.4	3:
2Bw4	38-64	10YR 4/5	10YR 6/5	83.4	14.9	1.8	5.2	10.0	0.4	1.8	23.8	0.2	0.4	4
2C	64-85+	2.5Y 5/4	2.5Y 6/4	93.6	5.6	0.9	5.1	9.5	0.1	0.9	17.7	0.1	0.1	0
Site 104 sandy-skeletal, mixed, frigid Vitrandic Udorthent														
Oi, Oe	6.0													
C	0-1	2.5Y 3/2	10YR 7/2 (St. Helens T ash)											
A	1-11	7.5YR 3/4	10YR 5/4	80.5	16.3	3.2	5.6	9.8	1.0	4.4	26.4	0.3	0.4	7
Bw1	11-32	7.5YR 4/4	10YR 5/4	82.0	15.5	2.6	6.0	9.7	0.6	3.7	23.9	0.3	0.4	5
Bw2	32-55	7.5YR 4/5	10YR 5/5	84.9	13.6	1.5	6.3	9.9	0.4	3.4	24.4	0.3	0.4	2
2Bw3	55-80	2.5Y 4/5	2.5Y 6/5	90.9	8.1	1.0	6.1	9.4	0.2	2.2	19.1	0.2	0.2	1
2C	80-100+	2.5Y 4/4	2.5Y 6/4	92.5	6.9	0.7	5.9	8.8	0.1	1.4	16.2	0.2	0.1	0
Site 101 loamy-skeletal, mixed, frigid Typic Xerochrepts														
Oi, Oe	4.0													
A	0-10	10YR 3/2	10YR 4/3	64.9	28.3	6.8	6.1	8.4	3.2	4.0	27.0	0.5	0.2	2
Bw1	10-27	10YR 3/4	10YR 5/4	68.4	25.4	6.2	6.2	8.4	0.7	3.0	25.8	0.5	0.1	0
Bw2	27-46	10YR 3/4	10YR 5/4	61.5	32.7	5.8	5.9	8.7	0.8	3.0	26.5	0.5	0.2	0
C	46-64+	10YR 4/3	10YR 6/3	77.5	19.7	2.8	5.7	7.8	0.2	1.4	25.1	0.3	<0.1	0

*very fine sand

Steep slopes and greater susceptibility to fire and subsequent erosion associated with this drier site may have resulted in removal of much of the volcanic ash. There is only moderate ash influence on this coarse-textured soil as evidenced by intermediate NaF pH values, low P retention, and small quantities of glass in the very fine sand fraction, resulting in classification as a Vitrandic Udorthent. This classification indicates the soil has some of the characteristics associated with volcanic ash-derived soils, but they are too weakly expressed for inclusion in the Andisol order (Soil Survey Staff 1992). Development of Bw horizons results in classification as either an Entisol or Inceptisol, depending on soil texture (Soil Survey Staff 1992) and both of these soil orders are well-represented throughout this vegetation zone.

Site 101 is located on a 50% slope at an elevation of 585 m and represents the warmer, drier end of the climatic gradient observed in the Trout Creek drainage. Parent material is glacial drift and vegetation is classified as a *P. menziesii*-*Physocarpus malvaceus* (ninebark) h.t., *Physocarpus malvaceus* phase. *Pinus ponderosa* (ponderosa pine), absent from the higher-elevation sites, and Douglas-fir are the only tree species. The increased abundance of graminoids has resulted in formation of the darkest A horizon of any of the soils

90

examined in this study. There is also sufficient B horizon development to meet the requirements for a cambic horizon. resulting in placement of the soil into the Inceptisol order. There is little or no volcanic ash influence and the soil is therefore classified as a Typic (rather than Andic or Vitrandic) Xerochrept (Soil Survey Staff 1992). Throughout this region. it has been observed that Mazama ash is usually absent in soils associated with Douglas-fir h.t.'s (Barker 1981: Weisel 1982). During the warmer. drier conditions that existed at the time of the cataclysmic eruption of Mt. Mazama, these sites most likely did not have sufficient canopy cover to prevent erosion of the ash that presumably was deposited uniformly throughout the area.

Conclusions

In the Trout Creek drainage of northern Idaho. Spodosols formed in volcanic ash are associated with the A. *lasiocarpa* series at the higher elevations. Classification of these soils is determined by the albic-spodic horizon sequence. These soils are also classified as intergrades to the Andisol order because of the strong volcanic ash influence. Habitat types of the *T. heterophylla* series occupy the middle elevations. Andisols are the dominant soils at the moister and cooler end of this zone. At the warmer, drier end of the western hemlock zone. there has been less influence of volcanic ash on soil properties. Accordingly. soils are classified as Andic (and Vitrandic) intergrades of Inceptisols and Entisols. The *P. menziesii* series occupies the frigid and xeric climatic regime of the lower elevations. Soils have little or no volcanic ash influence and. based on our data, are placed in Typic rather than Andic or Vitrandic subgroups of Inceptisols and Entisols.

This study illustrates some of the changes in soil properties that occur in association with different habitat types along elevational gradients in the Selkirk Mountains. These changes reflect differences in volcanic ash influence, climate, and various soil-vegetation interactions . Because recent changes in Soil Taxonomy better recognize the range of characteristics in soils such as these, we suggest that many quantifiable relationships exist between vegetation and soil classification systems in volcanic ash-influenced regions of the Pacific Northwest. We further suggest these relationships can be utilized by resource managers and field scientists as a means of extrapolating limited amounts of data that exist for these forested ecosystems.

Acknowledgements

We thank Dr. Robert Mahler, Dr. Steve Bromsfeld, and two anonymous reviewers for their constructive comments on this manuscript. This work was supported by the Idaho Agricultural Experiment Station and is Paper No. 93710.

Literature Cited

Bacon, C.R. 1983. Eruptive history of Mount Mazama and Crater Lake caldera, Cascade Range. U.S.A. J. Volcanol Geotherm. Res 18: 57-155.

Barker, R.J. 1981. Soil survey of Latah County area, Idaho. U.S. Dept. of Agriculture-Soil Conservation Service. U.S. Govt. Printing Office. Washington. DC.

Blakemore, L.C., P.L. Searle, and B.K. Daly. 1981. Soil bureau laboratory methods. A: Methods for chemical analysis of soils. New Zealand Soil Bureau Scientific Report 10A. DSIRO. New Zealand.

Conners, J.A. 1976. Quaternary history of northern Idaho and adjacent areas. Ph.D. dissertation. University of Idaho, Moscow. 504 pp.

Cooper, S.V., K.E. Neiman, and D.W. Roberts. 1991. Forest habitat types of northern Idaho: A second approximation. Gen. Tech. Rep. INT-236. USDA Forest Service Intermountain Research Station, Ogden, UT. 143 pp.

Dahlgren, R.A., and F.C. Ugolini. 1991. Distribution and characterization of short-range-order minerals in Spodosols from the Washington Cascades. Geoderma 48: 391-413.

Daubenmire, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. Ecological Monographs 22: 301-330.

———. 1970. Steppe vegetation of Washington. Tech. Bull. no. 62. Washington Agric. Exp. Stn., Pullman. 131 pp.

Fosberg, M.A., A.L. Falen, J.P. Jones, and B.B. Singh. 1979. Physical, chemical, and mineralogical characteristics of soils from volcanic ash in northern Idaho: I. Morphology and genesis. Soil Sci. Soc. Am. J. 43: 541-547.

Fryxell, R. 1965. Mazama and Glacier Peak volcanic ash layers: Relative ages. Science 147: 1288-1290.

Gee, G.W., and J.W. Bauder. 1986. Particle-size analysis. *In* A. Klute (ed.) Methods of soil analysis. Part 1. 2nd ed. Physical and mineralogical methods. Agronomy 9: 383-441.

Hironaka, M., M.A. Fosberg, and A.H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Bull. no. 35. Forestry, Wildlife, and Range Exp. Stn., Univ. of Idaho, Moscow. 44 pp.

91

Hironaka, M., M.A. Fosberg, and K.E. Neiman. 1991. The relationship between soil and vegetation. p. 29-31 *In* A.E. Harvey and F. Neuenschwander (compilers) Proceedings: Management of productivity of western-montane forest soils. Gen. Tech. Rep. INT-236. USDA-Forest Service, Intermountain Research Station, Ogden, UT.

Hitchcock, C.L. and A. Cronquist. 1973. Flora of the Pacific Northwest. Univ. of Washington Press, Seattle. 730 pp.

Houston, K.E. 1988. Soil-habitat type relationships in the Idaho Selkirk Mountains. M.S. thesis. Univ. of Idaho, Moscow. 86 pp.

Hunter, C.R. 1988. Pedogenesis in Mazama tephra along a bioclimatic gradient in the Blue Mountains of southeastern Washington. Ph.D. dissertation. Washington State Univ., Pullman. 128 pp.

Jackson, M.L. 1975. Soil chemical analysis Advanced course, 2nd rd.. 10th printing. Published b, author. Madison, WI. 895 pp.

Jenny, H. 1941. Factors of soil formation. McGrawHill Book co.. Inc. New York, 281 pp.

Klute, A. 1986. Water retention: Laboratory methods. *In* A. Klute (ed.) Methods of soil analysis. Part 1. 2nd ed. Physical and mineralogical methods. Agronomy 9:635-662

Major, J. 1951. A functional, factorial approach to plant ecology. Ecology 32: 392-412.

Mullineaux, D.R. 1986 Summary of prc-,980 tephra-fall deposits erupted from Mount St. Helens, Washington State, USA. Bull Volcanol., 48: 16-26.

Neiman, K.E. 1986. Soil discriminant functions for six forest habitat types in northern Idaho. Ph.D dissertation Univ. of Idaho. Moscow. 174 pp.

Nelson, D.W.. and L.E. Sommers. 1982 Total carbon, organic carbon. and organic matter. *In* A.L. Page et al (ed.) Methods of soil analysis Part 2. 2"d cd. Agronomy 9:539-579.

Okazaki, R., H.W. Smith, R.A. Gilkeson, and J. Franklin. 1972. Correlation of West Blacktail ash with pyroclastic layer T from the 1800 A.D. eruption of Mount St. Helens. Northwest Sci. 46: 77-89.

Pfister, R.D., B.L. Kovalchik, S.F. Arno, and R.C. Presby. 1977. Forest habitat types of Montana. G". Tech. Rep. INT-34. USDA-Forest Service. Intermountain Research Station, Ogden, UT. 174 pp.

Received 18 February 1993
Accepted for publication 12 September 1993

Pottkin, M.A. 1991. Soil vegetation relationships of subalpine and alpine environments, Wind River Mountains, Wyoming. M.S. thesis. Univ. of Wyoming, Laramie. 290 pp.

Schauer, P.S. 1976. Soil moisture and temperature characteristics under five forested habitat types in northern Idaho. M.S. thesis. Univ. of Idaho, Moscow. 130 pp.

Smith, H.W., R. Okazaki, and J. Aarstad. 1968. Recent volcanic ash in soils of northwestern Washington and northern Idaho. Northwest Sci. 42: 150-160.

Smith, H.W., R. Okazaki, and C.R. Knowles. 1975. Electron microprobe analysis as a test of the correlation of West Blacktail ash with Mount St. Helens pyroclastic layer T. Northwest Sci. 49: 209-215.

Soil Conservation Service. 1972. Procedures for collecting soil samples and methods of analysis for soil survey. Soil Survey Invest. Rep. 1. USDA-SCS. U.S. Gov. Print. Office. Washington, DC.

________. 1984. Procedures for collecting soil samples and methods of analysis for soil survey. Soil Survey Invest. Rep. 1. USDA-SCS. U.S. Gov. Print. Office. Washington, DC.

Soil Survey Staff. 1975. Soil Taxonomy. A basic system of soil classification for making and interpreting soil surveys. USDA-SCS Agric. Handbk. 436. U.S. Govt. Print. Office. Washington, DC.

________. 1990. Keys to Soil Taxonomy. 4th ed. SMSS Tech. Monograph No. 19. Blacksburg, VA.

________. 1992. Keys to Soil Taxonomy. 5th ed. SMSS Tech. Monograph No. 19. Pocahontas Press, Inc. Blacksburg, VA.

Steele, R., R.D. Pfister, R.A. Ryker, J.A. Kittams. 1981. Forest habitat types of central Idaho. Gen. Tech. Rep. INT-114. USDA-Forest Service. Intermountain Research Station, Ogden, UT. 138 pp.

Tisdale, E.W., and M. Bramble-Brodahl. 1983. Relationships of site characteristics to vegetation in canyon grasslands of west-central Idaho and adjacent areas. J. Range Mgmt. 36: 775-778.

Weisel, C.J. 1982. Soil survey of the Bonner County area, Idaho. U.S. Dept. of Agriculture-Soil Conservation Service. U.S. Govt. Printing Office, Washington, DC.

'ECOSYSTEM MANAGEMENT: PRINCIPLES AND APPLICATIONS

John A. Nesser
Correlator, Northern Region, USDA-Forest Service

Ecosystem management involves the maintenance of sustainable ecosystems while providing for a wider array of uses, values, products, and services from the land to an increasingly diverse public (Overbay, 1992).

Overbay (1992) proposes that the following principles be used to describe the initial components of ecosystem management:

- Multiple-use, sustained-yield management of lands and resources depends on sustaining the diversity and productivity of ecosystems at many geographic scales.
- The natural dynamics and complexity of ecosystems means that conditions are not perfectly predictable and that any ecosystem offers many options for uses, values, products, and services, which can change over time.
- Descriptions of desired conditions for ecosystems at various geographic scales should integrate ecological, economic, and social considerations into practical statements that can guide management activities.
- Ecosystem connections at various scales and across ownerships make coordination of goals and plans for certain resources essential to success.
- Ecological classifications. inventories, data management, and analysis tools should be integrated to support integrated management of lands and resources.
- Monitoring and research should be integrated with management to continually improve the scientific basis of ecosystem management.

Land Evaluation

Ecological land units (ELU's) are based on ecosystem components which do not change readily following management. These components include landform, geology and macro climate. Ecological land units are basic, bio-physical units which delineate similar landscapes with respect to ecosystem function, composition and structure. They may be delineated at different scales dependent on analysis needs. As an example, geology may be important in characterizing landscapes at the Ecoregion scale while soils may be more appropriate at the plot level. Ecological land units also provide the basic bio-physical template for interpretation of ecosystem processes such as fire regimes, historic vegetation patterns and succession, hydrologic function, and habitat relationships. Ecological land units also serve as a template for interpreting change in those ecosystem components that display great temporal variability such as existing vegetation and wildlife populations.

The effects of management practices can be assessed by contrasting the existing condition of a site to other managed or unmanaged sites that occur on the same ecological land unit. The differences observed are then attributable to management, not site variability.

EM Framework

The following steps describe how the land evaluation process may be used to achieve ecosystem management:

- Determine the desires and requirements of people who will be influenced by the planning outcome.

- Describe the ecological potential of the land for meeting stated societal needs. Such descriptions must include a description of the range of conditions required to maintain long-term system sustainability, a description of current condiiions, and a description of desired landscape conditions that achieve societal needs.

- If desired landscape conditions fall outside the range of conditions required for long-term system sustainability, inform the people who will be affected. Public awareness of ecosystem potential is critical In developing achievable 'desired future condition' strategies for land management. Public desires are refined through this process, based on an understanding of sustainable ecosystem criteria.

- Once a socially acceptable, sustainable vision of the landscape is achieved, if is then contrasted against available technology to determine if it can be implemented. For example, in many instances the desired landscape condition may differ from existing conditions. In these situations, factors such as system design and equipment availabilii must be considered to determine if it is technologically feasible to move the existing landscape to some desired set of conditions.

- Determine what parts of the stated human desires can be fulfilled given economic factors. If resources (economic and technological) are not available to construct the desired landscape, the public should be notified and alternative strategies developed. In most situations, short-term economic reasoning and large management impacts contribute to situations that violate land ecological and human values. Accordingly, they should be avoided in the development of strategies for ecosystem management.

These steps refine human desires baaed on land ecology, technology, and economic considerations. Such refinement requires that the public be informed of land evaluation findings and that public opinion be solicited throughout the process. The maintenance of sustainable ecosystems (as a basic tenent of ecosystem management) requires constant public input; however, ecosystems (in and of themselves) do not require management, The ability of our planet to sustain itself through periods of major climate change (glaciation), tectonic activity, and other disturbance events (biblical floods) indicates that the earth is quite capable of maintaining itself without our assistance. Instead, we manage ecosystems to ensure that desires and requirements of people are met now and In the future. Managers must understand the ecological potential and interactions of the land if they are to provide sustainable ecosystems for future generations.

Landscape Ecology Principles

One of the major landscape ecology and conservation biology principles applicable to ecosystem management are summarized below:

- Hierarchy theory-the development and organization of landscape patterns (e.g., vegetation communities) is best understood in the context of spatial and temporal hierarchies. Disturbance events that maintain landscape patterns and ecosystem sustainability are also spatial-temporal scale dependent phenomena Acknowledgment of these facts is critical to the development d management strategies for ecosystem sustainability. Applying these principles requires that land evaluation be conducted at multiple scales of ecological description rather than at traditional detailed scales such as stands or stream reaches. The temporal variabilii (e.g., vegetation succession dynamics) of landscapes also needs to be addressed in land evaluation.

Natural variability-all ecosystems vary across time and space, even without human influence. Knowledge of this variability Is extremely useful in determining if the current condition of a landscape is sustainable given historic pattern and process criteria. Descriptions of historic landscape disturbance regimes (e.g., fire magnitude and frequency) and the ecosystem component patterns they maintained (e.g., vegetation composition) provide an initial template for assessing ecosystem health. Such descriptions are useful in broad-level resource analyses of risk as well as in more detailed Identification of watershed restoration treatment needs. These descriptions also provide information for forest plan implemenation and monitoring.

. Coarse-filter conservation strategy--the conservation of diversity (e.g., species, ecosystem pro cesses, and landscape patterns) is the primary method for maintalning the resilience and productivity (health) of ecological systems. Traditional approaches to conserving diversity have relied on a species-by-species approach (i.e.. fine filter) which emphasized maintaining habitat for threatened, endangered, and sensitive species. A more proactive approach to species conservation is the 'coarse-fitter' approach to biodiversity maintenance. This approach assumes that if landscape patterns and process (similar to those that species evolved with) are maintained, then the full complement of species will persist and biodiversity will be maintained. Application of this concept requires an understanding of the natural variability of landscape patterns and processes. Landscape ecology principles provide this understanding and are the foundation for experiments in ecosystem management. Such experiments are effectively implemented through an adaptive management approach to land management.

Summary

Ecosystem management may be implemented through the current planning process and should consider management strategies based on various scales as appropriate to the analysis.

Landscape ecology and conservation biology principles provide a framework for our ecosystem management philosophy which is an experiment and should be implemented based on adaptive management concepts.

References

Bourgeron, P.S.; Jensen, M.E. 1993. An overview of ecological principles for ecosystem management. In: Jensen, M.E.; Bourgeron, P.S., eds. Eastside Forest Ecosystem Health Assessment-Vol. II: Ecosystem Management: principles and applications. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Jensen, M.E.; Everett, R. 1993. An overview of ecosystem management principles, In: Jensen, M.E.; Bourgeron, P.S., eds. Eastside Forest Ecosystem heakh Assessment-Vol. II: Ecosystem management: principles and applications. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

SOIL RELATIONSHIPS TO ECOSYSTEM MANAGEMENT

Robert T. Meurisse[1]

I. INTRODUCTION

A. Our dilemma is one of communicating knowledge and ideas about complex systems. Questions needing answers are: What are ecosystems? What is ecosystem management? what is soil?

B. Objectives:

1. Review concepts of Ecology, Ecosystems and Soil
2. Describe and discuss some Principles of Ecosystem Management
3. Describe a "Model" of Soil Science-Unifying Concepts
4. Issue some challenges to Soil Scientists

II. SOME CONCEPTS ABOUT ECOLOGY, ECOSYSTEMS AND SOIL

A. Concepts of Ecology and Ecosystems:

Ecology: The science that deals with the interrelations of organisms and their environment. (Glossary of Science Terms, Soil Science Soc. Amer. 1975) Term coined by Ernst Haeckel, German biologist, circa 1866.

Ecosystem: Any unit including all of the organisms (i.e., the "community) in a given area interacting with the physical environment so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles within the system. (E.P. Odum, 1971) Term proposed by A.G. Tansley, British Ecologist, 1935.

While ecology is literaly the study of organisms at home, for many people, the focus has been on the organisms themselves. But, it is clear that the emphasis needs to be on the relationship of organisms with their environment, especailly the soil. From the definitions, the concept of ecosystems rest on the following: The importance of spatial and temporal scales; material cycles; energy flows: dynamic interactions and connectivities, and the interaction of organisms with their environment.

B. Concepts of Soil: Humans have a natural affinity to the soil as a result of **the long history of tilling it for growing food and fiber, But soil is more than a medium for plant growth. Soil genesis, hence pedology, gained a prominent place when Jenny (1941) published his** classical work on the factors of soil formation. Where: Soil- f(climate, parent material, organisms, relief, time). This concept can also be expressed as state variables, where, given certain state factors, predictions about soil can be generated as a function of another variable. For example, $soil = f(Climate)_{pm, o, r, t}$

[1] Regional Soil Scientist, Pacific Northwest **Region, USDA Forest Service**

Soil also is an open system, where energy and material moves into, within and through it. Some examples are: gains and losses of water: biocycling of materials; erosion and deposition; and leaching losses.

C. Ecosystem function is an important concept that inixtricably links soil with the notion of ecosystems. It is exemplified in the concept of bioenergetics and cycles where soil plays a crucial role in regulating ecosystem composition, structure and function. A graphic illustration is provided by Richards (1987).

Soil plays an important role in the regulation of the type and magnitude of producers, the storage of potential energy as organic carbon or inorganic nutrients, and the decomposers that are largely soil organisms. Soil organisms are important not only for their functional roles in carbon and nutrient cycling, but they represent a major portion of the earth's biodiversity. We need to know more about the population of organisms, their functions, fluxes with management, and distribution in soils.

Soil biota exhibit wide diversity. For example, soil meso fauna in a cool temperate grassland have a wide range of population densities. They range from several hundreds of ants to many thousands of mites and springtails to more than millions per meter^2 of nematods (Richards, 1987.)

III. ECOSYSTEM MANAGEMENT PRINCIPLES (Following are six principles developed by the Forest Service and are elaborated on in the proceedings from a national workshop in 1992, "Taking an Ecological Approach to Management." However, the principles are applicable elsewhere)

A. Manage for Sustainability of Ecosystems:
Sustain vitality, productivity and diversity of ecosystems.
Sustainability is a function of bio-physical, economic and social-political interactions.

B. Ecosystems are Dynamic, Complex and Have Multiple Options:
They are shaped by pertubations from fire, wind, floods, insects, pathogens, volcanoes, glaciers, and human activities.
They have various opportunities and limitations based on capabilities and resiliencies.
Some, such as wetlands and riparian systems have disproportionate importance to their size and extent.

C. A Desired Future Condition Expresses Integrated and Pragmatic Ideas about Ecosystems:
Resource plans establish direction.
Management prescriptions must be based on physical and biological capabilities of the land.
DFC's are described in terms of composition, structure and patterns of important ecosystems/components.

D. Ecosystems are Connacted at Various Scaler:

- Ecosystems occur at various scales and cross ownership boundaries.
- Consider linkages among terrestrial, riparian and aquatic ecosystems.
- Analyses must consider spatial and temporal scales for direct, indirect and cumulative effects.

E. Planning and Management Utilizes Integrated Data:

- Classify, map, inventory, and analyze both abiotic and biotic components at various scales.
- Integrate components for "holistic" view.
- Spatial analysis (GIS) and data management systems are essential tools.

IV. AN INTEGRATED MODEL OF SOIL SCIENCE-UNIFYING CONCEPTS

Meurisse and Lammers (1993) described a framework of five models for communication and understanding knowledge of the complexity of the soil system. These models, or viewpoints, are a basis from which we examine a pool of facts, formulate and test hypotheses, and make interpretations. They are not mutually exclusive or independent from each other. An illustration of these models follows.

ECOSYSTEM OR COMPONENT ⟷ WATER-TRANSMITTING MANTLE

ECOSYSTEM OR COMPONENT
- o Dynamic interactions/rates of change
- o Nutrient cycles/transport processes
- o Decomposition/Trophic relations
- o Environmental filter
- o Time scale 10 to 10^{7} yrs.

WATER-TRANSMITTING MANTLE
- o Movement/storage of water/energy
- o Soil physical properties
- o Erosion processes
- o Pedotransfer functions
- o Time scale 10 to 10^{2} yrs.

NATURAL BODIES
- o State factors
- o Weathering processes
- o Geomorphic history
- o Soil individuals
- o Classification
- o Mapping
- o Time scale 10^{2} to 10^{3} yrs.

MEDIUM FOR PLANT GROWTH ⟷ STRUCTURAL MATERIAL

MEDIUM FOR PLANT GROWTH
- o Available moisture/nutrients/heat
- o Aeration/anchorage
- o Plant physiology
- o Response to management
- o Time scale 10 to 10^{3} yrs.

STRUCTURAL MATERIAL
- o Mechanical properties (strength/plasticity)
- o Drainage/porosity
- o Conductivity--heat/water/energy
- o Time scale 10 to 10^{2} yrs.

The model should be viewed as a means of integrating multiple aspects of soil science. It also needs to consider the various technologies and tools for analysis and interpretation for each of the individual models. Soil science teaching, research, extension, and management prescriptions need to be structured to incorporate these or similar models.

V. SUMMARY AND CONCLUDING CHALLENGES FOR NCSS SOIL SCIENTISTS (To implement ecosystem management principles)

It seems clear that the soil is is not only a component of ecosystems, but are ecosystems in themselves. Thus, the role of soil and soil scientists in **ecosystem management is** integral to implementing the basic principles as described above. In order to provide for a sustainable planet, society must have access to timely and accurate soil information in a readily accessible form. I suggest the following challenges as a means to success:

A. Wisely use technology:

Western/Midwestern Regional Cooperative
Soil Survey Conference

Coeur d'Alene, Idaho
June 12-17, 1994
Ecosystem Basis for Soil Survey[1/]

The Steering Team for this joint Western-Midwestern Regional National Cooperative Soil Survey Conference has developed a timely and excellent agenda. I am pleased to address some of the positive issues pertaining to the increased interest and demand to utilize the concepts of ecosystem in our preparation and use of soil surveys.

This morning I would like to share with you some of the guides in the new Soil Survey Manual pertaining to doing business according to ecosystems, review some current activities being driven by the ecosystem approach by the agencies with which we are employed and discuss current trends and activities toward a coordinated ecosystem soil survey.

Ecosystem concepts -- Soil Survey Manual

Collectively, as we look across the United States, Alaska, Hawaii, and Puerto Rico, the members of the National Cooperative Soil Survey have a responsibility to prepare soil surveys for a diversity of landscapes and user demands.

The "Soil Survey Manual', one of our long-awaited documents concerning the preparation of soil surveys, has recently been released. This is the third revision of our guide for making soil surveys. I have taken the opportunity to carefully review several sections in this manual. Even though this manual does not discuss ecosystems as such, many of the principles end techniques included in this manual on how we make and interpret soil maps are based on principles of ecosystems.

The term "Soil Survey" as defined by the Soil Survey Manual, refers to the National Cooperative Soil Survey. Thus, this document provides a common source of information and guidance on how we go about our business of making soil surveys.

A review of a few basic concepts end definitions as stated in the new Soil Survey Manual which have bearing on the ecosystem approach to soil survey are appropriate. Soil is defined as 'all natural bodies that contain living matter and are capable of supporting plants." The knowledge of soils at the end of the nineteenth century was gained from 1) farming, 2) agricultural chemistry, 3) biology, and 4) geology. The first soil surveys in the United States were made in different parts of the country to test the proposed mapping technologies and applicability for use. These surveys, in Pecos Valley, New Mexico; Salt Leke City, Utah; Connecticut Valley, Connecticut; end Cecil County, Maryland, provided our first look at a long line of soil surveys mapped and published by the United States Department of Agriculture.

1/ Jim Culver, Assistant Director of Soil Survey Division, SCS-USDA

In a sense most of the early soil surveys indirectly observed and used many of the current principles of the ecosystem soil survey. An observation made in the 1904 Tama County, Iowa Soil Survey is illustrated in the Soil Survey Manual. It was recorded the soils formed under forest were contrasting different then soils formed under grass even through the parent material was similar.

Hans Jenny's "Factors of Soil Formation,' as applicable to making soil maps, is discussed. The formation of the soils is treated as an aggregate of several interrelated processes, such 8s physical processes, chemical processes, and biological processes. There are several references on the importance of the correlations between vegetation and soils in making quality maps. Vegetation is closely related to the soil and its genesis. The three main relationships discussed are a better understanding of soil genesis, assistance in recognizing soil boundaries, end assistance in predicting from soil maps ebout the kind and amount of vegetation produced.

The Soil Survey Manual contains a number of comments on how we make soil maps, and the skills of the soil scientists, which utilize the ecosystem principles. Soil mapping is 8 technical art! It requires 8 sound training in soil science with 8 familiarity of the earth science principles.

A skilled soil scientist who makes a quality ecosystem soil map is one who

-- is a perceptive observer

-- understands significance of landscapes

-- is able to visualize the pattern of the soils

– is able to associate sets of landscape features with sets of internal soil properties

-- is able to abstract the essential pattern of the soil

-- is able to express soil patterns and relationships on 8 map

-- strives for accuracy

-- is truthful about reliability of the maps.

Some of the consideration the soil scientist uses in making a ecosystem map are:

-- looks ahead on the projected route or traverse and predicts the kinds of soils on the landscape ahead

-- observes breaks in slope gradient

-- notes change in landscape, i.e. change in convex to concave slope configuration

– observes any change in kind or vigor of vegetation

-- makes a view of landscape from a new vantage point.

Agency Ecosystem Activity

Tansley, a Botanist in 1935, defined the concept of Ecosystem as en aggregate of plants, animals, microbes, plus the environment in which they live.

Within the past few years several Federal agencies have developed pdicies and have an increased awareness towsrd an ecosystem approach. The Soil Conservation Service integration of soil, water, air, plants and animals (SWAPA) approach has evolved into the current ecosystem-based assistance concept. The Forest Service, in their "National Hierarchical Framework of Ecdogicel Units,' gives priority to the factors of climate, physiography, water, soils, air, hydrdogy, and potential natural communities. The Bureau of Land Management (BLM) has prepared some excellent documents on the importance of identifying and mapping riparian areas.

The principles of these systems have much in common with the discussion given in the 'Factors of Soil Formation' section included in most of our published soil surveys. These factors are parent material, climate, plant end animal life, relief, and time.

Current activity end trends toward ecosystem regional soil surveys

A number of major soil survey activities are directed toward using ecosystem principles in making and maintaining quality soil surveys. Some highlights are:

-- doing a project soil survey based on a major land resource area or physiogrsphic area rather than by strict political boundaries. The concept of soil surveys by Major Land Resource Area (MLRA) is now included in the National Soil Survey Hsndbook. All updates or maintenance soil survey projects now require that work on them be done by MLRA or its equivalent physiographic area. Presently, there is some level of update maintenance for 60 MLRAs, and 12 have been approved by the Director of the Soil Survey Division.

-- proposals have been put forth to fund soil survey projects by physiographic or major land resource areas instead of by traditional state area.

-- techniques have been developed and are being tested to map riparian areas as part of soil survey field operations.

-- develop a national strategy for Soil Conservation Service, Forest Service, and Bureau of Land Management to collectively agree on one common eco-mapping scheme and one given scale -the suggested scale is between 1:2,500,000 end 1:7,500,000. The Environmental Protection Agency and National Biological Survey (NBS)) have also been invited to join in this endeavor.

_ increase interest in temporal soil properties. Bob Grossman. research soil scientist, NSSC, hes developed a number of field techniques to measure and evaluate temporal soil properties.

-- greater concern in soil mapping and soil correlation procedures. Examples include wetlands and hydric soil indicators, emendments in Soil Taxonomy complementing ecosystem soil surveys, broader options to separate map units that are distinctly different for some uses or potential future uses, i.e. similar or the same tsxonomic pedons on uplands and terrace landscapes need to be separate map units.

Several models on how we view soil science have been proposed over the years. An excellent brief summary of five models is included in 'Use of Soil Survey information for Management of Natural Forest and Grasslands" by R. T. Meurisse and D. A. Lammers.[2] One of the references in these concepts is Cline[3], who was the original principal author of the Soil Survey Manual. I hold the opinion that en ecosystem-based soil survey is en integration of these five soil science models. A brief overview of each model is es follows:

Soil es a natural area.

-- Pedon

-- Classification

-- Spatial variability

Soil as a medium for plant growth.

-- Agronomy

-- Forage

- Forest

Soil as an ecosystem or ecosystem component.

-- Nutrient cycles

-- Energy flows

-- Organisms

Soil es a vegetated water-transmitting mantle.

-- Hydrologic cycle

Physical properties.

-- Vegetation

Soil as a structural material.

-- Soil strength end plasticity

-- Liquid and plastic limits

-- Porosity

2/ R. T. Meurisse end D. A. Lammers. 1992. Use of Soil Survey Information for Management of National Forests end Grasslands.

3/ **Cline.** M. G., 1961. The **Changing Model** of Soil Science. Soil Sci. **Soc.** Amer. **Proc.** 26: 442-446

The Federal Geographic Data Committee provides national oversight in terms of consistent definitions of data elements, a control base map, etc. for effective use in a Geographic Information System. The Soil Conservation Service for the soil data layer, while the Forest Service has responsibility for the land use data.

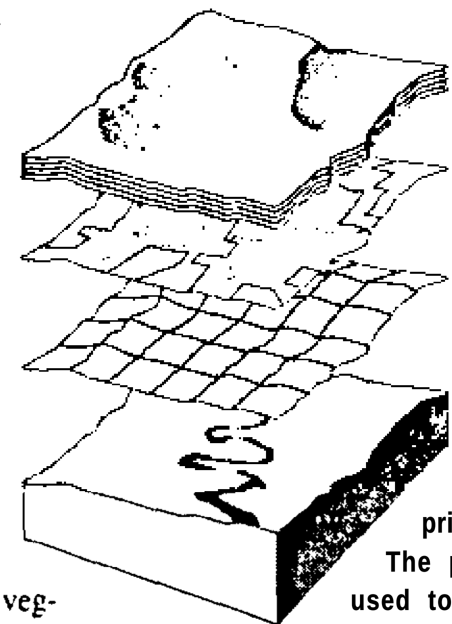
We will collectively plan future strategies for quality ecosystem soil surveys. As one looks et the cover of some recent soil surveys, it is apparent that, outwardly, our products will take on a different look. At the same time, we must ensure that the soil map we prepare adequately documents the special and attribute data that records the **actual** observed, measured, and inferred properties we know about each soil map unit we design.

I am excited. There is a tremendous interdisciplinary opportunity to improve our capacity to provide our users quality soil information in a wide variety of presentations.

An Integrated Landscape Resource Analysis Approach to Comprehensive Watershed Management

By Alan E. Amen, Jacek Blasczynski, Jim Harte, and Dick Page,
Bureau of Land Management

ABSTRACT - The Bureau of Land Management is using Geographic Information System (GIS) analytical techniques to assist with the development of comprehensive watershed management planning on rangeland and wildlands. The Sagers Wash Watershed near Moab. Utah, has been proposed as a prototype watershed for the reduction of salt input into Colorado River. Soil erosion prediction (using the RUSLE/GIS interface), sediment yield, and salt input are being modeled under various erosion control and grazing management practices to provide for best management alternatives. Data used include: digital soil survey information; Digital Elevation Models; remote sensing imagery; vegetation: surface geology; and resource condition information. Geographic information system techniques are used for enhancing resource inventories, generating interpretations and analysis maps with accompanying records data to support resource management decisions. The methodology incorporates a strong landscape - resource analysis approach. Digital soil maps are interpreted for the parameters of precipitation, soil salinity, soil hydrologic groups , and presence or absence of various percentages and sizes of coarse fragments on the surface and other interpretations. Overlays are made for the various data themes and analyzed to produce a treatment opportunities map showing areas appropriate for various erosion control and grazing management practices, that could be utilized on the watershed. The final step in the process involves selection of treatment priority areas for the watershed. The public lands survey theme is used to identify precise locations of streams and channels, proximity to pathways of sediment transport, and to locate archeological sites, where erosion practices might impact the cultural resources. The methodology is also effectively used to display and communicate resource information and comprehensive planning activities.



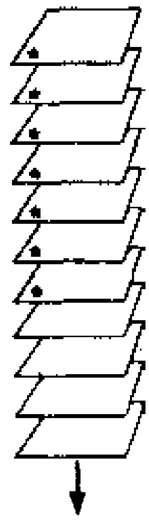
For additional information:

Alan E. Amen
Soil Scientist; BLM
Division of Resources (SC-210)
Service Center, P.O. Box 25047
Denver, CO 80225-0047
Phone (303) 236-0154

Jacek Blaszczynski
Physical Scientist; BLM
Branch of Geographic Information System Services (X-344)
Service Center, P.O. Box 25017
Denver, CO 802250047
Phone (303) 236-6253

GIS
Terrain/Resource Analysis
(Sagers Wash Watershed Comprehensive Plan)

Climate (Precipitation)
Topography (DEMs)
Geology (Soil Parent Materials)
Soils (Physical & Chemical Properties)
Vegetation (Type, Cover, and T&E Plants)
Surface Hydrology
Land use
Resource Condition (Soils & Range)
Archeological Sites
Existing Treatment & Structures
Research Information



Existing Condition Evaluations
- Soil Erosion Prediction
- Sediment Quantity & Quality
- Salt Transport

Management Opportunities
- Site &Practice Selection
- Practice Effectiveness Prediction

Cost-Benefit Evaluations

* Soil Survey Mapping, Modeling & Enhancement

SOIL SURVEY ENHANCEMENT AND ECOLOGICAL SITE CORRELATION

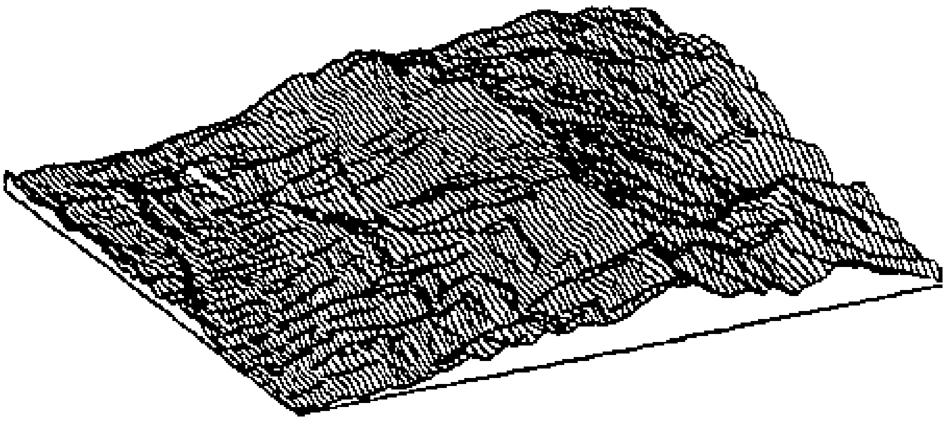
by: Alan E. Amen, Jacek Blaszczynski, Dick Page, and Jack Sheffy
Bureau of lond Monogement

The soil survey enhancement ond ecological site correlation process uses Geographic Informotion Systems (GIS) technology to integrate digital elevation data, orthophotos, Landsat Thematic Mopper, ond other supporting data (climate, geology, vegetation, ond adjoining soils data) for improved definition of toxonomic soil components within mop ping units. This methodology emphosizes a landscope ond geologic onolysis opprooch. Use of GIS landform/hydrologic characterization methods, ond odditionol geologic interpretotion provide m ore detoiled information on the spotiol voriobility of soil properties within mopping units. This approach hos been effective in wildlands ond rongelond areas in Utoh, Arizona ond Wyoming thot hove large areas of shallow ond medium-depth soils ond occomponying exposures of geologic formotions. The enhanced soil data provides odditionol interpretotion ond analysis capabilities for specific needs, e.g. water quality, riparian area and grazing management on public lands. information and technology provided by this methodology is effectively used to enhance existing soil surveys ond also for disploying and communicating soil information.

Application •

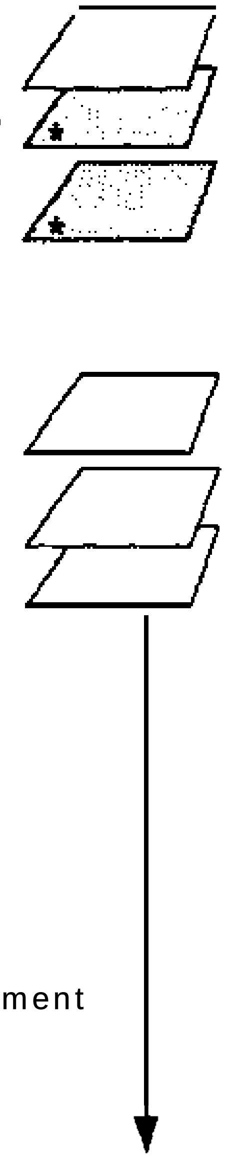
The soil survey enhancement and ecological site correlation process provides additional detoil, interpretation ond onolysis capability for land management such as:

1. Wotershed onolysis . woter quolity
2. Riparian area identification and monogement
3. Ecological site identification ond grozing monogement
4. Archeological ond cultural
5. Threotened ond endongered species
6. Monitoring site selection



Soil Survey Mapping, Modeling, and Enhancement

Data



Climate Data

Topography (Slope, Aspect, Elevation)

- Digital Elevation Model (DEM) Data

Geology and Soil Parent Materials

- Geologic formation, member. & sediment properties
- Geomorphic processes
- Spectral data (TM)
- Geologic interpretations

Vegetation (Types & Cover)

- Spectral dato (TM)

Existing Soil Information

Land Use

Process

Soil Pro-Map Preparation

- Composite resource and ancillary information by overlay process
- Extropolate soil informotion from selected sampled areas ond existing soil data
- Mop unit design (bared on needs)
- Delineate soil map units
- Aerial photogtaph (stereo and interpretations)

Field Verification and Pre-Map Refinement

- Field observations ond sampling
- Refine delineations
- Record field notes
- Complete soil map unit descriptions

Final Soil Map & Accompanying Attribute Data

* Soil Survey Enhancement on Rangelands and Wildland Areas—Emphasizes use of geologic and topographic data to supplement soil and landscape interpretations for areas of shallow and medium depth soils, and geologic exposures.

Colorado River Basin. In a" effort to check expected increases in salinity, Congress, in 1974, passed the Colorado River Basin Salinity Control Act (PL 98-569). Amendments to this act in 1984 direct the Bureau of Land Management (BLM) to develop a comprehensive program for minimizing salt contributions to the Colorado River from BLM-administered lands (public lands).

Salinity yields from public lands occur from both point and nonpoint (diffuse) sources, with the latter being the greatest contributor. The primary salt source is highly erodible saline soils derived from the Mancos Shale formation, a Cretaceous sedimentary marine deposit. It ie estimated that within-the Upper Colorado River Basin states of Colorado, Utah and Wyoming-the salinity yield from diffuse sources on public lands approximates 700,000 tone annually (USDI-BLM, 1978).

Past studies, summarized in Schumm and Gregory, 1986, have conclusively demonstrated that salt production ie greatest from steep Mancos Shale terrain when compared to salt production from other land forms such as pediment surfaces and alluvial valley floors, unless these lens steep landforms are highly dissected or contain visible salt deposits (efflorescence). The high production of salt from steep terrain is mainly attributed to high rates of erosion from soils formed directly from Hancos Shale. Variations of salinity on steep Mancos Shale terrain have been documented (Schumm and Gregory, 1986; Jackson and Julander, 1982; Johnson, 1982; Ponce, 1975; Laronne, 1977; White, 1977; and Thorne et al, 1967), but responsible factors (lithology, topography, microclimate, and biological and physical soil formation processes) have been weakly defined.

Therefore, the objective of this study is to define soil salinity variations on steep Mancos Shale terrain and determine the primary responsible factors. Also, the study was designed to define landform descriptors to be used in a geographical information system (GIS) to assist in identifying high salinity concentration areas. With millions of acres of Mancos Shale terrain in the Colorado River Basin, a process to screen acreage for salinity "HOT SPOTS" would prove valuable for salinity management efforts.

STUDY AREA

The study is based on a saline soil inventory conducted by the Bureau of Land Management Montrose District, Colorado during the 1990 field season. The four management areas that were inventoried have been identified for future salinity reduction (USDI-ELM, 1989). Inventory efforts were concentrated in the Elephant Skin Wash area (figure 1) because previous monitoring showed runoff waters from different subbasins yielded different salinity concentrations, and because of visual observations of variable salt efflorescence on badland terrain (figure 2). Thus, the remainder of this report concentrates on inventory results from the Elephant Skin wash area.

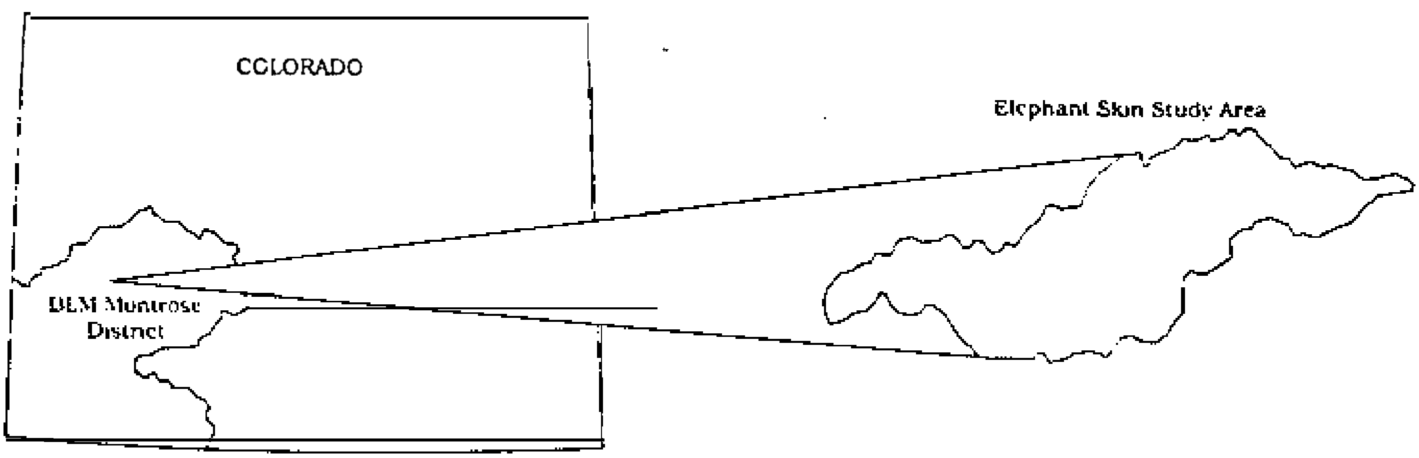
Elephant Skin Wash is located approximately 5 miles northeast of Montrose, Colorado, lying west of the Black Canyon rim. The drainage is 3.70 square miles with the mainstem-ephemeral channel flowing in a westerly direction. Relief varies from 5,720 to 7,076 feet in a distance (basin length) of 4.9 miles. The climate is semi-arid with annual precipitation ranging from 9 to 12 inches. August is the month of heaviest precipitation with most coming from high intensity thunderstorms.

The Elephant Skin Wash Drainage was formed from erosional dissection of a pediment surface into underlying, undivided Mancos Shale. The resultant topography is characterized by steep badlands, occasionally capped with remnants of the pediment surface, and an alluvial valley floor (figures 3).

Steep badland terrain dominates the area. This terrain is unstable as evidenced by mass wasting and the formation of dense rill networks. Instability is especially visible on southern aspects where slopes can exceed 90 percent and watershed cover is often less than 1 percent. Soils are largely undeveloped except for inclusions of shallow, clayey Chipeta and Persayo soils on north slopes (USDA-SCS, 1981). Vegetation is dominated by mat and fourwing saltbush, yucca, and bunchgrasses (Stipa, Elymus and Oryzopsis).

The alluvial valley floor, adjacent to the mainstem channel and larger tributaries, was formed from deposited sediment, eroded from the steep upland terrain. The alluvial valley floor averages 400 feet in width, has an overall down-valley gradient of 2 percent, and is erosionally stable or depositional except for areas of active gullying. Soils are predominantly Billings silty clay loam (USDA-SCS. 1981). Common vegetation consists of shadscale, winterfat and, western wheatgrass.

Land uses include seasonal sheep grazing, off highway vehicle use(OHV) and hunting. surface disturbance from OHV use has resulted in some accelerated



'Figure 1. Study Area Location

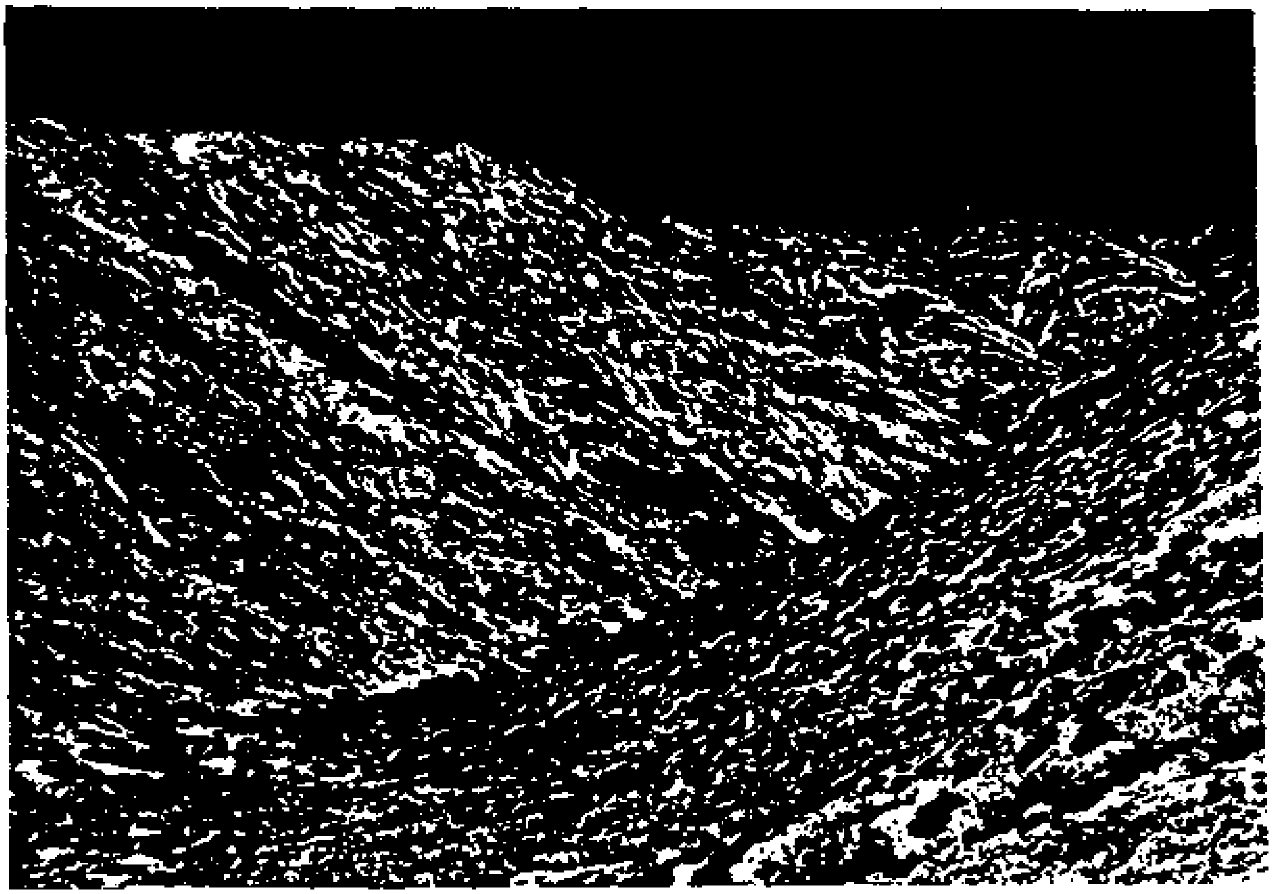


Figure 2. Elephant Skin Wash - Southern (left) and Northern (right) Aspects, Showing Differences in Watershed Cover and Salt Efflorescence.

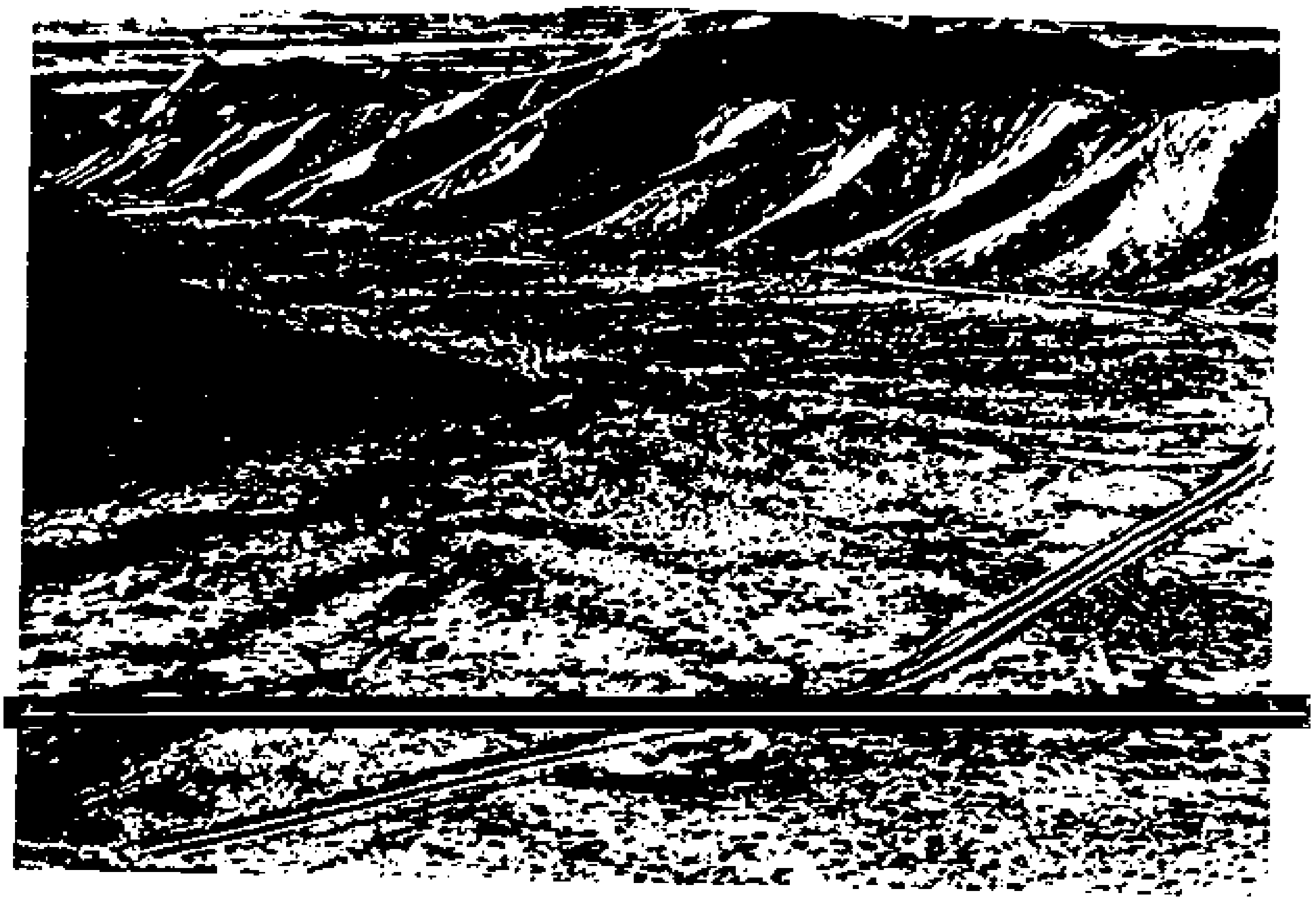


Figure 3. Elephant Skin Wash - Alluvial Valley Floor with Incised Channel and Steep-eroding Terrain.

erosion. Present management limits OHV use to designated roads and trails (USDI-BLM, 1989).

The Elephant Skin Wash drainage is currently managed under a watershed activity plan, with the goal of determining effectiveness of structural measures for reducing salt yields from steep Mancos Shale terrain. At present, three subbssine have functional salinity reduction structures in place.

METHODS

The salinity inventory included both field and laboratory procedures. Field measurements were made in erosional environments (steep terrain) and depositional environments (alluvial valley floors) at a ratio of about 3:1, respectively. Sampling was thus concentrated on the steep erosional terrain in order to define soil salinity variability. Additionally, the steep terrain was inventoried at mid-slope including as many aspects as possible. Sampling transects were established by extended a 100 foot tape along the contour, and elevation, and topographic location (hillslope freeface, debris slope, alluvial valley floor) were recorded. A visual determination was also made as to whether the local environment was erosional or depositional. The hillslope aspect and slope were determined using a compass and clinometer, respectively.

A composite soil sample was collected by coring and combining 10 evenly spaced soil samples along the tape. The samples were cored to a depth of 4 inches, which was estimated to be representative of soil surface salinity (rill development from large runoff events can approach this depth). Two soil cans were filled with the soil sample to determine electrical conductance (EC) and moisture content. Watershed cover was estimated along the transect using a quadrat frequency frame (USDI-BLM, 1985), recording bare ground, persistent and non-persistent vegetation litter, rock, basal cover, and canopy cover (noting whether the canopy hit had underlying cover), until 500 points were documented.

Laboratory procedures included determinations of soil EC, soil moisture content, and watershed and basal cover. soil EC was measured from liquid, extracted from a saturated soil paste, using a CLA 1433.1 Instant EC Salinity Drop Tester. Variation in soil salinity can be indirectly measured by electrical conductance due to its direct relationship with ionic concentration (salinity). Since only relative differences in salinity were needed, absolute values of salinity concentrations were not deemed necessary. Watershed cover was calculated by summing all "on bare ground hits (litter, rock, and canopy and basal vegetation cover - canopy hits with underlying cover were not included, as this would result in a double count) and dividing this by total recorded points. Total live perennial vegetation basal hits were divided by total recorded points to calculate basal cover.

RESULTS

Extreme drought conditions prevailed prier to and during field data collection. Consequently, soil moisture content "ever exceeded 7 percent. Due to such low and static soil moisture Conditions, this variable was dropped from further analysis.

Analyses of soil EC showed differences between values for steep Mancos Shale terrain (erosional environment) and the alluvial valley floor (depositional environment). Soil EC means (table 1) for erosional and depositional sites were compared using the t-test, and found to be significantly different at the 0.001 significance level. That is to say, there is greater than a 99.999 percent chance that the soil EC means from erosional and depositional sites are from different populations. The soil EC mea" for erosional sites is 5.2 times greater than the soil EC mea" for depositional sites. This supports conclusions reached in other studies, previously cited, that show salinity is not as great on alluvial areas as on steep Mancos Shale terrain.

For the purpose of analysis, hillslope aspect for erosional sites was transformed into four aspect zones. These are shown in table 1 (e.g. aspect zone 1 corresponds to northern aspects from 316 to 45 degrees, etc.). An analysis of variance (table 2) shows soil EC values differ between aspects. As shown in the graphical display in table 2 and the soil EC mea" values in table 1, soil EC for aspect zone 3 is significantly greater than all other aspect zones, being 2.2 times higher than the next highest mea", aspect zone 4.

The data obtained in this study do not reflect direct measurements Of hydrologic processes, but the relevant hydrologic processes can be deduced from the indirect observations. Figure 4 (C and D) shows that both watershed and basal cover are weak predictors of soil EC. Values of soil EC are low and relatively constant over a wide range of the higher cover values. Soil EC is

Table 1. STATISTICAL SUMMARY OF INVENTORY DATA

ELEPHANT SKIN WASH

	MEAN VALUES				
	SLOPE %	SOIL EC mmhos/cm	WATERSHED COVER %	BASAL COVER %	SAMPLE NUMBER
EROSIONAL SITES (ASPECT ZONES)					
1 NORTH (316 TO 45 DEG.)	52	3.6	49	12	9
2 EAST (46 TO 135 DEG.)	58	4.5	33	7	8
3 SOUTH (136 TO 225 DEG.)	72	12.2	2	0	20
4 WEST (226 TO 315 DEG.)	51	5.5	35	9	11
COMBINED EROS. SITES	61	7.8	23	6	48
DEPOSITIONAL SITES	5	1.5	51	6	19

Table 2. ANALYSIS OF VARIANCE BETWEEN ASPECT ZONES FOR SOIL EC

Source	DF	SS	US	F	P
aspect zone	3	700.85	233.62	25.79	0.000
ERROR	44	398.63	9.06		
TOTAL	47	1,099.47			

```
                                          INDIVIDUAL 95 PCT CONFIDENCE
                                          INTERVALS FOR SOIL EC MEANS

ASPECT ZONE  N    MEAN    ST.DEV.  ------+---------+---------+---------+
     1       9   3.556    1.373    (-----*-----)
     2       8   4.500    3.231       (-----*-----)
     3      20  12.225    3.764                          (---*---)
     4      11   5.464    2.034          (-----*----)
                                    -----+---------+---------+---------+
          POOLED ST. DEV.= 3.010        3.5       7.0      10.5      14.0
```

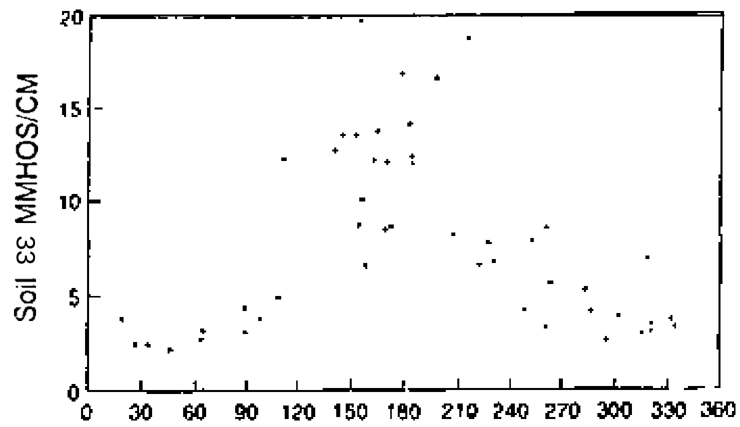


Figure 4A. Aspect vs. Soil Salinity
Erosional Environment

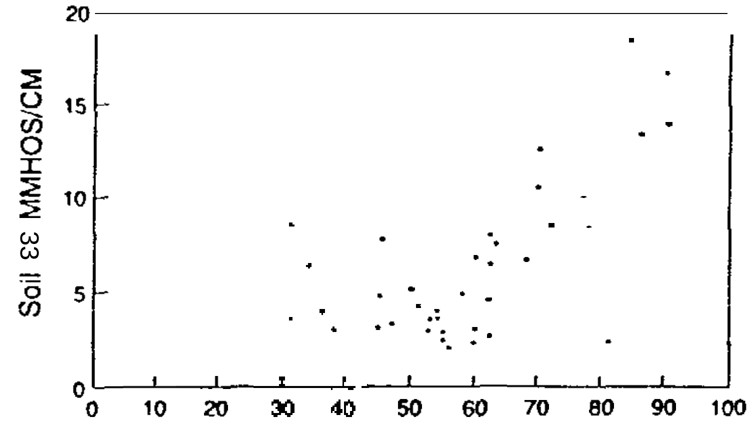


Figure 4B. Slope vs. Soil Salinity
Erosional Environment

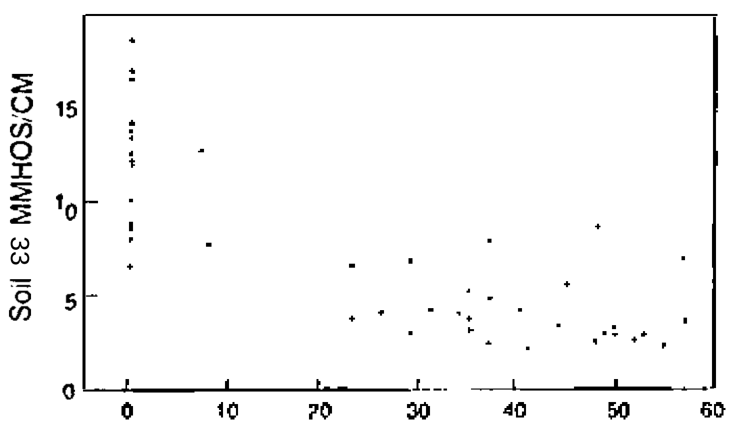


Figure 4C. Watershed Cover vs. Soil Salinity
Erosional Environment

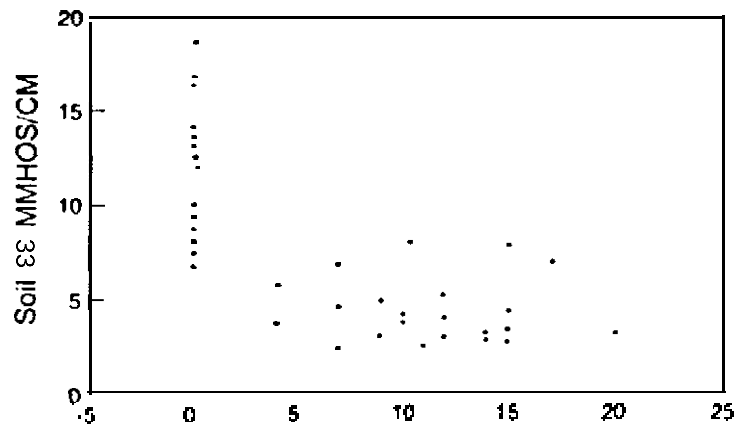


Figure 4D. Basal Cover vs. Soil Salinity
Erosional Environment

highest when cover values are zero, but a wide range of soil EC is possible near zero cover. Slope steepness has an apparent positive relationship with soil EC throughout the measured range; however, the measured range does not extend below 30 percent. Soil EC not only shows a distinct pattern with hillslope aspect, but measured values exist over the full range of aspects. Hydrologic processes vary with aspect due largely to variation in exposure to solar radiation.

The exposure of a hillslope to solar radiation has a marked affect on microclimate and the rate at which geomorphic processes operate (Branson et al, 1981). Northern aspects receive the least better soil development and increased vegetation cover. On northern aspects, lower soil erosion and higher infiltration rates result in lower surface soil salinity. Surface salinity variations with aspect should be interpreted as

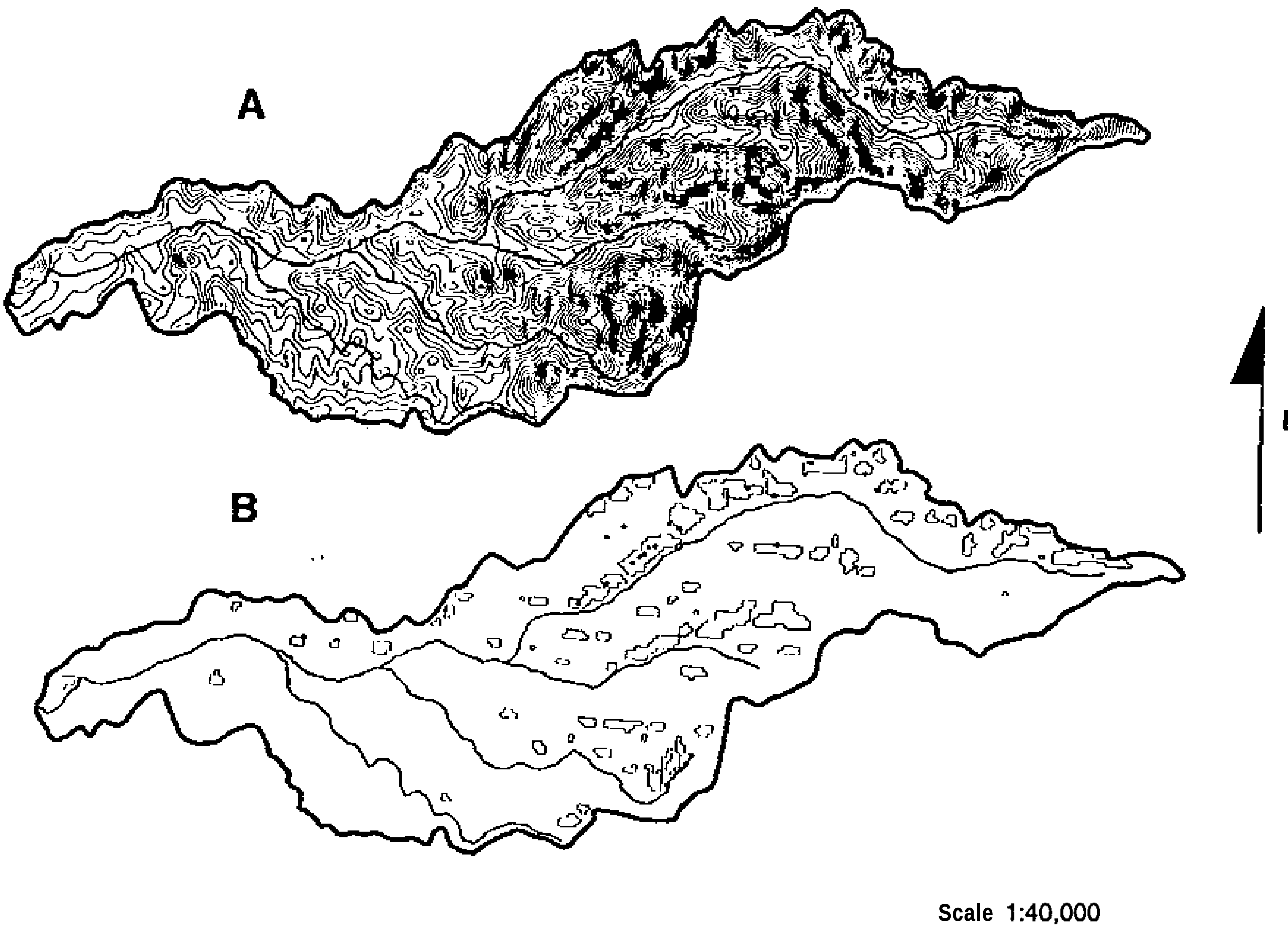


Figure 5. Elephant Skin Wash

A. 7-meter Contour Intervals and Major Drainages

B. DEM-generated Southern Aspect Parcels (slopes 30% or greater), and Inventory Transect Locations on Southern Aspects (+)

of Elephant Skin Wash, an attempt was made to delineate the most saline areas, i.e., steep southern aspects. Hap B of Elephant Skin Wash (figure 5) shows parcels where slope is greater than 30 percent (approximately the lower limit of slopes measured on southern aspects in erosional environments) and hillslope aspect is between 136 and 225 degrees (southern aspect). To determine if transects conducted on southern aspects were representative of the parcels identified by the DEM. transect location6 were added to Hap B. All but one of the inventory transects fall within or immediately adjacent to the defined parcels. The outlying transect results from a GIS limitation on pixel size of 30 x 30 meters. Small segments of steep southern aspect that fall short of these dimensions can not be defined by the DEM.

Past salinity reduction efforts by the BLM have included restricting surface disturbing activities to improve watershed condition and structural controls to retain saline runoff and/or sediment. Applying these techniques directly to steep Mancos shale terrain has limitations. Due to the harsh environments1 conditions on steep southern aspects., the potential for improving the hydrologic condition on these areas is low. However, salinity reduction benefits could be realized by optimizing watershed condition on debris elopes and alluvial areas receiving runoff from steep southern aspects. Additionally, it is important to maintain good watershed condition on the remaining aspects (east, west, and north). Since surface soil salinity on steep terrain has an inverse relationship with watershed cover, reducing cover would increase erosion and salinity.

Due to the high cost of constructing and maintaining structures in Mancos Shale-derived soils, these should only be considered where other management options are not feasible or when other resource benefits (e.g. riparisn, wildlife, livestock, etc.) can be achieved simultaneously. To optimize salinity reduction benefits from structural controls on steep Mancos shale terrain, they should be located where the largest percentage of the drainage area is comprised of steep southern aspects.

For deeign of structures and management of surface disturbing activities considered effective in reducing salt yields, see USDI BLH, 1978; 1980; end 1984.

LITERATURE CITED

Branson, F. A., and Owen, J. B. 1970. Plant cover, runoff, and sediment yield relationships on Mancos shale in Western Colorado. Water Resources Research, vol.6, no.3, June, 1970.

Branson

Thorne, J. P., Wilson, L., Hutchings, T. B., and Swenson, J., 1967, Chemical and physical properties of soils in the Carbon-Energy area Utah; Utah State Univ. and Utah Agr. Exp. Sta., URS39:37.

U.S. Dept. of Agriculture, Soil Conservation Service. 1981. Soil Survey of Paonia Area, Colorado; Parts of Delta, Gunnision, and Montrose Counties. 184 pp.

U.S. Dept. of the Interior, Bureau of Land Management. 1978. The effects of surface disturbance on the salinity of public lands in the Upper Colorado River Basin, 1977 Status Report. Denver, Co. 180 pp.

----- 1980. Control of salinity from point sources yielding ground water and from diffuse surface runoff in the Upper Colorado River Basin, 1978-79 Status Report. Denver, Co. 37 pp.

----- 1984. Results of Bureau of Land Management studies on public lands in the Upper Colorado River Basin. 1980-82 Salinity status Report. Denver, co. 54 pp.

----- 1985. Rangeland Monitoring Technical Reference 4400-4 and 7

----- 1987. Salinity control on BLH-Administered Public Lands in the Colorado River Basin. A Report to Congress.

----- 1989. Uncompahgre Basin Resource Management Plan and Environmental Impact Statement. Montrose District, Colorado.

White, R. B., 1917, Salt production from micro-channels in the Price River Basin, Utah: unpub H.S. Theses, Dept. of Soil Sci. and Biomet., Utah State Univ., 69 p.

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

The National Long-Term Soil Productivity Study and Site Installations on Volcanic Ash soils

presented by

Deborah Page-Dumroese

U.S. Forest Service

Moscow. ID

What is it?

The long-term soil productivity (LTSP) trials are a joint effort of the research and administrative timber and soil arms of the USDA Forest Service. It is a long-term, designed stress experiment which will answer some basic questions about process science and land management practices. It will try to define what the inherent potential of the land for net primary productivity is, how this potential is altered by changes in organic matter content and soil porosity, and how we can change the current monitoring standards at the National Forest level.

The idea is not to mimic operational practices, or our best guess at what may be operations in the future, but to manipulate the fundamental properties of a site that are always affected to some degree by timber management. This will help make the results usable by other investigators across the country.

Sustaining the wood-growing capacity of commercial forests is a fundamental goal of forest management in North America. The Multiple Use Sustained Yield Act of 1960 binds the Forest Service to achieve and maintain outputs of various renewable resources in perpetuity without permanent impairment of the productivity of the land. Section 6 of the National Forest Act of 1976 (NFMA) charges the Secretary of Agriculture with ensuring research and continuous monitoring of each management system to safeguard the land's productivity.

Objectives

The principal objectives of the LTSP installations are to (1) define the potential productivity of forest sites along a soil and climatological continuum, (2) understand how modifications in site organic matter and soil porosity affect the fundamental processes controlling site productivity, (3) develop and validate soil quality monitoring standards for assessing changes in potential productivity, and (4) develop models for generalizing our results over broad geographic areas.

Treatments

This study utilizes a 3*3 factorial design with the following compaction and organic matter treatments.

Compaction level	Organic Matter level
No compaction	Bole only removal
No compaction	Bole and crown removal
No compaction	Bole, crown, and forest floor removal
Moderate compaction	Bole only removal
Moderate compaction	Bole and crown removal
Moderate compaction	Bole, crown, and forest floor removal
Maximum compaction	Bole only removal
Maximum compaction	Bole and crown removal
Maximum compaction	Bole, crown, and forest floor removal

No compaction is the "natural" bulk density of the site, medium compaction is a intermediate level of compaction, and maximum compaction results in a soil bulk density of about 20% less than the root-growth limiting bulk density of the specific soil. Each location is also encouraged to install ameliorative treatments such as fertilization or soil ripping.

The Intermountain/Pacific Northwest Study Sites

In the Inter-mountain Region there is one replication that has the pre-harvest data collected, timber harvested, trees planted, and first year post-harvest measurement taken. This study site is located on a bench adjoining the Priest River at the Priest River Experimental Forest, Priest River, ID. The study area habitat type is classified as Tsuga heterophylla/Clintonia uniflora. The soil has a silt loam surface layer 28 to 38 cm thick derived from Mount Mazama volcanic ash. The subsoil is 50 to 75 cm thick. The soil is a medial, frigid Ochreptic Fragixeralf (Mission series).

Treatments were applied as described above. Moderate compaction was achieved by driving a Grappler log carrier over the plots twice. Maximum compaction was obtained with four passes by a D-6 Caterpillar tractor. Bulk densities were increased from 0.65 g/cc (no compaction) to 0.81 g/cc (maximum compaction). Overall, after the first growing season, rooting depth was significantly less in the moderate and maximum compaction plots that had total organic matter removed as compared to the no compaction plot with no organic matter removed. Ectomycorrhizal short root counts were greatest in the high compaction, total organic matter removal plots. This corresponds to other research in this region that correlates high ectomycorrhizal counts with stressful or harsh environments.

Another set of three replications will have the pre-harvest data collected in the summer of 1994. Harvesting will begin in the fall of 1994. These plots are located on the Payette National Forest near Council, ID.

In the Pacific Northwest Region, one replication near Troy, OR on the Walla Walla National Forest has the pre-harvest data collected. Three replicates on the Umpqua National Forest, Toketee Ranger Station will have the pre-harvest data collected in the summer of 1994 with harvesting to take place soon after that.

All of the sites in these two regions are on volcanic ash cap soils (principally the Mount Mazama eruption). Volcanic ash soils are susceptible to compaction and given the slow rate of natural recovery, long-term site degradation is an important concern for land managers. Long-term productivity is of particular concern when uneven-aged management and multiple stand entries are becoming emphasized. This study, and the other sites around the country, will help identify the levels of compaction and organic matter that will still maintain productivity.

Ecosystem Inventory and Analysis in the Northern Region

C. Lee Maynard
Soil Scientist/Ecologist Region 1

'If we are serious about sustainability we must raise our focus in management and planning to large landscapes and beyond' (Odum, 1904).

The Northern Region of the U.S. Forest Service has recently been in the process of implementing the directions for ecosystem inventory and analysis detailed by the National Ecosystem Mapping Hierarchy (USDA, 1004). In general. the purpose of ecological unit inventories is to provide information about biological capabilities, limitations to land use, and management opportunities at both the broad (landscape level) and refined (project level) scales. Using methods outlined in the Ecological Classification and Inventory Handbook, a soil resource inventory usually forms the basis for the development of ecological unit inventory (Region 1 USDA, 1903). Within the Northern Region consistent soil resource map units have been delineated at 1:24,000 for dominant soil subgroups in conformity with the Land System Inventory (NCSS survey) mapping procedures and are referred to as 'landtypes'.

Using differentia inherent to the landtype delineations a systematic stratification of a landscape or ecosystem can be generated to provide a Qeoclimatic template upon which other physical and biological properties can be interpreted. This template is based on predictable. inherent landscape features which are intimately related to ecosystem composition, structure and function. It is also nested within the section and subsection levels of the National Ecosystem Mapping hierarchy. Using this template it is possible to conduct and ecosystem inventory efficiently and accurately so that consistent, statistically valid analysis can be performed. By displaying the range of existing information in the context of this consistent environmental template it is than possible to identify data gaps and additional inventory needs.

To facilitate broad scale ecosystem analysis in the Columbia and Missouri river systems, soil scientists within the Northern Region are in the process of map ping associations of existing landtype delineations, These associations stratify environmental site data by variables having the greatest predictive power with regard to the phenomenon being evaluated. To address both upland and riparian land use questions such as susceptibility and response to disturbance, two sets of 'Landtype Associatons' are being mapped and characterized. The first, with an emphasis on characterizing watershed, stream and riparian properties (aquatic landtype associations-ALTA's); and a second, the (terrestrial landtype associations-TLTA's), with an emphasis toward characterizing the inherent site properties of upland environments.

Aquatic landtype associations are being mapped at a scale of 1:100,000 with delineations based on grouping landtypes with similar landform and geologic properties, The use of these differentia is based on the assumption that landiorm and geology are the two variables which can be mapped consistently at the landscape level, that mosl closely predict significant changes in inherent watershed, stream and riparian properties. Stratification of the landscape based on these criteria provides for the development of map units with predictable ranges in drainage density, erosion properties. valley-bottom and stream width and gradient attributes, dominanl riparian soil and vegetation types, and streambed structural features (i.e. pool/riffle ratios) and panicle size distribulion.

Terestrial land type associations, also mapped at the 1:100,000 scale will provide map units capable of predicting general landscape patterns in the distribution of dominant soil and vegetation groups, and natural disturbance regimes. they are being developed based on the predictive value of landform, geology, soils, local climatic regimes and potential vegetation.

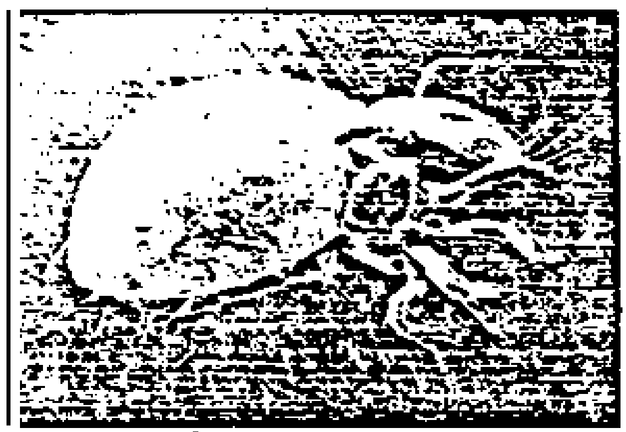
Due to the extensive volume of spatial and attribute data associated with ecological analysis units, a geographic information system is a highly valuable. if not essential tool. Depending upon the size and complexity of the analysis area, the iterative number of structural and biological combinations can be extensive. Computerized mapping tools are essential for the efficient storage, retrieval and manipulation of the information necessary for accurate ecosystem characterization and interpretation. In a GIS, landtype associations can be assigned to landtype polygons and spatially displayed, allowing the extent and distribution of each unique delineation be evaluated and the ecosystem to be characterized by the attributes of its componenls. In addition, tabular data summaries of LTA properties such as erosion rates and sediment delivery features can be complied and statistically analyzed. When stream and watershed delineations are intersected with LTA's and evaluated in the context of their LTA components, landtype association attribute data can be used to describe the range of habitat paramelers for aquatic, riparian, and upland species of both plants and animals. The use of a GIS allows for a simultaneous analysis of multiple scales using the same analytical framework throughout the process.

Following the environmental characterization provided by the landtype association template, disturbance history is then introduced into the analysis, With the introduction of disturbance history (bolh natural and management induced), and other existing condition informalion it is possible to conduct valid comparisons between potential and exisling conditions for any selected site within a delineation. The ecological impacts of current management activities can then be monitored and evaluated by the same measurable parameters used to inventory and charanerize the overall landscape, and the components of its ecosystems. Management guidelines may also be developed based on those same measureable parameters of site and soil properties that accurately reflect change over lime. Likewise, rehabilitation for componenls of highly disturbed ecosystems (i.e riparian areas, stream segments or watersheds) can then be proposed with an ecological framework as their foundation.

Denizens of **the Soil:** Small, but Critical

by Andy **Moldenke,** Research Entomologist, **Oregon State** University. **Corvallis, Oregon**

Very few people really understand how soils work. I'd like to give



Pentoilje oribatid mite

vertebrates in that experiment. What

An oak tree puts lots of chemicals in its leaves called phenols that prevent caterpillars from destroying the trees. When the leaves die and enter the litter on the ground, all those chemicals are still in the leaf. When a millipede or an earthworm comes along and starts to eat that leaf, the pH changes and the phenols polymerize and form a great big plastic rubbery mass killing the millipede. However, on clay soil, a little springtail lives in the soil. At night, before it comes up to feed on the litter, it fills its belly with inorganic clay particles. Then it comes up to eat fungi and leaves and litter. The inorganic clay particles in the gut prevent the polymerization from taking place and the springtail lives and grows happily. As a result, the nutrients in that ecosystem cycle; they don't pile up on the ground. The moral of the story is that the productivity of that entire forest ecosystem is basically the result of one little arthropod in that soil.

The last example is another one from oak forests in England. Joe Anderson went out in oak forests in England and brought all the different soils back to the lab. He sterilized those soils killing the bacteria, fungi, arthropods, worms, etc. Then he added back to the

Denizens cont.

Continued from page 3

species of arthropods in every square meter of soil. There are literally hundreds of thousands of individual arthropods per square meter of soil. These are all things you can see walking around in your hand; they've got eyes they've got legs, they get hungry, they get tired, they lust after their mates, they do little mating dances, they have behavior. These arc not bacteria, they are not amoebae, these are rather highly complicated organisms.

You can find a variety of these critters any time you go out and take a shovelful of dirt. The most common things in the soil arc oribatid mites, and the variation among mites is amazing. The biggest one is the size of a period on a printed page; the smallest one is 1/250th of an inch in length. There is a long-legged otibatid mite. There is a flat-backed. aircraft-carrier oribatid mite. There are oribatid mites that have great big ostrich plume feathers all over their bodies.

There are about 250,000 onbatid mites in every square meter of soil. One is called a pen-knife oribatid mite. When it's at-tack@ it folds up like a turtle. One is what I call a stegasaurus onbatid mite. The mite itself is very small and has big moveable flat plates covering the body. Some of them have basically bombay doors: flexible wings that they can retract their legs into. One even has a special trap door that comes up and protects the at-tire bottom of the face, all the little appendages for eating. There is another oribatid mite that has a cannon on the side of the body. It shoots a sticky goo when • aackul. There is one that hides by covering the whole top of the body with mud that it cements on top.

Oribatid mites are fungal feeders. They eat fungal hypha with great lobster-like claws. A fungal hypha is like a piece of spaghetti with a skeleton on the outside. so the mire has to crush it and crack it open with shears and then jab them into its mouth like you would spaghetti. Another species feeds by inserting the whole feeding aparatus into the breathing pores on the pine needles. When they feel a fungal hypha, they grab it. As they pull one chelicera, the other one goes in and it all works hydrostatically. There are also some oribatids that suck bacteria through straws. Huge muscles that work the suction cup inside the mouth attach to the back of its head.

The other major group of soil dwellers are springtails. There are about 100.000 per square meter out in the forest. They're called springtails because they have this tail at the end of the body that normally is held underneath under very high blood pressure. When attacked, they have a little clamp which releases and catapults the springtail way up into the air. A springtail that may be 1112th of an inch long can jump maybe a yard away. A very effective device. Another springtail is all covered with scales like the wings of a butterfly.

Now springtails and oribatid mites are just two things in the soil. Any meter of soil has lots and lots of things that live in it. Bright, red bdellid mites are not only in the soil. Thy are used in biological control in many parts of the world. In Oregon we use them heavily in the pear industry down in Ashland and Medford. There are pseudoscorpions, skunk spiders. centipedes, aod snail-feeding beetle.

The point that I want to make is that all the upper layers of the soil are biogenic. microstructure of the soil is fashioned arthropods and worms, and therefore the major chemical and physical properties a directly under biocontrol. Every chemic and physical property of soils is basically driven by the surface:volume ratio of the particles that make it up. The upper lay of soil are composed of the living bodies countless invertebrates, fungi, and bacteria, and the skeletons of all the dead ones well.

Oregon State University is actually the fi place in the U.S. where researchers h actually made slides of soil and looked at them. We found that even deep down in the soil all of it is made up of invertebrate fec Most things eat the manure or feces of other things. The total nutrient content of the soil is actually of secondary importance. Also of secondary importance whether the nutrients are immobilized in the organic debris or whether they're immobilized in the inorganic phase down the mineral soil. The critical paramete is how dynamic soil-converting processes are. In other words. how many dung beetles you have in the system. and how ma species do you have in that system? Now. when I occasionally teach a lecture to for groups in ecology at osu. the first thin do when 1 come in to the board is I write 'BPGT." I write those on the board at the beginning of a lecture and I tell everyone the beginning that they arc supposed to be able to tell me what that means. I'll tell you what it is and make a lo story short: "Bug Po Grows Trees."

I want to finish up by g ing you three facts for your consideration, because you've probably nev thought like a root befo I want you to think like a root. The first fact is th plant roots are only p sive sponges. They can do nothing themselves. Th

Stilt-legged mite with shed larval skins on back

Denizens, cont.

continued from page 4

...ey can effect no process of nutrient solubility; they can make no chemical change ... the soil. The second point is that soil ...ical transformations—the decomposition, the mineralization, and the recycling—are actually caused by the extracellular digestion of the secreted enzymes of bacteria and fungi in the soil. There are some abiotic changes that take place in the soil, freezing and thawing and drying, but ...ose generally take place at times when they're not terribly useful to the plants. The third point is that absorption of nutrients is directly dependent upon the cell's surface area. In all soils, anywhere you are in the world, the surface area of soil microbes is millions, billions, zillions times that of plant roots. Plant roots are at a competitive handicap to get those nutrients.

So in the real world, how does it work'? How do plants grow? On the one hand in the real world, you have a plant that's got a lot of energy from photosynthesis but it needs nutrients to grow. On the other hand you have a soil microbe that's got lots of nutrients but it needs energy to grow.

So there're two solutions to the problem. The first solution is soil critters—anything from protozoa to the two-foot long Oregon earthworm. Nutrients am either pooled in ...al plant cells in the soil or in the tissue of the living microbes themselves. Each time one of those invertebrates feeds, it ...te the physical state of those nutrients ...ually by munching it up with its jaw. It exposes those nutrients to new kinds of microbes in its own gut. It extracts its own ... percentage as tax. The invertebrate grows and then it defecates, and for a few seconds or at most a few minutes there are ... the nutrients available to the community at large. As soon as they're grabbed up they are immobilized again. Now remember everybody in the soil is eating everybody else's pre-packaged resources. This process is going on all the time. Sooner or later some of those nutrients are going to be ...ed close enough to a root that the root can grab it.

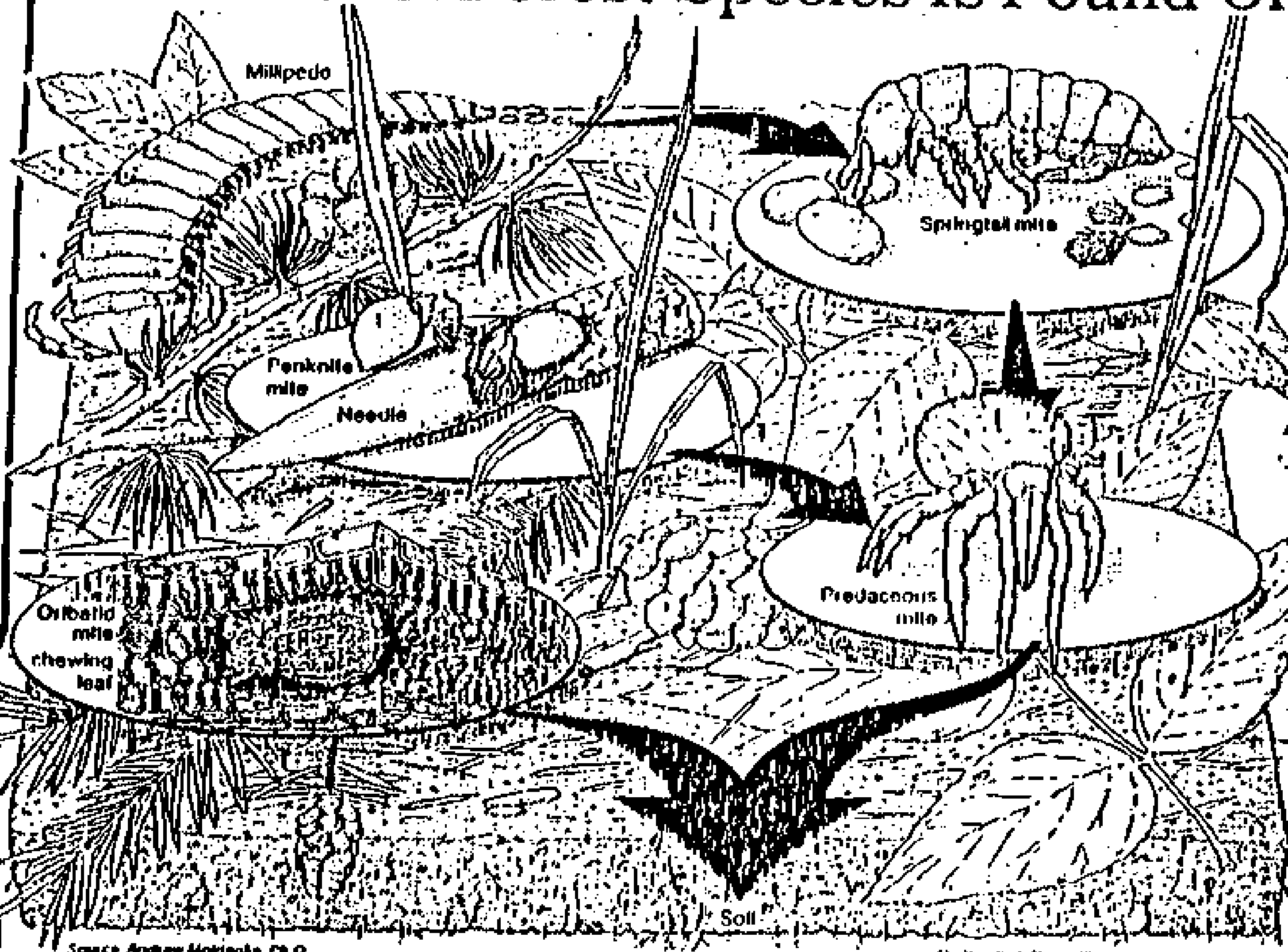
The second solution to that problem is an incomplete solution: a mycorrhizae. A mycorrhizae is a symbiosis between a fungus and a plant root. The fungus makes an attachment to the plant root and grows out into the soil. As it grows out into the soil, the plant pumps fuel into the mychorrhiza (sugars fixed in photosynthesis), the mycorrhiza dissolves its surroundings, and what it doesn't want it sends to the plant root.

There are several living species that live in the soil, each one responding to its own set of environmental variables, its own unique web. We can use that information as indicator species. If you bring me back a vial full of soil from an area I've studied, I can tell you the time of year you took that sample. I can tell you the stage of forest succession. I can tell you the altitude you took it from. I can tell you the overstory canopy. I can probably tell you something about the understory canopy. I can tell you whether it was from a north-facing slope, east-facing slope, ac. If you took it from Sisters and the Ponderosa Pine forest there, I could tell you how far it was from the nearest tree trunk, whether that tree trunk was alive or dead, or whether it was a juniper or a Ponderosa Pine. I can tell you that because of the species composition of that soil community.

So the structure of the actual community an

One species that can't be substituted for by any other?

A Wealth of Forest Species Is Found Underfoot



Manufacturing Fertility for the Forest's Soil

Tiny creatures eat forest debris, and each other, in a process that breaks plant matter into smaller and smaller pieces and exposes it to decomposer bacteria. A millipede devours a pine needle; its feces feed a springtail mite. A penknife mite also eats pine needles. A predaceous mite feeds on other mites. An oribatid mite eats leaves.

Army of unseen animals recycles forest detritus.

By JON R. LUOMA

ENVIRONMENTALISTS have focused great attention on spotted owls and ancient trees in the forests of the Pacific Northwest. But a small cadre of researchers who have been studying insects and other invertebrates of the forest soil now say that the old-growth forest has been hiding underfoot perhaps its most astonishing biological secret.

Detailed studies of arthropods including insects, spiders, mites and centipedes in the soil of the old-growth forest suggest that the soil under the region's forest floor is the site of some of the most explosive biological diversity found on earth. Some experts believe that these temperate forests harbor a diversity of species that approaches the much-touted biological diversity of tropical rainforests.

As part of one of the most detailed analyses of arthropod diversity ever conducted, scientists now estimate that about 8,000 distinct species inhabit a single study site in an Oregon old growth forest, most of them in the soil. The findings are "especially surprising because we think of that kind of diversity as being related to the tropics, not the temperate forests," said Melody Allen, executive director of the Xerces Society, an invertebrate conservation group.

But scientists say that those num-

Continued on Page C9

In Old-Growth Forests, a Wealth of

Continued From Page C1

bers are far less significant than strikingly hints of the role insects and other arthropods apparently play in the temperate forest ecosystem. "We've come to suspect that these invertebrates of the forest soil are probably the most critical factor in determining the long term productivity of the forest," said Dr. Andrew Moldenke, an entomologist Oregon State University in Corvallis.

In tropical rainforests, twigs, fallen leaves and dead organisms are decomposed rapidly by bacteria and fungi that thrive in the warm, wet ecosystem. But in the temperate forests of the Pacific Northwest, arthropods appear to be linchpins in the decomposition process.

Billions of extremely tiny insects, mites, "microspiders" and other invertebrates serve as biological recycling engines that reduce tons of organic litter

New techniques for identifying and examining soil samples offer great promise in increasing understanding of the rich ecosystems in the forest soil. Researchers caution that they still know "almost nothing" about precisely how all the thousands of arthropods interact and survive.

Catalogue Is Only Begun

Yet, according to Dr. John Lattin, director of the Systematic Entomology Laboratory at Oregon State University, the number of species catalogued so far probably represents less than half of the estimated species present on just the Andrews Forest site.

mites, beetles, centipedes, pseudoscorpions, springtails, "microspiders" and other creatures.

Dr. Moldenke and his students have in recent years begun studying soil and arthropod ecosystems using a technique called thin-section microscopy, originally developed by oil-exploration geologists. That approach has revealed that the very structure of temperate forest soils, and hence much of their biological and chemical

plished by infusing, in a pressure chamber, epoxy into a carefully removed core of soil. Once the epoxy hardens, the now rock-like soil sample can be sliced into exceedingly thin wafers and polished smooth for examination under a microscope.

The technique preserves the soil with its parts in place, from larger bits of partly decayed plant matter to microscopic soil particles. On one such slide, Dr. Moldenke showed a visitor the image of what was clearly a needle from a coniferous tree, partly decayed, but still mostly intact.

Magnified, however, the small needle in the soil turn out to be an assemblage of thousands of infinitesimal fecal pellets arranged in almost precisely the shape of the needle. Not long after a bit of vegetation falls, millipedes descend on it, grinding it up. Chewed up bits of vegetation pass through the insects' digestive tracts in a matter of seconds and are redeposited virtually in place as a pellet.

A closer microscopic look at each pellet reveals that each is nothing more than chopped up bits of plant cells, reassembled into a sort of jigsaw puzzle of plant matter. These tiny clumps of cell tissue will, in turn, be eaten by other arthropods.

Deeper in the soil, the jigsaw like cell tissues become progressively

Working in turn, tiny creatures gradually turn insoluble cells into nutrients.

less recognizable, as successive waves of "microshredder" arthropods crush and partly digest these fecal pellets, like a series of minute millstones grinding food down to finer and finer bits.

Yet for a living ecosystem to perpetuate itself, nutrient chemicals that are locked into insoluble organic mole- ... dead organisms ... luble to be

ly, insoluble ce... oluble nutrients

In the ol... cess is ... slow. Soil ... completing ... some giant ... earth abou... ed land.

Precisely ... and chemical ... which of th... survival is ... others, are n... ly understoo... point where ... more about t... at the end of ... was known ... 19th," Dr. M...

Mysterious D...

And resea... why there ar... species in th... "There are ... about ...

[redacted]ed a[redacted]site i[redacted]

136

THE NEW YORK TIMES, TUESDAY, JULY 2, 1991

...wth Forests, a Wealth of Species Is Found Underfoot

plished by insinuating, in a pressure chamber, epoxy into a carefully removed core of soil. Once the epoxy hardens, the now rock-like soil sample can be sliced into exceedingly thin wafers and polished smooth for examination under a microscope.

The technique preserves the soil with its parts in place, from larger bits of partly decayed plant matter to microscopic soil particles. On one such slide, Dr. Moldenke showed a visitor the image of what was clearly a needle from a coniferous tree, partly decayed, but still mostly intact.

Magnified, however, the small needle in the soil turn out to be an assemblage of thousands of infinitesimal fecal pellets arranged in almost precisely the shape of the needle. Not long after a bit of vegetation falls, millipedes descend on it, grinding it up. Chewed-up bits of vegetation pass through the insects' digestive tracts in a matter of seconds and are redeposited virtually in place as a pellet.

A closer microscopic look at each pellet reveals that each is nothing more than chopped-up bits of plant cells, reassembled into a sort of jigsaw puzzle of plant matter. Then any clumps of cell tissue will, in turn, be eaten by other arthropods.

Deeper In

Working in turn, tiny creatures gradually turn insoluble cells into nutrients.

less recognizable, as successive waves of "microshredder" arthropods crush and partly digest these fecal pellets, like a series of minute millstones grinding food down to finer and finer bits.

Cell tissue cannot dissolve in water. Yet for a living ecosystem to perpetuate itself, nutrient chemicals that are locked into insoluble organic molecules in tissues of dead organisms must somehow be made soluble to be taken up by the roots of plants.

Each arthropod extracts only the whisper of nutrition from food that was once living cell matter. But in the process, each arthropod exposes more surface area to decomposer bacteria. The bacteria, in turn, biochemically process a trace more cell matter on the pellet's surface into soluble

In the old growth forest, the process is sometimes excruciatingly slow. Soil organisms are just now completing the decomposition of some giant trees that crashed to earth about the time Columbus sighted land.

Precisely how all these biological and chemical interactions occur, and which of the thousands of species' survival is key to the survival of others, are matters that remain poorly understood. "We've reached the point where we know just a little bit more about the fauna of the forest soil at the end of the the 20th century than was known at the beginning of the 19th," Dr. Moldenke said.

Mysterious Diversity

And researchers still don't know why there are so many invertebrate species in the forest soil first place. "There are still a lot of questions about why there's so much diversity," said Dr Lattin. "But the fact that they are out there in such great numbers suggests that they play a very, very important role in the ecosystem."

Dr. Moldenke agreed "I don't

One potential practical benefit of all that diversity lies on the research horizon; the arthropod communities may be able to serve as an exquisitely tuned gauge of changes in the forest ecosystem.

In 1986, Dr. Moldenke began plugging data about the tens of thousands of arthropods collected from dozens of sites into a computer for statistical analysis. The results were so surprisingly consistent that he worried that the computer had been misprogrammed. Computer analysis proved

By analyzing such characteristics among thousands of arthropod data-points, a researcher may be able to monitor changes at a site brought on by, say, global warming or herbicide use.

"A tree doesn't tell you too much about what's happening," said Dr. Moldenke. "If you want to monitor change in the environment, the worst thing to look at is an organism that's centuries old. But the arthropod community allows to look at what's happened over a different time frame, as little as a few months. And you can only do that because you have all that diversity."

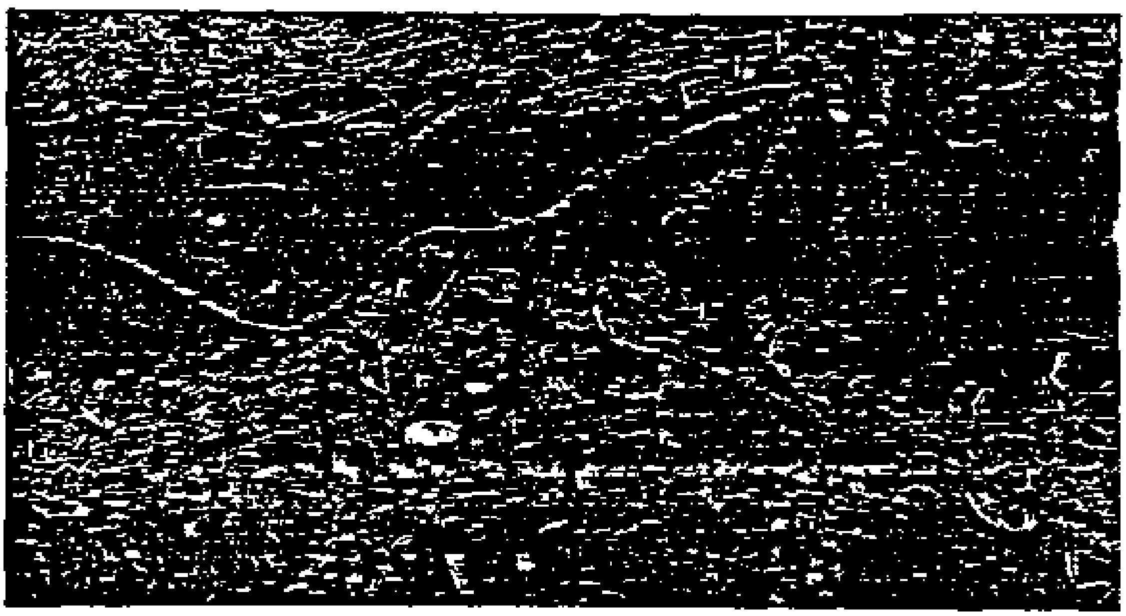
137

One Hundred Twenty Thousand Little Legs

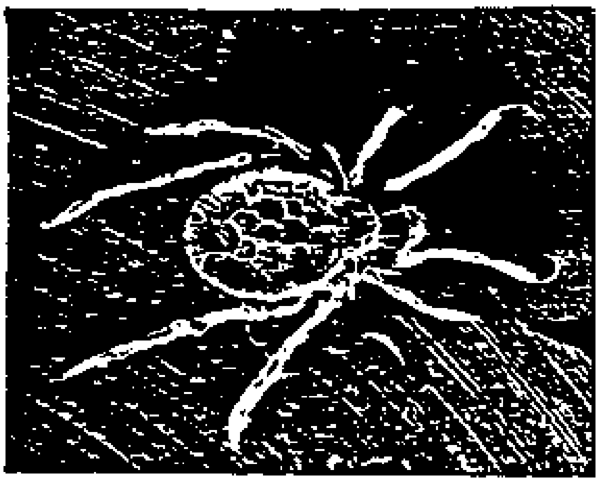
Andrew ***Moldenke***

Nowhere are the critical roles of insects and other invertebrates easier to understand, yet more poorly investigated, than in forest soil. Proper growth of forest trees depends on receiving appropriate nutrient levels and water from the roots. The metabolic activity of fungi and bacteria liberate nutrients through litter decomposition and chemical transformations of the soil. Experiments have shown that insects and other microarthropods control these rates.

No one has ever counted the number of kinds of bacteria and fungi under a single tree in the forest; no ecologist knows just how many chemical transformation processes are necessary for the full recycling of nutrients. We do know, however, that in undisturbed forests there are 200 to 250 species of invertebrates per square meter of forest soil in the Pacific Northwest – probably literally thousands of kinds in all the microhabitats of a square mile of forest. There are 100,000 to



Dead logs are crucial for forest health. The final step in nutrient recycling is uptake of nutrients by mycorrhizal fungi, which pass nutrients to the trees in exchange for phobsynthetic sugar pumped to the roots. Here the mycorrhizal fungus* Russula emetica *is attached to the roots of western hemlock Photograph 0 1990 by Gary Braasch.



-Odontodamaeus veriomatus is *one of the larger (750 microns or about .03 inch) fungiwrous oribatid mites There are 100,000* to 200,000 *oribatid mites per square meter of undisturbed Pacific Northwest forest Scanning* electron *micrograph by A. H. Soeldner.*

200,000 oribatid mites per square meter of undisturbed forest, including perhaps as many as 75 species. Forest ecosystems ***cannot*** afford to lose species such as these, which are involved in critical nutrient recycling.

In our conifer forests, the pioneering work of Forest Service mycologist Jim Trappe has shown that most essential nutrients are passed to trees through a network of symbiotic fungi known as mycorrhizae. **Mycorrhizae** may be microscopic fungi deep within the tree roots, dense sheaths offungal tissue wrapped around the root tips, or even meter-wide mats of woven **fun**gal hyphae permeating the soil while attached to the tree root. There might be as many as 150 different kinds of mycorrhizae on the roots of a single Douglas-fir tree. Different kinds **of** my corrhizae provide different services to the tree, such as nutrient uptake and resistance to drought and disease.

The mycorrhizae don't act alone. Many different types of soil bacteria and fungi are required to perform the many transformations necessary to break down the complex organic chemicals in litter, wood, and carcasses. The role of soil invertebrates is to facilitate these processes by stimulating the growth of microbes, mixing the substrates, aerating the soil, and transporting spores and living **fungal** hyphae to a place where they can grow, thereby driving the succession of the myriad different microbial species living in the soil.

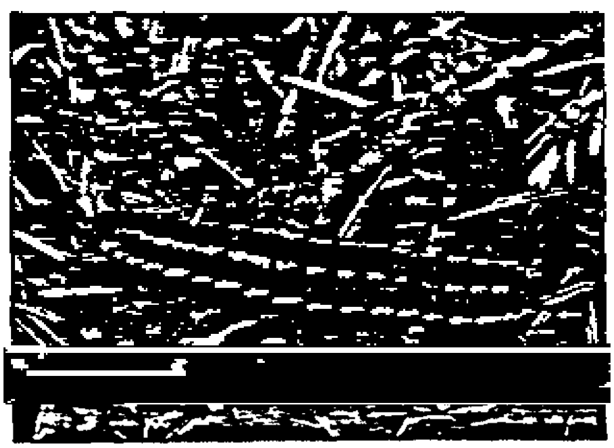
The strikinglycolored millipede ***Harpaphe haydeniana*** is a crucial ecosystem link. It grazes on fallen conifer needles, and by crunching up many plant ceils, mixes their contents with the bacteria in its gut. Then it deposits a fecal pellet, which is attacked by a different set of bacteria which further the decomposition process. The fecal pellet is invaded by fungi, eaten by a smaller arthropod like the **chocolate-**brown oribatid mite ***Odontodamaeus veriornatus,*** exposed to yet a different set of enzymes and gut bacteria, and transformed into smaller fecal pellets. Then, perhaps, an immature ***Harpaphe*** engulfs many tiny fecal pellets, mixes them with the mineral soil, and starts the whole cascading fragmentation process over again.

The numbers and kinds of soil fauna are so large that forest managers and soil scientists mistakenly take them for granted. U.S. Forest Service **silviculturalists** have **learned** that examination of the diverse forest understory can reveal critical aspects of soil type and moisture availability more efficiently than chemical tests.

Likewise, soil invertebrates can be used as "biological probes- of soil processes that operate over time scales and spatial scales that are difficult to monitor in the field.

Chemical tests measure chemical concentrations at a moment in time, and seldom distinguish between what is there and what is available for tree growth. Tree growth integrates all the numerous factors affecting a tree over decades; it is difficult to distinguish soil-related factors from all the other types. Most soil creatures have surprisingly long life cycles: (*Odontodamaeus* probably one year; ***Harpaphe*** probably several years). Their growth rates integrate over several months in small areas of forest soil many of the properties important for tree growth.

Soil arthropods respond clearly to soil properties relevant to their ways of life: soil temperature, moisture, fungal abundance, limiting nutrients,



The cyanide-producing 3- to 3½-inch millipede,* Harpaphe haydeniana, *is* a *conspicuous part of Northwest conifer

It is likely, based on Petersen and Luxton's review of world soil fauna, that temperate soil diversity equals or exceeds that of tropic soil. South-d estimates that about 80 percent of the temperate **forest** insect fauna spend a significant portion of their life cycles in the soil. In absolute terms, then, it is quite probable that the highest levels of terrestrial diversity anywhere on earth occur in the soils of our temperate forests.

Every time you take a step in a mature Oregon forest, your foot is being supported on the backs of 16,000 invertebrates held up by an average total of 120,000 legs. Just think how many creatures it takes to support a single tree.

Dr. Andrew Moldenke is a research biologist and teacher in the Department of Entomology at Oregon State University His interest lies in the interactions ***of invertebrates and their environment, particularly the subjects of pollination ecology and*** soil ***fauna***

NEWS BRIEFS

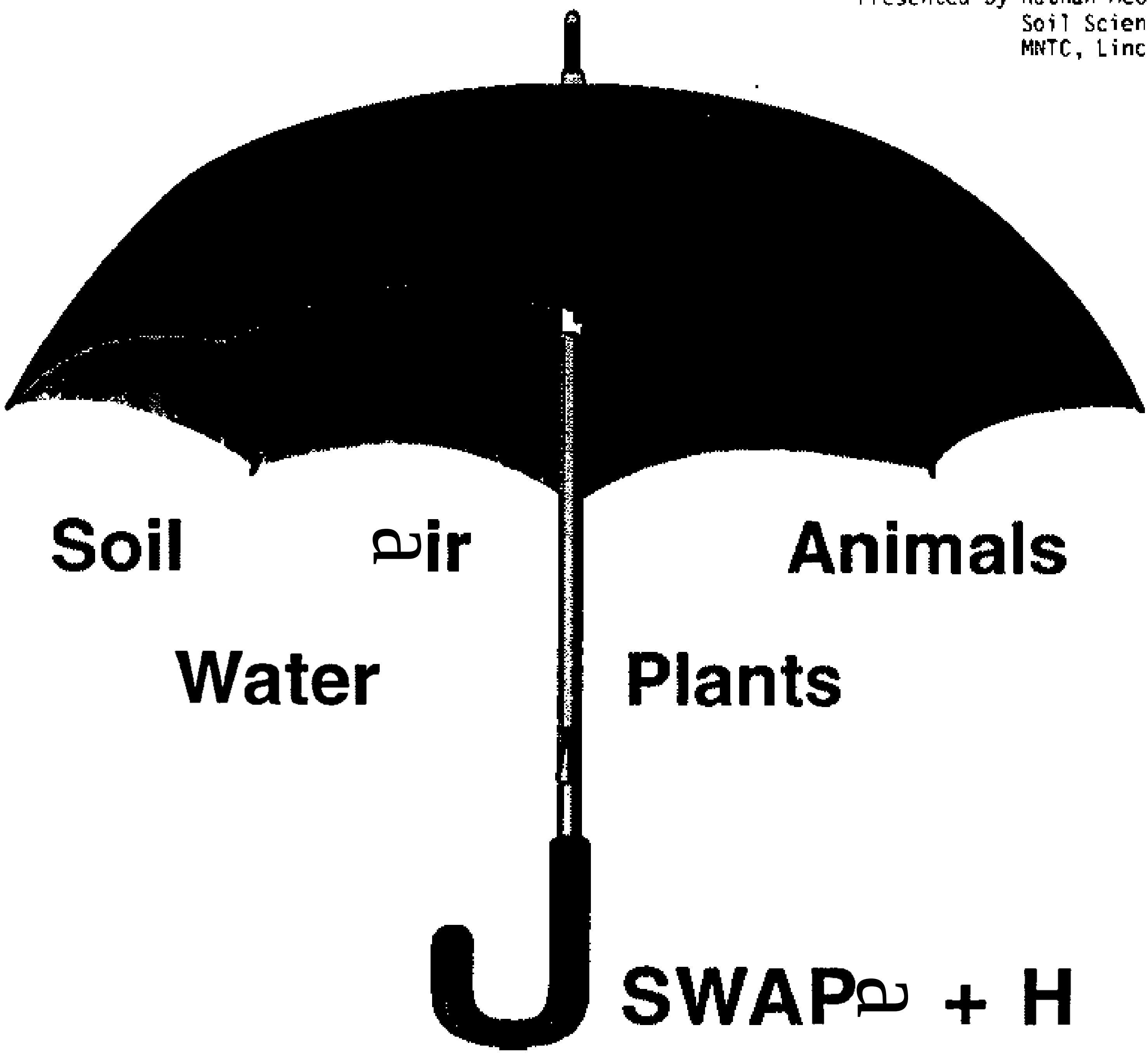
This fall, Sierra Club Books will publish ***Butterfly Gardening: Creating Summer Magic in Your Garden,*** **by** the Xerces Society and the Smithsonian Institution. Advance orders will be filled at that time.

The book features ***more than*** 100 close-up color photographs of butterflies and flowers, garden design diagrams, a master plant list, and essays by leading **butterfly,** gardening, and conservation experts. The book, which will sell for $18.95 retail, is available to Xerces Society members for $14.95 plus $2.50 shipping **and handling. If you are not a member, you may join Xerces now and order the book at the discounted price. To order, send a $17.45 check or money** order to: The Xerces Society, **10 S.W. Ash Street,** Portland, OR 97204.

An Oregon **Silver-spot** Butterfly Recovery Team has been reconstituted and is actively working on conservation ***measures*** **for the** species and its habitat. ***Speyeria serene hippolyta*** is a **threatened butterfly that lives along the Pacific coast from southern Washington to northern California. Its habitat is endangered by development and forest succession.**

The team includes Xerces Society **members Paul Hammond, Cathy Macdonald, Dennis Murphy, Paul Opler, and Katrin Snow. For** *mole* **information:** Paul **Opler,** United States Fish and Wildlife **Service (USFWS)** Office of Information Transfer, **1025 Pennock Place, Suite 212,** Fort Collins, CO 80524, **(303)** 493.8401.

Presented by Nathan McCaleb
Soil Scientist
MNTC, Lincoln, NE



Integrate Soils Interpretations for the Five Resource Concerns Into the Planning Process as They Relate To:

– Conservation Practice Physical Effects

– Quality Criteria

▶ Practice Standards

PROCEDURE FOR DEVELOPING SOIL INTERPRETATIONS FOR THE CPPE PROCESS

Step 1

Develop list of soil properties/data elements that effect the resource concern.

Step 2

Ask - Would this practice normally be selected to solve this problem or concern? (Yes or No)

If YES, then go to Step 3, if NO then go to the next question.

Ask - Would the implementation of this practice affect the concern?

If YES, then go to Step 3, if NO then go to the next concern on the CPPE.

Step 3

List soil properties that influence the design and/or applicability (+ or -) of the practice to solve the concern.

The test statement for significance, positive or negative, of each property of soil map units for the CPPE process:

> Does the (soil property) influence the design and applicability of the (practice) to solve the (resource concern)?

Step 4

Develop interpretive criteria for soil properties/data elements listed in Step 3.

Step 5

Create planning consideration statements for the soil interpretive criteria.

Process

- – Identify. Critical Practices
- – Form Interdisciplinary Team
- – Identify Critical Soil Properties
- ▶ Develop Criteria Tables

LIST OF SOIL PROPERTIES / DATA ELEMENTS

AWC (Aridic, Udic, & Ustic)

$CaCO_3$ EQUIVALENT AND/OR $CaSO_4$ EQUIVALENT

CAPABILITY UNIT

CEC

COARSE FRAGMENTS

DEPTH TO ROCK OR CEMENTED PAN

FLOODING

K FACTOR

ORGANIC MATTER %

PERMEABILIT

pH

PLASTICITY INDEX

SALINITY (Commodity Crops or Adapted Pasture)

SAR/ESP

SLOPE (% and/or Aspect)

SOIL ALBEDO

T FACTOR

TEXTURE

VADOSE ZONE

WATER TABLE - PONDING

WIND EROSION GROUP

WIND EROSION I VALUE

Soil Interpretations for CPPE Process
Conservation Practice: Conservation Tillage - Mulch Till
S WAPA Resource: Water
Resource Concern: Quality - Ground Water Contaminants - Pesticides

Soil Property	Portion Pedon	Rating	Property Limits	Resource Concern Statements
Permeability	<40"	slight moderate severe	< 0.2 in/hr 0.2 - 6.0 > 6.0 in/hr	deep perc deep perc deep perc
Texture	layer1	slight moderate severe	clays loams sands	high trans. high trans., low sorp. poten.
Water table	whole soil	slight moderate severe	> 5' + to 5'	shallow wtr. tbl. shallow wtr. tbl.

- **Algorithms**
- **Field Office Computer System**
- **Soils Database**
- **Soil Interpretations**
- ▶ **Eco-Based Conservation Plan**

Spatial Land Treatment Practice Tracking for Water Quality Conservation Planning

T. M. Sobecki* and R. L. Hummel

T. M. Sobecki, USDA-SCS, West National Technical Center, 511 N. W. Broadway, Rm. 248, Portland, OR 97209-3489; and R. L. Hummel, USDA-SCS, Oregon State Office, 1220 S. W. 3rd Avenue, Portland, OR 97204-2881.

ABSTRACT

Knowledge of the spatial distribution of land treatment practices within a watershed is needed to assess the impact of conservation planning and practice application on water bodies impacted by agricultural nonpoint source (AgNPS) pollution. The U. S. Geological Survey's River Reach database was utilized for lov precision georeferencing of land treatment and management practices in the Dairy-McKay Hydrologic Unit Area (HUA) Project in Oregon. The Graphical Resource Analysis Support System (GRASS) geographic information system (GIS) was used to produce maps allowing spatial tabulation of conservation practice application with the River Reach Number (RRN) as a tag. The RRN proved an effective way to aggregate conservation practices within the HUA in a hydrologically-meaningful way. Vadose and phreatic zone attributes important in determining the movement of AgNPS pollutants within the HUA were able to be associated with subasins drained by specific RRN-designated stream segments. This allowed transparent access to vadose zone information needed for water quality conservation planning.

INTRODUCTION

The fundamental data carrier of physical land attributes used by the Soil Conservation Service (SCS) in planning to conserve the soil resource is the soil map unit (Soil Survey Staff, 1991). The term "data carrier" in this context implies: a) a spatially-delineated, georeferenced portion of the the earth's surface, with which b) a number of physical and chemical attributes are associated. The first characteritsic is represented either by hand-compiled soil map unit delineations, or by digitized delineations in a geographic information system (GIS). The second chracteristic is exemplified by the practice of naming soil map units for soil series, which are physically represented by a type pedon (Soil Survey Staff, 1975). Soil interpretations for the map unit or a phase of a series (Soil Survey Staff, 1991) are conveyed in narrative or tabular form, or as attribute data in a GIS. The conservation planner uses the principle of cartographic generalization (Buol, et al., 1973) to group map unit delineations in a given geographic area into various interpretive groups, manually or electronically, to meet his planning needs.

The SCS also has the responsibility of planning for four additionnl resources: water, air, plants, and animals (Soil Conservation Service, 1990a). It is now necessary to 'determine the physical effects relevant to each resource during the planning process" so that the planner can "select combinations of practices that solve the identified or predictable problems without creating new problems." (Soil Conservation Service, 1990b).

The Conservation Practice Physical Effects (CPPE) matrix of the Field Office Technical Guide (Table 1) lists two aspects of the water resource, quantity and quality, that must be considered in conservation planning (Soil Conservation Service, 1990b). The CPPE matrix, in its present state, presents the conservation planner general, qualitative effects ratings. There is often a range in the rating for a given effect. The planner, however, must make a site-specific assessment of conservation practices physical effects in order to design her conservation management system (CMS) for a field or other conservation treatment unit (CTU) (Soil Conservation Service, 1992).

To adequately assess practice effects on water quality, the planner must know where she is in relation to potentially impacted surface or groundwater bodies. This requires geographic data, but not of extreme absolute precision. Some knowledge about location in relation to the surface drainage network in a watershed and relative to groundwater recharge areas is usually sufficient. She must also know the physical characteristics of the root, vadose, and phreatic zones in order to assess pathways of pollutants to the potentially impacted waterbodies (Soil Conservation Service, 1988). This suggests some knowledge of attributes about the geographic area of concern. This information is available for the root zone in the soil survey. For the vadose zone, however, there is no comparable, easily retrievable information. It must often be generalized from sources intended for another purposes, or is of less detail than needed.

The objective of this paper is to present: a) a system for the low-precision geo-referencing required in water quality conservation planning, and b) suggest a way to make vadose zone information more readily available to the planner. This system does not require an electronic GIS at the field office level. Because it has a geographhic component, it facilitate6 CPPE determinations for conservation practices effectiveness monitoring, and is useful in implementation and project monitoring (E&TA Committee, 1990; MacDonald, et al., 1991; Soil Conservation Service, 1991).

METHODS AND MATERIALS

Geo-referencing

River Reach files were obtained from U. S. Geological Survey (USGS) for the Dairy-McKay Hydrologic Unit Area (HUA) in Western Oregon (Fig. 1). In this geographic database each stream segment, at 1:100,000 scale, is assigned a unique numerical designation, the River Reach Number (RRN). The system was originally constructed from map scales of 1:250,000 by EPA, and USGS has extended it to 1:100,000 scale to pick up smaller tributaries (Mike Darling, personnal communication, USGS, Portland, OR) (Fig. 2).

A series of maps coincident with standard USGS 7.5 min. topographic quadrangle6 (Fig. 1) were generated, using the Graphical Resource Analysis Support System (GRASS), that depict the RRN associated with a particular stream segment (Fig. 3). Practices applied to fields in tracts of land within subbasins of the HUA were spatially "tagged" at the field office level by assigning field6 to the appropriate stream segment as identified by the RRN. The 7.5 min. topographic quadrangles were used to assist placing farm (operating unit) fields in the appropriate basin of a RRN-designated stream segment.

Vadoze/Phreatic Zone Attribute Data

A list of vadose and phreatic zone attributes (V/P attributes) that were deemed important in assessing subsurface pathway6 of pollutant6 to groundwater and surface, water bodies (Caine and Swanson, 1999; Driscoll, 1986; Freeze and Cherry, 1979; C. E. Stearns, personnel communication, USDA-Soil Conservation Service, Portland, Oregon) was established (Table 2). Readily available geologic reports were canvassed (Allison, 1953; Hart and Newcomb,

RESULTS AND DISCUSSION

Georeferencing

Table 3 is a sample of farm (operating unit) fields from the Dairy-McKay HUA which have been tagged with their respective RRN. The general location of selected operating units in Table 3 is shown in Fig. 3. The fields were assigned to a particular RRN based on that field falling within a subbasin of the watershed that the RRN-designated stream segment drains. Therefore, it is possible to spatially track the application of conservation and managment practices that have the potential to impact water quality of a particular water body by sorting fields by RRN. Note how some fields within a given tract often have the same RRN, while others within that sane tract have different RRNs (Table 3).

River Reach Numbers, once assigned to a field, can be stored in the current SCS data managment system for the field office, CAMPS (Computer Assisted Hanagment and Planning System). They can then provide a spatial dimension to the field office electronic data base that is meaningful to water quality conservation planning, without having a GIS onsite.

The River Reach database contains a number of attributes in addition to the RRN. For instance, there are pointers indicating the adjacent upstream and downstream RRNs for each RRN-designated stream segment. This makes it possible to consider general routing of agricultural nonpoint source pollutants within or through a watershed if a local GIS database or watershed hydrologic model is unavailable. Also included is a stream level identifier (LEVEL), which in essence is a reverse Strahler stream order (Ruhe, 1975).

Vadose and Phreatic Zone Attributes

Once a low precision, relative georeferencing system is available, it can be used to convey attribute information. Table 4 gives the assignment of V/P attributes to selected RRNs found in the Forest Grove, OR USGS 7.5min. quadrangle. The attribute information can be general or detailed, based on the availability of resource references and subject matter expertise.

There are no specific depth or lateral limits implied in the above assignments. It is suggested that, as a minimum, V/P attributes realized from the bottom of the root zone to the top of a *regional* water table (Driscoll,1986), and vithin a hillslope segment from a first- *or* second-order divide to the respective first- or second-order drainageway should be considered. This represents a basic *segment of* almost all landscapes (Ruhe, 1975), and corresponds to the conceptual models frequently proposed to convey subsurface water flow to surface and groundwater (Freeze and Cherry, 1979; Hall and Olson, 1991). Low-order hillslopes are also important elements in sediment delivery to surface waters (Caine and Swanson, 1989). The collection of V/P attributes assigned to RRNs in a watershed should give a sense of the depositional system or three-dimensional facies relationships (Galloway and Hobday, 1983) that characterize the geology underlying the main watershed and that are important to determining the direction of vadose-zone water flow.

The assignment of V/P attributes to a particular RRN can be considered a 'propositional pedon" in Holmgren's sense: observational propositions are associated with a locus (space inclusive of the feature under study, in this case physical parameters of near-surface earth materials important in dictating water movement) geographically referenced to a focus (a particular location, in this case identified by the RRN) (Holmgren, 1998). It represents an application of Holmgren's pedon concept to e geographic point location at a scale smaller than typically used in detailed soil survey work, however. The RRN might also serve as the focus for referencing additional stable-static and temporal-dynamic geologic, soil, or surface feature5 (Arnold, 1990; Grossman, et al., 1990).

Benefits to the Conservation Planner

The planner is forced to make daily decisions about specific tracts of land in the conservation planning a::d implementation process. Yet he is often faced with a paucity of easily obtainable information about the specific location vhere he is planning. It is best that she make informed decisions, and to do that she must have up to date resource information available in a transparent, easy to obtain manner.

The ideas of Holmgren (1988) are again appropriate: "In the modern informational sense, we are concerned with propositions about location rather than with the properties of polypedons.". He is referring to the information age6 liberation from artificial constructs, such a6 the soil scientists polypedon, that in the past were needed to convey spatially referenced attribute6 of volumes of the earths surface. We no longer require such constructs. All our planner needs are borne proposition6 about location: propostions about water and agrichemical movement in a specific volume of the the upper portion of the earths crust.

CONCLUSION

This study indicate6 that the River Reach database provide6 a rather simple means of spatially tracking conservation practice6 using currently available technology. After, initial importation of the database and creation of quadrangle-sized map6 depicting RRNs, a GIS system is not needed to spatially track practice application at the field level.

Coupled with an electronic data managmement system, as complex a6 CARPS or as Simple a6 a Spreadsheet, practices can be aggregated by hydrologically meaningful units within watersheds, using a system recognized by other Federal and State agencies. This aides in attempting to estimate the potential impact of conservation practices on AgNPS pollution and water quality in project areas.

The potential for use of the River Reach database to organize and convey vadose and phreatic zone information to the planner should be further investigated.

REFERENCES

Allison, I. S. 1953. Geology of the Albany Quadrangle, Oregon. Oregon State Dep. Geol. Wineral Ind. Bull. 37. Portland, OR.

Arnold, R. W. 1990. soil Taxonomy, a tool of soil survey. In B. G. Rozanov (ed.). Soil classification. Reports of the International Conference on Soil Classification, 12-16 Sept., 1988, Alma-Ata, USSR. International Soc. Soil Sci., Moscow.

Buol, S. W., F. D. Hole, and R. J. McCracken. 1973. Soil genesis and classification. Iowa State University Press, Ames, IA.

Caine, N. F., and F. J. Swanson. 1989. Geomorphic coupling of hillslope and channel systems in two small mountain basins. Z. Geomorph. N. F.33(2):189-203.

Driscoll, F. G. 1986. Groundwater and wells. The Johnson Division, St. Paul, MN.

E&TA Committee, 1990. Strategy for monitoring and evaluation of water quality education and technical assistance (E&TA) activities. U. S. Department of Agriculture, Washington, D. C.

Freeze, R. A., and J. A. Cherry. 1979. Groundwater. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Galloway, W. E., and D. K. Hobday. 1983. Terrigenous clastic depositional systems. Springer-Verlag, New York, NY.

Grossman, R. B., F. B. Pringle, R. J. Bigler, W. D. Broderson, and T. M. Sobecki. 1990. Systematics and field methodology for a use-dependent, temporal soil data base for edaphological and environmental applications. Proc. Resources Technology 90 Htg., Nov. 12-16, 1990, Washington, D. C.

Hall, G. F., and C. G. Olson. 1991. Predicting Variability of soils from landscape models. p. 9-24. In (ed.) Spatial variabilities of soils and landforms. Soil Sci. Soc. Am. Spec. Pub. No. 29. Madison, WI.

Hart, D. H., and R. C. Newcomb. 1965. Geology and ground water of the Tualatin Valley, Oregon. USGS Water-Supply Paper 1697. U. S. Government Printing Office, Washington, D. C.

Heath, H. C. 1994. Ground-water regions of the United States. USGS Water-Supply Paper 2220. U. S. Government Printing Office, Washington, D. C.

Holmgren, G. S. 1989. The point representation of soil. Soil Sci. Soc. Am. J. 52:712-716.

MacDonald, L. H., A. W. Smart, and R. C. Wissmar. 1991. Monitoring guidelines to evaluate effects of *forestry activities on streams in* the Pacific Northwest and Alaska. University of *Washington,* Seattle, WA.

Ruhe, R. V. 1975. Geomorphology. Houghton Mifflin Co., Boston, MA.

Schliker, H. G., and R. J. Deacon. 1967. Engineering geology of the Tualatin Valley Region, Oregon. Oregon State Dep. Geol. Mineral Ind. Bull. 60. Portland, OR.

Soil Survey Staff. 1975. Soil Taxonomy. A basic system of soil classification for making and interpreting soil surveys. USDA Agric. Handb. No. 436. U. S. Government Printing Office, *Washington,* D. C.

Soil Survey Staff. 1991. Soil rurvey manual. USDA-Soil Conservation Service, Lincoln, NE.

Soil Conservation Service. 1986. Water quality field guide. SCS-TP-160. U. S. Government Printing Office, Washington, D. C.

Soil Conservation Service. 19908. General Manual, sec. 450, part 401.03(b)(3)(iii). USDA-Soil conservation Service, Washington, D. C.

Soil Conservation Service. 1990b. Conservation managment system formualation. A users guide for implementing the conservation practice physical effects process and concepts. USDA-Soil Conservation Service, Washington,, D. C.

Soil Conservation Service. 1991. Program guidance and format for annual reports: nonpoint source Hydrologic Unit Areas, Water Quality Demonstration Projects, and ACP Special Water Quality Projects. Presented at the Wrokshop for ASCS/CES/SCS Coordinators for Hydrologic Unit Areas-West, July 29-31, 1991. St. Louis, MO.

Soil Conservation Service. 1992. National planning procedures handbook glossary (draft). USDA-Soil Conservation Service, Washington, D. C.

LIST OF FIGURES

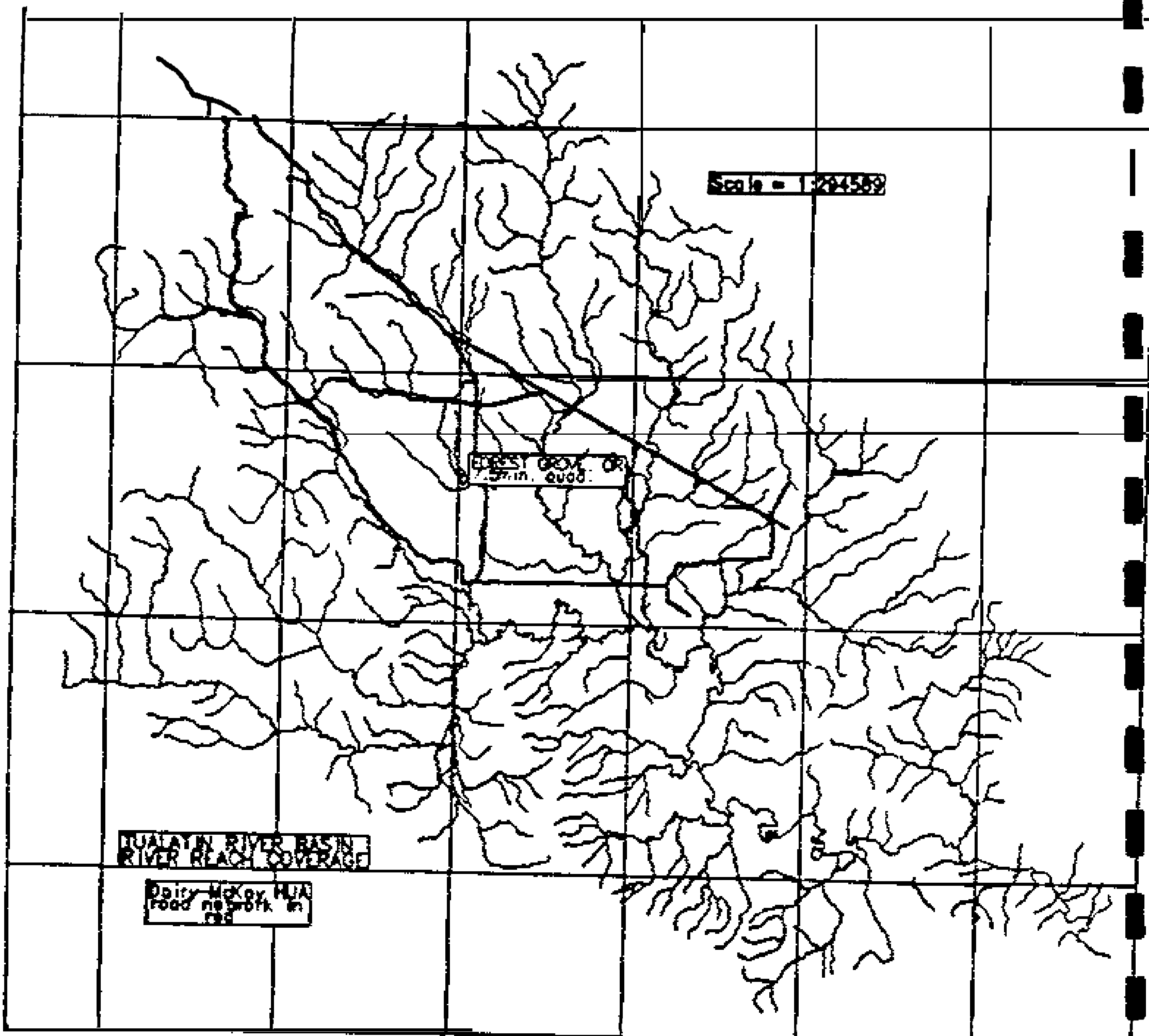


Fig. 1--River Reach database coverage

RRN = HUC_SEG_RMI

RRN = River Reach Number

HUC = USGS 8-digit Hydrologic Unit Code (Example: 17090010)

SEG = Arbitrarily assigned stream Segment Number:
1-500 for EPA-assigned numbers from 1:250,000 scale hydrography
>500 for USGS-assigned numbers from 1 :100,000 scale hydrography

RMI = Reach Number - the distance (in river miles) of a stream segment (SEG) upstream from the juncture with a higher order stream. Base reach numbers start at 0.00

Example RRNs:

17090010_012_5.04

170900 10_648_0.00

Fig. 2--Definition of component pans of the River Reach Number.

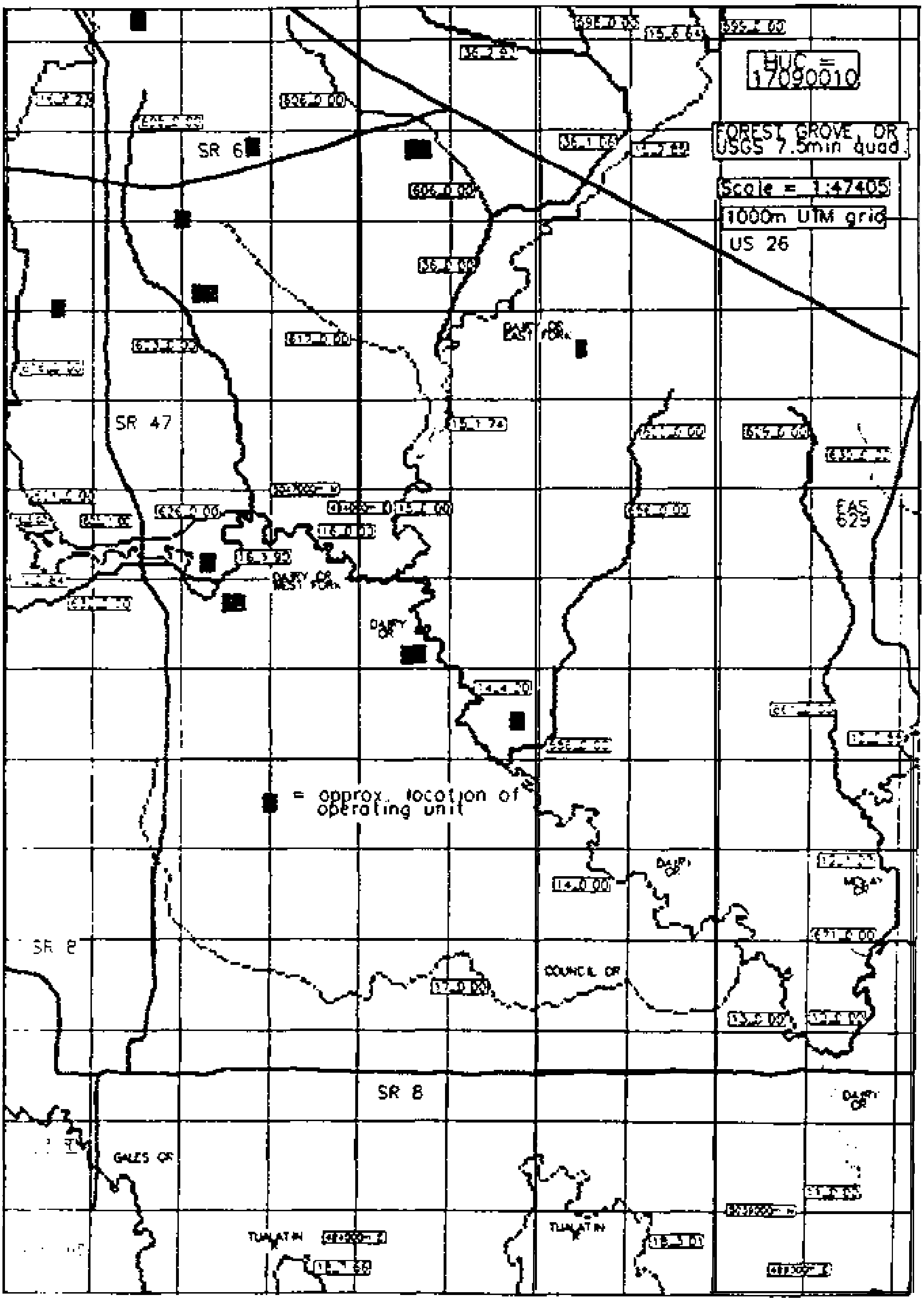


Fig 3--Identification of SEG_RMI portion (in red) of River Reach Numbers (RRN) in a portion of the Dairy-McKay Hydrologic Unit Area (HUA) Project.

Table I--Selected Conservation Practices Physical Effects (CPPE) for water quality

		Aspects/Problems			
		Groundwater Contaminants		Surface Water Contaminants	
Practice	Other Explanations	Nutrients and Organics (Groundwater quality is degraded because of contamination by natural or human-induced nutrients, or from animal and other wastes.)	Heavy Metals (Groundwater quality is degraded because of the introduction of natural or human-induced metals.)	Nutrients and Organics (Surface water quality is degraded because of contamination by natural or human-induced nutrients, or from animal and other wastes.)	Low Dissolved Oxygen (Surface water quality is degraded because of inadequate supplies of dissolved oxygen.)
680b - Nutrient Management; Excess	Applies to organic waste, commercial fertilizer, legume crops, crop residues, all agricultural land.	Significant decrease because excess nutrient applications are reduced. Effects variable because of climate, nutrient, soil, and vadose zone factors.	Slight to moderate decrease because of increased flexibility in selecting areas for waste application.	Significant decrease because excess nutrient applications are reduced. Effects variable because of climate, nutrient, soil, and vadose zone factors.	Significant decrease in dissolved oxygen because excess organic waste applications are reduced. Effects variable because of climate, organics, soil, and vadose zone factors.

Table 2--Set of attributes for the vadose and phreatic zones

A. Groundwater region (Heath, 1984)

B. Recharge area of domestic/public groundwater supply? (yes or no)

C. Regolith stratigraphy

Regolith thickness
Regolith origin
Regolith stratigraphy (grain size, bedding, rock unit names)
Depositional system (Galloway and Hobday, 1983)

D. Bedrock stratigraphy

Igneous or metamorphic? (yes or no)
Sedimentary? (yes or no)
Regional structural features (type)
Localized structural features (faults, deformation)
Rock type(s) (include rock stratigraphic unit name)
Bedding (orientation, thickness, type)
Strike and dip of beds
Soluble constituents (gypsum, soluble salts)
Fractures/Voids (type)
Depositional system (sedimentary only)
Structural basin (name)

E. Phreatic zone (saturated zone)

Perched water table? (yes or no): If yes, then:
Number
Depth
Elevation relative to confluence with downstream MN-designated stream segment (above or below)

Regional water table? (yes or no): If yes, then:
Number
Confined or Unconfined
Water table depth if unconfined
Water table elevation relative to basin baselevel if unconfined (above or below)
Aquifer depth if confined
Aquifer thickness if confined
Potentiometric surface relative to ground surface (above or below)
Aquifer (rock stratigraphic unit name)
Regional water table discharges to streams in rubbasin? (yes or no)

Table 3--Assignment of fields within selected tracts of land to stream segments identified by their River Reach Number.

Operating Unit	Tract	Field	Size	Practices+ 411	680	328	633	RRN‡
			ha					
A	to0121	1				x		605_0.00
		6	140.9'1.			x		605_0.00
		7	2.5			x		605_0.00
B	t00158	1	1.1	x	x	x		16 0.00
		2b	3.2	x	x	x		16-0.00
		3	52.6	x	x	x		16~0.00
B2	too23 1	1	7.2	x	x	x		623 0.00
		2	0.5	x	x	x		623-0.00
	t00256	1	7.4	x	x	x		623_0.00
C	to002 1	4	8.1				x	617_0.00
D	too529	1	15.1		x			36_0.00
D2	too559	1	13.6	x		x		606_0.00
		2	6.9		x	x		606_0.00
		5a	10.1	x	x	x		606_0.00
		5c	221.45		x	x		606_0.00
								36_0.00
E	too252	1	26.3	x	x	x		656 0.00
		3	12.3	x	x	x		164.20
		6	15.97.5	x	x	x		656-0.00
				x	x	x		14_0.00
E2	to051 7	1	10.8	x	x	x		14 4.20
		2	2.9.	x	x	x		1414.20
G	to0202	1	2.5		x	x		16_2.84
		2	2.8		x	x		16_1.90
G1	100202		7.0	x	x	x		632_0.00
		6	14.0	x	x	x		632_0.00
	100203	1	6.5	x	x	x		632_0.00
		2	8.3	x	x	x		632_0.00
I	to1119	1		x	x	x		15_1.74
		2	29.8 ...		x	x		15_1.74
		3	1.213.1	x	x	x		15_1.74

+Subset of conservation practices applied to respective fields: 411 = grasses and legumes in rotation, 680 = nutrient managment, 328 = conservation cropping sequence, 633 = waste utilization.

‡SEG_RMI portion of RRN (River Reach Number) for HUC = 17090010.

Table 4--Selected vadose/phreatic zone attributes for some River Reach Numbers (RRN) in the Forest Grove, Oregon 7.5 minute quadrangle.

RRN[†]	Ground-water Region[‡]	Recharge Area	Perched Water Table	Regional Water Table	No.	Conf.[§] or Unconf.	Water Table Depth (Unconf.)	Water Table Elevation rel. to Baselevel (Unconf.)	Aquifer Depth (Conf.)	Oischarges to Streams
							m	m	m	
19_0.00	Alluvial Basins	yes	no	yes	1	Unconf.	1.5-3.5	above	NA	yes
17_0.00	Alluvial Basins	yes	no	yes	2	Unconf.	1-3	above		ye
						Conf.	NA	NA	z-35	?
617_0.00	Alluvial Basins	yes	no	yes	2	Unconf.	2-6	above	NA	yes
						Conf.	NA	NA	122-170	no

†HUC portion of RRN = 17090010.
‡According to Heath (1964).
§Conf. = Confined aquifer, Unconf. = Unconfined aquifer.

Practice Total by River Reach Number

(Acres)

RRN	Nutrient Mgt. (590)	Conservation Tillage (329)	Irrig. Water Mgt. (449)	Subbasin Area
15_1.74	11.3	11.3	11.3	1502
15_2.85	436.8	251.8	300.9	1031
17_0.00	402.3	228.0	264.8	6000
36_0.00	64.8	14.7	64.8	1333
629_0.00	92.4	0.0	50.0	533
630_0.00	87.0	0.0	49.5	222

RRN = River Reach Number

A GUIDE TO
RECLAIMING HEAVY-METALS **CONTAMINATED** SOILS
IN THE COELJR **D'ALENE** RIVER VALLEY

F. B. Frutchey
Kootensi County Natural Resources Department
spring, 199-l

SYNOPSIS

Much of the soil in the 10,000-acre Coeur d'Alene River valley has become contaminated with heavy metals over the past 100 years. Mine tailings in the alluvium from yearly overflow has deposited a foot or more of medium-textured materials over the original fertile silt loam and peat muck soils. The lead content in this material generally tests between 4,000 to 6,000 ppm; the

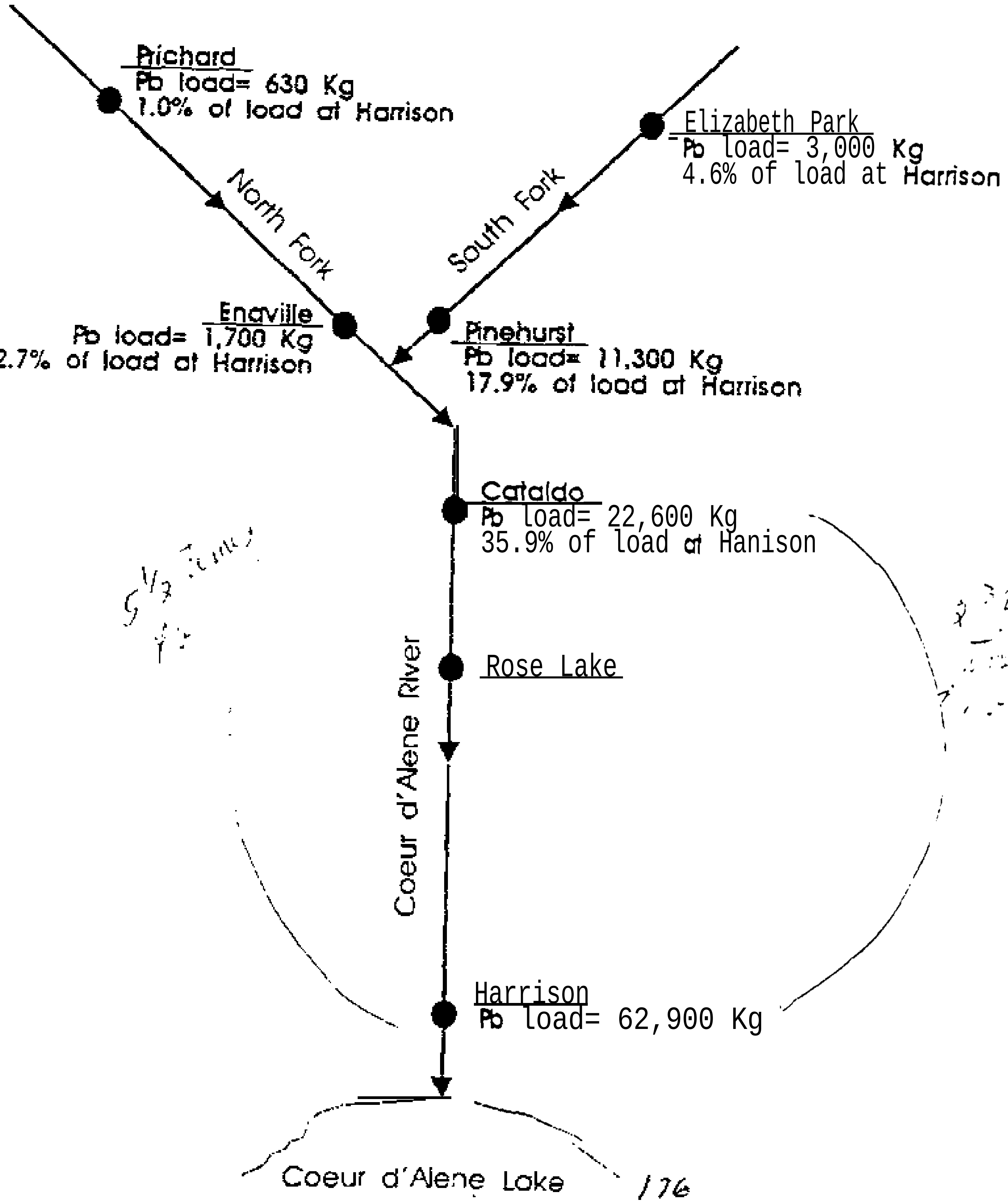
INTRODUCTION

Chemical research reports seem to explain some of the reactions to soil amendments which were observed here in the Coeur d'Alene River valley. Quote from Trace Elements in the Terrestrial Environment by Adriano, Chapter on Lead:

> *The extractability of Pb in soils is influenced by several soil properties. Soils limed to a high pH yielded less extractable Pb (Misra and Pandey, 1976; John, 1972, MacLean et al, 1969). Also, soils with high phosphate (MacLean et al, 1969), organic matter, or clay contents (Karamanos et al, 1976; Scialdone et al, 1980) tend to reduce the extractability of Pb from soils....Under certain conditions, Pb can be transformed by microorganisms....*
>
> *...As with other trace elements, the chemistry of Pb in soils can be qualitatively described as affected by: (1) The specific adsorption or exchange adsorption at a given mineral matrix; (2) The precipitation of sparingly soluble compounds of which it is a constituent; and (3) the formation of relatively stable complex ions or chelates that result from the interaction with organic matter.*
>
> *Using equilibrium batch studies and deducing forms from equilibrium solubility diagrams, Santillan-Medrano and Jurinak (1975) presented data suggesting that, in non-calcareous soils, the solubility of Pb appears to be regulated by* $Pb(OH)_2$, $Pb_3(PO_4)_2$, $Pb_4O(PO_4)_2$, or $Pb_5(PO_4)_3OH$, *depending on the pH ...*

This kind of rehabilitation has been accomplished in other places, in the western United States also. It has been done on some lands in the Coeur d'Alene River valley as well.

LEAD (Pb) LOADINGS
Coeur d'Alene River



MEMORANDUM OF AGREEMENT
(MOA)

Presented by:

Arlene J. Tugel
Soil Scientist
West National Technical Center
SCS, Portland, Oregon

at

Western/Midwestern Regional Cooperative
Soil Survey Conference
June 12-17, 1994
Coeur d'Alene, Idaho

Memorandum of Agreement (MOA)

Memo of *Agreement (MOA)*

- **Four federal agencies with wetlands protection responsibilities, in a new memorandum of agreement, recognize the U.S. Department of Agriculture s Soil Conservation Service as the lead federal agency for delineating wetlands on agricultural lands. This action will provide more certainty for farmers and provide more effective coordination among federal agencies with wetlands**

Memo of Agreement (MOA)
Delineation of Wetlands

Interagency agreement

- **USDA**
- **USDI**
- **EPA**
- **US Department of the Army**

Memo of Agreement (MOA)

Delineation of Wetlands

Soil Conservation Service (SCS)

Corps of Engineers (COE)

Environmental Protection Agency (EPA)

Fish and Wildlife Service (FWS)

Memo of Agreement (MOA)

- **Under this agreement, farmers will be able to rely on Soil Conservation Service wetland maps for determining the extent of wetlands under both the Farm Bill (also known as the Swampbuster program) and Section 404 of the Clean Water Act.**

MOA Delineation of Wetlands

Purpose

- **To specify the manner in which wetland delineations and certain other determinations of water of the United States made by USDA under the FSA will be relied upon for purposes of CWA Section 404.**

83

Memo of Agreement (MOA)
Delineation of Wetlands

- **Subtitle B of Food Security Act (FSA)**
- **Section 404 of Clean Water Act (CWA)**

Memo of Agreement (MOA)

Eliminate duplication

- **SCS makes delineations on all agricultural lands.**
- **SCS identifies "other waters", in coordination with the COE, when they are in the field identifying wetlands after appropriate guidance has been given.**

Memo of Agreement (MOA)

Eliminate duplication

- **COE makes determinations on non-agricultural lands where SCS is not involved.**
- **SCS identifies wetlands on non-agricultural lands, in coordination with the COE, for USDA participants.**

Memo of Agreement (MOA)

Consistency

- **NFSAM procedures will be used in making wetland determinations on agricultural lands.**

- **87 Corps of Engineers Manual procedures will be used to make determinations on non-agricultural lands.**

- **Cross-training between agencies on both manuals before delineations are made.**

RESPONSIBILITIES
Mapping Conventions

- **COE, EPA, FWS, SCS written concurrence on mapping conventions**
- **Offsite methods to make wetlands determinations**

RESPONSIBILITIES

Delineation Process Review and Oversight

- To achieve consistency
- Continuous improvement in delineation process
- EPA has leadership in establishing interagency oversight teams at state level

RESPONSIBILITIES

Reliance on Previous SCS Wetland Delineations for CWA Purposes

---

- **Certification procedures**
- **Coordination with COE/EPA**
- **Recertified every 5 years**

RESPONSIBILITIES

Appeals

- FSA appeals process for SCS wetland determinations (FSA or CWA)
- COE/EPA will have opportunity to review delineation changes based on an appeal
- FWS consulted

RESPONSIBILITIES

Training

- **Interagency training**
- **1987 Corps Wetlands Delineation Manual (CWA)**
- **National Food and Security Act Manual**

MOA Delineation of Wetlands

Definitions

- "Agricultural lands" means those lands intensively used and managed for the production of food or fiber to the extent that the natural vegetation has been removed and cannot be used to determine whether the area meets applicable hydrophytic vegetation criteria in making a wetland delineation.

93

MOA Delineation of Wetlands

Definitions

- Areas that meet the "agricultural lands" definition may include intensively used and managed cropland, hayland, pasture land, orchards, vineyards, and areas which support wetland crops (e.g., cranberries, taro, watercress, rice).

MOA Delineation of Wetlands

Definitions

- For example, lands intensively used and managed for pasture or hayland where the natural vegetation has been removed and replaced with planted grasses or legumes such as ryegrass, bluegrass, or alfalfa, are considered agricultural lands for the purposes of this MOA.

195

MOA Delineation of Wetlands

Definitions

- **"Non-agricultural lands" - "agricultural lands" do not include range lands, forest lands, wood lots, or tree farms. Further, lands where the natural vegetation has not been removed, even though that vegetation may be regularly grazed or mowed and collected as forage or fodder (e.g., uncultivated meadows and prairies, salt hay), are not considered agricultural lands for the purposes of this MOA.**

1994 Western/Midwestern Regional Cooperative

Soil Survey Conference

June 12-17, 1994

Water Quality Issues and Related Soil Information Needs in the Clark Fork-Pend Oreille Watershed

presented by

Ruth Watkins

Project Coordinator for the
Tri-State Implementation Council

Sandpoint, Idaho

The Clark Fork-Pend Oreille watershed encompasses about 25,000 sq. miles in an area spanning western Montana, northern Idaho and eastern Washington. The Clark Fork River, Pend Oreille Lake and the Pend Oreille River are the main bodies of water in the basin, and are the focus of a three-state water quality management effort now underway.

As a result of citizen concerns about increased aquatic weeds and algae in the Clark Fork River and Pend Oreille Lake, language was added to the 1987 Clean Water Act directing EPA to study the sources of pollution in the basin. Focusing on nutrients, the three-year study led to the development of a watershed-wide management plan. The first priority of the management plan was to establish, in October 1993, the Tri-State Implementation Council to oversee the implementation of the plan. Since that time, the Council has been working to carry out pollution control measures through a series of local community-based subcommittees who are dealing with such issues as wasteload allocation, wastewater treatment discharge alternatives, nonpoint source contributions, monitoring, and education.

In the work of these committees, the need often arises for accurate data on soils, ranging from: types of soils and their feasibility for land application of discharge wastes; capacity of soils to handle development and other human activities; and delineation of areas of high erosion risk. This information is not only necessary in the design stages, but prior to the design in the feasibility and planning stages of pollution control measures. Planners and policy makers alike needs good soils information and an understanding of the issues in order to make sound decisions in the watershed.

Soil experts can help by getting involved in local watershed issues, and by making soil information readily available to managers and decision makers.

The Idaho Cumulative Effects Process and it's use of Landtype Associations

Brian D. Sugden, Forest Hydrologist
Plum Creek Timber Company, L.P.

Soil Survey Conference -- June 16, 1991
Coeur d'Alene, Idaho

As some of you are aware. an interdisciplinary task force consisting of representatives of industry. state and federal agencies, and the environmental community have been working for the past three years on developing a cumulative effects assessment and control process for forest practices in Idaho. This task force was formed to address legislation passed in 1991 which directed the Idaho Department of Lands to develop methods for controlling watershed impacts resulting from the cumulative effects of forest practices. For the past two years I have participated as a member of this task force. Earlier this spring, the draft process underwent a final technical review and now is in the last stages of completion. The process will be presented to Idaho's Forest Practices Advisory Committee this fall and could be adopted by the years end. This afternoon I will provide an overview of the draft process developed by the task force: and more specifically, I will explain how this process uniquely utilizes landtype associations,

This flowchart describes the steps involved in the assessment process (See Figure 1). Without getting into too much detail about how the process may be administered, the initial boxes describe the initiation of the watershed analysis, formation of the watershed committee, and the selection of analyst(s). The first major step to be done by the analyst is an evaluation of mass failure (landslide) and surface erosion hazards in the watershed. These are determined from Forest Service 1:100,000 landtype association maps for which mass failure and surface erosion hazards have been assigned. As most of you are aware, landtype associations are based on the concept that the underlying parent material and the erodibility of that parent material interact to form a particular landscape. Landtype association maps divide the landscape into areas based on landform. terrain shape. and parent material. By having an understanding of the inherent hazards in a drainage, you can better design harvest and transportation systems and the with site specific evaluation, determine the necessary erosion control measures.

The next major step in the flowchart directs the analyst to evaluate the current instream conditions with respect to channel stability and the presence of fine sediment. This will provide the information necessary to determine if forest management activities such as road construction and timber harvest have affected the stream channel. One difficulty in conducting the instream assessment is knowing what portion of impacts are caused by forest practices versus other land uses such as mining and livestock grazing. The process will only regulate forest practice impacts. To help solve this issue, when conducting stream evaluations in watersheds with multiple land uses, the analyst will do their best to try to measure locations where forest practices activities can be separated out. For example. if there is a definite boundary between upstream forest lands and downstream agricultural lands, sample points should be located at the forestlag boundary.

The third major step in the process is an evaluation of the current watershed conditions. The assessments in this section include evaluations of riparian canopy condition as it influences stream temperature, forest canopy condition as it affects the watershed hydrology. a nutrient evaluation, and an evaluation of sediment delivery to streams from roads, skid trails and mass failures.

Once the watershed hazards, instream conditions, and hillslope conditions have been evaluated. the next step is to ask the question "do adverse instream conditions exist?" With Idaho's principle cumulative effects concern being fine sediment in streams, it is imperative that we have a basic understanding of what the expected levels of fine sediment should be for a particular stream. This is the second way which the process incorporates landtype associations.

Right now, the Idaho Department of Lands and the Forest Service are compiling fine sediment data collected on streams in pristine watersheds in Idaho. The are also collecting information on adjacent landtype association, stream gradient, channel confinement, and average annual flow at the same location sediment was measured. Once we have this information, a correlation analysis between observed levels of instream fine sediment and the other stream attributes will be conducted. For example. the process will hopefully give us predictive capabilities such as "for a 3% gradient unconfined stream in a 2-5 Landtype (old surface in alluvium) we would expect natural fine sediment levels between 30% and 50%: whereas, in a 3% gradient confined stream in a 3-1 Landtype association (colluvial landform in belt parent material) we would expect 5%-10% fine sediment.

The data collection and correlation analysis is still underway. Initial reports indicate that this approach is promising. If it works. we will have accomplished a monumental feat: Knowing how much fine sediment should be in streams in managed watersheds.

For hydrology, channel condition, nutrients, and stream temperature, we have other criteria by which we determine if adverse instream conditions exist. If. in fact, it is determined that there are adverse instream conditions and they can be reasonably linked to upslope forest management. the landowners are required to develop "Cumulative Watershed Effects Management Prescriptions (CWEMPs)." These CWEMPs must address the problems identified in the analysis and are enforceable in future forest practices.

One example of this is as follows:

> The instream evaluation reveals 60% surface fines. Based on our data correlation. a pristine stream in that landtype association with the same stream characteristics should have fine sediment levels between 20-30%. Also observed were frequent points of

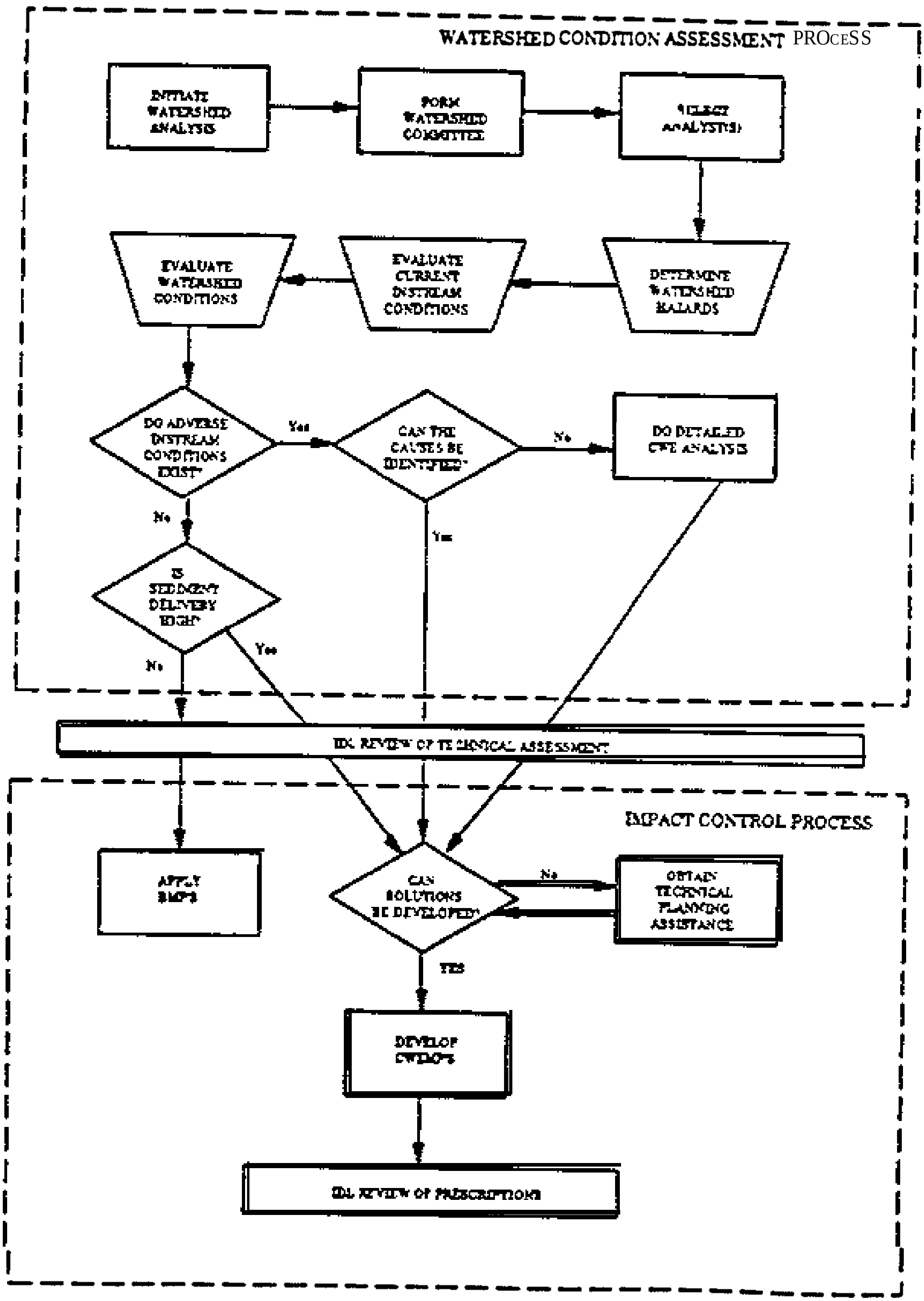
sediment delivery to streams and an existing road and skid trail system which is poorly maintained and actively eroding. Given the instream evidence and hillslope observations. the stream is found to be in an unacceptable condition and future forest management must find a solution to these problems. The CWEMPs developed may include plans for road improvement, stabilization of fill slopes, etc.

The Idaho Cumulative Effects Process is an exciting new approach to forest management. Managing for specific watershed hazards and instream conditions will over time will create management practices specifically tuned to the unique characteristics and condition of each watershed. Landtype associations are the foundation for this effort and will require continued research and mapping.

-END -

FIGURE 1. CUMULATIVE WATERSHED EFFECTS PROCESS FLOWCHART

6/94



Presented by Harold Maxwell, State Soil Scientist, SCS, Boise, Idaho

NASIS for NCSS
West Midwest Joint Meeting 1994
Coeur de Alene, IDAHO

ODTLINE:

OVERVIEW

A. Data Flow Diagram

1. NASIS begins with the collection and storing of point data including Soil Characterization Records (SCR).
2. Data aggregation and correlation is used to create the map unit record (MUR).
3. MUR includes spatial data and is linked to other databases such as crop yield, rangeland or woodland tables.
4. Interpretations can be made for MUR or Point data.
5. The National Standard will be used to compare and correlate MUR or Point data.
6. MUR at the field level will be aggregated from the field level to create state and national databases.
7. A National Data Access Facility will be established.
8. MUR will not have limits on number of components that can occur in each map unit.
9. Components will not be restricted to taxonomic limits. The representative values for the component must fall with in the taxonomic limits of the name for that component.
10. NASIS will store the component pedon information by horizons not layers. The numbers of horizons will not be limited.

B. NASIS STRUCTURE

1. NASIS is structured around the DATA DICTIONARY..
2. The backbone allows data access by various paths without duplicating storage. Each map unit will have a unique identifier nation wide
3. NASIS will include both spatial and attribute data.
4. Security systems allow multiple users to share data but provides the owner the ability to control and maintain integrity.
5. Modular Generic design allows unique access capability.
6. Data elements can be added without affecting the existing information or its use.
7. The component data will be stored by high, low and representative values. Representative

values will be controlled by the field soil scientist.

8. Pedon information will be stored by horizon with no limit to the number of layers that can be stored

C. Three Types of Data

1. Point data from field notes to SCR will be stored and available for interpretation. Much of the point data will be collected using the Pedon Software.
2. MUR or map unite and components of map units will be stored and interpreted. Components will be a result of aggregation of the point data.
3. The National Standard will contain Soil Series and other conceptual standards used to correlate soil point data or components.

SPECIFICS:

A. Timing

1. NASIS 1.0 has been tested and will be released October 1994. There will likely be at least one interim release prior to 2.0
2. NASIS 2.0 is in the analysis stage and scheduled for release October 1995.
3. Additional releases are planned for each October as needed. The selection of team members to conduct analysis for NASIS 3.0 will begin later this year.

B. Functionality

1. NASIS 1.0 will be used at the State Office level to accommodate the changeover from the existing system to NASIS.
2. NASIS 2.0 will be designed to replace the existing with functionality as good as or better than existing systems. This version will be fully functional at the field level and will replace the form 5 and form 6.
3. Future releases of NASIS will include spatial interfaces, new modules and interpretations.

C. Platform

1. NASIS is designed on a Sun Work Station and will be ported to a 486 or Pentium platform.

2. UNIX, INFORMIX is the operating software.

3. Pedon will be written in DOS to accommodate field data recorders.

WHY CHANGE:

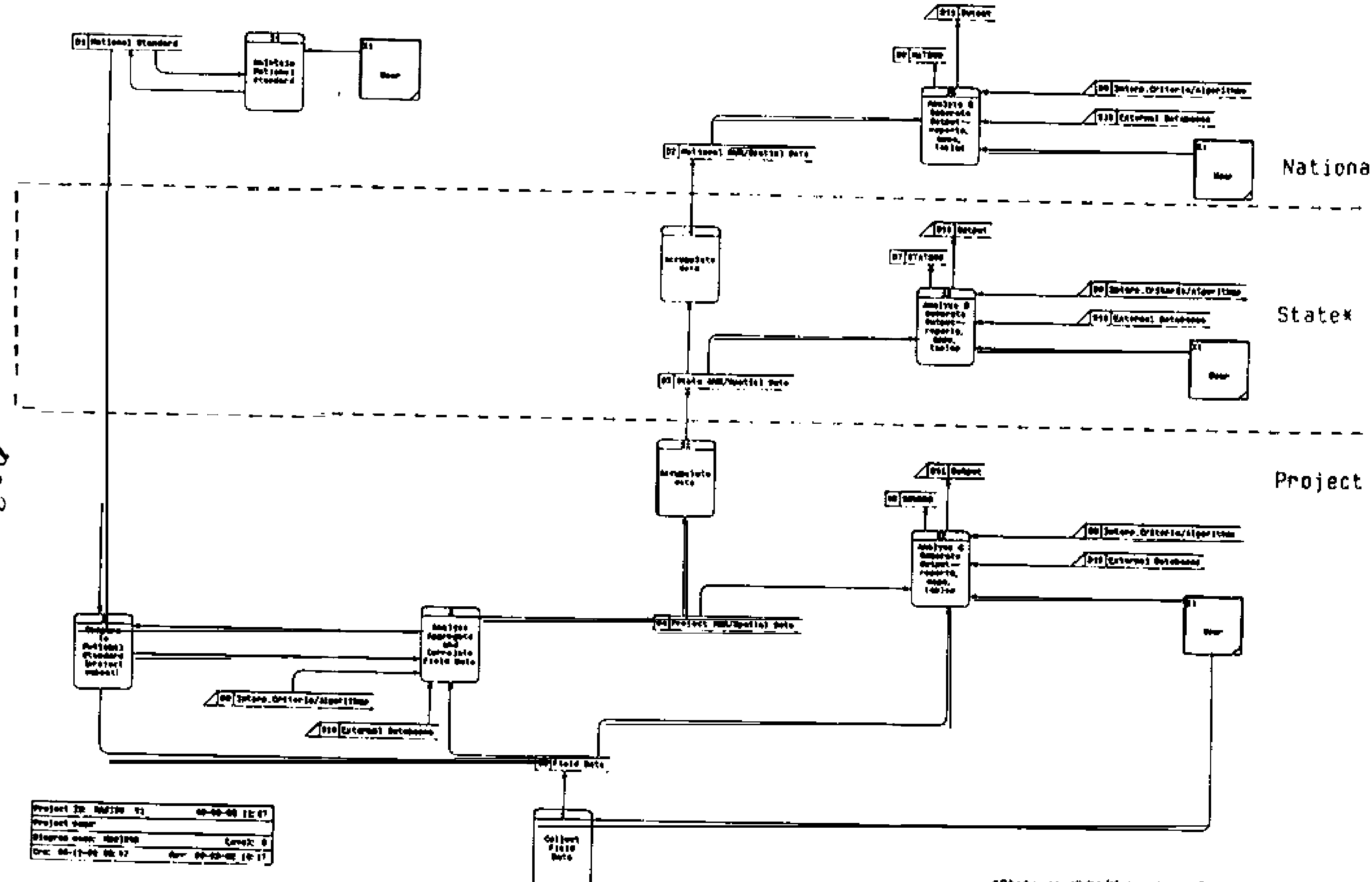
A. Advantage6

1. Allow unlimited component6 in map units and allow all components to be interpreted.
2. Eliminate political or manmade boundaries from the database.
3. The table structure is more flexible at all levels. Adding of data element6 or increasing the length of a data table does not affect operation of the software.
4. The data is managed at the field level. The field staff will have all the capabilities of NASIS.
5. Spatial data is integrated at the mapping level and can used for testing tool as well a6 a delivery tool.
6. Interpretation6 can be tested at the developmental stages of a soil survey as map units are designed.
7. Will allow for field data recorders 60 that information needs to be recorded only once (developmental).
8. Representative value6 developed at the field level will allow software designers to use the data more accurately.
9. Tempo.al data can be stored and retrieved as needed.
10. Removed restraints imposed on the old system such as storing layer6 instead of storing soil horizons. The system currently used by SCS was greatly restricted by field length6 and number of fields.

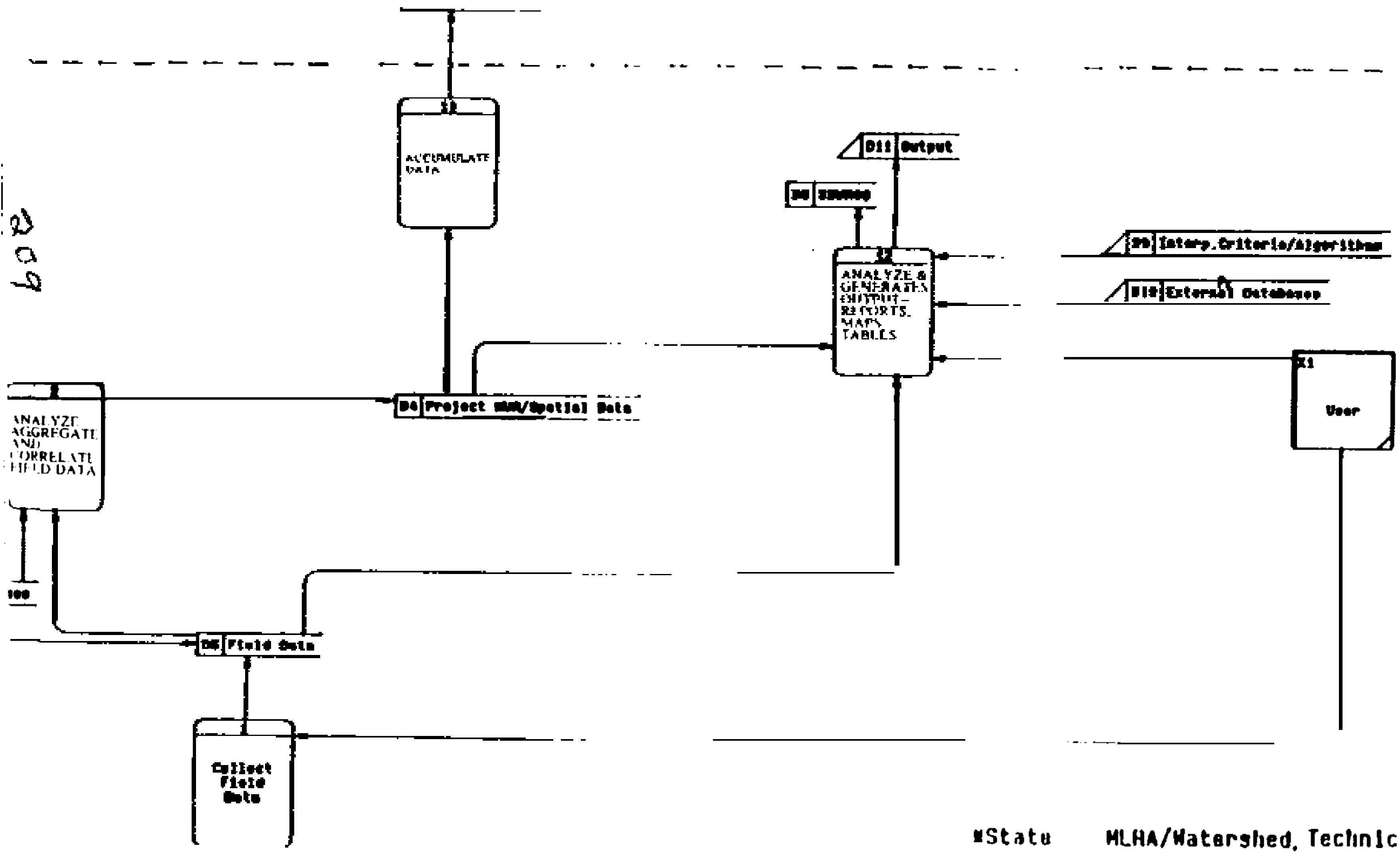
B. Why now

1. The present system Was beginning to show weakness and had served many years.
2. The data base management system for SC5 was being changed from Prelude to Informix.
3. The advent of new uses of soil survey required the addition of new data elements to the data store.
4. Info-share and data sharing between government agencies showed a need for new ways to access data and to be able to Share data rapidly.

GENERALIZED NASIS DIAGRAM

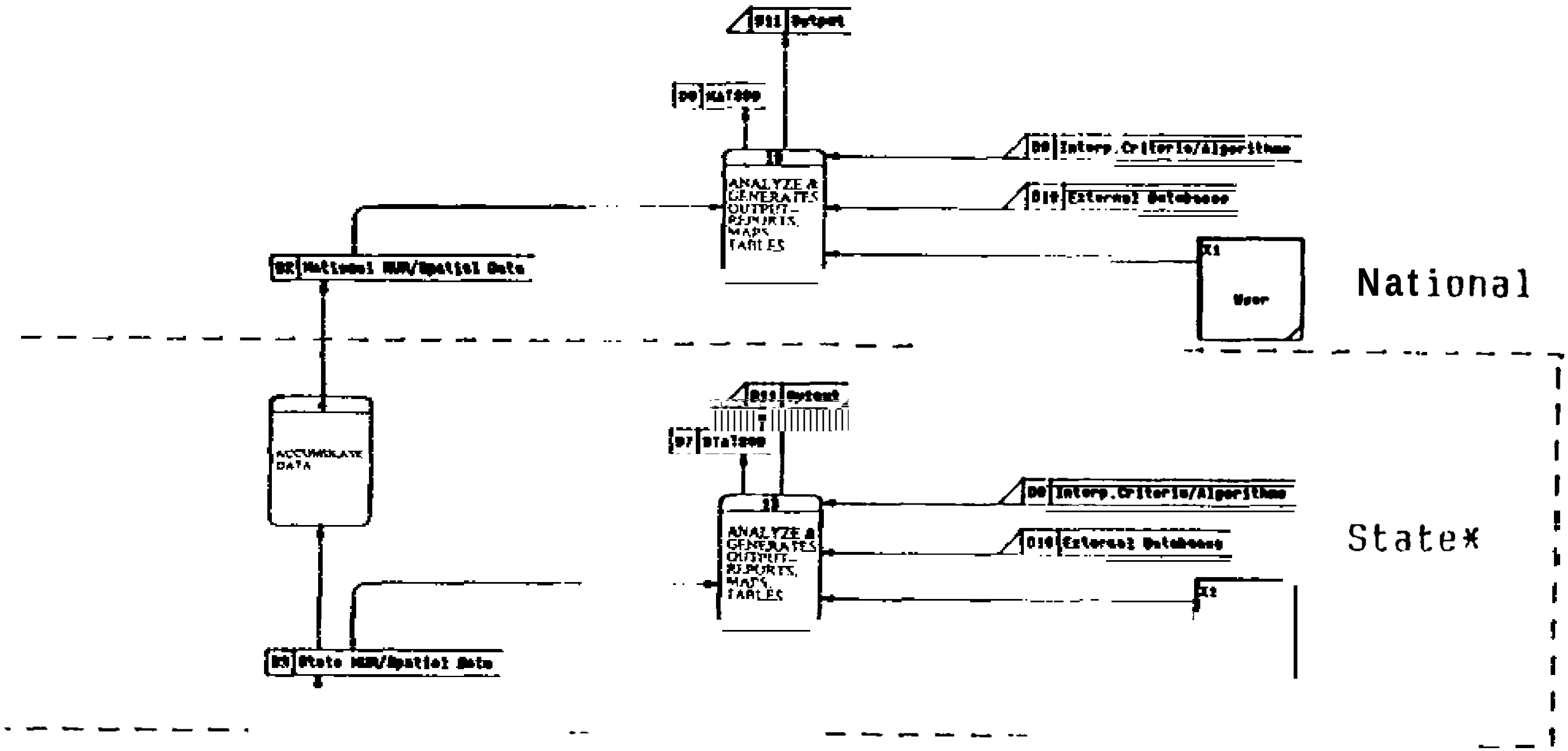


*State or MLRA/Watershed, Technical Center, etc

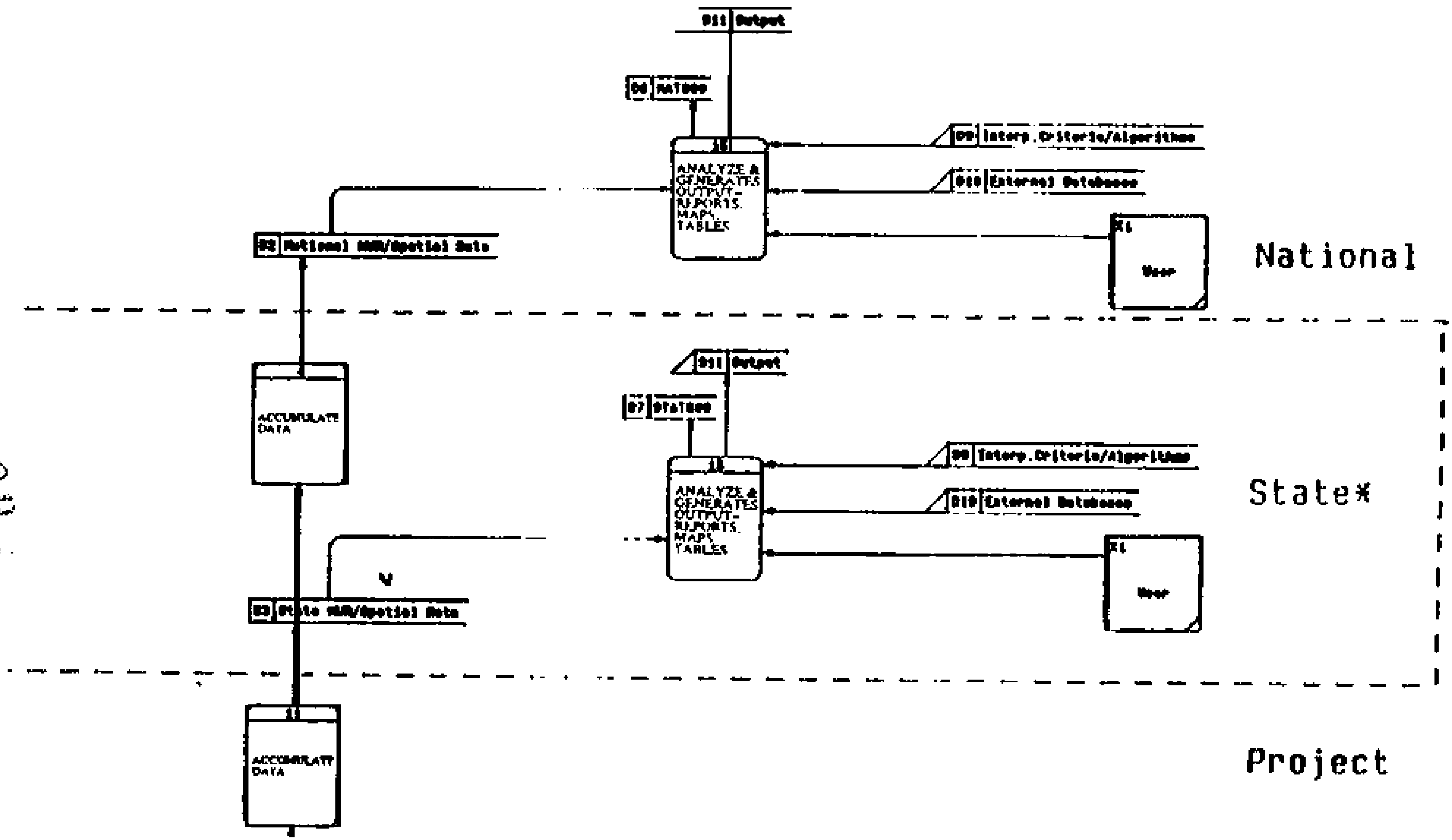


Project

*State MLHA/Watershed, Technical Center, etc.


Output
Interp.Criteria/Algorithms
External Databases
ANALYZE & GENERATES OUTPUT-REPORTS, MAPS TABLES
User
National
ACCUMULATE DATA
STATSGO
State*

210



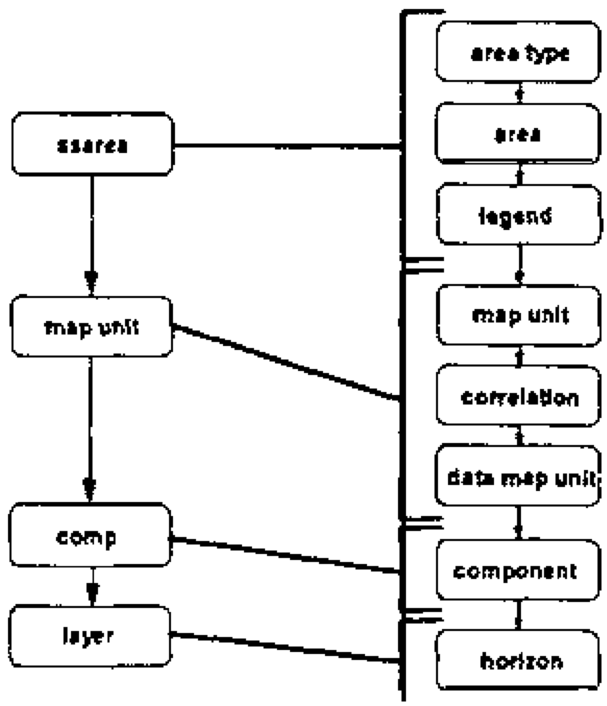
D11 Output
D6 NATDBB
D9 Interp. Criteria/Algorithms
D10 External Databases
ANALYZE & GENERATES OUTPUT-REPORTS, MAPS, TABLES
D2 National NRR/Spatial Data
User
National
ACCUMULATE DATA
D11 Output
D7 STATDBB
D9 Interp. Criteria/Algorithms
D10 External Databases
ANALYZE & GENERATES OUTPUT-REPORTS, MAPS, TABLES
User
State*
D3 State NRR/Spatial Data
ACCUMULATE DATA
Project

National *Soil Information* System

NASIS Overview

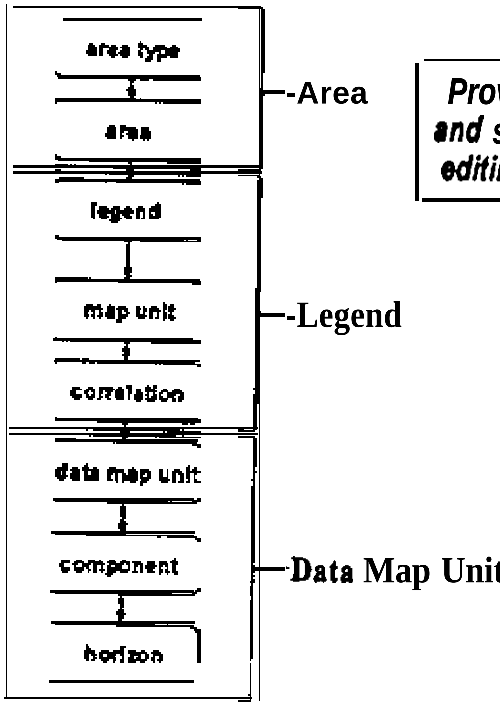
SSSD vs. NASIS
Implementation Timeline
Release 1.0 to 3.0 Features

SSSD NASIS



1

NASIS Security & Owned Objects



Provides capability to read and share data while limiting editing to authorized users.

Security Classes
- Databases
- Groups
- Users

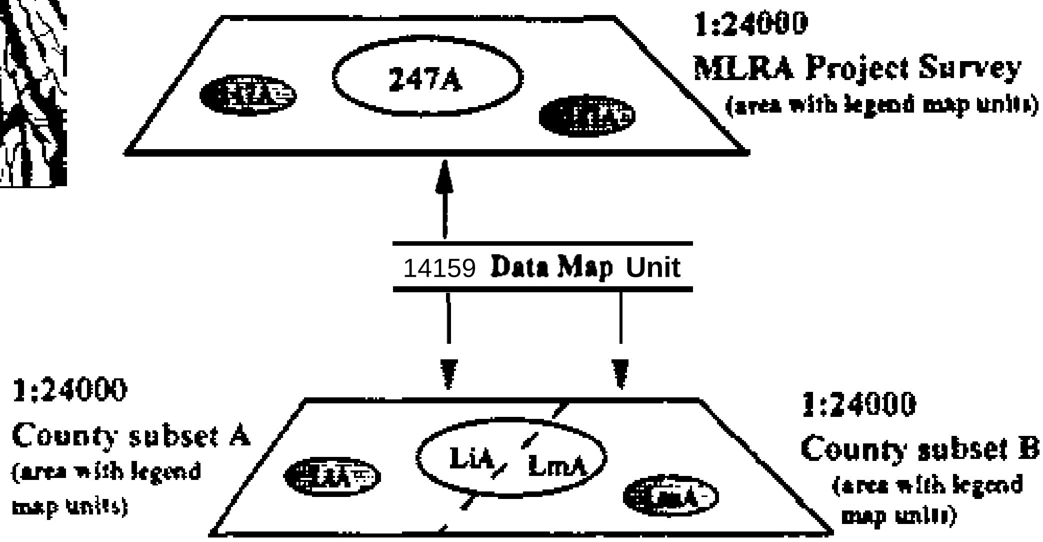
Owned Objects
- Areas
- Legends
- Data Map Units

SOIL-S's & SOIL-6's vs. NASIS

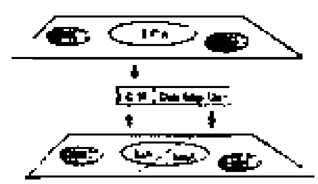
SOILS Functions:	NASIS:
• Repository for downloading SDR tables	• All of tbe data associated with a SOILS will be managed within NASIS locally
• Repository for populating MUIR components	• Map units are populated by copying data within NASIS
• Complement to the OSED for specifying RIC	• Map unit data may be compared with a recognized standard

[SOIL-6 Functions	NASIS:
• Retrieve up to tbree SOIL-5(s) for a map unit, adjust layer depths and/or delete specific layers	• Map units are linked to multinle compooeots (unlimited) locally
• Create conversion legend for additional symbols	• All correlation rod conversion records are maintained withinth NASIS correlation table
• Record acres in multi-county surveys	• NASIS stores acreages by area for multiple-area surveys

NASIS Legend Map Unit & Data Map Unit Relationships



NASIS Correlation Table



survey area	map symbol	status
MLRA	247A	approved
subset A	LiA	approved
subset B	LmA	approved
subset B	AvA	inactive

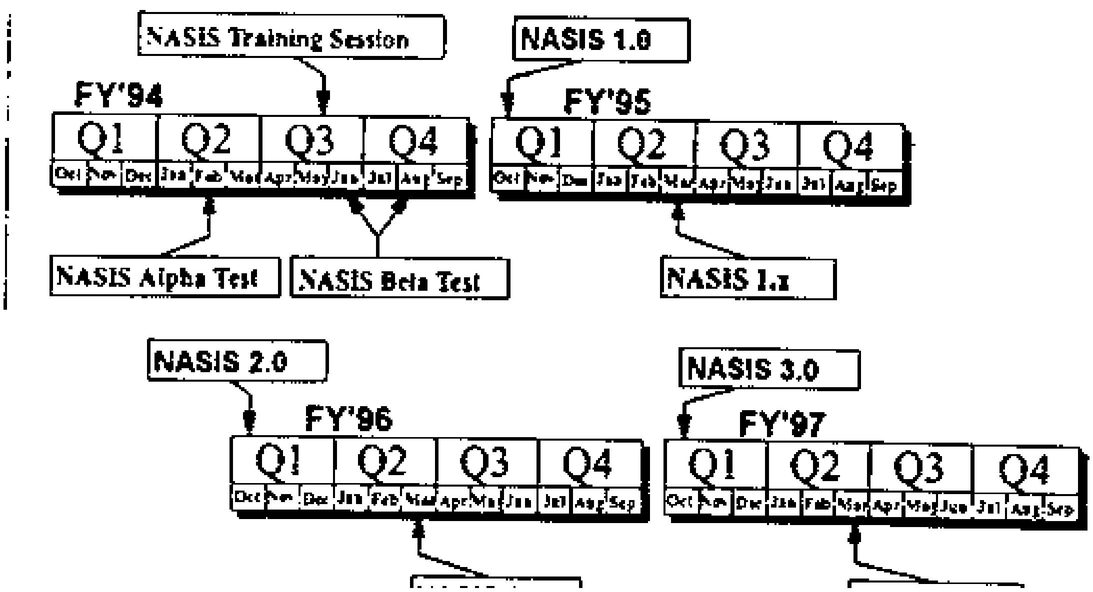
Legend Map Unit Table

legend map unit	data map unit	representative
247A	14159	yes
LiA	14159	yes
LmA	14159	yes
LmA	54321	no
AvA	54321	yes

Correlation Table

Data Map Unit Table

data map unit ID	map unit data	owner
14159	data tables	MLRA correlator
54321	data tables	subset B project leader


NASIS Training Session
NASIS 1.0
FY'94
Q1
Q2
Q3
Q4
FY'95
Q1
Q2
Q3
Q4
NASIS Alpha Test
NASIS Beta Test
NASIS 1.x
NASIS 2.0
NASIS 3.0
FY'96
Q1
Q2
Q3
Q4
FY'97
Q1
Q2
Q3
Q4

Release 1.x Features

- Cut/Copy and Paste Function
  - Select object to cut or copy
  - Paste into new or existing object
- Configurable Edit Screen Setup
  - Choose columns (attributes) to edit
  - Specify order for columns
  - Name & save edit setups
- Query Generator (Select)
  - Select by legend or data **mapunits**
  - Select by attribute criteria
  - Name 8 save queries
- Global edit function
  - Changes work on entire selected set

Release 1.x Features

- Communication Support
  - **SoilNet** capabilities
  - Facilitate Data Exchange with Security Features
- Calculation & Validation
  - Provides for derivation of data elements
  - **Facilitates** interpretation generation
- interpretation Generation
- Reports (primarily for DSM)
  - Where Used Data **Mapunits**
  - Unlinked Data **Mapunits**
  - Data dump

Release 2.0 Features

- Export to FOCS, external users
- Interpretation Criteria Maintenance
- Enter/Edit PEDON Data
- Exchange Data between NASIS Sites
- Soil Survey Schedule

@Additional Reports

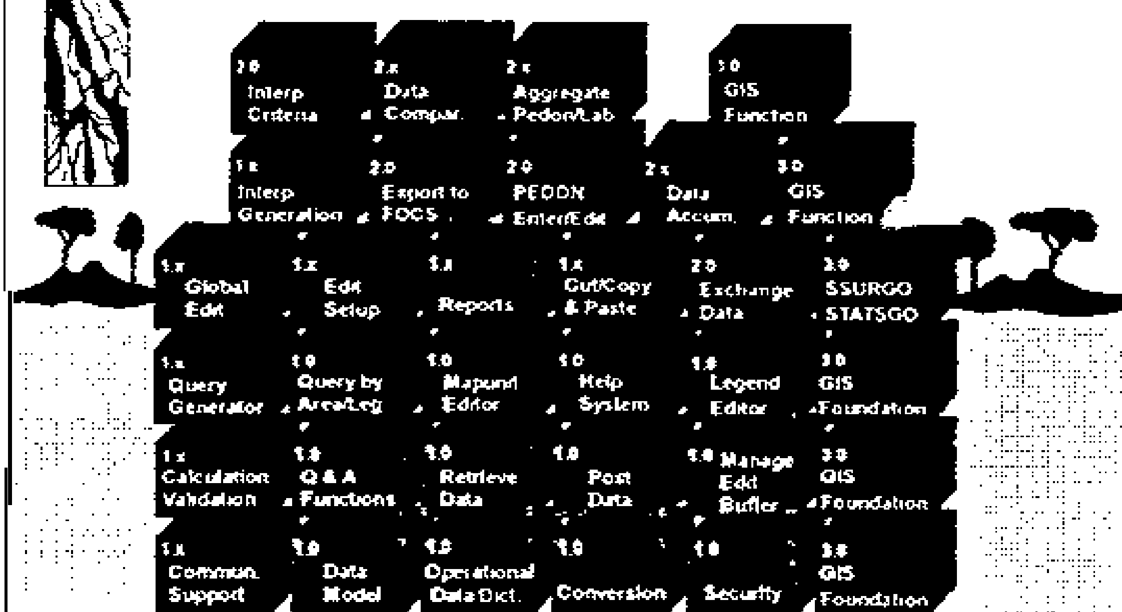
Release 2.x Features

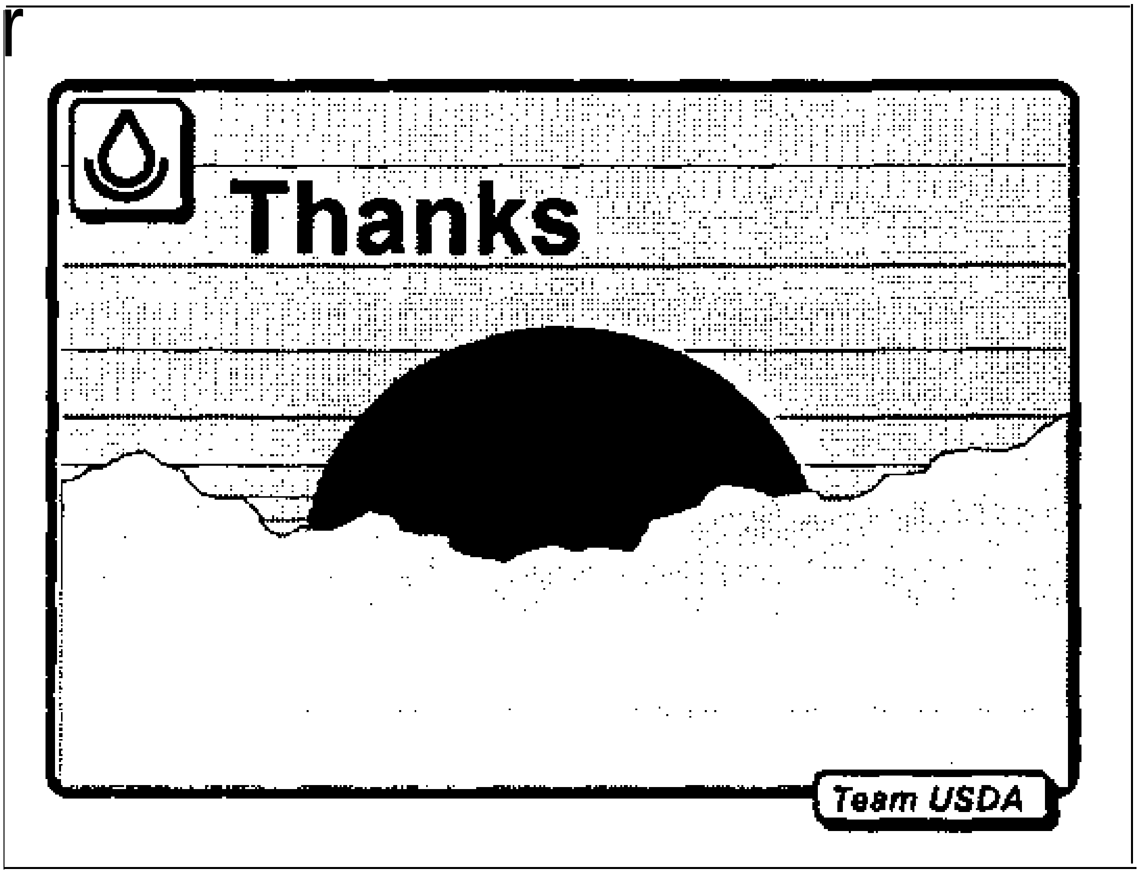
- Data Accumulation
  - **Site Characterization Data (SCR)**
  - **Map Unit Data (MUR)**
  - **Taxonomic Unit Data (TUR)**
- Generalized Data Comparison
  - **Pedon or Component RV vs. RIC for Series (National Standard)**
  - **Pedon vs. Component, Series vs. Series, . . .**
- Aggregate PEDON & Lab Data
  - **Help create mapunits**
  - **Statistically determine RIC**

Release 3.0 Features

- Add GIS capabilities to **NASIS**
- Manage SSURGO, **STATSGO,** NATSGO
- True Survey Area Editor
  - **Coincident areas**
  - **Acreage tabulation**
- Enter/Edit PEDON Data
- Incorporate “Fuzzy” Logic

Release 3.0




Thanks
Team USDA

THE NATIONAL SOIL INFORMATION SYSTEM

BACKGROUND

The SCS and its National Cooperative Soil Survey (NCSS) partners have maintained a soil survey database at Iowa State University (ISU) mince about 1975. Starting in about 1985 the SCS began an effort to reevaluate the soil data base. That effort has lad to the development of a National Soil Information System (NASIS).

WHAT IS NASIS?

NASIS is a ● yrtom that provider for the collection, storage, manipulation and dissemination of soil survey information within the National Cooperative Soil survey.

NASIS is also the umbrella project name under which the SCS Soil Survey Division is developing automated ● y8tomr , and much of the talk lately has been about NASIS in this context, but the overall NASIS will continua to have both manual and automated processes.

An information system such ● # NASIS is not simply ● collection of computer programs that operate on data filer. It is a means to ● chiovm organizational objectives by coordinating computer hardware, software, data, process logic, policy and operating procedures to implement organizational objectives.

Much of the work that ham been done to date has involved mapping out the current ● y*tem and then ● ettlinp on the organizational objectives mentioned earlier. A Soil Business Area Analysis Group (SBAAG) and other teams from the field, state and national staffs are continuing this effort. We will form many new teams as we continually strive to ● nhanca and improve our NASIS into the year 2000 and beyond.

The first software to be released under the NASIS umbrella, was the Pedon Dercriptlon Program. It provides the foundation on which we will build. The next release will deal with the storage, manipulation, and dissemination of soil ● urvay information. We plan to make this release in October 1994. It will address many of the inadequacies we have with the current ● yst8m and it is designed based on a new logic for soil ● urwy data that was developed in the ● nalyeia mentioned earlier

Projected release dates for NASIS and a brief ● xplanatlon of the functionality that will be included in each release ● re listed below:

NASIS 1.0 Components - October 1994
- Conversion SSSD to NASIS
- security system & Controls
- Operational Data Dictionary
- Data Editors
- On-line Help System

NASIS 1.x Components - March 1995
- cut, copy and Paste Functions

Configurable Edit Screen Setup
Query Generator (select)
Global Edit
Communication Support
Calculation L Validation
Interpretation Generation
Additional Reports (Duplicate Data Map Units, Unlinked Data Map Units)

<u>NASIS 2.0 Components - October 1995</u>
Export to FOCS, External

that ● valuation will indicate whether the data base will ● tay at ISU or be moved to another location.

WHAT ABOUT ALLOWING NON-SCPCRS TO ACCCSS AND CONTRIBUTE DATA TO THE SOIL DATA BASE AT ISU?

We have recently begun a project to put all of the map unit data or the data that LB created from the Soil Form 5 and 6 data. up in an ORACLE relational data base on Project Vincent, a UNIX workstation network at ISU. We are creating A capability to access this data over INTERNET. We also have . National Cooperative Soil Survey Data Management Team that is designing a c-n soil data dictionary and data structure that will ● vontwlly ● l10u non-SCSers to contribute soil data to the ISU database. These ● ffortr will feed a federal government interdepartmental ● ffort being lead by the Federal Geographic Data Committee to provide easy access to all natural resource and other data. The soil data may eventually become available over ● lactronic networks with software that tells what's available, where it's at, what it costs, and maybe eventually a means for on-line ordering and retrieval.

WHAT ABOUT ACCCSS TO THE DIOITIZCD COUNTY LEVEL (SSURGO) SOIL MAPS AND STATSGO DATA?

These data will continue to be available from the SCS National Cartographic and CIS Center at Fort Worth Texas. They may ● ventully be made available over the same network previously mentioned.

WHAT ABOUT THE AVAILABILITY OF NASIS SOFTWARE TO NON-SCSERS?

The NASIS software will be available to any non-SCSer. It will be distributed from the National Soil survey Center at Lincoln Nebraska.

WHAT KIND OF COMPUTER HARDWARE AND SOFTWARE WILL NASIS REQUIRE?

Except for a DOS personal computer version of the Pedon Description Program which is being developed, all of the NASIS ● oftuare will require a 486 or workstation computer and UNIX and INFORMIX software. Specifics can be obtained from the National Soil Survey Center.

FOR MORE INFORMATION CONTACT:

Ricky J. Bigler
National Soil Survey Center
Hail Stop 36
Federal Bldg. Room 152
100 Centennial Mall N.
Lincoln, NE 68508-3866

Presented by Jim Carley, State Soil Scientist, SCS, Spokane, Washington

WIND EROSION and PM < 10

Today I will be discussing wind erosion and Particulate Matter < 10 (PM < 10). It's an issue

The non-attainment areas identified are working within their jurisdictions to control the PM< 10 problem. Spokane, for instance, must address high PM < 10 occurrences during two primary times of the year. I'm excluding the grass burning and wood burning. During late winter, winter traction materials are a source of dust. The traction materials in the past contained large amounts of silts. When the roads dried sufficiently, vehicles entrained the fine silts into the air. Hopefully using cleaner traction sand materials and use of chemical de-icer will clean up this problem.

The other critical time Eastern Washington experiences PM c 10 problems is in late summer and early fall when the major wind events come from the southwest. There is evidence that the origin of that dust is agricultural. Although more research is needed in this area,, a correlation has been observed of wind events, wind erosion, and high PM c 10 readings in Spokane in late summer and fall with the winds from the southwest.

The stage of wind erosion that plays the largest role in PM < IO is suspension.

Wind causes the soil particles to bounce along the soil surface; each time they strike the soil surface! they dislodge other soil particles. This is called saltation. This repeating process results in soils being moved by wind.

The finer, silt-sized, particles become suspended in the air. This suspension is the airborne material that can end up miles or hundreds of miles from the source.

When we think of wind erosion we generally think of sandy soils and wind erosion evidence as seen in these slides. Accumulations of fine sand size soil particles that have been deposited on:

- fence rows
- in the furrows
- ditch banks
- and sand dunes.

In order to get a perspective of how soils land and wind erosion influences agricultural fugitive dust, let's take a look at the state of Washington and geographic locations of the major soils that play a role in PM < 10 problems in the state. This is a State General Soil Map.

Point out:

Columbia Basin
Palouse

This is a general soil map of the SE quadrant of WA.

Point out:

Spokane
Tri-Cities

The dark brown areas area deep sandy soils located in a 6-9 inch precipitation zone. These soils are used for irrigated cropland.

DEEP, SANDY SOILS
Quincy soils - Six or Seven to about Nine or Ten inches precipitation

LAND USE

1. Irrigated cropland - Precipitation is too low and available water capacity is to low for non-irrigated cropland
2. Potatoes, grapes, asparagus, spring grains, and mint are the main crops grown.

RESOURCE CONDITIONS

1. These soils are subject to saltation - minor amounts enter suspension. They lack the silt size soil particles to go into suspension.

2. They are subject to wind erosion in spring of year when tilled for seedbed preparation, and prior to the time the crop germinates and achieves enough size to prevent soil blowing.

3. Also subject to wind erosion in fall where crop residue or cover is not present.

4. Because it is irrigated there are several options available to reduce soil blowing. These are:

Wind break plantings, follow-up cover crops: and delayed tillage.

These soils are also subject to FSA/FACTA. Although severe wind erosion may occur on these soils, they are not a major agricultural fugitive dust source. This is due to the fact that they do not readily go into suspension, they are irrigated and therefore, many different lands of conservation measure can be readily applied.

SE Quadrant of State General Soil Map -
Map Units Ll, L2, Lt2
RED area on map.

LOESS SOILS - DEEP SILT LOAM SOILS
- 2.7 M acres in Washington.

Typically in seven to twelve or thirteen inches of precipitation.

1. Fifty percent very fine sand
2. Fifty percent silt, (high amount of very fine sand and silt combined)
3. Two to three percent clay, which is low
4. Less than one percent organic matter, which is low
5. Very weak structure - Structure is easily destroyed
6. Soils have an ash component

LAND USE

1. Non-irrigated cropland for winter wheat
2. Summer fallow system
3. Large fields

The climate particularly affects this non-irrigated area. Low precipitation between 6-12 inches results in low yields and low amounts of residue. About the only way this area can be cropped is with a winter wheat-summer fallow rotation.

RESOURCE CONDITIONS

1. Soils subject to both saltation and suspension
2. Low yields resulting in low residue levels
3. Seeding time in late August or September which coincides with major wind events.

At the end of the summer fallow year when seeding is done in the fall, the soils are the most susceptible to wind erosion. Residue and clods have been broken down by tillage. Large fields have soil surfaces that are bare, dry and powdery or fluffy and very susceptible to wind erosion. This is due to the low amount of clay (1 to 3 percent) and organic matter (< 1 percent). The soil lacks "glue" It is at this same window of time that the wind events occur.

The wind erosion on these soils is much more subtle than the wind erosion we see from the sandy soils. The silt size loam particles readily go into suspension. As you can see, this field is in very powdery or fluffy condition.

We don't see the sand dunes. We do see some evidence of the filling of the deep furrow drill rows with the very tine sand soil particles. .

Roth the saltation and suspension stages of wind erosion result in poor visibility and the consequences that may on Highway occur. Numerous. accidents have happened on highways during big wind events. These have resulted in loss of property and life. These soils are the primary source of the agricultural fugitive dust concerns of PM < 10

Most of these soils are not Highly Erodible for water or wind erosion by FSA criteria and therefore are not subject to Conservation Compliance.

Not Highly Erodible:

Wind Erosion	Water Erosion
Low "C" Value (30)	Low "R" Factor
Deep Soils (T=5)	Deep Soils (T=5)
Low "I" Value (86)	

Some solutions to reduce wind erosion on non-irrigated cropland include:

permanent cover (grass seedings)
crop residue management
wind strips
straw mulching on isolated blow out prone areas
soil roughness

Due to the low precipitation, the traditional wind breaks and/or cover crops cannot be established or maintained unless irrigation is provided. The conservation options are less than those on irrigated lands.

Traditionally wind erosion research has not been oriented toward agricultural fugitive dust, We have been more concerned with measuring what ends up in a fence line or road ditch than with what's in the air.

Currently, SCS is working with the Agricultural Research Service (ARS) to better predict wind erosion. We jointly established a Wind Erosion Prediction System (WEPS) site in the Horse Heaven Hills of Central Washington 3-4 years ago and have been collecting data since.

Although we can be getting conservation on the ground now, research still needs to be done. We need to:

determine how much PM < 10 varies from soil to soil
determine what part of agricultural fugitive dust in suspension is PM< 10
-support the development of tools necessary to accurately estimate PM <10 due to wind erosion
-quantify PM < 10 reductions resulting from conservation practices
do further soil analysis (especially on soils with ash content).
-establish what intensity of wind event should we be planning conservation practices for?
15 mph wind event
or
50 mph wind event
-determine the economics of resource practices for PM < 10

The complexity of wind erosion and how it related to agricultural fugitive dust is significant. For example:

Pilots have reported observing the dust from a few individual fields. Only a handful of fields were covering all of eastern Washington with dust. Adjacent fields with the same land use were not eroding. We need to learn from this. What makes the difference?

The main reason this has been on the agenda today is because we have recognized that wind erosion and agricultural fugitive dust is a problem. We need to further evaluate the extent and severity of the problem.

It's a big job. No one can do it alone. This is an opportunity for those of us in agriculture to work as partners. We need to approach this task as a coalition committed to solving the problem.

We need to develop strategies and methods to tackle the problem. Progress is made when we adopt the best technology to our knowledge but then continually ask ourselves, "What more can we do?"

In Washington, SCS and the Conservation Districts are working with DOE, EPA and local Air Quality authorities in order to address this problem. Through our technical knowledge and delivery system, we are assisting the agricultural and environmental communities with:

- identification of problem areas
- providing data for establishing quality criteria
- information activities
- educational activities
- technology improvements
- planning assistance

2238

In order to assist with technology improvement, the SCS is evaluating:

- residue reduction with associated tillage
- soil structure and clodiness with associated tillage.
- soil moisture
- accuracy of synthetic erosion inhibitors
- soil erodibility "I"
- effects of clodiness on wind erosion
- economics

We need to adopt, implement and apply new techniques to field conditions. Hopefully we can make progress in the development and implementation of new techniques to reduce wind erosion and blowing dust from the agricultural lands.

The public awareness of air quality is increasing. For instance, the health of over a 1/2 million people in Eastern Washington is being adversely affected by agricultural fugitive dust from 2.8 million acres of cropland. In the Western U. S. approximately 45 million acres have been identified as contributing to PM < 10.

As conservationists we are challenged to provide the best possible technology and solutions to maintain and improve the air quality.

Thank You.

Any Questions?

A CENTURY MINUS FIVE --- AND COUNTING

West-Midwest Soil Survey Conference
Coeur d'Alene ID June 1994

Dick Arnold, Director, Soil Survey
USDA-SCS, Washington, DC

1. Have you heard the rumors? Soil surveys are almost completed. The once-over is going to happen. The Soil Survey is obviously on a one way track and will pass over the far horizon into oblivion.

2. Others have rumored that we have passed our zenith and are really over the hill. The glory days were in the 1960s and 1970s they say, certainly not in the 1990s.

3. But if we look all around us we see nothing but change. Everywhere there is change, beautiful, wonderful, exciting, and to some extent predictable.

4. ILet me tell you something ladies and gentlemen the world is changing and your soil survey will be changing with it. Take heart and get on with life. It is far too short to waste.

5. There will be no ruins perched high on the slopes waiting the return of unknown ghosts of yesteryear.

6. There will not be any reason to dredge for gold again with a fever that consumes reason and caution. We don't need rusting buckets to remind us of what might have been.

7. The sky is gray and ominous. The forest closes sin around us. But look, there ahead in the bend in the road is a golden promise of a bright new day. A ray of hope that pushes aside the gathering storm clouds.

8. It is not a new beginning. It is not a rebirth. It is not the smoke and mirrors of magicians. It is the adherence to the reality of living in a world which continues to evolve and grow and recycle the goodness thereof.

9. Remember when outsiders used to tell us that the only thing we knew to do was look at "holes in the ground"?

10. What some folks have never understood is that we learned the value of teamwork, From the smallest to the strongest we set our minds to the task at hand and pulled, and pulled, and pulled together.

11. We stretched that little hole in the ground into a trench reaching across the landscape a6 far a6 we needed it to go. We Paw new relationships, and learned how the underground world was put together. We created the Pedosphere.

The U.S., like much of the rest of the world, ha6 recognized the significance of *clean water - for man* and beast, for land and feast. It is Crucial for a sustainable, productive nation.

13. The quality of water is more than the sediment load swirling by on it6 way to degrade other part6 of the *environment. It* is also the way water travel6 through the landscape. Gently, peacefully, meaningfully - or in a destructive rush to engulf all that lie6 ahead.

14. The quality of animal habitat is receiving deserved attention a6 we search for an appropriate balance of what will remain a6 the biodiversity of plant and animal life.

.15. Ecosystem-based assistance for integrated total resource management. It is far more than a catchy phrase. It is cognizance of the relevance of sustainable "humanized" ecosystems.

16. When you no longer can see the forest because of the trees, it just might be those majestic redwood6 that hold each of us spellbound at the grandeur of Nature.

37. Resilience is the ability or capacity to return to a former state when disturbed. But perhaps more interesting is the concept of adaptability - that ability or capacity to change with changing Conditions. This is north central California, not the Andes mountain6 of Peru.

18. Like and amoeba - stretching, groping, encircling and digesting it6 own environment. The social system is a6 important a6 the ecosystem in making this a "one world". There are 60 many potential customer6 for soil information.

19. Ho matter what we do, or say, or think, it is other people who make the major decisions about land use, farming systems, and managing resources. But we can promote stewardship. Stewardship of all resources. Stewardship. Consider this, "Stewardship is the social acceptance of sustainability".

20. Prom space one can glance across the Hawaiian islands to the farthest horizon and see the curvature of the earth. What goes around, comes around. What comes around is surely connected to that which wa6 before and that which is yet to come.

21. There are many acres of public land and land of Native Americans that would benefit from detailed *inventories as* plans are **prepared** the changing conditions in the decades ahead.

22. With a policy of "no net loss of wetland", there likely will be more and more "reconstructed" wetlands such as these vernal pools. Getting it right the first time is not at all easy.

23. Monitor the status, condition and trend of natural resources. conduct sophisticated research. Delineate special features. But for goodness sake, get the geographic coordinates - because it is a world of cadastral accuracy and geographic information systems.

24. Caring for renewable resources means knowing which species of seedlings to plant on which sites. Rotations, once started, are not so easy to change. The margins for error are small when you tinker with the risks of 'sustainable ecosystems that are in concert with the rest of the environment.

25. Efficient, thrifty fanners: effective, thrifty farming systems; integrated, thrifty ecosystems. Headed for a productive nation in harmony with a quality environment.

26. Do we really understand soils like this? Will we ever know the story of their genesis? Was it dry once? Has it always been wet? So much yet to learn about that which we have made maps of.

27. Use dependent properties can be measured. Techniques have been developed. NASIS will likely be able to store and manage such information. How far and how fast will we move toward measuring the quality of soils?

28. Soil Taxonomy has led us into strange new ventures, helped us meet new friends, and lt us search for improved understanding together. It is a stimulus, not an answer. It is a thermometer, not a climate. It is the most comprehensive system devised - and yet it's flaws will eventually destroy it.

29. Teamwork. Shoveling together. Filling in something. Teams change the way we do things and help us find better ways.

30. And after the filling in, there is often a brief moment of silence, the bowing of heads. Collectively there is recognition of the passing of a friend whose time had come.

31. **Yes, a team -** maybe two teams - or more, have worked long and hard to bury the concept that the only way to present soil information is the paper bound standard soil survey report. There is light at the end of the tunnel. There is sunshine at the bend in the road ahead.

32. Soil survey is a global science. It is helping others who want help. It is teaching, reaching, and preaching. The opportunities that exist today have never presented themselves before in our lifetime. If this is possible, what next?

33. Well, for one thing, equality for those who see a place for themselves in the scheme of things. Equality in training, in job opportunities, and in being the best we can make each other be.

34. Another thing is equality of ecosystems as they are integrated into an interactive wholeness not before perceived as necessary, nor particularly desirable as implemented.

35. And still there is the challenge to obtain food from healthy, uncontaminated soils. Clean environments now - and far, far into the future. Where? For how long? Who will protect all of this?

36. Diversity *means* different things to different people. Uniformity is not diversity. Standards appear to be essential for meaningful feedback, yet conformity is not diversity. Concepts, ideas, theories, laws, incentives, regulations, lawmakers, governance for the good of the many and not the few - these are a few of diversity things. Diversity is what made us strong and it will keep us strong if we once again embrace the value of such a reality.

37. There will be some unexpected events in the years ahead. Things aren't always predictable or the same as before. Chaos is ordered, it is simple, and it has a charm of its own.

38. Weather vanes patterned after pigs or rabbits? Possibly, but not a good choice. This is the silhouette of reversible plows. Some things are a one way trip.

39. Protected in the cornfields of the Midwest from the harvest of eawloge in the West, I had no perception of what a sheared stump might look like. Awesome.

40. A century minus five. Not much time left is there? You can get US there by leading. you can't push wet noodles, but you can pull them. How does Nature lead a river? Change a baselevel and you change the playing field.

41. Be delighted when beauty graces beauty. Enjoy the unusual, the unexpected.

42. Be sensitive to the little things that disturb the environment around you. Great care will have rewarding results.

43. Shake up those things that cling too tightly to the past, to tradition for tradition's sake. There are new ways. There are times to try and times to fail. Progress is a process, not a place.

44. Turn a corner and there may be another illusion beckoning you to venture further. False starts are acceptable but not blindly following the wrong signs. Illusions are a challenge, an opportunity to re-evaluate where we are.

45. A century will come and go, yet our mission of helping others will still be there in shining golden letters.

46. Always read the landscapes before you. They are witnesses to the behavior of society. They have clues that can help unravel the pieces of the puzzle about how mankind has fared on his journey through space and time.

47. Yes, you can read stewardship. In the eye of the beholder is the reflection of a value system.

48. Social acceptance of conservation is dependent on cultural aspects, economic impacts, and available technology. Social acceptance of sustainability is what we call stewardship.

49. There it is. Right before your eyes. The beauty of the countryside is a measure of man's love for the land and his diligence in caring for its resources.

50. A few of the marvels of the world are not of man's doing. Icebergs beneath the mist shrouded hills of Glacier Bay National Monument are one of those marvels.

51. Another are the oblique dunes in the Oregon Dunes Natural Resource Area.

52. A century minus five. Ninety-five years of marvelous beauty and still looking great. Changes are a part of our history, vital to our traditions, and hold forth promise of success. Success, as we have learned, is a journey, it is not a destination.

THANK YOU.

NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS

ECOMAP, USDA Forest Service, Weshlngton, D.C.

October 7, 1993

presented by

Tom Collins
U.S. Forest Service
Ogden, Utah

235

PREFACE

The National Hierarchical Framework of Ecological Units was developed to provide a scientific basis for Ecosystem Management. Use of the Framework will improve consistency in developing and sharing resource data and inlormation at multiple geographic scales and across administrative and jurisdictional boundaries. Implementation of the Framework will help integrate the principles of Ecosystem Management info national, regional and forest planning and assessment efforts. The required use of consistent terminology, common maps and standard data will improve communications internally and wkh our publics and partners. This Hierarchical Framework has taken a year to develop and active participation in its development came from all regions, several research stations and with input from several federal and state agencies and universities. The Framework is hereby adopted for use. As we learn from its application, coordination with other agencies and from newly developed information, adjustments will be made as needed. The process of use and development of this Framework can best be viewed as a journey.

Chief .

Date .

Summary
NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS

ECOMAP, USDA Forest Service, Washington, D.C.

The National Hierarchical Framework of Ecological Units is a regionalization, classification and mapping system for stratifying the Earth into progressively smaller areas of increasingly uniform ecological potentials for use in ecosystem manage. ment Ecological types are classified and ecological units are mapped based on associations of those biotic and environmental factors that directly affect or indirectly express energy, moisture, and nutrient gradients which regulate the structure and function of ecosystems. These factors include climate, phys-iography. water, soils, air. hydrology, and potential natural communities.

The hierarchy is developed geographically from both the top-down and bottom-up; conditions that change at broad scales such as climate and geology are continually related lo conditions that change at finer scales such as biotic distributions and soil characteristics. This approach enables scientists and managers to evaluate broader scale influences on finer scale conditions and processes, as well as to use finer scale inlormation to determine the significance of broader scale influences. In this iterative procedure, Ecoregion and Subregion levels of the hierarchy are developed by stratification as fine scale field classifications and inventories are being completed.

This regionalization, classification, and mapping process uses available resource maps Including climate, geology, soils, water, and vegetation. In some cases. however, additional Information is needed. Data bases and analysis techniques are being developed to provide interpretation of the ecological units.

Uses of the hierarchy vary according to management information needs and level of inlormation resolution. These applications are summarized below. The hierarchical framework is largely a Forest Service effort, although there has been involvement by the US. Soil Conservation Service. Bureau of Land Management, Fish and Wildlife Service, U.S. Geological Survey, The Nature Conservancy and other national and regional agencies. Our goals are to develop an ecological classification and inventory system for all National Forest System **lands. and to** provide a prototype system acceptable to all agencies. Nationally coordinated ecological unit maps will be developed for Ecoregion and Subregion scales covering all U.S. lands.

National hierarchy of ecological units.

PLANNING AND ANALYSIS SCALE	ECOLOGICAL UNITS	PURPOSE, OBJECTIVES, AND GENERAL USE	GENERAL SIZE RANGE
Ecoregions Global Continental Regional	Domain Division Province	Broad applicability for modeling and sampling RPA assessment. International planning.	1,000,000's to
Subregions	Sections Subsections	RPA planning. Multi-forest, statewide and multi-agency anatysis and assessment.	
Landscape	Landtype Association		
Land Unit	Landtype Landtype Phase		

NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS

ECOMAP[1], USDA Forest Service, Washington, D.C.

INTRODUCTION

To implement ecosystem management, we need basic information about the nature and distribution of ecosystems, To develop this information, we need working definitions of ecosystems and supporting inventories of the components that comprise ecosystems. We also need to understand ecological patterns and processes, and the interrelationships of social, physical, and biological systems. To meet these needs, we must obtain better information about the distribution and inter. action of organisms and the environments in which they occur, including the demographics of species, the development and succession of communities, and the effects of human activities and land use on species and ecosystems (Urban et al. 1987). Research has a critical role in obtaining this information.

This paper presents a brief background of regional land classifications, describes the hierarchical framework for ecological unit design, examines underlying principles, and shows how the framework can be used in resource planning and

[1]Peter E. Avers, David T. Cleland, W. Henry McNab, Mark E. Jensen, Robert G. Bailey, Thomas King, Charles B. Goudey, and Walter E. Russell. Others who contributed to this paper through helpful review comments and suggestions include many Forest Service employees, and members of other federal and state agencies, The Nature Conservancy and universities. A list of reviewers and commenters appears in Appendix 1 of this paper.

(1984), Gallant et al. (1989), and Omernik (1987) in the United States and those of Wiken (1986) and the Ecoregions Working Group (1989) in Canada. Concepts have also been presented for ecological classification at subregional to local scales in the United Stales (Barnes et al. 1982), Canada (Jones et al. 1983, Hills 1952), and Germany (Barnes 1984).

But no single system has the structure and flexibility necessary for developing ecological units at continental to local scales. Each of these systems have strong points that contribute to the strength of the national hierarchy. The concepts and terminology of the national system draws upon this former work to devise a consistent framework for application throughout the United States,

ECOLOGICAL UNIT DESIGN

The primary purpose for delineating ecological units is to display land and wafer areas at different levels of resolution thal have similar capabilities and potentials for management. Ecological Units are designed to exhibii similar patterns in: (1) potential natural communities, (2) soils, (3) hydrologic function, (4) landform and topography. (5) liihology. (6) climate. (7) air quality and (8) natural processes for cycling plant biomass and nutrients (e.g. succession, productivity, fire regimes).

It should be noted that climatic regime is an important boundary criteria for ecological units, particularly at broad scales. In fact climate, as modified by topography, is the dominant criteria at upper levels. Other factors, such as geomorphic process, soils and potential natural communities take on equal or greater importance than climate at lower levels. The discussion under the Classification Framework section and Table 2 provide more details on map unit criteria for each hierarchical level.

An ecological type is defined as 'A category of land having a unique combination ot potential natural community soil, landscape features, and climate; and differing from other ecological types in its ability to produce vegetation and respond to management' (FSM 2080.05). An ecological unit is defined as 'A mapped landscape unit designed to meet management objectives, comprised of one or more ecological types' (FSM 2060.05).

It follows, then, that ecological map units are differentiated and designed by multiple components including climate, physiography. landform. soils, water, and potential natural communities (FSM 2060, FSH 2090.11). These components may be analyzed Indiiidually and then combined or multiple factors/components may be simultaneously evaluated to classify ecological types which are then used in ecological unit design (FSH 2090.11). The first option may be increasingly used as geographic Information systems (GIS) become more available. The Interrelationships among independently defined components, however, will need to be carefully evaluated, and the results of layering component maps may need to be adjusted to identity units that are both ecologically significant and meaningful to management. When various disciplines cooperate in devising integrated ecological units, products from existing resource component maps can be modified and integrated interpretations can be developed (Avers and Schlatterer. 1991).

CLASSIFICATION FRAMEWORK

The National Ecological Unit Hierarchy is presented in Tables 1, 2. and 3. The hierarchy is based on concepts and terminology developed by numerous scientists and resource managers (Hills 1952, Crowley 1967, Wertz and Arnold 1972, Rowe 1980. Allen and Starr 1982, Barnes et al. 1982. Forman and Godron 1986, Bailey 1987. Meentemeyer and Box 1987, Gallant et al. 1989, Cleland et al. 1992). The following is an overview of the differentiating criteria used in the development of the ecological units. Table 2 summarizes the principal criteria used at each level in the hierarchy.

ECOREGION SCALE At the Ecoregion scale, ecological units are recognized by differences in global. continental. and regional climatic regimes and gross physiography. The basic assumption is that climate governs energy and moisture gradients. thereby acting as the primary control over more localized ecosystems. Three levels of Ecoregions, adapted from Bailey. are identified in the hierarchy (Bailey 1980):

1. **Domalns -** s&continental divisions of broad climatic similarity, such as lands that have the dry climates of Koppen (1931). which are affected by latitude and global atmospheric conditions. For example. climate Of the Polar Domain is controlled by arctic air masses, which create cold, dry environments where summers are short In contrast, the climate of the Humid Tropical Domain is influ-

enced by equatorial air masses and there is no winter season. Domains are also characlerired by broad differences in annual precipitation, evapotranspiration, potential natural communities, and biologically significant drainage systems. The four Domains are named according to the principal climatic descriptive features: Polar, Dry, Humid Temperate, and Humid Tropical.

2. **Divisions** - subdivisions of a Domain determined by isolating areas of definke vegetational affinities (prairie or forest) that fall within the same regional climate, generally at the level of the basic types of Koppen (1931) as modified by Trewartha (1968). Divisions are delineated according to: (a) the amount of water deficit (which subdivides the Dry Domain into semi-arid, steppe, or arid desert, and (b) the winter temperatures, which have an important influence on biological and physical processes and the duration of any snow cover. This temperature factor is the basis of distinction between temperate and tropical/subtropical dry regions. Divisions are named for the main climatic regions they delineate, such as Steppe, Savannah, Desert, Mediterranean, Marine, and Tundra.

3. **Provinces** - subdivisions of a Division that correspond to broad vegetation regions, which conform to climatic subzones controlled primarily by continental weather patterns such as length of dry season and duration of cold temperatures. Provinces are also characterized by similar soil orders. The climatic subzones are evident as extensive areas of similar potential natural communities as mapped by Kuchler (1954). Provinces are named typically using a binomial system consisting of a geographic location and vegetative type such as Bering Tundra, California Dry-Steppe and Eastern Broadleaf Forests.

   Highland areas that exhibit altitudinal vegetational zonation and that have the climatic regime (seasonality of energy and moisture) of adjacent lowlands are classified as Provinces (Bailey et al. 1995). The climatic regime of the surrounding lowlands can be used to infer the climate of the highlands, For example, in the Mediterranean Division along the Pacific Coast. the seasonal pattern of precipitation is the same for the lowlands and highlands except that the mountains receive about twice the quantity. These provinces are named for the lower elevation and upper elevation (subnival) belts, e.g., Rocky Mountain Forest-Alpine Meadows.

SUBREGION SCALE Subregions are characterized by combinations of climate, geomorphic process, topography, and stratigraphy that influence moisture availability and exposure to radiant solar energy, which in turn directly control hydrologic function, soil-forming processes, and potential plant community distributions. Sections and Subsections are the two ecological units mapped at this scale.

1 **Section** - broad areas of similar geomorphic process, stratigraphy. geologic origin, drainage networks, topography, and regional climate. Such areas are often inferred by relating geologic maps to potential natural vegetation 'series' groupings as mapped by Kuchler (1964). Boundaries of some Sections approximate geomorphic provinces (for example Blue Ridge) as recognized by geologists. Section names generally describe the predominant physiographic feature upon which the ecological unit delineation is based. such as Flint Hills, Great Lakes Morainal. Bluegrass Hills, Appalachian Piedmont.

2 Subsections - smaller areas of Sections with similar surficial geology. lithology. geomorphic process, soil groups, subregional climate, and potential natural communities. Names of Subsections are usually derived from geologic features, such as Plainfield Sand Dune, Tipton Till Plain, and Granite Hills.

LANDSCAPE SCALE At the Landscape scale, ecological units are defined by general lopography. geomorphic process, surficial geology, soil and potential natural community patterns and local climate (Forman and Godron 1986). These factors affect biotic distributions, hydrologic function, natural disturbance regimes and general land use. Local landform patterns become apparent at this level in the hierarchy, and differences among units are usually obvious to on-the-ground observers. At this level. terrestrial features and processes may also have a strong influence on ecological characteristics of aquatic habiiats (Plans 1979, Ebert et al. 1991). Landtype Association ecological units represent this scale in the hierarchy.

Landtype Associations - groupings of Landtypes or subdivisions of Subsections based upon similarities in geomorphic process, geologic rock types, soil complexes. stream types. takes, wetlands. and series, subseries, or plant association vegetation communities. Repeatable patterns of soil complexes and plant communities are useful in delineating map units at this level. Names of Landtype Associations are often derived from geomorphic history and vegetation community.

LAND UNIT SCALE At the basic Land Unit scale, ecological units are designed and mapped in the field based on properties of local topography, rock types, soils. and vegetation. These factors influence the structure and composition of plant communities, hydrologic function, and basic land capability. Landtypes and Landtype Phases are the ecological units mapped at this scale.

1. **Landtypes** - subdivisions of Landtype Associations or groupings of Landtype Phases based on similarities in soils, land. form, rock type, geomorphic process and plant associations. Land surface form that influences hydrologic function (e.g., drainage density, dissection relief) is often used to delineate diflerent landtypes in mountainous terrain. Valley bonom characteristics (e.g.. confinement) are commonly used in establishing riparian landtype map units. Names of Landtypes are to include an abiotic and biotic component (FSH 2090.11).

2. **Landtype** Phsse - more narrowly defined Landtypes based on topographic criteria (e.g.. slope-shape, steepness, aspect, position, hydrologic characteristics, associations and consociations of soil taxa, and plant associations and phases. These factors influence or reflect the microclimate and productivity of a site. Landtype phases are often established based on inter-relationships between soil characteristics and potential natural communities. In riparian mapping, landtype phases may be established to delineate different stream type environments (Herrington and Dunham 1967). Naming is similar to Landtypes (FSH 2090.11).

   The Landtype Phase is the smallest ecolog ical unit recognized in the hierarchy. However, even smaller units may need to be delineated for very detailed project planning at large scales (Table 1). Map design criteria depend on project objectives.

PLOT DATA Point or plot sampling units are used to gather ecological data for inventory, monitoring, quality control and for developing classifications of vegetation, soils or ecological types This plot data feeds into data bases for analysis, description, and Interpretation of ecological units (Keane et al. 1990). The plots can serve as reference sites for ecological types. Plots, while not mappable, can be shown on maps as point data.

In summary, the national framework has an extensive scientific basis, and provides a hierarchical system for mapping ecological units ranging in size from global to local. At each level abiotic and biotic components are integrated for delineation of geographical areas with similar ecological potential. These ecological units, combined with information on existing conditions and ecological processes, provide a basis for managing ecosystems.

UNDERLYING PRINCIPLES

ECOSYSTEM CONCEPT Ecosystems are places where life and environment interact; they are three dimensional segments of the Earth (Rowe 1960). Tansley introduced the term 'ecosystem' in 1935. and the explicit idea of ecological systems composed of multiple abiotic and biotic factors was formally expressed in our language (Major 1969). The ecosystem concept brings the biological and physical worlds together into a holistic framework within which ecological systems can be described, evaluated, and managed (Rowe 1992).

Ecosystems exist at many spatial scales, from the global ecosphere down to regions of microbial activity. The level of discernible detail, the number of factors comprising ecosystems, and the number of variables used to characterize these factors progressively increase at finer scales, Hence the data and analysis requirements, and investments for ecosystem classification and mapping also increase for finer scaled activities.

The structure and function of ecosystems are largely regulated along energy, moisture, nutrient, and disturbance gradients. These gradients are affected by climate, physiography, soils hydrology, flora, and fauna (Barnes at al. 1962. Jordan 1962. Spies and Barnes 1965). And while the association of these factors is all important in defining ecosysterns. all factors are not equalty important at all spatial scales. At coarse scales, the important factors are largely abiotic, while at finer scales both biotic and abiotic factors are important.

The conditions and processes occurring across larger ecosystems affect and often override those of smaller ecosystems, and the properties of smaller ecosystems emerge in the context of larger systems (Rowe 1984). Thus. ecosystems are conceptualiied as occurring in a nested geographic arrangement, with many smaller ecosystems embedded in larger ones (Allen and Starr 1982, O'Neill et al. 1986, Albert et al. 1986). This nested arrangement forms a hierarchy that is organized in decreasing orders of scale by the dominant factors affecting ecological systems.

At global, continental, and regional scales, ecosystem patterns correspond with climatic regions, which change mainly due to latitudinal, orographic, and maritime influences (Bailey 1987, Denton and Barnes 1988). Within

Range

knowledge of processes to this infrmation will1 containing few takes, for example, functions differently than one embedded within a landscape composed of many lakes for wildlife, recreation and other ecosystem values. Aquatic systems delineated in this indirect way have many characteristics in common, including hydrology and biota (Friiell et al. 1986). Overlays of hierarchical watershed boundaries on ecological mapping units are useful for mast watershed anaiysis efforts. In this case, the watershed becomes the anaiysis area which is both superposed by and composed of a number of ecological units which affect hydrologic processes such as water runoff and percolation, water chemistry, and ecological function due to context.

DESIRED FUTURE CONDITIONS Desired future conditions (DFC's) portray the land or resource conditions expected if goals and objectives are met. Ecological units will be useful in establishing goals and methods to meet DFC's. When combined with information on existing conditions, ecological units will help us project responses to various treatments.

Ecological units can be related to past present, and future conditions. Past conditions serve as a model of functioning ecosystems, and provide insight into natural processes. It is unreasonable, for example, to attempt to restore systems like oak savannas or old growth forests in areas where they did not occur naturally. Moreover, natural processes like disturbance or hydrologic regimes are often beyond human control. Ecological units will be helpful in understanding these processes and in devising DFC's that can be attained and perpetuated.

Desired future conditions can be portrayed at several spatial scales. We can minimize conflicting resource uses (e.g., remote recreational experiences versus developed motorized recreation, habitat management for area sensitive species versus edge species) if we consider the effects of projects at several scales of analysis Ecological units will be useful in delinealing land units at relevant anaiysis scales for planning DFC's (Brenner and Jordan 1991).

RESOURCE MANAGEMENT Information on ecological units will help establish management objectives and will support management activities such as the protection of habitats of sensitive, threatened, and endangered species, or the improvement of forest and rangeland heaith to meet conservation, restoration. and human needs. Information on current productivity can be compared to potentials determined for Landtype Phases. and areas producing less than their potential can be identified (Host et al. 1988). Furthermore, long term sustained yield capability can be estimated based on productivity potentials measured for fine scale ecological units.

MONITORING Monitoring the effects of management requires baseline inlormation on the condition of ecosystems et different spatial scales. Through the ecological unit hierarchy, managers can obtain information about the geographic patterns in ecosystems. They are, thus, in a position to design stratified sampling networks for inventory and monloring. Representative ecological units can be sampled and information can then be extended toanalogous unsampled ecological units, thereby reducing cost and time in inventory and monitoring.

By establishing baselines for ecological units and monitoring changes, we can protect landscape., community., and species-level biological diversity; and other resource values such as forest productivity, and air and water quality. The results of effectiveness and validation monitoring can be extrapolated to estimate effects and set standards in similar ecological units.

Evaluation of air quality is an example of how the National Hierarchical Framework of Ecological Units can be used for baseline data collection and monitoring. The Forest Service is developing a National Visibility Monitoring Strategy that addresses protection of air quality standards as mandated by the Clean Air Act, along with other concerns (USDA Forest Service 1993). Key to this plan is stratification of the United Stales at the subregion level of the national hierarchy info areas that have similar climatic, physiographic, cultural, and vegetational characteristics. Other questions dealing with effects of specific air-borne pollutants on forest health, such as correlation of ozone with decline of ponderosa pine and other trees in mixed conifer forest ecosystems in the San Bernardino Mountains of southern California, will require establishment of sampling networks in smaller ecological units at landscape or lower levels.

CONTEMPORARY AND EMERGING ISSUES
The National Hierarchical Framework of Ecological Units is based on natural associations of ecological factors. These associations will be useful in responding to contemporary and emerging issues. particularly those that cross administrative and jurisdictional boundaries. Concerns regarding biological diversity, for example, can be addressed using

the ecological unit hierarchy (Probst and Crow 1991). Conservation strategies can be developed using landscape level units as coarse lifters, followed by detailed evaluations and monitoring conducted to verify or adjust landscape designs. We can rehabilitate ecosystems and dependent species that have been adversely affected through fire exclusion, fragmentation or other [illegible]

LITERATURE CITED

Albert, D.A.; Demon S.R.; Barnes, B.V. 1986. Regional landscape ecosystems of Michigan. School of Natural Resources, University of Michigan, Ann Arbor. 32 p.

Allen. T.H.F.; Starr, T.B. 1982. Hierarchy: perspectives for ecological complexity. Chicago: The University of Chicago Press. 310 p.

Avers, P.E.; Schlatterer, E.F. 1991. Ecosystem classification and management on national forests. in: Proceedings of the 1991 symposium on systems analysis in forest resources.

Bailey, R.G. 1980. Descriptions of the ecoregions of the United States. Washington DC: U.S. Department of Agricukure. Forest Service. Miscellaneous Publication 1391. 77 p.

Bailey,R.G.; Zoltai,S.C.; Wiken, E.B. 1985. Ecological Regionalization in Canada and the United States. Geoforum 16 (3):265-275.

Bailey, R.G. 1987. Suggested hierarchy of criteria for multi-scale ecosystem mapping. Landscape and Urban Planning 14:313-319.

Bailey. R.G. 1989a Ecoregions of the continents (map). Washington, DC: U.S. Depanment of Agriculture, Forest Service. Scale 1:30,000,000.

Bailey, R.G. 1989b. Explanatory supplement to the ecoregions map of the continents. Environmental Conservation 15(4):307-309.

Baldwin, J.L. 1973. Climates of the United Stales. Washington DC: U.S. Depanment of Commerce. NOAA U.S. Government Printing Office. 113 p.

Barnes, B.V.; Pregitzer K.S; Spies. T.A; Spooner, V.H. 1982. Ecological forest site classification. Journal of Forestry 80:493-498.

Barnes, B.V. 1984. Forest ecosystem classification and mapping in Baden-Wurttemberg, West Germany. In: Forest land classification: experience problems, perspectives. Proceedings of the symposium; 1984 March 18-20; Madison, WI:49-65.

Brenner, R.N.; Jordan, J.K. 1991. The role of an ecological classification system in forest plan development and implementation. In: Proceedings of the 1991 symposium on systems analysis in forest resources, 1991 March 3-6; Charleston, SC.

Gallant A.L.; Whittier, T.R.; Larsen, D.P.; Omernik, J.M.; Hughes, R.M. 1989. Regionalization as a tool for managing environmental resources. US Environmental Protection Agency EPA/600/3-89/060. Corvallis, OR. 152 p.

Herrington, R.B; Dunham. D.K. 1967. A technique for sampling general fish habitat characteristics of streams. Ogden, UT: U.S. Department of Agriculture. Forest Service. Research Paper INT-41. Intermountain Forest and Range Experiment Station. 12 p.

Hills, G.A. 1952. The classification and evaluation of site for forestry. Ontario Depanment of Lands and Forests. Resource Division Report 24.

Hix. D.M. 1988. Multifactor classification of upland hardwood forest ecosystems of the Kickapoo River watershed. southwestern Wisconsin. Canadian Journal of Forest Research 18:1405-1415.

Holdridge. L.R. 1967. Life zone ecology. Tropical Science Center. San Jose, CA. 206 p.

Host. G.E ; Pregitzer, KS: Ramm, C.W.; Han, J.B.; Cleland D.T. 1987. Landform mediated diierences in successional pathways among upland fores! ecosystems in northwestern Lower Michigan. Forest Science 33:445-457.

Host G.E.: Pregitzer, K.S; Ramm, C.W.; Lusch, D.T.; Cleland D.T. 1988. Variations in overstory biomass among glacial landforms and ecological land units in northwestern Lower Michigan. Canadian Journal of Forest Research 18:659-668.

Jensen, M.C.; McMicoll, C.; Prather, M. 1991. Application of ecological classification to environmnental effects analysis. Journal of Environmental Quality 20:24-30.

Jones, R.K. et al. 1963 Field guide to forest ecosystem classification for the clay belt site region 3e. Ontario, Canada: Ministry of Natural Resources. 123 p.

Jordan, J.K. 1982. Application of an integrated land classification. In: Proceedings, Artificial Regeneration of Conifers in the Upper Lakes Region. 1982 October 26-28; Green Bay, WI: 65-82.

Keane, R.E.; Jensen, M.E.; Hann, W.J. 1990. Ecodata and Ecopac: analytical tools for integrated resource management. The Compiler. 8(3): 24-37.

Koppen. J.M. 1931. Grundriss der Klimakunde. Berlin: Walter de Grayter. 368 p.

Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States. American Geographic Society Special Publication 36. 116 p.

Major, J. 1969. Historical development of the ecosystem concept. In: (Van Dyne, G.M. ed.) The ecosystem concept in natural resource management. New York: Academic Press: O-22

McNab, W.H. 1067. Rationale for a multiiactor forest site classification system for the southern Appalachians In: Proceedings of 6th Central Hardwood Forest Conference. 1987 February 24.26, Knoxville, TN: 283-294.

Meentemeyer. V. and E.O. Box. 1087. Scale effects in landscape studies. In: (Turner, M.G. ed.) Landscape heterogeneity and disturbance. New York: Springer-Verlag: 15-34.

Miller, P.R.; Taylor, O.C.; Wilhour. R.G. 1982. Oxidant air pollution effects on a western coniferous forest ecosystem. Environmental Research Brief. EPA-600-/D-82-276. 10 p.

Omernik, J.M. 1987. Ecoregions of the conterminous United Stales. Annals of the Association of American Geographers 77:118-125.

O'Neill, R.V.; DeAngelis, D.L.; Waide. J.B.; Allen, T.F.H. 1086. A hierarchical concept of ecosystems. Princeton, N.J; Princeton University Press.

Platts, W.S. 1980. A plea for fishery habiiat classification. Fisheries 5(1):2-6.

Platts, W.S. 1970. Including the fishery system in land planning. Ogden, UT: U.S. Depanment of Agricukure, Forest Service. Gen. Tech. Rep. INT-60. Intermountain Forest and Range Experiment Station. 37 p.

Pregitzer, KS.; Barnes, B.V. 1984. Classification and comparison of upland hardwood and conifer ecosystems of the Cyrus H. McCormick Experimental Forest, upper Michigan. Canadian Journal of Forest Research. 14:362-375.

Probst, J.R.; Crow, T.R. 1991. Integrating biological diversity and resource management. Journal of Forestry. 89:12-17.

Rowe, J.S. 1980 The common denominator in land classification in Canada: an ecological approach to mapping. Forest Chronicle 56:19-20.

Rowe. J.S. 1984. Forest Land Classification: limitations of the use of vegetation. Proceedings of the symposium on forest land classification. 1984 March 1820; Madison, WI: 132-147.

Rowe, J.S. 1992. The ecosystem approach to forest management. Forest Chronicle 68: 222.224.

Russell, W.E.: Jordan, J.K 1991. Ecological classification system for classifying land capabilii in midwestern and northeastern US national forests. In: Proceedings of the symposium, Ecological Land Classification: applications to identity the productive potential of southern forests. Charlotte, NC, January 7-9. Ashville, NC: U.S. Department of Agriculture, Forest Service Gen. Tech. Report SE-68

Smalley, G.W. 1986. Site classification and evaluation for the Interior Uplands. Atlanta, GA: U.S. Depanment of Agricutture, Forest Service. Tech. Pub. R8-TP9. Southern Region.

Spies, T.A.; Barnes, B.V. 1985. A multifactor ecological classification of the northern hardwood and conifer ecosystems of Sylvania Recreation Area, Upper Peninsula, Michigan. Canadian Journal of Forest Research 15:949-960.

Swanson, F.J.: Kratz, T.K.; Caine, N.; Woodmansee. R.G. 1988. Landform effects on ecosystem patterns and processes. BioScience 38:92-98.

Trewanha, G. T. 1968. An Introduction to Climate, 4th ed, New York, NY: McGraw-Hill. 408 p.

Urban, D.L.; O'Neil, D.; Shugart, H.H. 1987. Landscape ecology. BioScience 37: 119-i 27.

U.S. Depanment of Agricutture. 1981. Land resource regions and major land resource areas of the United States. Washington, DC: Agricultural Handbook 296. U.S. Government Printing Office. 166 p.

Udvardy, M.D.F. 1975. Aclasslfication of the biogeographical provinces of the world. Occasional Paper 18. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland. 48 p.

U.S. Department of Agriculture, Forest Service. 1976. Land systems inventory guide. Norlhern Region.

U.S. Department of Agriculture. Forest Service. 1993. Draft National Visibility Monitoring Strategy. Washington, DC.

U.S. Depanment of Agricutture, Forest Service Handbook 2090. Washington, DC.

U.S. Department of Agriculture. Forest Service Manual 2060. Washington, DC.

Walter, H.; Box. E. 1976. Global classification of natural terrestrial ecosystems. Vegetatio 32:75-81.

Wertz, WA: Arnold, J.A. 1972. Land Systems Inventory Ogden, UT: USDA Forest Service, Intermountain Region. 12 p.

Wiken, E.B. (compiler). 1986. Terrestrial ecozones of Canada. Ecological Land Classification Series No. 19. Hull. PO: Environment Canada, Hull.

Table 1. National hierarchy of ecological units.

PLANNING AND ANALYSIS SCALE	ECOLOGICAL UNITS	PURPOSE. OBJECTIVES, AND GENERAL USE
Ecoregions Global Continental Regional	Domain Division Province	Broad applicability for modeling and sampling. RPA assessment
Subregions	Sections Subsections	RPA planning. Multi-forest, statewide and multi-agency analysis and assessment.
Landscape	Landtype Association	Forest or area-wide planning, and watershed analysis.
Land Unit	Landtype Landtype Phase	Project and management area planning and analysis.
Hierarchy can *be* expanded by user lo smaller *geographical areas end more detailed ecological units if needed,*		Very *detailed project planning*

Table 3. **Map scale and polygon size of ecological units.**

ECOLOGICAL UNIT	MAP SCALE RANGE	GENERAL POLYGON SIZE
Domain	1:30,000,000 or smaller	1000,000's of square mllrs
Division	1:30,000,000 to 1:7,500,000	100,000's of square mllrs
Province	1:15,000,000 to 1:5,000,000	10,000's of ● qusro mllrs
Section	1:7,500,000 to 1:3,500,000	1,000's of ● qusro miles
Subsection	1:3,500,000 to 1:250,000	1 D's to low 1 ,000's of ● qusro miles
Landtype Association	1:250,000 to 1:60,000	high 100's to 1,000's of acres
Landtype	1:60,000 10 1:24,000	10's to 100's of acres
Landtype Phase	1:24,000 or larger	<100 acres

APPENDIX 1:

The National Hierarchical Framework of Ecological Units has evolved based on the ideas and contributions of many persons. The Forest Service appreciates the time and effort put forth by these contributors to strengthen the scientific credibility of this Framework. We have compiled a list that we believe includes most of the contributors, although we have likely overlooked others who deserve to be recognized. A sincere 'Thank you' is extended to everyone who contributed toward this paper.

OTHER ECOMAP AND REGIONAL ECOMAP CONTRIBUTORS:

ROB MROWKA, Ecologist Timber Management Staff. Washington, DC.

JANETTE KAISER, Range Conservationist, Range Staff, Washington, DC.

JIM FENWOOD, Wildlife Biologist, Wildlife and Fisheries Staff. Wash., DC.

WARREN HARPER, Waler Resource Manager, Watershed and Air Staff, Wash.. DC.

JOHN NESSER, Soil Scientist, Region 1. Missoula, MT.

WENDEL J. HANN, Regional Ecologist, Region 1, Missoula MT.

FRED SAMSON, Wildlife Ecologist, Region 1, Missoula, MT.

JERRY A. FREEOUF. Regional Soil Scientist. Region 2. Denver, CO.

DAVID

JIMAXWELLER,

ROY DROEGE, Forester, Lands Staff, Washington, DC.

DONNA V. LAMB, Air Program Manager, Watersjed amd Air Management Washington, DC.

RICHARD W. FISHER, Air Specialist, Watershed and Air Management. Washington, DC.

KEITH E. EVANS, Acting Station Director, Intermountain Forest and Range Experment Station, Ogden, UT.

NANCY GRAYBEAL (for) Regional Forester, Pacific Northwest Region, Portland, OR.

KENNETH HOLTJE. Ecosystems Team, Eastern Region, Milwaukee, WI

ADRIAN HAUGHT (for) Director of RPA. Washington, DC.

WALTER A. HOUGH, Assistant Director, Southern Forest Experiment Station, New Orleans, LA.

JAMES 0. HOWARD, Forest Products and Harvesting Research, Washington, DC.

ARIEL E. LUGO, Acting Director, International Institute of Tropical Forestry, Rio Piedras, P.R.

ROBERT D. NELSON, Director of Wildlife and Fisheries, Washington, DC.

CHRISTOPHER RISBRUDT (for) Regional Forester, Northern Region, Missoula, MT.

ROBERT M. ROMANCIER (for) Station Director, Northeastern Forest Experiment Station, Radnor, PA.

CHARLES VAN SICKLE, Assistant Director. Southeastern Station, Ashville, NC.

JIM WEIGAND. Pacific Nonhwest Station, Portland. OR.

EDWARD WHITMORE, Director, Forest Management Pacific Southwest Region, San Francisco, CA.

KEITH EVANS, Acting Station Director, Intermoutain Station, Ogden, UT.

JACOB L WHITMORE, Acting Assistant Director, Northeastern Forest Experiment Station, Radnor, PA.

JERRY WILLIAMS. Fire and Aviation Management, Washington. DC.

THOMAS R. CROW, Landscape Ecologist, North Central Station, Rhinelander, WI.

MARIE-LOUISE SMITH, Ecologist, Northeastern Station, Durham, NH.

JOHN R. PROBST, Wildlife Ecologist, North Central Station, Rhinelander, WI.

DAVID V. SANDBERG. Pacific Northwest Station. Corvallis, OR.

LOUISE M. TRITTON, Research Forester, Northeastern Station, Burlington, VT.

The Nature Conservancy:

DENNIS GROSSMAN, Lead Ecologist, The Nature Conservancy, Washington, DC

PATRICK S. BOURGERON, Landscape Ecologist, The Nature Conservancy, Denver, CO.

Other Federal Agenclea and States:

RON BAUER, Soil Scientist, Soil Conservation Service, Lincoln, NB

JIM CULVER, National Leader, Correlation, Soil Cons. Service, Lincoln, NB.

DENNIS LYTLE, National Coord., Soil Geography, Soil Cons. Service, Lincoln, NB.

COLIN VOIGT. Soils Program Manager, Bureau of Land Management, Wash., DC.

MIKE JENNINGS, GAP Program Coordinator, US Fish and Wildlife Service, Moscow, ID

JOHN C. ALMENDINGER. ECS Coordinator, Minnesota Department of Natural Resources, Deer River, MN.

H. WILLIAM ROCKWELL, JR. Michigan Department of Natural Resources, Lansing. MI.

Universities:

BURTON V. BARNES. Professor of Forest Ecology, School of Natural Resources and Environmem, University of Michigan, Ann Arbor, MI.

DAVID M. HIX, Assistant Professor and Principal Investigator. School of Natural Resources, The Ohio State University, Columbus, OH.

GEORGE E. HOST, Research Associate, Center for Water and the Environmem, University of Minnesota, Duluth, MN.

KURT S. PREGITZER, Professor of Forest Ecology, Michigan Stale University, East Lansing, MI.

DONALD M. WALLER. Professor of Botany & Environmental Studies, University of Wisconsin, Madison, WI.

ROBERT ROGERS, Professor of Forestry, University of Wisconsin-Stevens Point, Stevens Point, WI.

Other Groups:

JAMES R. CRAINE, California Forestry Association. Sacramento, CA.

MARY LOU REED
DISTRICT 4
KOOTENAI, SHOSHONE
& BENEWAH COUNTIES

HOME ADDRESS
10 GIESA ROAD
COEUR D'ALENE IDAHO 83814
(208) 664-3564
(208) 664-1815

COMMITTEES
RESOURCES & ENVIRONMENT
STATE AFFAIRS

DEMOCRATIC LEADER
Idaho State Senate
CAPITOL BUILDING
BOISE, IDAHO 83720

A POLITICAL PERSPECTIVE ON ECOSYSTEM MANAGEMENT AND ITS CONSEQUENCES FOR IDAHO

Sen. Mary Lou Reed 6/17/94

Headline, November 1993: "ECOSYSTEM MANAGEMENT. An Idea Whose Time Has Come...but are we ready?"'

Good question. By now, June 1993, most of you scientists are probably convinced that Ecosystem Management is the key to tomorrow. Each of you probably enthusiastically agree that "the system is the solution".

You've probably known all along that the whole is greater than the sum of its parts. Integration. Cooperation. Participation. Comprehensiveness. Connections. Change. Sustainability. All are words you are comfortable with as operating words for implementing a holistic approach to resources management. You're probably happy and relieved that the top guns in charge of the show are finally getting with the program. The generals at the top are finally looking at the big picture and are now calling for a comprehensive systems approach.

So **you** are, **in** fact, READY. You are **READY** AND EAGER.

But what about the rest of the world? What about THE PUBLIC? Are the) ready? What about the politicians? Are we ready?

In a word, NO. The general public is in the dark. Politicians see through the proverbial glass dimly. The public needs to be informed, politicians need to be reassured and special interests need to be interrupted and diverted. I want to talk with you today about ways to turn the lights on and up.

I have been asked to bring a political perspective to ecosystem management. The questions would seem to be: Will the public and its leaders embrace a new approach to shepherding the resources of the earth we live on, which will preserve and protect that earth, even if it requires human restraint and self-discipline? Does good science make good politics? Can the human species with all its clutter and greed exist in its natural ecosystem without mucking it up?

When you think of politics you may think of power and manipulation in the backrooms and boardrooms. I would suggest in a democracy, political power does in the final say reside with the people. Persuasion must first be aimed at the people. Their leaders are never very far behind.

Let me list some of the human factors and political realities that I see as barriers to easy implementation of Ecosystem Management:

1. COMMUNICATION. We have to start with definitions that reflect the good sense of the concept. At this point the public isn't sure whether ecosystem management is a sound bite or sound science. We have to surmount the ever-present language barriers. I want to give you one good example that I ran across of how NOT to define Ecosystem Management, if you want to reach out to those of us who are uninitiated and

We must never sell the public short. Their wisdom is there to be tapped.

3. SPECIAL INTERESTS. Concurrently, we must never underestimate the power of special interests to persuade and influence that same public. Money does talk. Money pays for talk. Talk pays off.

One of Idaho's U.S. Senators ballyhoos the Clinton Administration's so-called War on the West. The senator's goal is to maintain the status quo provided by an older-than-Custer Mining Act, a grazing policy that destroys streams and adds to the destruction of species, and a timber program that overcuts forests and alters ecosystems. The senator hopes to reap political hay in the process.

The so-called Wise Use Movement, which promotes a reincarnated Sagebrush Rebellion, is a serious roadblock toward implementing Ecosystem Management on federal lands, since Wise Use proponents believe that federal lands exist for their private purposes.

Demagoguery abounds when industry-backed spokesmen appeal to the very real economic fears that ordinary people who live in resource dependent towns hold in their hearts toward change and an uncertain future.

4. RESPECT FOR DIVERSITY. One of the basic goals of Ecosystem Management is to preserve bio-diversity. I have my doubts that folks who live in small communities, smack in the middle of vigorous, dynamic ecosystems, consider diversity of any sort to be of unique value - be it bio-diversity, political diversity, economic or social diversity.

In our attempts to speak in a common language, reach out to the public, we must also teach and persuade. We must convince local people of the value of preserving and promoting diversity. At the same time we can reassure communities that their ecosystem is not just for us to study, or to look at and recreate in. The commodities they produce are needed and their work is of value.

5. STUDY VS. ACTION. I mention that ecosystems are not just their for us to study as a reminder of the public's impatience with studies. You hear it all the time. Don't study the problem. DO SOMETHING. We are not a people with much patience for planning. And we all know that planning is another word for thinking.

Because a major component of Ecosystem Management is further analysis and intensive research, part of the communication with the general public must include good strong explanations of the importance of additional knowledge to the design of a management strategy. Respect for the SHOW ME needs of the public requires short term action at the start, to run concurrently with a long range planning process.

So, a summary of some political hurdles we must surmount in order to implement ecosystem management includes:

1. definitions, language and communication,

2. the public's lack of knowledge and understanding,

3. special interests, the Wise Use Movement, political games,

4. the importance of the production of commodities to the lives of individuals and their communities . . . to their identities and their livelihoods,

Add to the mix an American discomfort with abstractions. After all, Ecosystem Management *is* a philosophy - a bundle of ideas.

Mix in the scary specter of change - any change.

Plus the human propensity to gravitate toward the simple and away from the complex.

Ecosystems are by definition "intricate, complex, change constantly, and are not always predictable."

Will the public ever be ready for Ecosystem Management? Is it contrary to the human imperative?

Despite the hurdles, the answer is a solid yes. I just believe it is important to keep identifiable components of the human condition in mind in setting forth on a course that involves an ecosystem, including the people who inhabit it.

Let me give you some examples of forays into ecosystem management that have very positive political ramifications. You can see that the principles of good ecosystem management do transfer into good politics.

1. Here in North Idaho we have been engaged for several years in our own fumbling attempt to apply many of the same principles of Ecosystem Management to the restoration of the Coeur d'Alene Basin. The situation has been ripe for a cooperative effort. At the headwaters of the Coeur d'Alene River lies one of the world's most productive silver, lead and zinc mining areas. One of the nation's most contaminated Superfund sites is encompassed in the 21 square mile former Bunker Hill complex at Kellogg. Mining activity over the past 100 years has sent over 72 million tons of metals down the river to Coeur d'Alene Lake. The lakebed is encrusted with a layer of heavy metals.

In 1989 the Coeur d'Alene Basin Interagency Group (CBIG) was organized - a loose collection of federal, state and county agency staff members, industry representatives, members of local lake and river protection groups, all with a common concern.. the health of Coeur d'Alene watershed. The spirit of cooperation and coordination has held sway over the years. A more formal structure has been imposed along with funding, by the state and EPA, and a full blow-n restoration project is in progress with a lake management plan expected to be produced within the year.

Research dollars and projects have been coordinated, the public has been included from the beginning, and the effort has broad political support.

2. A unique experiment was conducted in the 1994 session of the Idaho legislature. Conservationists and industry spokesmen came together with legislators of all stripes to consider drafting a state Endangered Species Act. All parties sparred cautiously as the concepts were discussed. The air was filled with mistrust. But painstakingly a program that was drafted to address ways to eliminate reasons for new listings of endangered species and to foster de-listing of species. Knowledge that the federal Endangered Species Act was not going to go away, and a desire for the state to play a larger role provided the necessary incentives. The result amounted to a habitat enhancement act. The timber, mining and cattle folk stayed on board as did the wary conservationists. Only the ever-difficult Farm Bureau jumped ship.

As the bill went to the Senate floor it scored a first -- the first time the Association of Commerce and Industry and the Idaho Conservation League had circulated their green sheets of endorsement for the same piece of legislation. The bill passed the Senate 24 to 11 in the late days of the session. In another year it should make it into law.

All the elements of ecosystem management were there, even if the political support came for the wrong reasons. No question but that the federal Endangered Species Act served as a hammer, just as the threat of Supetfund status acts as a prod for action in the Coeur d'Alene Basin.

3. A parallel exists in Idaho in the salmon issue. Opposing political entities throughout Idaho stand together in support of Andrus's Idaho plan, which favors a restructuring of the federal dams on the lower Snake River to permit the salmon smolts a swifter passage to the sea. Unanimity of purpose is inspired by the larger threat posed to Idaho's water all the way to the Upper Snake, if Idaho's water is seen as the way to save the endangered salmon. The economic threat to Idaho's agricultural base is taken very seriously by water users and politicians alike. Making the river run like a river, returning it to its natural process, is seen by most participating parties as good business as well as good ecosystem management. Certainly better than draining the state's rivers and reservoirs.

The salmon issue is fraught with controversy and political disagreement. But in Idaho, except for Lewiston, a fragile agreement holds the groups together, united in a common goal of saving water, saving salmon.

From my vantage point, the major obstacles to saving the salmon continue to be immovable institutions such as the Army Corps of Engineers and the Bonneville Power Administration, who have no interest in restoring the river's natural processes.

In conclusion, I see glimmers of hope for the political progress of ecosystem management in Idaho. If the process of setting common goals -- goals that reenforce economic well-being coinciding with sound stewardship -- are clearly defined, and are inclusive of a well-informed public, I believe ecosystem management can be accepted in Idaho, just as anywhere else. Further analysis of my examples would underscore the need for strong laws and strong leadership.

* This 1st page quote and others are from People and Forests, U.S.F.S. Cleatwater Forest publication, Nov. 1993.

WESTERN/MIDWESTERN REGIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Committee 1 Report
Role of NCSS in Site Specific Soil Survey

Charges

1. Develop NCSS guidelines and certification standards.
2. storage, retrieval and maintenance of attribute and spatial data.
3. Interpretation and use of site specific data, resolution of conflicting data.
4. Interaction between providers of site specific data.

In our changing world, there is an increased need for site specific soil surveys and investigation. Not all site specific soil investigations will be an order 1 soil survey. The specific land use will determine some data obtained. The following guidelines are recommended for multi-use order 1 soil survey.

1. The legend is to be separate from order 2 soil survey. Scale differences between order 1 and order 2 soil surveys do not permit use of same legend.

2. Phases of soil series are mapped

3. Generally no dissimilar inclusions in soil mapping units.

4. Scale is at least 1:6,000

5. Observations will be made on transects or grids, will be georeferenced and will be made to a depth of 2 meters generally.

6. Detail descriptions are required of each soil series or potential soil series. A detailed description will be made in each soil mapping unit Other observations may be described in how they differ from the representative pedon.

7. A map unit description that includes the range(s) of taxonomically related data must be prepared.

HETA data will be submitted with each order 1 soil survey. These data will serve for certification. The Soil Conservation Service will keep the HETA file.

The Soil Conservation Service will have responsibility for storing and maintaining order 1 soil surveys.

The SCS will correlate order 1 soil surveys but a correlation is not required.

If laboratory data are to be collected, the laboratory procedures in the "Soil Survey Laboratory Methods Manual" by Soil Survey Laboratory staff are to be used. Analyses that assist in correlation and classification should be included.

Interpretations will not be stored, only data. Interpretations can be generated by computers.

Conflicts will be minimized if good guidelines are followed.

The NCSS should develop a meaningful memorandum of understanding with private soil scientists through the National Society of Consulting Soil Scientists at the national level.

These recommendations should be distributed to the other regions and to appropriate agencies as soon as possible.

The committee should be continued to follow up on these recommendations.

Committee

Delbert Mokma, Michigan, Chairperson
Bruce Frazier, Washington, Vice-Chairperson
Ferris Allgood, Utah
Alan Amen, Colorado
George Hall, Ohio
Randall Miles, Missouri
Gerald Miller, Iowa
Henry Mount, Nebraska
Curtis Munger, New Mexico
Gerald Nielson, Montana
Ken Olson, Illinois
Pierre Robert, Minnesota
Richard Schlepp, Kansas
Gary Stienhardt. Indiana
Tim Sullivan. Colorado
Carol Wettstein, Colorado

COMMITTEE 2 - DRASTICALLY ALTERED SOIL

Committee Chair: Sam J. Indorante, USDA-SCS, Belleville, IL

Objective of Committee

To review concept, applications, and research on what is known about disturbed soils and to formulate a working definition of drastically disturbed (altered) soils.

Charae #1

Develop definition of drastically altered soil.

Recommendation

A soil which, by human activity, has been physically altered, and/or formed to a lithic contact or to a depth $\geq$ 2 meters, whichever is less.

Charae #2

Develop procedures for inventorying drastically altered soils.

Recommendation

Use existing data to obtain information on the nature of the drastic alteration and their acreages (by state).

A form would be sent to all State Soil Scientists. Information can be gathered from various state and federal agencies (i.e., state universities, state departments of mining and minerals, etc. Information would be compiled by state and then made available to NCSS cooperators.

Example of form to be sent out.

Date __________

State __________

Type of Alteration	Approximate Acreage

Charae #3

Provide guidelines for updating soil surveys with drastically altered soils.

Recommendations

1. Use current/correct imagery.

2. Map at update soil survey scale: 1:24,000 1:12,000

3. Collect history and background of alteration. (i.e., mining and reclamation methods).

4. Establish time benchmarks in selected drastically altered soils (i.e., time zero) to monitor pedogenesis.

5. Reinvestigate, reclassify and reinterpret drastically altered soils to meet current NCSS standards.

6. Record deficiencies in Soil Taxonomy and suggest improvements.

Charses for Continuins Committee

1. Develop and recommend a sampling protocol that addresses the unique horizontal and spatial variability of drastically altered soils (i.e., coarse fragments).

2. Recommend appropriate physical, chemical, and biological characterization methods for these soils - in addition to the traditional soil characterization methods (i.e., acid/base accounting).

3. Recommend or propose suffixes to designate specific kinds of master horizons and layers in drastically disturbed soils (i.e., "tt" suffix to indicate fritted soil structure in a horizon).

Committee Recommendations

1. This committee should continue as a function of the NCSS until the duties of the international committee on disturbed soils is defined.

2. The committee should function in both the Midwest and West regions.

3. Committee report should be sent to international committee (Dr. Ray Bryant, Cornell University, Chair). International committee report should be sent to Midwest and West committees.

COMMITTEE THREE: ECOSYSTEM BASED SOIL SURVEYS FOR RESOURCE PLANNING

Charges :

1. Refine objectives and goal statements for ecosystem based soil surveys.
2. Develop model for conducting ecosystem based soil surveys.
3. Develop funding strategies.

Following are discussion points and recommendations for each of the charges. Note that most of the recommendations are really short term action items that can and should be implemented immediately. The more general recommendations requiring longer term, interagency effort, are at the end of the report and identified with a" asterisk.

CHARGE 1. REFINE OBJECTIVES AND GOAL STATEHENTS FOR ECOSYSTEM BASED SOIL SURVEYS.

Discussion points:

Following are some of the key discussion points. They reflect the complexity of the charge and wide range of views about ecosystems, soil surveys, and their interrelationships. Some examples are: "we need to clearly define an ecosystem based soil survey;" it is "a soil survey that records the basic soil properties, one that is consistent, and one that represents the landform or landscapes; rather than one that has map units designed strictly to meet the needs of one federal or state program;" "many soil surveys have used a" ecosystem approach, although the ecosystem label may have been absent;" "map units should be named based on their landform and/or vegetation characteristics: " "ecosystems atr complex;" "must have interdisciplinary teams;" "they are tailored to user needs;" and "there is need for deeper sampling or exploration." The comments suggest there is a vagueness about the meaning of "Ecosystem Based Survey." Perhaps this reflects the complexity of ecosystems and the information requirements for their management.

Goals/ or objectives:

- Produce and deliver timely, high quality, cost effective surveys. with a record of important properties, based on sound scientific principles.
- Evaluate and update surveys in light of "customer" needs.
- Maximize use of interdisciplinary teams. This applies to updating or re-interpretation of existing surveys, or conducting new surveys.
- Provide for flexibility to meet customer needs or respond to key issues or land uses within a "landscape" area.
- Provide information transfer to help society understand, value and wisely ❑ a"age soil, land and water resources.

Specific objectives/actions:

- Conduct and maintain surveys by physiographic region, ecoregion, river basin. or other large scale geographic area. For example, MLRA, Section or Subsection of the Forest Service Hierarchy of Ecological Units, USGS defined river basin or sub basin.

- o Provide users with statements of important patterns and shapes of natural bodies on specific landscape segments. Give more emphasis to soil-geomorphic relationships.

- o Provide users with reasonable estimates of accuracy and variability of the survey. Use appropriate statistical techniques to characterize data sets.

- o Identify data gaps and develop a strategy to fill the gaps

- o Continually evaluate and update interpretations in light of new knowledge. Develop interpretations from multiple models of soils.

CARGEE 2. DEVELOP A MODEL FOR CONDUCTING ECOSYSTEM BASED SUREVEYS

Discussion points:

The comments for this charge centered on four themes. They are: (1) conduct and manage surveys on broad geographic scales such as MLRA or the Forest Service Hierarchy of Ecological Units; (2) use technology, especially spatial and attribute data systems, and remote sensing; (3) have greater interdisciplinary and interagency cooperation; and (4) improve characterization of the soil/landscape system by giving more attention to standardizing landform terminology, giving more emphasis to landform delineation, using multiple, integrated models for characterizing and interpreting soils, and emphasize both spatial and temporal variability.

Recommendations:

A "model" for conducting ecosystem based surveys would contain several elements as follows: Survey Areas-Planning and Implementation, Multiple, Integrated Models of Soils, Effective Use of Technology, and Technology and Knowledge Transfer.

I. Survey Areas-Planning and Implementation:

- o Set interagency goals, objectives, and schedules by Ecoregion. eg, MLRA, Section, Subsection, River Basin. (Based on natural systems-not political boundaries.)

- o Assess the adequacy of existing data and information and use cost effective approaches for providing current, accurate, and "useful" information to natural resource planners, managers, scientists, and other interested parties. (Recognize the realities of limited financial resources and set clear, interagency priorities for conducting and maintaining surveys and data bases.)

II. Use Multiple, Integrated Models of Soil for Characterization and Interpretation:

A. For example, models of soil after Meurisse and Lammers, (1993); and Dumanski, (1993).

ECOSYSTEM OR COMPONENT
- o Dynamic interactions/rates of change
- o Nutrient cycles/transport processes
- o Decomposition/Trophic relations
- o Environmental filter
- o Time scale 10 to 10 yrs.

WATER-TRANSMITTING MANTLE
- o Movement/storage of water/energy
- o Soil physical properties
- o Erosion processes
- o Pedotransfer functions
- o Time scale 10 to 10 yrs.

NATURAL BODIES
- o State factors
- o Weathering processes
- o Geomorphic history
- o Soil individuals
- o Classification
- o Mapping
- o Time scale 10^2 to 10^3 yrs.

MEDIUM FOR PLANT GROWTH
- o Available moisture/nutrients/heat
- o Aeration/anchorage
- o Plant physiology
- o Response to management
- o Time scale 10 to 10 yrs.

STRUCTURAL MATERIAL
- o Mechanical properties (strength/plasticity)
- o Drainage/porosity
- o Conductivity--heat/water/energy
- o Time scale 10 to 10 yrs.

B. Recommended actions, regardless of model:

1. Emphasize the model of soil es natural bodies es the central concept. Others are derived from it.

2. Renew emphasis on the Jenny model of soil where S=f(Cl, Pm, O, R, T).

3. Increase characterization of soil organisms.

4. Provide insights to rates end magnitudes of material cycles, energy flows, pedotransfer functions, and transport processes.

5. Develop criteria and rate soils for resiliency to management impact.

6. Use multi-factor approach to design of mapping units, including geology, landform, potential natural community. end slope, with due consideration to the major uses. Increase emphasis on geomorphic process.

III. Make Effective Use of Technology:

- o Expedite development and implementation of readily accessable relational data base with common standards, and measures of data quality. Use compatible hardware and software among agencies.

- o Expedite development and implementation of digital data for analysis at multiple scales across multiple land ownerships or jurisdictions.

- o Make appropriate use of remote sensing, ground penetrating radar, DEMs, and other technology for data aquisition and interpretation.

IV. Improve Technology and Knowledge Transfer:

- o Identify continuing education needs and opportunities for soil scientists. Create a viable mechanism for implementing.

- o Maintain a staff of highly skilled soil scientists at strategic, subregional locations. Their purpose is to maintain data bases, provide current interpretations. and consult with users of surveys.

- o Dispense data and information to the public and agency personnel in multi-media formats such as CD ROM, graphic displays, and digital layers,

CHARGE 3. DEVELOP FUNDING STRATEGIES.

Points of Discussion:
This charge received little comment. However. there is some effort by the SCS to submit-budget proposals for surveys by MLRA. The Forest Service, in the Pacific Northewast Region, is attempting CO manage funding within an Ecological Section (comparable to an MLRA).

Recommendation:
Set clear, interagency priorities and ensure cost effective measures are in place to conduct, maintain, and use survey information for sustainable land use. Seek opportunities and capitalize on them to share equipment, personnel, and financial resources.

General Recommendations:

* Increase opportunities for soil scientists to increase their knowledge and skills through continuing education, special training sessions, and inter-agency details. Establish an interagency, NCSS task force, to identify training needs and continuing education opportunities.

* Identify knowledge gaps and develop the research to aquire the needed information. Soil science practitioners need to be involved in the research process.

* Develop a strategic plan for obtaining more knowledge, through research, about soil organisms. Relate to measurable soil properties as much as possible.

* Develop a strategy for marketing the valuable data sets of ecological factors.

References:

Meurisse, R.T. and D.A.Lammers. 1993. Use of soil survey information for management of national forests and grasslands. In: Utilization of soil survey information for sustainable land use. J.M. Kimble, ed. Proceedings of Eighth International Soil management Workshop. USDA Soil Conservation Service, National Soil Survey Center. 271 p.

Dumanski, J. 1993. Strategies and opportunities for soil survey information and research. ITC Journal 1993-1. Pg. 36-41.

Committee Members:

Robert T. Meurisse, USDA Forest Service, Chair
David Hopkins, N. Dakota State University
Carol Wettstein, USDA Soil Conservation Service
John Nesser, USDA Forest Service
Mark Kuzila, University of Nebraska
Joe Moore, USDA Soil Conservation Service
Terry Brock, USDA Forest Service
Thomas M. Collins, USDA Forest Service
Terry Aho, USDA Soil Conservation Service
Bill Dollarhide. USDA Soil Conservation Service
Jerry Freeouf, USDA Forest Service,
Jim Culver, USDA Soil Conservation Service
Lyle Linnell, BLM Retired
Jim Frances, USDI Bureau of Land Management
Tom Reedy, USDA Soil Conservation Service
Bill Ypsilantis, USDI Bureau of Land Management
Bob McLeese, USDA Soil Conservation Service
Dave Smith, USDA Soil Conservation Service

Appendix

Definitions:

Ecology: The science that deals with the interrelations of organisms and their environment. (Glossary of Science Terms, Soil Science Soc. Amer. 1975)

Ecosystem: Any unit including all of the organisms (i.e., the "community) in a given area interacting with the physical environment so that a flow of energy leads to a clearly defined trophic structure, biotic diversity, and material cycles within the system. (E.P. Odum, 1971)

Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space. (A Glossary of terms used in Range Management, (ISBN o-9603692-8-7) Jacoby)

The organisms of a particular habitat together with the physical environment in which they live: a dynamic complex of plant and animal communities and their associated non-living environment. (Biological Diversity on Federal Lands, Report of a Keystone Policy Dialogue. 1991)

The complex of a community of organisms and its environment functioning as an ecological unit in nature. (Websters dictionary)

Ecological Type: A category of land having a unique combination of potential natural community, soil, landscape features, climate, and differing from other ecological types in its ability to produce vegetation and respond to management. (USDA Forest Service Handbook, FSH 2090.11, Ecolgical Classification and Inventory Handbook)

Ecological Unit: A mapped landscape unit designed to meet management objectives, comprised of one or more ecological types. (USDA Forest Service Handbook, FSH 2090.11, Ecological Classification and Inventory Handbook)

Inventory: A detailed descriptive list of articles with number, quantity, and value of each. (2) A survey of natural resources: an estimate or enumeration of the (wildlife, soils, etc.) of a region. (3) A detailed study or recapitulation:survey. (Websters dictionary) **Note:Inventory and survey often used interchangebly.**

Potential Natural Community: The biotic community that would be established if all sequences of its ecosystem were completed without additional human-caused disturbances under present environmental conditions. Grazing by native fauna, natural disturbances such as drought. floods, wildfire, insects, and disease are inherent in the development of potential natural communities which may include naturalized nonnative species. (USDA Forest Service Handbook, FSH 2090.11, Ecological Classification and Inventory Handbook) **Note: Often used interchangebly with Potential Natural Vegetation (PNV).**

COMMITTEE 4 - DISTRIBUTION AND ACCESS TO SOIL SURVEY DATA

Committee Chair: Scott Davis

Charges:

1. Access to spatial and attribute data from soil surveys.
2. Certification of data.
3. Users' fees.
4. Update and coordination procedures.

DESCRIBE WHAT DATA NEEDS ARE AND REASONS FOR THOSE NEEDS:

First, provide analysis to determine what fundamental principles are needed. Separate the job by asking questions of what is desired and why is it necessary, and design systems accordingly. Develop a system or framework within which one can provide the capability without restrictions and conflicting requirements to satisfy a whole plythora of users' needs.

Identify base map needs and the methods to describe data. Describe limitations of data, i.e., method of how it was collected (derived, field, laboratory), reliability, levels of precision, etc. Next, provide the capability to link data.

NEXT DESCRIBE METHODS OF DATA STORAGE AND TRANSFER:

Four soil data bases and data element dictionaries are in the construction stages. They are the Soil Conservation Service's National Soil Information System (NASIS), the Bureau of Land Management's Soil Information System (SIS), the Forest Service's Soil Resource Information System (SORIS), and the work by the Tri-Services (Navy, Corps of Engineers, and Coast Guard). The need for widespread and diverse data interpretations have been large enough to warrant numerous separate data base products.

Three soil database concepts include a national standards database (official series description and soil interpretations record), and a site specific database (pedons, transects, and lab data).

Inter-agency committee efforts began in November 1992 in Denver. Work groups divided soil data set needs into four groups of data elements -- soil morphology/properties, soil chemical/physical properties, map unit, and site characteristics. The objective of this meeting was to identify a minimum dataset for the soils portion of the ecological database. The Soil Conservation Service and Forest Service continued this effort in Lincoln, in 1993, consolidating data elements into the following four data element groups -- pedon, map unit, interpretations, and lab-field-site. The third meeting (April, 1994, Denver) continued work of identifying a minimum data set for the transfer of soils data -- both map unit/aggregated data, and site/point data -- as directed by the Soils Subcommittee of the Federal Geographic Data Committee (FGDC).

- To fulfill the requirements of the FGDC, a coordinate effort evolved to develop a data dictionary to store soils data. This includes-- developing guidelines, determining data elements, establishing a common data structure, and establishing a procedure for changes or additions to the dictionary.

It was recommended that a core team be established to review and to make changes to the data element dictionary. This process is outlined in the report by Jim Fortner (Attachment 1).

Inter-agency efforts have focused on the development of a soil minimum data set, expanded soil and ecological data sets, and integrated resource data sets. It is desired to develop an integrated system by combining current data sets, keeping them current and consistent, removing redundancy, and standardizing access to all data.

Many data elements are interpretative and are needed to answer land management decisions involving soil-water-vegetative relationships. The minimum soil data set will focus on soil survey information which will be aggregated. Many elements falling under "interpretative kind" as well as some site data will not be aggregated.

Part 648, Geographic Databases (430-VI-NSSH, Nov. 1993) provides the basis for data format and exchange.

Keep methods flexible to accommodate assorted needs of users and collectors. Must be in an understandable format. Methods available include INTERNET, ARC-INFO, CD-ROM, and GIS.

COMMITTEE RECOMMENDATIONS

1. All agencies, entities, collectors, and users need a minimum data set with a common data dictionary and data structure. Data sets should cover all elements for all users. Storage of data bases can be separate, but must provide linkages for other data bases such as forestry, rangelands, plants, production yields, etc.

2. Data bases need to be linked to NASIS (the central storage of the SCS for the data dictionary, elements and

definitions), including multiple resource data bases, research initiatives such as INTO SHARE, and a data base layer to describe Potential Natural Vegetation. These extra data bases will create the need for additional point-site data tables.

3. Include other disciplines such as plant scientists, ecologists, and data administrators in development of data bases.

4. Set standards for the limitations of data reliability. Establish agreement on common standards to share soil survey files, soil data information. Develop approach to address use-dependency among assorted agencies/entities.

5. Utilize various network systems to accommodate transfer of data, i.e., DOS, UNIX. For transfer, have flexibility for use of INTERNET, CD-ROM, ARC-INFO, GIS, etc.

6. Refer to soil standards subcommittee to determine agency responsibility for storing data bases. Determine whether one agency or each agency should store/be responsible for updating individual resource data bases.

7. Refer to soil standards subcommittee to approve amendment recommendations on core team membership (see attachment 1).

8. Establish communication network with all entities (>18) through mailings and advertising in newsletters such as ASA and SWCS.

9. Set up certification approval/appear process for data elements/definitions. Refer to NSH Part 639, Soil Data Systems and Part 649, Geographic Databases (430-VI-NSSH, November 1993).

10. See attachment 2 (report from Dick Folsche) regarding digital soils data cost, archive and retrieval policies). Do not eliminate established or potential Memorandum's of Agreement among regional entities to exchange automated resource data.

Attachment 1

United States
Department of
Agriculture

Soil
Conservation
Service

National Soil Survey Center
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866

May 26. 1994

Jim Keys, US Forest Service, Atlanta, GA
Scott Davis, Bureau of Land Management, Denver, CO
Wayne Hudnall, Agronomy Dept., Louisiana State Univ. Baton Rouge, LA
Rick Bigler, NSSC, MS 36, SCS, Lincoln, NE

First I want to thank each of you for taking time to participate in our data base workshop in Golden, Colorado. I really appreciate the cooperation and interest in this project.

As promised at the workshop, I am sending you various products for your review. I will also be sending these same items to representatives of the other agencies, as we discussed. The enclosed products are as follow:

- a report of the workshop
- a listing of the data elements that we identified for the map unit data set, and for the pedon data.
- a printout showing the definition and other information about the data elements included on the above list.
- a conversion list showing the data elements from the 11192 meeting in Denver and the equivalent current data element.
- a draft of a set of minimum documentation to be included with proposals for change/addition to this data set. This is what we in SCS are currently using for NASIS.

Please review these documents and provide comments back to me by July 11, 1994, as previously discussed.

Representatives from SCS and USFS will be meeting in the near future to discuss the geomorphology issues. When they get something completed, I will send it to you.

Again thanks for your input and cooperation, and I look forward to continuing our work on this project.

Jim R. Fortner

JIM R. FORTNER
Soil Scientist
Mail Stop 33

Enclosures

ACTIVITIES:
The group first reviewed the proposed agenda items and identified priority items to address.

1. After the minimum data set is identified and accepted, there will be a need to keep it up to date. This will include a process to add new data elements or make changes to existing ones. Therefore, the group indicated that a "core team" would be needed to review and accept/reject these proposals.

The recommended membership of the Core Team is as follows:

- 2 members each from the Soil Conservation Service (SCS) and the university cooperators in the National Cooperative Soil Survey (NCSS). One university representative would represent the northeast and south regions, and the other the midwest and west regions.

- one member each from the following federal agencies: US Forest Service, Bureau of Land Management, Environmental Protection Agency, Corp of Engineers, and Agricultural Research Service.

- A representative from SCS will serve as team leader.

- we ask that each of the above mentioned agencies provide the name, location, and phone number of their representative to:

  Jim Fortner
  100 Centennial Mall North
  Room 152, Mail Stop 33
  Lincoln, Nebraska 68508
  Phone: 402-437-5353

- we recommend that the NCSS national work planning conference representatives appoint the two university representatives to the core team.

Terms of membership would be for three years each, expiring on a staggered basis -- three expiring each year beginning after the first three years.

Other agencies/entities such as US Fish and Wildlife Service, Bureau of Indian Affairs, Bur. of Reclamation, Bur. of Mines, Biological Survey, Dept. of Transportation, and US Park Service would be contacted for input related to data relative to their specialties. These are thought to be mainly users of soils data.

We intend to use the existing NCSS Work Planning processes and state contacts to allow for input from industry, non-industrial landowners, and non-traditional users to the core team.

2. The following process to review proposed changes will be used.

* Each core team member will receive, review and organize proposals originating within their respective agency/entity. They will then forward a recommendation for action to the core team leader.

- The core team leader will route the proposal along with the originating agency's recommendation to core tean members for review and recommendation.

- The core team will make the final decision. Each represented agency will have equal voting rights -- one vote per agency/entity.

- An appeal procedure will be established to allow for direct presentation of proposals to the core team leader.

- The data set will be maintained by SCS.

- We will establish a feedback and tracking mechanism to ensure that the originators of proposals are informed of actions taken on their proposals.

- A mininum standard for documentation to accompany all proposals will be established. (a draft of this is attached to this report)

* A mechanism to get input and/or review of proposals from agencies not represented on the core team will be established.

- A scheme to ensure timely review and processing of proposals will be established.

3. Discussion then turned to selecting those data elements to be included in the minimum data set. Those identified for map unit/aggregated data and those for pedon/site data are listed on enclosed printouts. These are not intended to be complete lists as representatives needed to discuss the geomorphology and plants related data elements were unable to attend. We tentatively included some of the geomorphology data elements, but decided to wait on including most of those related to plants. These folks will be meeting in the near future to discuss those elements.

The enclosed printouts also list the definitions of the data elements, additional information dealing with type, length, and ranges, and where aoppropriate a choice list or list of domain values.

4. The group also discussed how the data should be stored. The SCS is developing a National Soils Information System (NASIS) to manage their soils data. The USFS is developing a Soils Resource Information System (SORIS), and BLM is developing the Soil Information System (SIS). Other agencies are developing their respective systems. After some discussion it was proposed that this minimum data set use the data structure of NASIS since SCS will be managing the data set. Other agencies will then need to develop a procedure to download their data to that structure for transfer.

5. Discussion was also held as to what is the appropriate kinds and precision of data to be included with spatial data at significantly different map scales, ie. 1:12,000 vs 1;250,000 or 1:1,000,000. This isssue will need further discussion at a later date after it is known as to how FGDC is planning to deal with this kind of issue.

6. We then discussed what steps are needed to be able to present a product to FGDC for approval. The following were identified:

- SCS will route this report and lists of data elements and definitions as discussed above to the participants of the workshop and other appropriate representatives, by May 20, 1994. We will also provide a proposed set of minimum documentation to be included with proposals for changes and/or additions to the data set, and a copy of the data structure of NASIS for review and information.

- Those receiving the report and lists are asked to review the lists of data elements and definitions and provide comments to me by July 1, 1994.

- Depending on the response received, there may be a need to hold a teleconference to resolve issues.

- Representatives from SCS and USFS will be meeting in the near future to discuss a method to describe and store geomorphic information. When this is available, it will be routed for review and acceptance.

- We will be following up on the effort to include or link with vegetation data.

- As stated earlier, we will first concentrate on getting a minimum data set identified for map unit or aggregated data. We will then work on site or pedon data, and later on getting laboratory data included. Plans are to have the map unit data set ready to present for approval by October 1, 1994, and the pedon data set by January 1, 1995.

'JIM R. FORTNER
Soil Scientist
NSSC, SCS

United States Department of Agriculture

Soil Conservation Service

SOUTH NATIONAL TECHNICAL CENTER
P. 0. Box 6567
501 Felix Street
Fort Worth. Texas 761150567

June 3, 1994

Scott Davis
Bureau of Land Management
Colorado Slate Office CO-933
2650 Youngfield Street
Lakewood, Colorado 60215

Dear Scott

This is in response to your May 15. 1994. request for information regarding access and distribution of soil survey data. The National Cartography & GIS Center (NCG) has some responsibilities that your committee will find of interest.

We are in a pilot stage of providing a list of soils data available through NCG on the Mosaic in Internet. Those are attached.

NCG has worked with states on a process for the certification of STATSGO and SSURGO. this process is a draft Soil Manual for the Soil Conservation Service.

At the present time, NCG is charging S500 for a state coverage of STATSGO and S500 for a county coverage of SSUAGO. including the attribute data. This fee could be terminated ii the government funds and opens up access to the information highway.

The standaras for updating and coordinating procedures are now in the process of being updated everything else is either completed or in draft form of the Soils Manual.

I hope this is of some help. I will be at the meeting in Idaho. but will have lo leave on Thursday.

W. R. Folsche

W. R. FOLSCHE. Head
National Cartography & GIS Center

Attachment

DIGITAL SOILS DATA FACT SHEET

U.S. Department of Agriculture
Soil Conservation Service

DIGITAL SOILS DATA

I: 12.000 to 1:7.500.000-Scale Digital Soils Information from the SSURGO, STATSGO, and NATSGO Data Bases

Available from the National Cartography and GIS Center Fort Worth, Texas

The Soil Conservation Service (SCS) has the federal responsibility for the National Cooperative Soil Survey (NCSS) and federal leadership for collecting, storing. maintaining, and distributing soils information of privately owned lands in the United States. The Federal Geographic Data Committee and the Office of Management and Budget have formally assigned the responsibility for national coordination of digital soils data to the SCS.

As a step toward making digital soil data available. the SCS is releasing for sale. boundary and attribute data from it's major soil data bases.

SCS has established three digital soil geographic data bases representing different intensities of soil mapping. Common to each soil geographic (spatial) data base is the linkage to a soil interpretations (attribute) record data base. which gives the proportionate extent of the component soils and their properties for each map unit.

With these digital data bases, users can store. retrieve. analyze. and display soil data in a highly efficient manner. as well as integrate the data with other spatially referenced resource and demographic data in a Geographic Information System (GIS).

THE THREE DATA BASES

The three soil geographic data bases are the Soil Survey Geographic Data Base (SSURGO), the State Soil Geographic Data Base (STATSGO), and the National Soil Geographic Data Base (NATSGO). Components of map units in each geographic data base are generally phases of soil series. Phases of series enable the most precise interpretation. Interpretations are displayed differently for each geographic data base to be consistent with the level of detail mapped. The soil interpretations record data base encompasses more than 25 soil physical and chemical properties for approximately 18,000 soil series recognized in the United States.

Information such 3s particle size distribution, bulk density. available water capacity, soil reaction, salinity. and organic matter is included for each major layer of the soil profile. Also included are data on flooding. water table, bedrock. subsidence characteristics of the soil. and interpretations for erosion potential, septic tank limitations. engineering. building and recreation development. and cropland. woodland. wildlife habitat. and rangeland management.

The SSURGO Data Base

SSURGO. the most detailed level of information. is used primarily for farm and ranch conservation planning; range and timber management; and county, township, and watershed resource planning and management. Utilizing the soil attributes. this data also serves as an excellent source to review site development proposals 3nd land use potential. make land use assessments and to identify potential wetland areas.

Using national mapping standards. soil maps in the SSURGO data base are made by field methods, using observations along soil delineation boundaries and traverses. and determining map unit composition by field transects. Aerial photographs are interpreted and used as the field map base. Maps are made at scales ranging from *1:*12.000 to 1:31.680 and incorporated with comprehensive descriptions to produce the NCSS publications.

Digitizing is by line segment (vector) in accordance with SCS-established digitizing specifications and standards for duplicating the original soil survey map. The mapping bases are normally orthophotoquads or 7.5 minute topoquads. Digitizing is done by *SCS* or by cooperating state and local governments.

SSURGO data are collected and archived in 7.5 minute topographic quadrangle units. and distributed as complete coverage for a soil survey area usually consisting of ten or more quadrangle units. The adjoining 7.5 minute units are matched within the survey areas.

The STATSGO Dara Base

STATSGO is used primarily for river basin. state, and multicounty resource planning, management. and monitoring.

Soil maps for STXTSGO were made by generalizing the detailed soil survey maps. Where more detailed maps are not available, data on geology. topography. vegetation, and climate were assembled. together with satellite images. Soils of analogous areas are studied. and 3 determination of the classification and extent of the soils is made.

Map unit composition for STXTSGO is determined by transecting or sampling areas on the detailed maps and expanding the data statistically to characterize the whole map unit.

STATSGO was mapped on the U.S. Geologic31 Survey's 1:250,000-scale topographic quadrangle series. Soil boundaries were digitized by line segment (vector) to comply with national guidelines and standards.

STATSGO data are archived and distributed as complete coverage for a state. STATSGO data are joined between states.

The NATSGO Dara Base

NATSGO is used primarily for national, regional, and multistate resource appraisal. planning. and monitoring.

The boundaries of the major land resource area (MLRA) and land resource regions were used to form the NATSGO data base. The MLRA boundaries were developed primarily from state general soil maps,

Map unit composition for NATSGO was determined by sampling done as part of the 1982 National Resources Inventory. Sample data were expanded for the MLRAs. with sample design being statistically significant to state parts of the MLRAs.

The NATSGO map was digitized at a scale of 1:7.500.000. also by line segment (vector). and is distributed as a single data unit for U.S. coverage.

DATA CONTENT AND FORMAT

Spatial Dara

SSL'RGO. STATSGO. and NATSGO spatial data are distributed to the public from the National Cartography and Geographic Information System Center (NCG) in the USGS Digital Line Graph (DLG-3) Optional Distribution Format.

SSL'RGO data are archived in various formats. Depending on the format requested. the customer's request may be delayed to reformat the data of the DLG-3 Optional format. SCS soil map symbols (AbC) are not normally carried within the DLG-3 Optional format. However. these map symbols are made available as a unique ASCII file when SCS soils data are distributed in the DLG format.

The NCG primarily operates a Geographic Resource Analysis Support System (GRASS) GIS. SCS-GRASS and other GIS formats may be made available by mutual agreement.

The distribution medium for spatial data will normally be 9-track magnetic tape at 1600 bits per inch (bpi), but may be cartridge tape. also by mutual agreement.

Additional information regarding file formats for data, as well as the technical specifications for digitizing SCS soils data, is available from the NCG.

Attribute Data

SCS's attribute data for SSURGO and STATSGO are stored in a relational data base. This format is a nonfixed length. tab delimited. ASCII file. SATSGO is stored in a flat ASCII file. Attribute data are distributed on a 9-track magnetic tape or cartridge tape media.

Additional information regarding tile formats for attribute data are available from the NCG.

KNOWING WHAT TO BUY

Before pttrchasine digital soil data. the user needs to identify the area of interest and examine the anticipated use of the data. More importantly. **the user should be** knowledgeable of the software and/or data format capabilities available on the computer system intended for use. The user should be knowledgeable of soils data and their characteristics. If you **need** assistance. contact an SCS soil scientist for help or contact:

National Soil Survey Center
U.S. Department of Agriculture
Soil Conservation Service
Federal Bldg.. Rm 152
100 Centennial Mall. Sorth
Lincoln. NE 68508
(402) 437-5423

To obtain data. contact:

National Cartography and GIS Center
U.S. Department of Agriculture
Soil Conservation Service
P.O. Box 6567
Fort Worth. Texas 76 115
(817) 334-5559
FAX (817) 334-5290

DIGITAL SOILS **DATA** COST

Product
- 0 Coverage
- 0 Price

SSURGO
- o County/ Area
- 0 $500

STATSGO

- State
- $500

NATSGO
- United States
- $500

Placing Orders

STATSGO data mav be ordered by clicking here!

Submit a request to the NCG specifying the data being ordered. accompanied by a check made out to "USDA-SCS." Provtde the name and telephone number of a technical contact. Any special handling, which may require additional charges, will be discussed with the user before completion. A data base listing. describing the characteristics and status of available data. and status maps are also available.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis. without regard to race. color. national origin. religion. sex. age, marital status. or handicap.

JUNE 1992 / 1005853D Revised

Return to Geographic Databases Page.

USDA -SOIL CONSERVATION SERVICE / MAY 1994
Send comments and/or suggestions to www@ncg.scs.ag.gov.

GIS DATA ATLAS AND CATALOG

This catalog is a textual listing of the holdings of the National Cartography and GIS Center (NCG) media library. Many of these data were collected from soil survey digitizing projects performed in-house, by state soil staffs or from contracting sources. It is recognized that much of the soil data catalogued is the property of the Soil Conservation Service state soil staffs and may exist in a more current version elsewhere: the only exceptions include the certified SSURGO and STATSGO data bases that the NCG is responsible for storing and cataloging.

All vector or line-segment spatial data is distributed in the DLG-3 Optional Format or in the GRASS vector format unless otherwise noted. The attribute data may be distributed in a relational data base structure or in a flat ASCII format. Raster data are in the GRASS cell or raster format and are distributed as full GRASS mapsets unless otherwise noted. Raster attribute data are distributed in a relational data base format or in 3 flat ASCII format.

The NCG can provide data in a variety of media types. which include: 9 - track magnetic tape. quarter inch cartridge tape of several densities. 8 mm tape. erasable optical disk. compact disk - read only (CD-ROM) as well as floppy disks and diskettes.

FOR ADDITIONAL INFORMATION ABOUT THE DATA LISTED IN THIS CATALOG CONTACT:

National Cartography and GIS Center
U.S. Department of Agriculture
Soil Consenation Service
P.O. Box 6567
Fort Worth. Texas 76115

(817) 334-5559 *FAX (817) 334-5469*

TABLE OF CONTENTS

SECTION X. MISCELLANEOUS DATA

- A. NON-COPYRIGHTED DATA
- B. COPYRIGHTED DATA

Return to Geographic Databases Page.

USDA-SOIL ***CONSERVATION SERVICE/MAY*** *1994*

Send *comments* **and/or** *suggestions to www@ncg.scs.ag.gov.*

NCG DIGITAL DATA ARCHIVE POLICY

The National Cartography and Geographic Information Systems (NCG) center hosts a variety of digital spatial and attribute data as a service to several agency Divisions. In an effort to serve our customers better NCG staff are constantly trying to improve data access. storage. backup, archive. and distribution efficiencies.

Though a number of different data management options are available at NCG. the staff relies upon the data stewards to provide metadata and to define the client Division's requirements for data handling. A memorandum of understanding between NCG and the client Division, stating data storage, access, archive, and distribution requirements, will be drafted and signed.

NCG DATA ARCHIVE POLICIES

***The term** archive as **used in** this document implies the management of digital data. other **rhan** temporary **work space. on** magnetic **or** optical **media. This includes backups** of online data. **rapes on a** shelf, **and** data on any **hard disk.** magnetic **or** optical. **on** any NCG computer.*

When no clear requirements are stated for data management. NCG staff will implement the following:

1. Once categorized as "archivable" by agency data stewards. all data will be maintained offline either on magnetic tape or on optical media.. Offline **being** on a shelf within the premises.
2. Agency-owned data archived at NCG will be duplicated and stored off-site. under the provisions of the SNTC contract with "One Safe Place", which allows for routine monthly retrieval, or same-day service with the use of a courier. Within five days of receipt of the data. NCG staff will read the data with the appropriate software. If data are readable, duplication and off-site storage are done within 60 working days.
3. All data will be entered into a relational database maintained at NCG within ten days of receipt in the geodatabase section, including basic properties and as much metadata as are available.
4. All data at NCG will be inventoried once a year. and the database updated with any new or removed items. All public, SCS-owned. data archived at NCG will be listed on a public catalog, hardcopy and electronic. and made available to agency staff nationally as well as to the general public upon request, except when limitations are expressly stated in the relevant MOU.
5. Archive, retrieval. and database access service are available during working hours through any member of the geodatabase section staff. Randy English is the section head. Online read-only access to the database is provided upon

request. and access to data are provided either online or on electronic media within two working days or less.

ARCHIVING PROCEDURES

Upon receipt of data. information is entered into a database by the geodatabase section staff. If the data is on magnetic media it is duplicated for off-sire storage and shelved for retrieval upon request. Online storage is provided upon request once data are duplicated onto the appropriate media for off-site storage.

RETRIEVAL

Any data in the database can be retrieved by a member of the Geodatabase section. and duplicated on any available media or disseminated electronically upon request by an authorized client. Online data can be made available throughout the NCG nerwork. anonymous ftp, or Internet.

PRICING

Cost of services must be arranged between SCG management and Division representatives. This will vary according to the volume of data and type of service that is being requested.

SERVICES AVAILABLE

NCG employs a staff of data archive, management. and distribution specialists who are in charge of maintaining data and facilitating access to the specifications of the client Division. Some of the data-relative services available at NCG. and addressed within relevant MOUs with agency Divisions, are:

Off-site storage

- The SNTC maintains a contract with an off-site data storage facility for the safe-keeping of data tapes. 9-track and 8mm tapes are picked up and delivered to the center on a monthly basis, with same-day retrieval available

Online storage

- In addition to 15 Gbytes of RAID (Redundant Array of Inexpensive Disks – they are not inexpensive) storage, NCG computers have network access to over 10 Gbytes of distributed workspace storage.

Backups

- All online data on the server's RAID storage are backed up daily.

Inventory

- NCG's spatial and attribute data are inventoried at least once a year. and a data catalog is published for distribution, A pictorial data atlas is in the works.

Distribution

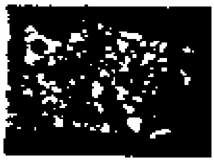
- Currently most distribution of data to customers, within the agency and to the public in general. is done via magnetic media: but a variety of alternatives are becoming available with the advent of optical media. increased storage capacities of small-format magnetic tapes, and with increased access to the nation's information superhighway.
  - **Media**—The once popular g-track magnetic tapes are rapidly being replaced by 8mm helical-scan cartridge tapes. Also available for storage and distribution at NCG are: 4mm tape cartridges. Quarter-Inch cartridges (QIC), 600 Mbyte erasable optical disks. 640 Mbyte ISO-9660 and rock ridge format CDROM disks. 5 and 3 -inch floppy disks. and 20 to 90Mbyte Bernoulli disks.
  - **Dial-up**--NCG has extensive dial-up capabilities, including modem access at various baud rates. asynchronous and synchronous packet switch service, Internet (currently 56k baud. but soon to be upgraded to either frame relav or T1 servicer. in-house X.25 protocol support. anonymous lip site support. and various UNIX uucp protocols.
  - **WAIS**--NCG maintains a WAIS server and offers WAIS-indexing support as an option for all in-house data upon request.
  - **Mosaic/WWW**--NCG **also** maintains a World Wide Web (WWW) server as a Mosaic client for MSwindows. Macintosh. and Xwindows customers.
  - **Charge-back--A** charge-back mechanism is in place at NCG, allowing for recovery of data duplication and dissemination expenses.

Return to Geographic **Databases** Page.

USDA-SOIL CONSERVATION SERVICE / MAY 1994
Send comments and/or suggestions to www@ncg.scs.ag.gov.

THIS IS A TEST FORM / MAY 1994

STATE SOIL GEOGRAPHIC DATABASE **(STATSGO)**
ORDER **FORM**



Thank you for your interest in the SCS-STATSGO database. To order data using this form, you must use a browser with online form features. If you cannot find somewhere below to type your answers, you cannot use this form. Instead. please send mail to *www@ncg.scs.ag.gov*, and an email version of the form will be sent to you.

When you have filled out the form to your satisfaction, click on the "**Mail** Order" button at the bottom of the form. You should receive an email verification of your order within a day or so.

I would like to request State Soil Geographic Database (STATSGO) data for the following state(s):

At a cost of 5500.00 per state: total

Please mail remittance in the form of a cashier check. personal check, non-govt. purchase order, AD-i42 for USDA agencies, or OPAC billing for non-USDA agencies to:

Soil Conservation Service
National Cartography and GIS Center
STATSGO DATA
P. 0. Box 6567
Fort Worth. TX 76 11.5
(817)334-5292
FAX-(817)334-5469

Checks are to be payable to SCS-National Cartography and GIS Center.

Shipment of data will follow receipt of payment. For prompt. accurate shipment. please type the following label:

Name:

Email Address:

Telephone:

FAX:

Position:

Affilation:

Street Address:

City State Zip:

Please select the data format and type of media you prefer:

Spatial Data Format:

ARC Export

GRASS Vector

DLG-3 Optional

Tabular Data Format:

ARC Export

Prelude

Media:

9-Track Tape

8mm Tape

1/4" Cartridge Tape

To send your order. press here:

To clear the form. press here:

Retum to Geographic Databases Page.

*USDA-SOIL **CONSERVATION SERVICE** / MAY 1994*
Send comments and/or suggestions to www@ncg.scs.ag.gov.

Redefining The Cooperative Role In NCSS

Committee report submitted to:
Western/Midwestern Regional Cooperative Soil Survey Conference
Coeur d'Alene, Idaho
June 17, 1994

Committee Chair – Paul McDaniel

Committee Members and Participants –

Mickey Ransom	Robert Klink
Wayne Robbie	Sian Conway
Joe McCloskey	Dennis Heil
LeRoy Daugherty	Jerry Nielsen
Eugene Kelly	Janis Boettinger
Harold Maxwell	Tom Fenton
Tim Gerber	Russ Langridge
Gordon Huntington	Don Franzmeier
Gary Muckel	

The National Cooperative Soil Survey (NCSS) is a nationwide partnership of Federal, regional, State, and local agencies and institutions (National Soils Handbook). The NCSS represents a long-standing cooperative soil survey effort that has served as a viable model for other countries. As such, redefinition of cooperative roles should consist of 'fine tuning' rather than a complete overhaul. It should be emphasized that the NCSS program is not 'broken' and therefore wholesale changes are neither required nor desired.

The committee considered the 4 charges set forth by the Conference Steering Committee. These charges are listed and discussed in the following sections.

1. Identify current NCSS cooperators

A definition of an NCSS cooperator is needed. It is important to distinguish between cooperators, collaborators, and users for purposes of accountability. Technically, a cooperator is any federal, state, or local agency or institution that has entered into a working agreement with the NCSS. These agreements are usually memoranda of understanding (MOU). Although MOUs are not legally binding contracts, they do provide the framework for operations and responsibilities related to soil survey activities.

On a more descriptive level, an NCSS cooperator should be thought of as an agency or entity that has a long-term commitment to 'investigate, inventory, document, classify, and interpret soils and disseminate, publish, and promote use of information about the soils of the United States and its trust territories' (NSH).

2. Describe the future role of each cooperator

White the role of the SCS is described in detail (see NSH), the roles of other NCSS cooperators is less well-defined. As such, future roles of NCSS cooperators need to be re-examined. Recent changes in cooperators' resources and priorities necessitate that existing MOUs be evaluated. Many MOUs are outdated and contain language that cooperators are uncomfortable with. It may be appropriate for all MOUs to be updated in order to more accurately describe actual cooperator roles.

It is generally agreed that MOUs are, by design, fairly vague and allow a certain degree of flexibility. However, agency and institutional administrators are increasingly reluctant to enter into agreements that may be perceived as a commitment of limited resources. All parties entering into a cooperative agreement should therefore be comfortable with both the wording and intent of an MOU.

Committee representatives from various cooperating agencies and institutions generally do not foresee immediate drastic changes in their current NCSS roles. For example, state agricultural experiment station representatives indicate that some traditional NCSS activities such as providing large-scale laboratory support have been cut back or eliminated because of budgetary and time constraints, However, participation in other activities such as soil survey planning conferences, field reviews, and peer review of technical documents is of substantial mutual benefit and will continue in the future.

All cooperators have been subject to declining budgets and, in many cases, personnel cutbacks. In view of this, there will be a need for more sharing of specialists among NCSS cooperators. This is especially true with the increasing locus on developing an ecosystem approach lo soil survey.

3. Determine where cooperator input is needed

Cooperator input is perhaps one of the major reasons that the NCSS program has been successful. As soil survey technology and application continue to evolve, it is extremely important for cooperators to work together to develop a strategic plan for the NCSS program.

Annual state-level soil survey work planning conferences are required (see NSH). There appears to be a widespread perception that these meetings tend to focus on what has been done rather than on true planning. Therefore, all participating agencies should be encouraged to take a more pro-active approach with regard to these conferences. One means by which to at least partially offset declining resources is by more efficient planning.

Continued cooperator input is needed in many areas. Continued peer review of technical documents such as proposed taxonomic changes and soil series descriptions is considered critical. Development and incorporation of new technology will result in rapid evolution of databases and information delivery systems. These areas will continue to require cooperator input. New opportunities of cooperator input will also present themselves. Implementation of NASIS will provide an opportunity at the local level for cooperators to provide appropriate data elements.

NCSS cooperators can also provide means to insure that priority items are delivered in a timely fashion. As an example, delays in publishing of soil surveys by the U.S. Government Printing Office have circumvented through publication of these materials as Agricultural Experiment Station Bulletins, U.S. Forest Service reports, etc. These types of arrangements can be put into MOUs when rapid delivery of soil survey data may be required.

4. Identify potential new NCSS cooperators (and collaborators)

In addition to some of the traditional cooperators, there are several agencies, organizations, institutions, and even individuals that will become major players in the NCSS. It is important that the need to involve these parties at various levels of the NCSS be recognized.

As an example, management of Indian tribal resources has been directed by the Bureau of Indian Affairs (BIA). The BIA has been a long-standing NCSS cooperator. New laws provide for more autonomy in the management of tribal resources, and as a result, tribal governments will be directly involved in regulation and management of their lands. At present, there are an estimated 12 million acres of tribal lands needing an initial soil survey. Thus, inclusion of tribal governments **as NCSS** cooperators will likely be appropriate for soil survey activities related to these lands.

Examples of other potential new cooperators include the Intertribal Agriculture Council, U.S. Department of Defense, U.S. Department of Energy, Corps of Engineers, state GIS agencies, state heritage programs, state and local health departments, conservation organizations such as the Nature Conservancy, and private individuals. All of these groups **have** recently demonstrated many of criteria for cooperators described in a previous section of this report. Many of the new cooperators and collaborators may best be identified at the state and local levels.

Committee Recommendations

Based on the discussion summarized above, the committee recommends that cooperators take the following steps to insure the continued success of the NCSS program:

- Maintain the distinction between cooperators, collaborators, and customers.
- Update and amend memoranda of understanding as needed.
- Encourage pro-active, annual coordination of soil survey activities.
- Continue to encourage diversity among cooperators, collaborators, and customers.

REDEFINING THE COOPERATIVE ROLE IN NCSS
Committee Recommendations
June, 1994

1. **Distinguish between cooperators, collaborators, and customers.**
   Although the distinction between cooperators, collaborators, and customers may not always be well defined, a distinction is needed for purposes of accountability and strategic planning of NCSS activities. A cooperator is defined as a federal, state, or local agency or entity that has entered into a working agreement with the NCSS. Additionally, a cooperator should have a long-term commitment to "investigate, inventory, document, classify, and interpret soils and disseminate,

COMMITTEE SIX- ALTERNATIVES TO TRADITIONAL SOIL INTERPRETATIONS

Committee Chair: Arlene Tugel, SCS, WNTC, Portland, OR

Charges:

1. Identify new methods to make interpretations.

2. Initiate development of a new method.

Committee Report
June 14, 1994
Coeur d'Alene, ID

The committee had a teleconference on March 14, 1993 to brainstorm ideas for charge no. 1, "Identify new methods to make soil survey interpretations." Minutes of the teleconference are attached. Committee members voted by mail to rank the proposed new methods. See below for a ranked list of suggested new methods with their item number and a brief description.

New Ways to Make Interpretations

Vote	Item #	Description
12/5	6.	Make interpretations on interrelationships between the landscape and soil.
B/3	2.	Interpretations that rate suitability with alternative measures applied.
S/3	5.	Identify and define soil behavior processes (such as nutrient cycling, shrink-swell, water transmission) and present alternatives to display the information (narrative, digital illustrations).
8/2	1.	Interpretations that emphasize positive qualities of soil.
7/3	7.	Affect of use dependent processes on soil properties.
6/3	15.	Start with a specific use. Then list the soil properties or characteristics that are needed to achieve optimal use. Bump those properties up against the existing database to find best

area for that use.

6/3 9. Develop criteria and standards to assess soil and watershed conditions.

6/2 13. Use soil potential to give relative values to different types of land uses.

5/2 4. Identify probability of "x" behavior based on spatial distribution of component or property. This is important where component property range overlaps the property use requirement.

4/1 3. Display interpretations as relative values of capabilities.

3/1 8. Define minimum amount of cover on rangeland to protect the soil.

2/1 10. Prepare guidelines to develop interpretations for miscellaneous land types, higher taxonomic units and geologic units.

l/l 11. Identify positive long term use of landscapes.

l/l 12. Identify suitability of geographically associated soils and landscapes.

0 14. Other - add as you are inspired.

Expanded descriptions of eight of the ideas were prepared prior to the Coeur d'Alene meetings and presented to the committee on Tuesday, June 14, 1994. These descriptions are attached (idea #2, 5, 6, 7, 9, 10, 13, 15).

At the Coeur d'Alene meeting, we had a discussion of the committee charges. The committee name, "New Ways of Making Soil Survey Interpretations," was changed to "Alternatives to Traditional Soil Interpretations." We clarified our charge to mean, "How else can we convey information about soil behavior?"

After presentations and discussions of the eight ideas, we grouped the alternatives into three categories:

Monitoring and assessment

9. Soil health/proper functions condition.
7. Affect of use dependent properties.

Making interpretations

7. Affect of use dependent properties.
2. Suitability with alternative measures applied.

Displaying information

15. Pick use query database for listing of optimal sites.
13. Use soil potentials to give relative values to different types of land use.
10. Miscellaneous land types.
5. Identify soil behavior processes.

We then discussed methods to implement the ideas. It was suggested that items 2, 5, 7, 13 and 15 would be pilot projects on on-going soil surveys. Number 7 could be implemented by gathering data on use dependent properties. Work groups consisting of various disciplines and agencies including NCSS would be the best approaches to initiate ideas 5 and 7. A literature search is needed for numbers 2 and 7. Idea 10, Soil Survey Enhancement - Interpretations for Miscellaneous Land Types could be carried out today with some minor expansion of existing procedures for the Soil Interpretations Record.

The committee identified three ideas/alternatives that would provide the greatest benefit for the least input. These were #15 Pick a Use, Query the Database; #10, Interpretations for Miscellaneous Land Types; and #5, Identify Soil Behavior Processes (Pedologic).

<u>Recommendations</u>

Recommendation 1:

The eight alternatives to traditional soil interpretations should be integrated into soil survey activities. (Current national level activities on soil health and use dependent properties should be continued.)

Recommendations 2:

#15 Pick use, query database: Begin development of # 15 as a pilot project on a new soil surveyproject.

Recommendation 3:

#10 Interpretations for miscellaneous land types: Implement #10 immediately using existing SIR procedures as modified to meet the needs for miscellaneous land types.

Recommendation 4:

#5 Identify soil behavior processes (pedologic): Establish a development committee of NCSS cooperators, modelers, other discipline specialists and universities to begin work on #5. Set up a pilot project to identify and display pedologic process information in a new soil survey.

Western/Midwestern Regional Cooperative Soil Survey Conference

Minutes of Committee Six Teleconference
March 14, 1994
New Ways of Making Soil Survey Interpretations

Charges: 1. Identify new methods to make interpretations.

2. Initiate development of a new method.

Participants:
*Wayne Backman, Assist State Soil Scientist, South Dakota
*Ken Vogt, Assist State Soil Scientist, Missouri
*Jon Gerken, Acting State Soil Scientist, Ohio
*Jim Carley, State Soil Scientist, Washington
*Cam Loerch, Soil Scientist, QAS, Lincoln, Nebraska
*Carol Franks, Soil Scientist, QAS, Lincoln, Nebraska
Bill Broderson, Soil Scientist, QAS, Lincoln, Nebraska
*Chris Smith, State Soil Scientist, Hawaii
Bill Volk, BLM, Billings, Montana
Carl Wacker, Assist State Soil Scientist, Wisconsin
Don Last, College of Nat. Res., Univ. of Wisconsin
*Dick Page, ELM, Salt Lake City, Utah
*Arlene Tugel, Chair, Committee Six, WNTC, Portland, Oregon

* - will attend Coeur d'Alene Conference

We reviewed the background material on current examples of soil interpretations. General discussion on charge 1 followed.

Can Loerch asked if we know what our customers need in regards to interpretations. Arlene said that the book "Soil and Water Quality: An Agenda for Agriculture," National Research Council, 1993 stated 4 objectives. She recommended we should ask if current interpretations meet these objectives. The 4 objectives are:

- conserve and enhance soil quality as a fundamental first step to environmental improvement;

- increase nutrient, pesticide, and irrigation use efficiencies in farming systems;

- increase the resistance of farming systems to erosion and runoff: and

- make greater use of field and landscape buffer zones.

Discussion:

Bill Volk, BLM, indicated that for rangeland, there is a need to define the minimum amount of cover to protect the soil. Each seral stage of the plant community could have different amount of cover. Organic carbon content of the surface layer lags behind changes in plant cover, particularly with changes in land use.

Chris Smith discussed soil qualities. We will need to ask what is: (1) a soils maximum potential? and (2) to what level can we allow a property degrade, (3) what is our target of use? There is considerable work in the tropics on properties in systems changing from forest to cultivation (porosity, root proliferation, organic carbon, nutrient status). We will need a protocol to measure and monitor quality: we already have the techniques of measurements.

Bill Broderson suggested that we become aware of other efforts that are ongoing. There is a Soil Quality Committee (SCS-ARS-University-EPA) to establish protocols for addressing soil quality. Committee Chair is Gary Muckel, SCS, Lincoln.

Bill Volk described a current BLM activity that requires the use of criteria and standards to assess soil and watershed conditions. It includes riparian areas and upland areas. Real life challenges are short time frame to define and apply criteria and the many categories of land ownership.

Carol Franks stated that the Soil Quality Committee discussed watersheds and has a list of potential indicators.

Another on-going activity is the use of Fuzzy logic to assist in presenting interpretations.

Dick Page recommended that we prepare guidelines for developing interpretations for miscellaneous land types, higher taxonomic units and geologic materials. He is working on this with Ferris Allgood, State Soil Scientist, SCS, Utah.

Bill Volk suggested we identify positive long term use of landscapes. Different components of the landscape have different highest and best uses that are not necessarily in line with the limitations of the soil. This will minimize the problem of avoiding severe rated hillside positions as building sites and ending up building on farmland.

Chris Smith asked where would this information be presented? in the map unit description? We should identify the suitability of geographically associated soils.

Soil potentials were discussed. They are an existing method. Unless changes to the method are needed, reviewing potential is probably not within the scope of our charges.

Jon Gerkin recommended we consider the use of soil potentials to give relative values to different types of land uses.

Chris Smith stated that the land capability classification system doesn't work well for specialty crops.

Chris Smith suggested that we compile possible products that can be generated with our data. This could be handled under the advertising and marketing by another group.

Charge 1. Identify new ways to make interpretations. We had a review discussion of items 1 thru 7 from the 2-17-94 list.

No. 1 Bill Broderson explained he developed a proposal about 7 years ago that focused on positive qualities of soil called "smart systems."

Bill Volk suggested indicators for soil quality should be simple to observe - example platy structure changed to granular structure.

Chris Smith said that the quality of organic matter needs to be a part of soil quality standards, not all organic matter sources have the same quality.

No. 2 Discussion ?

No. 3 Discussion ?

No. 4 Chris Smith explained that we should rate all components, including inclusions and identify percent of map unit with a certain rating or behavior.

No. 5 Arlene explained that identifying and defining soil processes is a prerequisite to developing soil quality standards. An understanding of processes, such as water movement, nutrient cycling, organic matter accumulation/oxidation is fundamental to making predications about soil behavior. ? suggested that a package of tutorials on soil processes should be developed. Organic matter would be a good example.

No. 6 Carol Franks stated an example of interrelationships between landscape and soil is runoff and runon.

No. 7 Discussion ?

The next step

The committee agreed on the following process to fulfill our charges.

1. Brainstorm list for Charge 1 will be sent to committee for review. We will use the TQM voting process thru the mail to select the highest priority items from the list.

2. Committee members will prepare 1 page summaries of the high priority items selected by vote to present as part of the report in Coeur d'Alene. Write-ups will include Definition, Description, Application and Methods of Display.

3. Committee will select at least one item to address for Charge 2. A draft write-up for Charge 2 will be sent to members prior to June meeting.

4. Charge 2 will be further developed at June meeting.

Follow-up

1. Distribute minutes of Soil Quality Committee to members - Tugel.

2. Send Fuzzy logic overview to committee - Broderson.

3. Send BLM information on criteria and standards to assess watersheds to members - Volk.

4. Send information on Smart System to members - Broderson.

DUE DATE: APRIL 25, 1994

Action: Review and mark priority 1, 2, 3, and 4. Send vote to Arlene Tugel by April 25.

Charge 1. Identify new ways to make interpretations
(Second Draft) 3/14/94

1. Interpretations that emphasize positive qualities of soil.

2. Interpretations that rate suitability with alternative measures applied.

3. Display Interpretations as relative capabilities.

4. Identify probability of "x" behavior based on spatial distribution of component or property. This is important where component property range overlaps the property use requirement.

5. Identify and define soil processes and present alternatives to display the information (narrative, digital illustrations).

6. Make interpretations on interrelationships between the landscape and soil.

7. Affect of use dependent processes on soil properties.

8. Define minimum amount of cover on rangeland to protect the soil

9. Develop criteria and standards to assess soil and watershed conditions.

10. Prepare guidelines to develop interpretations for miscellaneous land types, higher taxonomic units and geologic units.

11. Identify positive long term use of landscapes.

12. Identify suitability of geographically associated soils and landscapes.

13. Use soil potential to give relative values to different types of land uses.

14. Other - add as you are inspired.

Return to: Arlene Tugel BY: APRIL 25
West National Technical Center
511 N.W. Broadway, Rm. 248
Portland, OR 97209-3489

FAX: (503) 326-6308 or 5578

INTERPRETATION METHODS (A DRAFT)

Suggested Mea: No. 2. Interpretations that rate suitability wlth alternative measures applied.

Name of method: Soil Suitability with Alternative Ratings for Crop Production

Description: Current soil limitstion and suitability procedures generally emphasize rating Soils for engineering Interpretation. There is also a need to rate soils for the production of specific crops. This method, therefore, is associated more with crop Production and includes suitability retinas before and after appropriate management inputs.

This method duplicates the UNESCO FAO land evaluation procedure where the so-called land use system (LUS) is made up of (l) the land utilization type (LUT) and (2) the land map unit (LU). Depending on the intensity of the soil survey, the LUT can be brief or detailed, the latter describing the levels of input, etc. for a specified use. The LU, on the other hand, lists the appropriate interacting soil characteristics of a land in question.

In brief, the LUT describes the crop requirements with different levels of management input, while the LU is associated with the appropriate soil properties end behavior. The LUS, therefore, is the matching of the land (soil) use requirements with the land (soil) characteristics.

Application: Soil suitability ratings can be more meaningful if the ratings can be associated with the desired performance of, for example, 6 crop rather than only the status of the soil with its restrictive properties. That is, the ratings could reflect the correction of the manageable rstrictive properties with appropriate input.

For example, the Leilahua soil series in Hawaii (Ustic Kanhaplohumults, clayey, oxidic, isohyperthermic), according to the table of suitability ratings is poor for the production of corn.

We could specify that we would like to produce corn in the Leilehua soil with supplemental irrigetion, with the soils limed to pH 6.0 and phosphorus fertilizer epplied et the rate of 500 P pounds/acre, and with appropriate levels of the other nutrients.

The table of rstings could show not only the dominant mineralogy (e.g., oxldic. kaolinitic) with its rstings but al60 the input of phosphorus fertilizer with its ratings et different level6 of application. Depending on the different levels of lime and the phosphorus fertilizer, we could change the suitability rating of the Leilehua soil from poor to fair or good, depending on the man-cgomont input.

Method of display:	Use of GIS.
Other Information:	The proposed method Is not like the soil potential approach because a numerical rating of a group of soils is not used. Instead the mothod can be used to rate soils from different locations for o specified crop.
Further Work:	Unknown
Submitted by:	H. Ikawa (University of Hawaii), 06/08/94

New Interpretation Methods

Suggested idea: No. 5. Identify and define soil behavior processes (such as nutrient cycling, shrink-swell, water transmission) and present alternatives to display information (narrative, digital illustrations.)

Name of method: Soil Behavior Processes

Description: This method of interpreting soil behavior relies on the identification and characterization of pedoloqic processes that occur in a soil and that contribute to the daily or yearly functioning of the ecosystem (natural or aqroecosysteme).

Pedoloqic processes characterize soil behavior, not soil genesis. Performance of pedoloqic processes is effected by physical, chemical and biological properties of the soil. Pedoloqic processes can result in temporal variations in measured soil property values. Temporal variability may occur at any time frequency (diurnal, seasonal, etc.) Temporal variability can occur in response to use and management, successional statue, climate and weather.

Examples of pedoloqic processes are nutrient cycling, water movement through soils, freezing and thawing).

Application: An understanding of pedoloqic processes would add quality to all soil management decisions. Pedoloqic processes information could be applied at any scale (field, watershed, ecosystem). A description of the performance of pedoloqic processes of a given soil would be used in decision making for many activities. Examples include: designing management plane to improve soil health or condition: supporting ecosystem based planning, selecting suitable manaqement practices, or scheduling time of operation (such as logging, irrigation).

Methods of Display: Needs further brainstorming.

Other information: None

Further committee work needed: Identify and define pedologic processes.

Submitted by: *Arlene* **J. Tugel, 5/19/94**

Soil Survey of Aquila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona

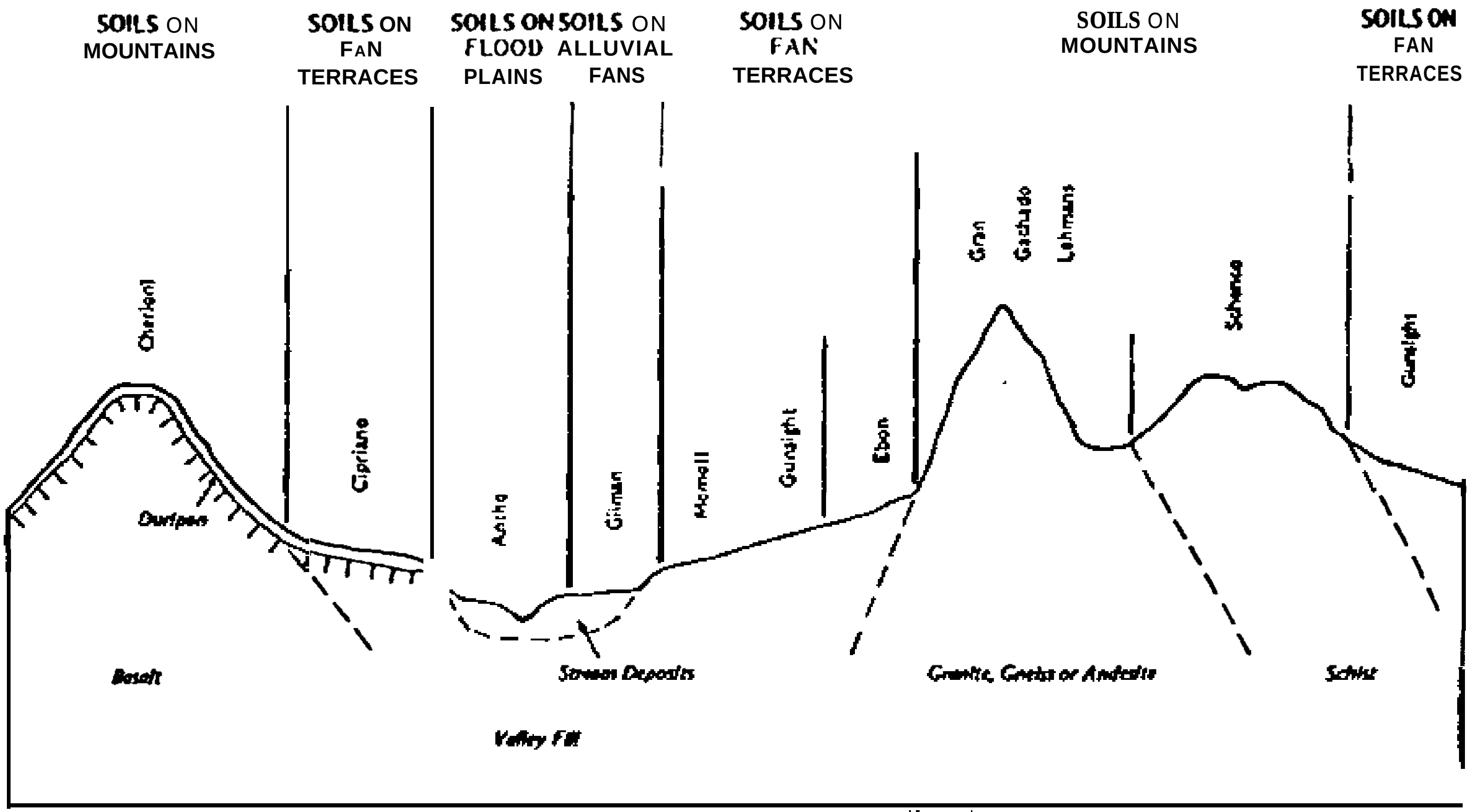


Figure 13.—Idealized soil-landscape profile.

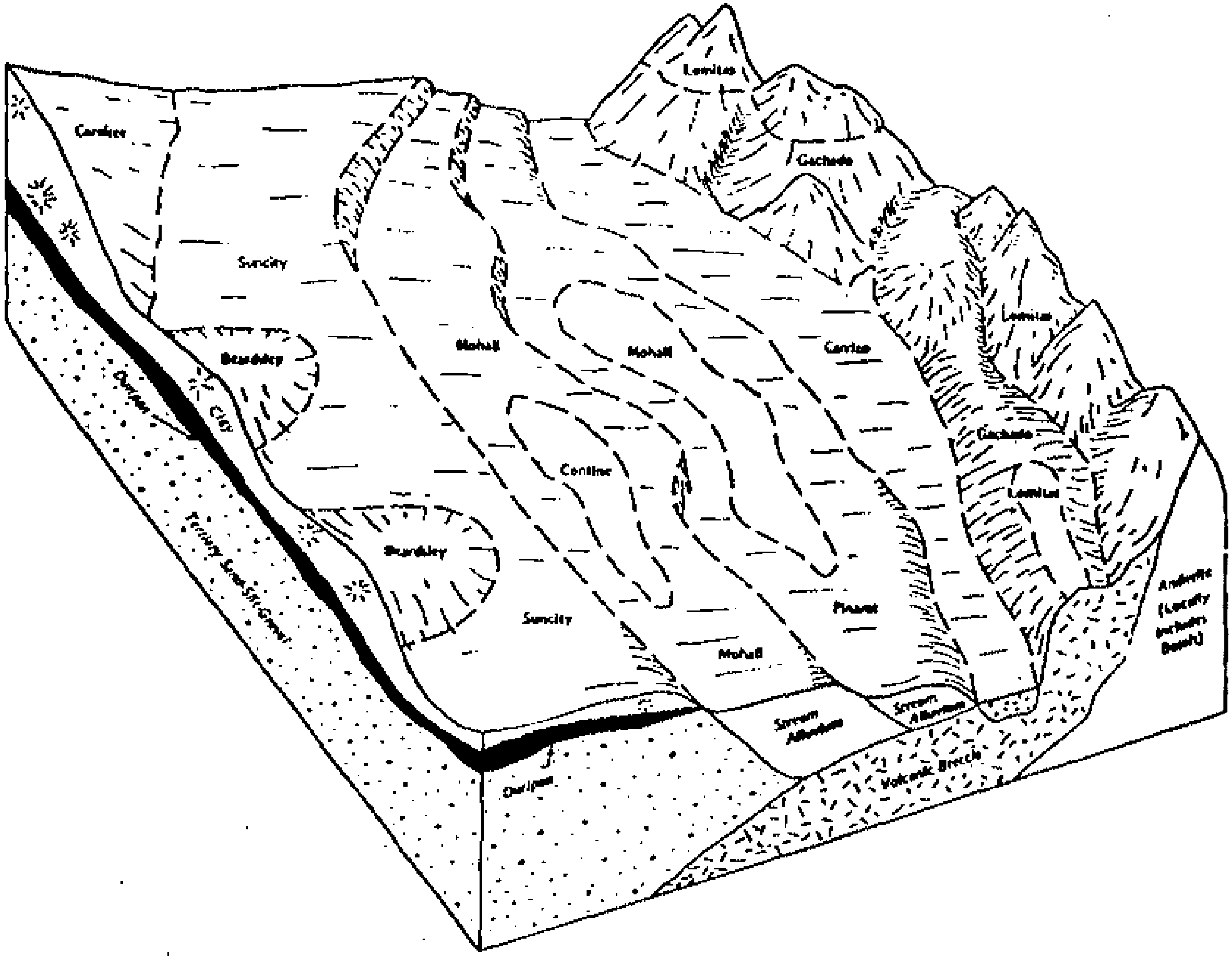
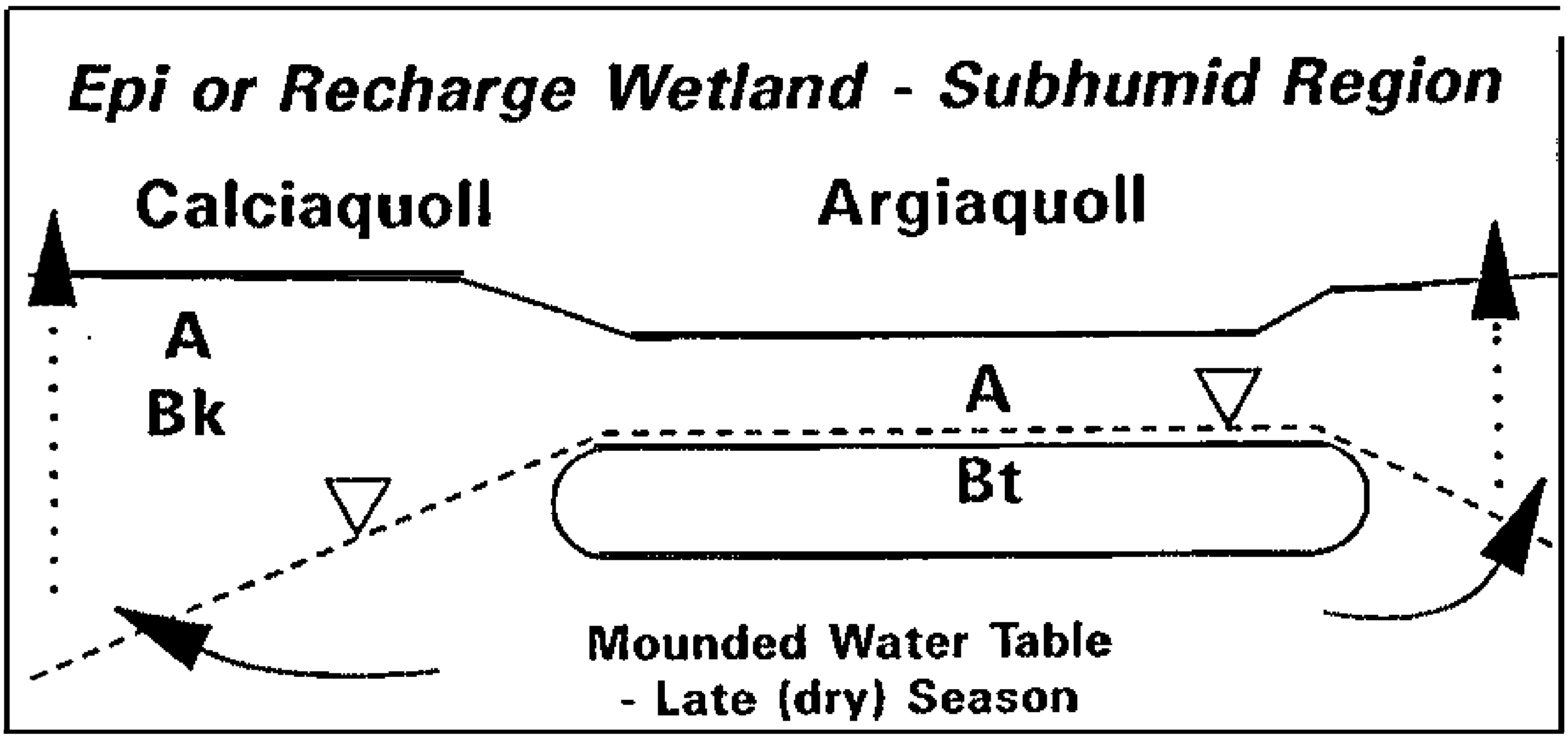


Figure 14.--Diagram of Agua Fria River-Lake Pleasant area.

Epiaquic or Recharge Depression During the Dry Down Phase



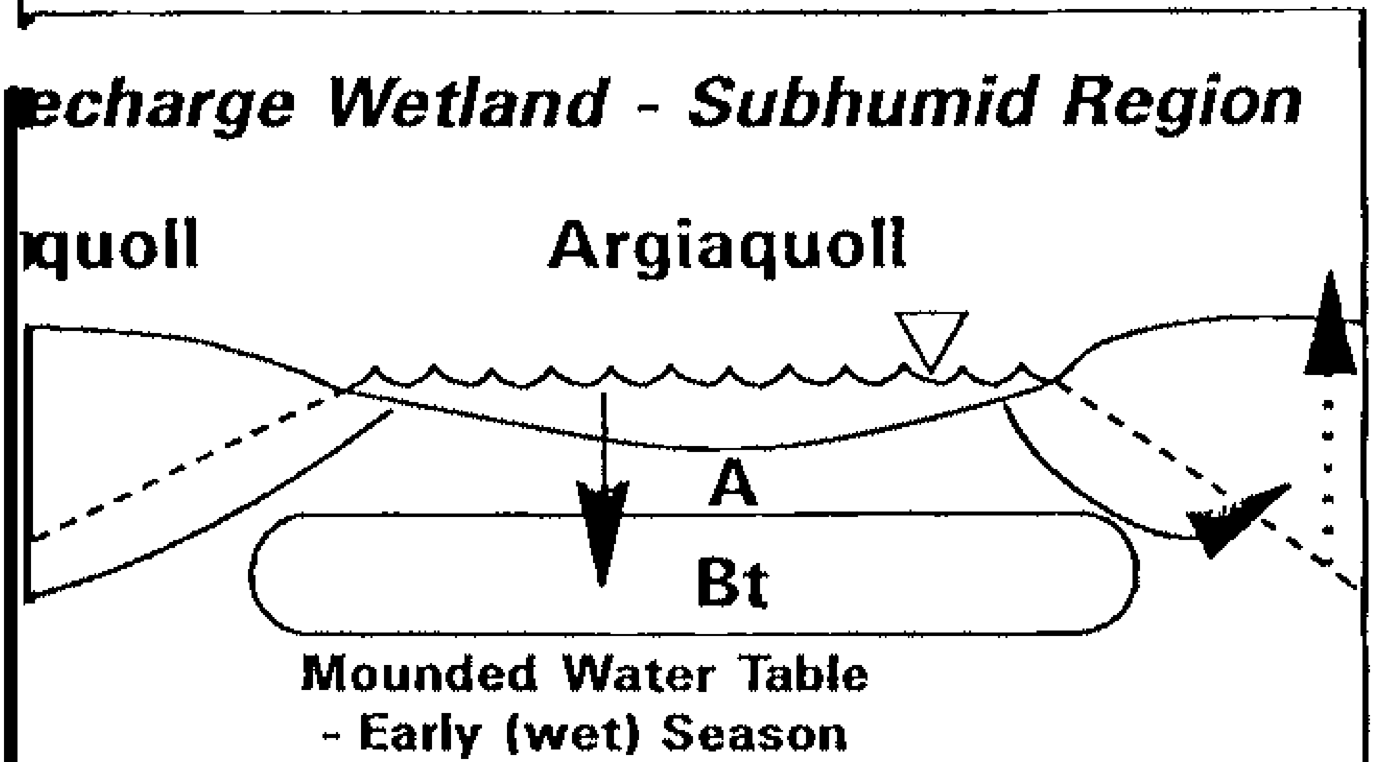
Figur· ?

(after Richardson, 1993)

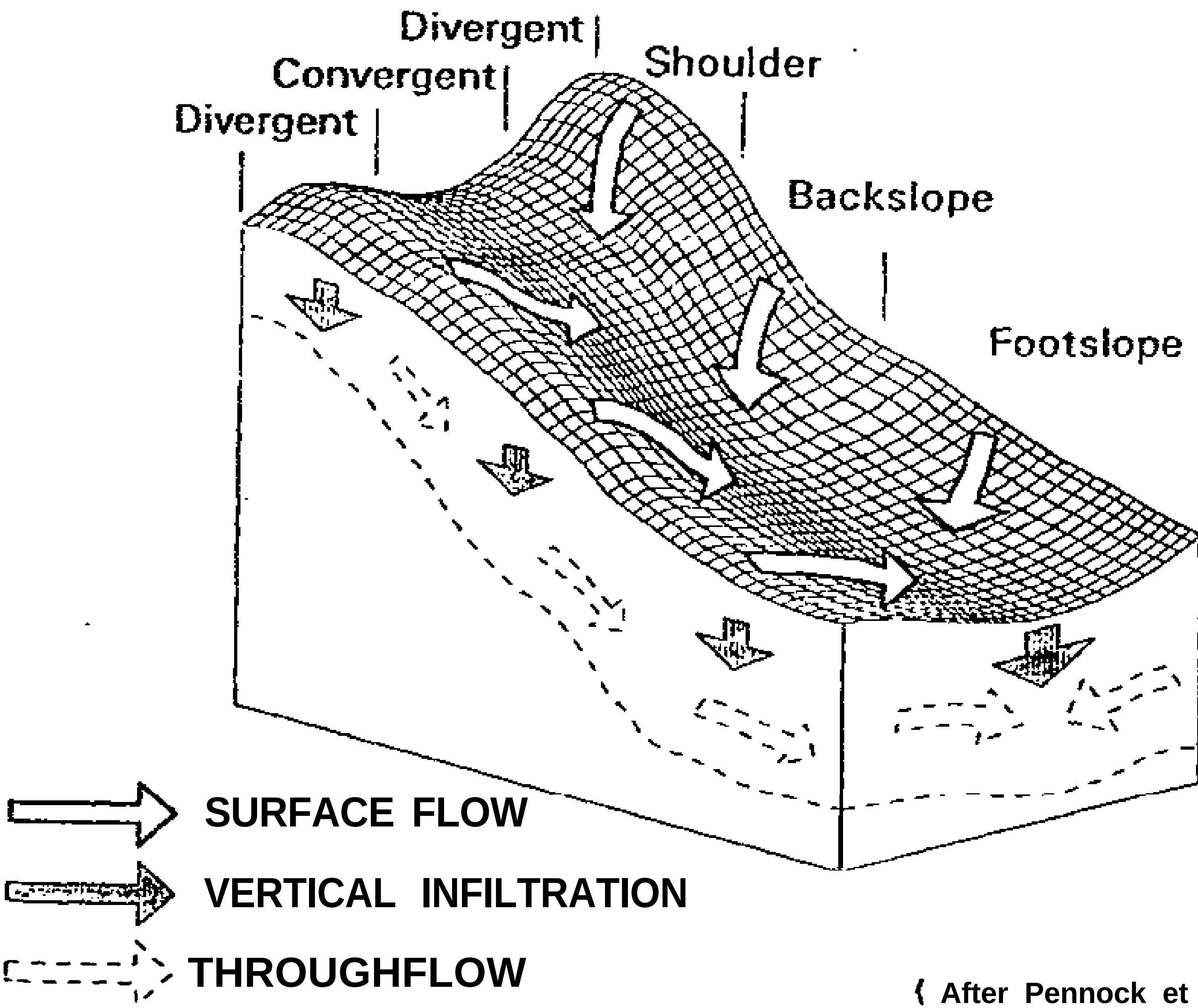
5

315

piaquic or Recharge ression with a Mounded Perched) Water Table



(after Richardson, 1993)



(After Pennock et al., 1987)

re 5.

DEVELOPING NEW WAYS TO DISPLAY INTERPRETATIONS

Suggested idea: No. 6 Make interpretations between the landscape and soil.

Name of method: Displaying Landfonn/Landscape Soil Relationships

Description: Additional information about landform and landscape soil relationships is needed by soil survey user. This information is needed to meet the requirements of FSA, HEL, CRP, NEPA, Clean Water Act and others. Clearer presentation of our existing knowledge and better understanding of these relationships (and hence the 'local landscape model') will begin to meet the above needs. Developing new ways to present this information will help us identify wetlands and riparian areas and develop leaching indices. In addition it will help us determine the impact of applied conservation practices or changes in land use.

The following questions should be considered when developing additional information and new display systems:

1. Which soils are associated with which landforms and landscapes?

2. What is the relationship between the soils on the landscape/landform?

3. How do these relationships affect:

water movement across the soil surface and within the soil profile?
erosion and deposition?
groundwater movement and leaching?
soil genesis and soil survey?

Application: Traditionally soil surveys have presented much of the landscape/landform information as narrative in mapping units and taxonomic units. Some soil surveys also present some information about soil series as block diagrams and topographic sequences. Block diagrams and topographic sequences could be modified to present map unit, component or general soil unit information rather than just series relationships. Computer graphics, GIS or image processing or landscape pictures could update these traditional presentations of soils information.

Methods of display: Block diagrams or topographic sequences could be developed for general soil units. They could be developed of the major landforms where the units occur, showing the landscape positions they include.

The named components (or their symbols) could be displayed on the diagrams rather than just the soil series names as we have done traditionally.

Diagrams could be developed for soil surveys at any level of detail. Order 2 consociations could have 2 or 3 of the associated map units displayed on one landform diagram or the potential location of inclusions. The components of complexes and associations could be displayed similarly.

Toposequences with the parent material identified could be developed for each major drainage within the soil survey. The location of each block diagram along the toposeguence could be identified leading to better understanding of the landform/landscape relationships of the entire survey.

Color or black and white pictures of the landforms/landscapes of a survey area could be used to display the typical location of the map units or components. Image processing makes it possible to delineate the landforms and landscapes on a picture of a typical area and show the direction of water movement.

Dr. Richardson of Montana State University has also developed a series of diagrams showing landscape hydrology. He indicates the direction of water movement within the soil and the vadose zone. He shows where wetlands tend to develop based on lateral movement, where salts will tend to accumulate and what types of soils will tend to develop in groundwater recharge and discharge zones. These types of diagrams also have potential to display additional soil information more clearly. These diagrams could be used to display map units, components, inclusions, etc. They could also be developed on landscape pictures using image processing.

Submitted by: Carol Franks

NEW INTERPRETATION METHOD

Submitted by: Christopher W. Smith 6/6/94
(808) 541-2605

Suggested idea:

NEW INTERPRETATION METHODS

Suggested idea: No. 9 Develop criteria and standards to assess soil and watershed conditions.

Name of Method: Soil Health/Proper Functioning Condition

Description: Field evaluation of soil health relies on the identification and characterization of pedologic properties which control or contribute to the daily functioning of a natural ecosystem.

Soil physical and/or chemical properties strongly influence, and in many instances control, the biological functions of a soil. Variability within and by the many soil types occurs in response to use, management, plant community or seral stage and climate.

An example of soil properties vital to biological functions is: vesicular crusts versus granular structure of a soil surface horizon.

Application: Identification and evaluation of minimum soil attributes to address its current health status and aid in the development of soil management strategies and decisions. When combined with vegetative and hydrologic attributes an assessment of watershed health could be determined.

Methods of Display: After evaluation soils would be placed into one of three groups: A) Proper functioning condition, B) Functioning at Risk, and C) Not functioning.

Other information: Soil attributes are to be selected for use on soils and landscapes that are under native plant species (non-natives included). Attributes should relate to a tiered system. A two or three tiered system would allow for attribute assessments to be done at different intensities for uses varying from site specific to a watershed or Major Land Resource Area (Ecological area).

Further committee work needs: Assistance in selecting soil attributes and the methods (point or plot) used for field evaluations varying from specific to broad in scope.

submitted by: William P. Volk

SOIL SURVEY ENHANCEMENT

INTERPRETATIONS FOR MISCELLANEOUS LAND TYPES

Suggested idea: No. 10 Prepare guidelines to develop interpretations for miscellaneous land types, higher taxonomic units and geologic units.

It is proposed that suitable soil interpretations for badland, rock outcrop, rubbleland, and similar type mapping units be developed for BLM multiple use management programs. These types of mapping units have soil limitations that generally preclude their use for commercial crop production, etc. They, however, have important watershed, wildlife, and scenic resource values. Physical, chemical, vegetative, and other management data have not been developed for these mapping units. The management problem is further compounded because of the acreage involved, i.e., lots of rangeland without adequate soil interpretative data. Management interpretations are needed for these mapping units.

Name of Method: Development of geologic/sol form 5 for these landscape/mapping units including associated vegetative conditions suitable for ecological site identification at a total mapping unit level. Example of a geologic 5 is attached.

Description: ELM particularly needs management interpretations on these mapping units for:

- Watershed analysis as it relates to water quality and reclamation potential to meet salinity control goals for the Colorado River.

- Resiliency rating on these particular and other mapping units is needed for various BLM management actions.

- Associated vegetative conditions suitable for ecological site determination is needed. Many of these areas have limited vegetative production capability even though they support the potential natural community for the area.

In summary, work here means identifying existing soil/vegetative attributes for the mapping unit.

Application:

- Salinity ratings in excess of 16 mmhos/cm is needed. Plant growth is occurring above 16 mmhos/cm ratings. Significant categories need to be developed. Off-site salinity contributions are important.

- Reaction of geologic materials (pH) is needed and we expect to use guides similar to those for soils.

- Potential wind and water erosion hazard ratings are also needed. Updating for acceptable "T" values on shallow and very shallow soils should accompany this effort. Any soil loss on these kinds of mapping units is extremely detrimental to the productive capacity of the soil.

- Soil resilience determinations are needed as this soil property is affected by BLM management actions. Particular attention is needed for identification -needed.

SOID ......   GEOLOGIC INTERPRETATIONS RECORD   (SAMPLE)

MLRA(S) .... KIND OF UNIT .... UNIT NAME ....
DATE .... RECORD SC .... AUTHOR(S) .... DATE .... REVISED .... UNIT MODIFIER ....

CLASSIFICATION: ....

BRIEF SOIL DESCRIPTION: ....

LANDSCAPE AND CLIMATE PROPERTIES

ANNUAL AIR TEMPERATURE	ANNUAL PRECIPITATION	ELEVATION (FT)	DRAINAGE CLASS	SLOPE (PCT)

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >10 IN. (PCT)	FRACT 3-10 IN. (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	CLAY (PCT)

DEPTH (IN.)	LIQUID LIMIT	PLASTICITY INDEX	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SAR	CEC (ME/100G)	CACO3 (PCT)	GYPSUM (PCT)

DEPTH (IN.)	ORGANIC MATTER (PCT)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND ERODIBILITY GROUP	WIND ERODIBILITY INDEX	CORROSIVITY STEEL	CORROSIVITY CONCRETE

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYDROLOGIC GROUP	POTENTIAL FROST ACTION

Geologic Interpretation Record

NEW WAYS TO MAKE INTERPRETATIONS

Suggested item: No. 13 Use soil potential to give relative values to different types of land values.

Name of method: Relative soil potential.

Description: This method of developing soil interpretations uses the standard concepts used in developing soil potentials for a specific land use and compares the results for one land use with the results for other land uses. This method could be used to determine the best use of land within a given area.

Soil potentials are used to provide more definitive information regarding an areas potential for a given land use than those provided through the soil interpretations record. However, soil potentials and soil interpretations records share a common characteristic, they both show relatively good ratings for one group of soils for most land uses and relatively poor ratings for another group of soils for most land uses with no way of relating the information to allow the determination of the best use of a given area.

Application: Developing soil potentials for common land uses in an area can provide useful information about the potential of a given area for a given land use. However, soil potentials could also be used to assist in providing comprehensive land use plans. This could be done by comparing the potential for one land use with potentials for other land uses to develop a relative soil potential for each spot within a given area. This type of system could allow an area that has severe limitations for both cropland and homesites and medium potential for both cropland and homesites to have a "highest potential" for homesites because the cost of implementing this land use and the cost of dealing with continuing limitations may be lowest for that proposed land use.

Methods of display: Hard copy maps/text, GIS.

Other information: None

Further work: Method of calculating relative values.

Submitted by: Jon Gerken

Soil Survey Conference Committee 6:
New Ways of Making Soil Survey Interpretations

An outcome of the group discussion resulted in the breakdown of what we understood of the charge. In lieu of "New ways of making soil survey interpretations" we decided on the following title and subject divisions.

Alternatives to Traditional Soil Interpretations

1. Monitoring and Assessment
2. Making Interpretations
3. Dieplaying Information

The proposed action I am presenting here is involved vlth item 3 - Displaying Information but also involves item 2.

In a teleconference ● easlon prior to the conference an emphasis on supporting thr positive qualities of soils vas brought out. With that in mind I proposed an approach to displaying

Application: This method not only focuses on tha positive aspects of the soil but is designed to be flexible to the manager/user.

I proposa to select a soil survey that is ● ithax in the maintananca mode as part of a MLRA Update, or a survey that is ongoing. Posaibla survey areas include the update of tha Island of Hawaii or a rurvry on Forest Service lands such as the Wat Mountains/Spanish Peaks survey area in Colorado. Choosing a Purvay on the Forest presents us in SCS with an opportunity to promote the soils database and illustrate ways to utilize the information.

Methods of Display: Reports that list and rank roils from most optimal for tha use to least optimal. Also, linkaga with spatial data through a GIS oould provide a "picture" of the optimally suited areas.

Further work needed: Specific study site determined. Availability of the Interpretations Generator Module la not ● xpactad until February or March of 1995. Actual use of the IGM will have to wait until such time as its available for testing.

Submitted By: Cameron Loerch 8/29/95

1

South Dakota asked if there was an ***interest*** in a Sunday meeting. It was decided to send out a questionnaire to see about interest,

The **ASA** meeting is set for November **12-18**, 1594 in Seattle. A steering committee meeting during the NCSS meting is set for San Diego in June or July 1995. Steve Shetron motioned the meeting be adjourned and it was seconded by Wayne **Bachman**, South Dakota. The meeting was adjourned.

Midwest Region Business Meeting
June 17, 1994

Meeting was called to order by Nathan McCaleb, Chairman.

About 40 members from the Midwest attended this years joint conference. South Dakota was nominated by Steve Shetron, Michigan and Jon Gierken, Ohio seconded the motion to host the 1996 Midwest National Cooperative Soil Survey conference. The rotation set up has the Missouri Experiment Station listed to host the 1998 conference.

Old Business:

Taxonomy Committee: There should be 3 NCR and 3 SCS members on the taxonomy committee. At the present time only one of the three SCS members are known. Two years ago in St. Paul, it was decided that the national leader for taxonomy would receive any regional suggested changes or additions to soil taxonomy instead of going to the Midwest National Technical Center lead soil scientist. Because of reorganization, it was motioned by Bob Ahrens that Soil Taxonomy suggestions or additions go directly to him at the National Soil Survey Center and then he would distribute to the members of the regional committees. This was agreed upon by the attending representatives. Also, it was suggested that members of the committee would be selected by alphabetical order or on a regional approach. Nathan will review both methods for selecting the SCS members and let them.

Committee reports for the joint meeting were accepted during the general session.

New Business:

Next steering committee will be set up in the near future. At this time it includes Nathan McCaleb, Ken Olson, and Jerome Schaar.

Nathan McCaleb left a few charges that members of the Midwest NCSS need to let there ideas be known to the steering committee prior to final arrangements for the 1996 South Dakota meeting. They were: consider current format, length of meeting, has it been efficient, is there a better format, and can there be a better electronic transfer of information.

Ken Olson summarized 50 questionnaires from the St. Paul Meeting that discussed some of the items Nathan wanted each member to review. One of the answers was that the committee work needed to be expanded. Another was that there needed to be an accountability from the MNTC and NSSC staffs for the charges.

The present membership of the West Regional Taxonomy Committee is as follows:

Permanent Chair:	Robert Ahrens
Permanent Member:	Dennis Heil
State Representatives:	Randy Southard
	Chein Lu Ping
	Dave Hendricks*
Federal Representatives:	John Nesser*
	Terry Aho

*** New Members**

Site for 1996 Conference:

Two states, Colorado and Montana, volunteered to host the 1996 Regional Conference. Due to the fact that too few voting members remained, the membership will vote on the site through mail vote. The two states will submit proposals to Dennis Heil to be circulated for voting.

There being no-further business, a motion was made by Neil Peterson, seconded by Chad McGrath, to adjourn. Motion carried.

WEST REGIONAL COOPERATIVE SOIL SURVEY CONFERENCE
BUSINESS MEETING
JUNE 17, 1994

The Conference Business meeting was held on completion of the conference committee reports. The meeting was called to order by Dennis Heil, Chairman, at 10:00 am on Friday June 17, 1994. The minutes are as follows.

Conference Committees:

Motion was made by Neil Smeck to accept the Committee 1 report on 'The Role of the NCSS in Site Specific Soil Survey' as presented by Del Mokma. Seconded by Eddie Garner. Motion carried.

Motion was made by Del Mokma to accept the Committee 2 report on 'Drastically Altered Soils' as presented by Sam Indorante. Seconded by Ken Olsen. Motion carried.

Motion was made by Bill Ypsilantis to accept the Committee 3 report on 'Ecosystem Based Soil Surveys for Resource Planning' as presented by Bob Meurisse. Seconded by Dave Maurer. Motion carried.

Motion was made by Nathan McCaleb to accept the Committee 4 report on 'Distribution and Access to Soil Survey Data' as presented by Scott Davis. Seconded by Tommie Parham. Motion carried.

Motion was made by Karl Hipple to accept Committee 5 report on 'Redefining the Cooperative Role in the NCSS' as presented by Paul McDaniel. Seconded by Eddie Garner. Motion carried.

Motion was made by Bill Dollarhide to accept Committee 6 report on 'Alternatives to Traditional Soil Interpretations' as presented by Arlene Tugel. Seconded by Duane Lammers. Motion carried.

Regional Taxonomy Committee:

The membership of the West Regional Taxonomy Committee has been changed. This change, approved by a membership mail vote in late 1993, is to facilitate the processing of proposed amendments to taxonomy. The member ship of the committee will be as follows:

Permanent Chair: Lead Soil Scientist, Soil Taxonomy, SCS
Permanent Member: Regional Soil Scientist, WNTC, SCS
Three federal representatives
Three state representatives

The conference by-laws will be amended to reflect this change.

NATIONAL COOPERATIVE SOIL SURVEY

North Central Regional Conference Proceedings

St. Paul, Minnesota
June 15-18, 1992

United States
Department of
Agriculture

Soil
Conservation
Service

Champaign,
Illinois

National Cooperative Soil Survey

North Central Soil Survey Conference Proceedings

St. Paul, Minnesota
June 15 - 18, 1992

TABLE OF CONTENTS

North Central Soil Survey Conference
St. Paul, Minnesota
June 15-18, 1992
Edited by K.R. Olson

Table of Contents (Continued)

2

Table of Contents (Continued)

Committee Reports

AGENDA

NORTH CENTRAL REGION - Work Planning Conference

June **15-18, 1992**

June 15
10:00-12:00 Registration - Radisson-St. Paul

Moderator: [illegible]
1:00-1:30 [illegible]

1:30-2:00
2:00-2:20
2:20-2:40
2:40-3:00

3:00-3:20

3:20-4:45

4:45-???

June 16

1

4

Reom. Statenninservgistr (R.ation)Ti 380 0 2.1600.92 1 2 2.18 483.30 2.-0.5848 11.93999969 cm BI1/W 1727/H 62 /BI

1992CONFERENCESPONSORS

BRAUN INTERTECH Environmental, Inc.

CARGILL, Central Research

CENEX/LAND-O-LAKES

CENTROL, Cottonwood, Minnesota

MINNESOTA PLANT FOOD AND CHEMICAL ASSOCIATION

PIONEER HI-BRED INTERNATIONAL, North Central Sales Region

SPECTRUM RESEARCH INC.

TYLER, Benson, Minnesota

Mailing lists, attendance rosters, and staff lists may be given to or shared only with other employees of the Minnesota Extension Service unless special permission is granted by the Dean and Director. This policy is in compliance with the U.S.D.A. policy that "they comprise a system of records established to assist in carrying out the various programs of Cooperative Extension (MES) ... are for the sole use of Extension personnel (for Extension purposes) and should not be furnished directly or indirectly to any person, firm, association, or Federal Government agency" (or state or local agency). This also complies with Minnesota State Data Practices Laws, adhered to by the University of Minnesota, that are restrictive in allowing the distribution of lists.

COURSE NUMBER: 929418 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Allcon, Hugh A	Nat'l. Ctr. for Cartography 501 Felix Box 6567 Fort Worth, TX 76115
Anderson, James L	University of Minnesota Dept. of Soil Science St. Paul, MN 55105
Bachman, Wayne J	SCS 200 4th St., S.W. Huron, SD 57350
Balogh, James C	Spectrum Research, Inc. 31 S. 60th Ave., E. Duluth, MN 55804-2507
Bell, Jay	University of Minnesota 439 Borlaug Hall 1991 Upper Buford Circle St. Paul, MN 55108-6028
Belohlavy, Francis	University of Nebraska 113 Nebraska Hall Lincoln, NE 68588-0517
Bigler, Rick	SCS USDA, SGIS, Room 152 100 Centennial Mall, N. Lincoln, NE 68508-3866
Boeckman, Louis E	SCS Route 4 Box 26 Creston, IA 50801

COURSE NUMBER: 929418 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Ceolla, Dale J	USDA/SCS 5309 Sutton Dr. Urbandale, IA 50322
Culver, Jim	SCS-NSSC 611 Jeffery Lincoln, NE 68505
D'Avello, Tom	SCS 1902 Fox Dr. Champaign, IL 61820
Engel, Robert	USDA/SCS 1620 S. 22nd St. Lincoln, NE 68502
Fenton, Thomas E	Iowa State University Agronomy Dept. Ames, IA 50011
Finnell, Paul	USDA-SCS 760 S. Broadway
Floren, Jerry	University of Minnesota Soil Conservation Serv. 209 W. Mulberry St. St. Peter, MN 56082
Fortner, Jim R	SCS 2723 Odessa Ct. Lincoln, NE 68516
Frederick, William E	SCS Room 101 1405 S. Harrison Rd. E. Lansing, MI 48823
Gehring, Richard M	USDA/SCS 200 N. High St. Room 522 Columbus, OH 43215
Geller, Alice N	Missouri DNR Box 176 Jefferson City, MO 65010

COURSE NUMBER: 929418 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Gerber, Tim D	OH Dept. of Natural Resources Fountain Square, Bldg. E-2 Columbus, OH 43220
Gerken, Jon C	200 N. High St. Room 522 Columbus, OH 43215
Giencke, Al	SCS 7365 Logan Court Brooklyn Park, MN 55444
Grossman, Robert B	SCS Box 174A Waverly, NE 68462
Heidt, C. J.	USDA/SCS Box 1458 Bismarck, ND 58502
Helzer, Norman P	USDA/SCS 100 Centennial Mall, N. Federal Bldg., Room 152 Lincoln, NE 68508-3866
Hopkins, David	North Dakota State University Soil Scinece/Walster #225 Fargo, ND 58105
Huffman, Keith	SCS 153 Heischman Ave. Worthington, OH 43085
Khakural, Bharrat R	University of Minnesota Dept. of Soil Science 1991 Upper Buford Circle St. Paul, MN 55105
Kichler, Larry	USDA/SCS 1333 E. Broadway Bolivar, MO 65613
Kuzila, Mark	University of Nebraska 113 Nebraska Hall Lincoln, NE 58588-0517

COURSE NUMBER: 929418 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Lee, Clayton F	USDA/SCS 100 Centennial Mall, N. Room 152, Federal Bldg. Lincoln, NE 68508-3866
Lockridge, Earl D	SCS/NSSC/SSQA 7710 Myrtle St. Lincoln, NE 68506
Love, Charles L	USDA/SCS 525 S. 5th St. Springfield, IL 62629
Lubich, Kenneth W	SCS 220 Thompson St.
Luethe, Ron	USDA/SCS Box 1458 Bismarck, ND 58502
McCaleb, Nathan	SCS 5011 South St. Lincoln, NE 68506
McSweeney, Kevin	Univ. of Wisconsin-Madison
McWilliams, Victor	USDA/SCS/NCC/NCSS 5102 Dufferin Arlington, TX 76016
Miller, Ed	OH Dept. of Natural Resources 4730 Beard Rd. Sunbury, OH 43074
Minor, Paul E	SCS 2601 Shepard Blvd. Columbia, MO 65201
Mokma, Delbert	Michigan State University 1044 Cliffdale Dr. Haslett, MI 48840
Nagel, Byron	SCS 6013 Lakeside Blvd. Indianapolis, IN 46278

COURSE NUMBER: 929416 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Nielson, Robert	SCS 550 St. Johns Ct. Crete, NE 68333
Olson, Kenneth R	University of Illinois N405 Turner Hall 1102 S. Goodwin Ave. Urbana, IL 61801
Pauls, Bill	USDA/SCS 3901 Pineview Dr. Columbia, MO 65202
Paulson, Richard O	SCS Farm Credit Services Bldg. 375 Jacskon St., Suite 600 St. Paul, MN 55101
Perry, Mark L	SCS Earl Brown Tower 6120 Earle Brown Dr., Rm. 650 Brooklyn Center, MN 55430-2123
Potter, Dennis K	USDA/SCS Route 1 Box 52A Fayette, MO 65245
Ratliff, Larry F	USDA/SCS 5417 S. 65th St. Circle Lincoln, NE 68516
Robert, Pierre C	University of Minnesota 1991 Upper Buford Circle St. Paul, MN 55108-6028
Robinson, Dennis P	Michigan Dept. of Agriculture 256 Timber Lane Marquette, MI 49555
Roth, Bill E	SCS Box 2890 Washington, DC 20013
Russell, Walt	USDA Forest Service Suite 500 310 W. Wisconsin Ave. Milwaukee, WI 53203

COURSE NUMBER: 929315 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Rust, Richard H	University of Minnesota Dept. of Soil Science 1991 Upper Buford Circle St. Paul, MN 55108
Schaar, Jerome	SCS 200 4th St., S.W. Huron, SD 57350
Schellentrager, Gregg	SCS 210 Walnut St. Des Moines, IA 50309
Schlepp, Richard L	SCS 760 S. Broadway Salina, KS 67401
Smallwood, Ben	SCS 3191 Newcastle Lane Riva, MD 21140
Smeck, Neil E	The Ohio State University Dept. of Agronomy 2021 Coffey Rd. Columbus, OH 43210
Steffen, Kim	SCS 7739 115th Ave. Champlin, MN 55316
Thompson, Bruce	USDA/SCS 1413 Lamberth Dr. Columbia, MO 65202
Tornes, Lawrence A	SCS Room 101 1405 S. Harrison Rd. E. Lansing, MI 48823
Tummons, Richard	SCS 3013 Meghann Dr. Columbia, MO 65203
Vogt, Kenneth D	USDA/SCS 5401 Lake Bluff Dr. Columbia, MO 65203

COURSE NUMBER: 929416 COURSE DESCRIPTION: NC Soil Survey Conference

SELECTION CRITERIA: NONE

PARTICIPANT NAME / TITLE	ADDRESS / PHONE
Wacker, Carl	USDA/SCS 4709 Sherwood Rd. Madison, WI 53711
Ward, Bobby	SCS 6013 Lakeside Blvd. Indianapolis, IN 46278
Yee, Mon S	Soil Survey Division Box 2690
Ziegler, Tom	SCS 10 S. Tahoe Ct. Lafayette, IN 47905

Committee Assignments
North Central Soil Survey Conference

COMMITTEE 1 -- Soil Survey in the 1990's.
Chairperson - Neil Smeck, Ohio
Vicechair -

Members
Jim Culver, Nebraska
Alice Geller, Missouri
Tim Gerber, Ohio
Norman Helzer, Nebraska
K.K. Huffman, Ohio
Ken Lubich, Wisconsin
Delbert Mokma, Michigan
Ken Olson, Illinois
William Pauls, Missouri
Gregg Schellentrager, Iowa
Kay Sinclair, Nebraska
Jim Thiele, North Dakota
Larry Tornes, Michigan
Bobby Ward, Indiana

COMMITTEE CHARGES

1. There is a continuous need for the NCSS to improve operations and products. What strategies can be used to accomplish this.

2. WI&strategies can be used to maintain and improve working relations within the

3. What additional strategies can be used to develop and implement committee recommendations.

4. What educational approaches are needed to address users needs such as producers, consultants and county and state governments.

5. What future direction and charges should this committee pursue. (Please allow enough time to address this charge)

COMMITTEE 2 -- Geographic Information Systems
Chairperson - Bruce Thompson, Missouri
Vicechair - Al Giencke, Minnesota

Members
Tom D'Avello, Illinois
Renee Gross, Nebraska
George Hall, Ohio
R. David Hammer, Missouri
Donald Last, Wisconsin
Kevin McSweeney, Wisconsin
Robert Parkinson, Ohio
Jerry Schaar South Dakota
Jay Bell,

COMMITTEE 3 -- Soil Correlation and Classification
Chairperson - Tom Fenton, Iowa
Vicechair -

<u>Members</u>
Louis Boeckman, Iowa
Tom Fenton, Iowa
Richard Gehrig, Ohio
Corneilius Heidt, North Dakota
Mark Kuzila, Nebraska
Ed Miller, Ohio
Dick Paulson, Minnesota
Dennis Potter, Missouri
M.D. Ransom, Kansas
Larry Ratliff, Nebraska
Dennis Robinson, Michigan
Ken Voigt, Missouri

COMMITTEE CHARGES

1. How series control section change will impact on series differentiae.

2. How do we need to change correlation procedures to address MLRA correlations.

3. How can we better coordinate interpretations during the correlation process.

4. Series differentiae - subdividing the series control section into sections as a means of competing.

5. Develop subgroup criteria to help reduce the number of series in families that have large populations. (Mollic subgroups in fine-silty, mixed, mesic Hapludalfs have 25 senes)

6. What future direction and charges should this committee pursue. (Please allow enough time to address this charge)

COMMITTEE 4 -- Water Quality
Chairperson - Robert Nielson, Nebraska
Vicechair -

Members
Dr. Thomas Bicki, Illinois
Bob Grossman, Nebraska
Jerry Larson, Indiana
Dave Lewis, Nebraska
Randall Miles, Missouri
Walter Russell, Wisconsin
Michael Thompson, Iowa

CO- CHARGES

1. How can we improve our data bases to better interpret soils for water quality concerns. What additional or new data is needed.

2. Based on individual state experiences, what new or additional interpretations are needed to address water quality concerns.

3. How cautious should we as soil scientist be in providing investigations/interpretations for zones deeper than two meters. What depths should we be comfortable with.

4. What future direction and charges should this committee pursue. (Please allow enough time to address this charge)

COMMITTEE 5 -- Soil Interpretations
Chairperson - Richard Schlepp, Kansas
Vicechair -

Members
Wayne Bachman, South Dakota
Loren Bemdt, Michigan
Doug Malo, South Dakota
Steve Messenger, Illinois
Paul Minor, Missouri
Larry Rap Nebraska
Richard ummons, Missouri
Michael Ulmer, North Dakota

COMMITTEE CHARGES

1. What criteria and/or interpretations need to be revised and why.

2. Should soil interpretation records be separated by MLRA's in order to more accurately describe soil properties and mterpretations.

3. Should the 2 to 10 meter zone be examined using data from other sources to address water quality concerns.

4. What new data elements need to be added to the SIR.

5. What future direction and charges should this committee pursue. (Please allow enough time to address this charge)

COMMITTEE 6 -- Soil Survey Databases
Chairperson - Rick Bigler, Nebraska
Vicechair - Pierre Robert, Minnesota

Members
Francis Belohlaw. Nebraska
John Doll, Illinois
Jim Fortner, Nebraska
William Frederick, Michigan
Jon Gerken, Ohio
William Hosteter, Indiana
Joe McCloskey, Minnesota
Doug Oelmann, Iowa
Vic McWilliams. Texas

COMMITTEE CHARGES

1. What are the future software data base needs that would benefit either 3SD or soil survey programs available to field soil scientists. (DOS or UNIX)

2. Outside of cooperating agencies, who are the users of the soil survey information in your state, and what mformation is being requested.

3. What are the future anticipated needs for storing data base information. What systems (hardware) woud be best to use.

4. Are the users of soil survey software programs receiving the needed training to use database programs What training programs have worked and what have not.

5. What future direction and charges should this committee pursue. (Please allow enough time to address this charge)

North Central Soil Survey Conference
St. Paul, Minnesota
June 15-18, 1992

Minutes of the General Session and Business Meeting

The 1992 meeting of the North Central Soil Survey Conference was called to order by Chairman AI Giencke at 1:00 P.M. on June 15, 1992. Conference attendees were welcomed by Mr. G. Nordstrom, State Conservationist, USDA-Soil Conservation Service. Mr. E. Redalen, Commissioner, St. Paul, Minnesota Dept. of Agriculture, and Dr. H.H. Cheng, Head, Dept. of Soils, University of Minnesota at St. Paul.

General session activity reports were given between 1:30 and 3:00 P.M. on June 15, 1992 and from 10:00 to 11:55 A.M. on June 16, 1992. These reports are provided in the Activity reports section of the proceedings.

General Session topics were presented from 8:00 to 9:30 A.M. on June 16, 1992. These presentations are provided in the Guest Presentation section.

A well-planned and interesting field trip provided the activity for Wednesday, June 16, 1992.

From 12:10 to 2:00 P.M. on June 18, 1992, separate NCR-3 and USDA meetings were held. The minutes for these meetings are provided under the sections on NCR-3 minutes and USDA meeting minutes.

Committee work sessions were conducted from 3:20 to 4:45 P.M. on June 1.5, 1992 and from 3:15 to 4:45 P.M. on June 16, 1992. Committee reports were presented to conference participants on Thursday morning (June 17, 1992) by the committee chair or vice-chairman. The full reports are provided in the Committee Reports section. The following is a brief discussion of each of the North Central Soil Survey Conference committee reports which were presented by the chairman or vice-chairman on Thursday morning (June 17, 1992):

Committee 1 - Soil Surveys in the 1990's - Larry Tornes

Committee 1 developed two or three priority strategies to address each of the 5 charges. Two of the recommendations that need special attention are:

1. Report progress on committee action items to the regional membership at subsequent North Central Soil Conference.

2. Identify and coordinate users needs for soil survey information at the local and state levels. Ask states to report accomplishments in identifying and serving **users needs at the 1994 conference.**

Committee 2 - Geographic Information Systems - Al Giencke

Recommendations to the 4 charges are:

1. An advance distribution of the NSH should be released a policy prior to NSH being

(pcc

printed and released.

2. Design purchase contracts for intended use. Get correct platform to match the task. Make sure current contracts can meet future needs.

3. Use advance technology to support and enhance our knowledge and not replace it. Technology could be a crutch that could hamper sound development of geomorphic and landscape analysis. Sound analysis comes first and is supported by technology.

4. Establish an MOU with key State and Federal agencies that are leaders in GIS to spell out that any joint project with sponsors will meet SCS SSUR GO standards.

Committee 3 - Soil Correlation and Classification - Tom Fenton

Committee 3 found:

1. There is a need to flag new series or substratum phases from the MUUF between states for consistency. MLRA activities may help in this regard. Also need to note any change of substratum phases into new series.

2. There is a need to better define MLRA operating procedures. Establish a "super steering committee" for land resource regions that will keep abreast of ongoing activities. This will track uniformity between MLRA's and inform others of what is going on in all MLRA's.

3. New subgroups are needed in some families. The use of clay mineralogy criteria in fine-silty and fine-loamy families was proposed as an alternative way of subdividing some families with large number of series.

Committee 4 - Water Quality - Robert Nielson

Recommendations include:

1. Organize published spatial and tabular soil maps unit data according to their geomorphic and stratigraphic unit occurrence. Provide soils spatial and tabular soil map unit data by watershed.

2. Validate and verify the soil tabular data (MUIR) and provide data reliability information. Need to validate data model against measured soil data. Establish a test area where there is sufficient lab data to verify and validate MUIR data.

3. Provide a mechanism for storing and retrieving state and local data for water quality interpretations and information.

Committee 5 • Soil Interpretations • Richard Schlepp

The committee recommended:

1. During the MLRA update process the capability class and subclass should be coordinated between states.

2. The 2 to 10 meter zone should be examined from other sources as part of the MLRA update procedure with guidelines developed by NSSC on what level of data collection would be needed to provide water quality interpretations.

3. Structure and consistence below the surface horizon be incorporated into the NASIS data base to provide interpretations for root penetration and water movement.

Committee 6 • Soil Survey Databases • Pierre Robert

Recommendations to the 6 charges include:

1. Must continually address current and future software and hardware needs.

2. Review past recommendations and implementations to assure follow-up.

3. Need to promote more training in use of soil data, basic computer operations, and software use.

4. Gather and distribute information on types of data needed, innovations in **SSSD** applications being used, and need for application software.

5. Needs to provide access of the soil database to users outside NCSS.

6. A standards committee was established at the 1991 NSSC meeting. This committee needs line of communication to funnel needs to proper database staff. A streamlined process with a check by Quality Assurance and a check for compatibility with SSSD modules needs to be established or promoted.

7. A standing national committee is needed with representatives from: a) NSSC, (NSSL, SQA, SGIS); b) state labs; c) state cooperators; and d) state office level SCS.

A motion that all 1992 NCSS committee reports be accepted was made, seconded and passed.

Nathan McCaleb called the business meeting to order at 11:00 A.M. on June 18, 1992. K.R. Olson was appointed secretary. Nathan served as chairman due to C.L. Girdner's recent surgery.

K.R. Olson made a motion that Illinois host the 1994 NCSSC in Illinois, or co-host the joint (NC and West) Regional SSC at a location to be determined later. The motion was seconded and passed. At tbe 1990 NCSSC, Gary Muckel of the WNTC invited the NC region to meet with the West region for a joint NC-WSSC at a site either close to the regional border or at a hub city with good, but low-cost, air connections. Jim Culver who was to attend the West SSC the week of June 22, 1992, was asked to convey our desire to hold a joint meeting if details could be worked out. Ken Olson was appointed to work with the host of the 1994 WSSC to see if a joint meeting location and agenda could be arranged.

Rick Bigler made and motion that the minutes and committee recommendation\ of the 1992 NCSSC be forwarded to Dr. Richard Arnold (Director of Soil Survey) and request that his office respond to recommendations or indicate status of actions on recommendations. Jim Fortner seconded the motion. K.R. Olson questioned the need to send duplicate copies of the minutes and committee recommendations since the Director of Soil Survey will already receive them in the 1992 NCSSC proceedings. Other committee members suggested the minutes, recommendations, actions, and follow-up should be addressed by the MNTC staff. Others noted the need to transfer our recommendations to the 1993 National Soil Survey Work Planning steering committee. N. Smeck outlined current procedures for transferring information between the regional and national SS conferences and indicated the 1992 co-host (Pierre Robert) would serve on the steering committee and the host of the 1994 NCSSC (Ken Olson) would be asked to forward our recommendations to the 1993 National SSC. Members finally agreed that procedures (by-laws) appear to exist for both the National and Regional SS Conferences but that they were not being followed. Nathan McCaleb and/or Neil Smeck were asked to locate copies of the by-laws for distribution to the membership. The motion and second were withdrawn.

Rick Bigler made a new motion that our NCSSC representatives to the 1993 National SSC (Pierre Robert and Ken Olson) forward our committee recommendations and the MNTC staff respond at the 1994 NCSSC to the disposition or status of 1992 NCSSC recommendations and action items. Jim Former. seconded and the motion passed.

Keith Huffman made a motion that the steering committee for the 1994 NCSSC consider appointing a committee on MLRA operations and management. The motion was seconded and passed.

Nathan McCaleb (at the request of C.L. Girdner) made a motion that the Chairman of the Regional Soil Taxonomy Committee be the Supervisory Soil Scientist, Central staff of the National Quality Assurance Staff instead of the Head of the MNTC. The motion was seconded, discussed and passed. The Head of the MNTC would remain a committee member.

Nathan McCaleb made a motion that present members list themselves along with any colleagues to the Head, Soil Section, ESSP Staff, MNTC. List will be distributed between October 1, 1992 and January 1, 1993 with information about either the national or regional SSWPC. The motion was seconded by Tim Gerber and passed.

Respectfully submitted,

Ken R. Olson
Secretary

NCR-3 ANNUAL MEETING

June 18, 1992

St. Paul. Minnesota

ATTENDANCE

*Ken Olson	University of Illinois	217-333-9639
*Tom Fenton	Iowa State University	515-294-2414
*Del Mokma	Michigan State University	517-353-9010
*Pierre Robert	University of Minnesota	612-625-3125
Jay Bell	University of Minnesota	612-625-6703
Jerry Flores	University of Minnesota	507-931-2530
*Randy Miles	University of Missouri	314-882-6607
*Mark Kuzila	University of Nebraska	402-472-7537
Dave Lewis	University of Nebraska	402-472-1570
Francis Belehlavy	University of Nebraska	402-437-5322
*Neil Smeck	Ohio State University	614-272-9059
Tim Gerber	Ohio Dept. of Natural Resources	
*David Hopkins	North Dakota State University	701-237-8948
*Kevin McSweeney	University of Wisconsin	608-262-0331

*NCR-3 representative

MINUTES

The meeting was called to order by Chair Kevin McSweeney at 12:OO noon on June 18, 1992.

The minutes of the 1991 meeting were distributed and approved.

Jim Culver, Soil Conservation Service, informed the NCR-3 Committee that a Standing Committee on NCSS (National Cooperative Soil Survey) Standards has been formed. NCR-3 may select a member and a" alternate to serve on the Standing committee, Chair Kevin McSweeney will appoint a member and alternate after discussing it with them.

Chair Kevin McSweeney reported that NCR-3 Committee was approved for extension.

COMMITTEE REPORTS

Tom Fenton reported the Soil Taxonomy Committee dealt with the issues (Alic subgroups and K horizons) that affect the North Central Region. Alic subgroups have been established for high concentrations of exchangeable Al in K horizons.

Tom Fenton reported on the activities of the National Soil Survey Data Base committee. Ellis Benham (SCS) will be visiting states to get laboratory data to add to the national data base. The Committee will be developing a data dictionary including laboratory methods.

Dave Lewis reported on the National Cooperative Soil Survey Technical Advisory Committee. The NCSS is under the Regional Technical Center and this hides the visibility. There was no reference to NCSS in SCS priorities. NCSS appears to be support for District and Area Conservationists. A mission statement for NCSS is being prepared, none exists. A draft statement has been prepared and will be sent to states for comments. SCS may be required to move out of the Federal Building in Lincoln, Nebraska. It is uncertain where it may be relocated. A motion to have Dave continue on this Committee was passed.

Robert Grossman discussed with NCR-3 the following items: TERRA, SCS's Global Warming program, National Soils Handbook and the new Soil Survey Manual. If NCR-3 members feel the administrative and technical components of the National Soils Handbook should be published separately, they should write letters soon.

At the Eroded Mollisols Conference two committee were formed. The chairs of the two committees are NCR-3 members, as are three members of the committees.

OLD BUSINESS

Tom Fenton reported the remaining information needed for the Regional Soil Map should be received by July. Then the map and explanatory legend will be published.

NEW BUSINESS

Location for the 1993 annual meeting was discussed. The following list of priority was agreed to: Indianapolis, St. Paul, and Omaha. Del Mokma, next chair, will contact Don Franzmeier about hosting the meeting.

Pierre Robert was elected as the 1993 NCR-3 secretary and will serve as 1994 chair.

Kevin McSweeney was elected to replace Tom Fenton on the Soil Taxonomy Committee. NCR-3 members of the committee are: Smeck (93), Kuzila (94) and McSweeney (95).

Pierre Robert was elected to serve as a member of the Steering Committee for the National Soil Survey Work Planning Conference. Ken Olson was elected as a representative to the Work Planning Conference.

Writing a proposal for the formation of an NC Committee that would deal with research activities during MLRA updates was discussed. Del Mokma will discuss the feasibility of writing such a proposal with Administrative Advisor Bob Gast.

State reports were distributed by attendees.

The meeting was adjourned at 2:00 pm.

Respectfully submitted,

Delbert L. Mokma
Secretary

SCS Breakout Business Meeting Minutes

North Central Region - Work Planning Conference

St Paul, MN

June 15-18, 1992

The SCS Breakout session was chaired by Nathan McCaleb, Soil Scientist, MNTC, Lincoln, NE.

Item 1 - C. L. Girdner will select the representative form SCS to attend the National Cooperative Soil Survey Work Planning Conference in 1993 and forward the name to NHQ.

Item 2 - Nathan McCaleb entertained a motion from the floor that a committee of Grossman, Nielson, Schlep, Bigler, Girdner, and a representative for SSQA be appointed to address Use Dependent databases and that they lobby the Steering Committee to address the topic at the NCSS-Work Planning Conference. Motion made by Helzer - NE, seconded by Schlep - KS. Motion passed. Bob Grossman to chair the committee.

Item 3 - Larry Ratliff presented two issue papers.

1. Soil Survey Update/Maintenance - Management and Progress Reporting

2. Map Scale in the Soil Survey

Copies of these papers are attached.

Item 4 - Motion made by Tornes - MI that the GIS Committee develop charges for the NCSS - Work Planning Conference and put together an issue paper to be presented at the NCSS - Work Planning Conference in 1993. Notion seconded by Huffman - OH. Motion passed.

Item 5 - Motion by Huffman - OH to adjourn. Second by Minor - MO. Motion passed, meeting adjourned.

MAP SCALE IN THE SOIL SURVEY

(Abridgement of **Issue** Paper)

Berman Hudson **06/92**

It is widely believed that the amount of detail that will be mapped in a soil survey **is** highly correlated with scale. **Assume** that an individual mapped the soils in an area at a scale **of 1:24,000.** Then **assume** that another individual came in and mapped the same area at a scale of **1:12,000.** The conventional thinking ie that he/she would prepare a recognizably more detailed **soil** map. This scenario is based on the assumption that the amount of detail that will be shown on a **soils** map is highly correlated with scale. For example, **since** a **1:12,000** map is four times larger **than** a **1:24,000** map, it is assumed that four times the detail will be mapped.

However, examining almost any published soil survey will show that this is not true.. At a given scale, some parts of a soil **survey** will have many small delineations - "a lot of detail." However, other locations in the same survey area will have a relatively few large delineations. Just because one can cartographically delineate smaller areas on a **soils** map, he/she **does not necessarily** do **so.** The amount of **detail** on a **soils map is mostly det**ermined **by** the natural **soil-landscape relationships** in the **survey** area. One is not able to delineate increasingly smaller soil areas at larger scales unless these smaller, heretofore undelineated but mappable soil-landform units actually exist -- and can be **identi**fied on **the photograph.**

The smallest delineation that can be shown on a soil map with an included symbol **is** about **1/4** inch by **1/4** inch. On a **1:12,000** map this is 1.5 acres; at **1:24,000** it is about 5.5 acree. This tells us which soil-landform units can be delineated at **a scale** of **1:12,000,** but which cannot be delineated at **1:24,000.** These are soil areas which are larger than 1.5 **acres** (the **1:12,000** limit), but smaller than about 5.5 acres (the **1:24,000 limit).** Therefore, going from a scale of **1:24,000** to a scale of **1:12,000** will affect only those mappable soil-landform units between 1.5 and 5.5 acres in size. Soil-landfonn units larger than 5.5 acres can be delineated at either scale. Most naturally occurring soil delineation6 mapped in the National Cooperative Soil Survey are larger than 5.5 acree. Therefore, whether one maps at **1:12,000** or **1:24,000,** most of the delineations will be the **same.**

In mapping soils, the relative ability to delineate small alluvial and colluvial **areas is always** an important issue. Assume that the widest delineation that can be shown on a soil map is **1/4** inch. The minimum width of linear soil delineations than can be shown on a **soil** map at a scale of

1:12,000 is 250 feet; at 1:24,000 it is 500 feet. Therefore, going from a scale of 1:12,000 to 1:24,000 will affect only those linear soil-landform units narrower than 500 feet (the 1:24,000 limit) but wider than 250 feet (the 1:12,000 limit). Soil-landform units wider than 500 feet can be delineated at either scale.

RECOMMENDATIONS

Considering the foregoing discussion, there are at least two viable options for dealing with scale in the soil survey. One option is, depending upon local need or preferende, to map both at 1:12,000 and 1:24,000 in the same MLRA. Most map units will not be affected. However, some smaller (1.5 to 5.5 acre) soil-landform units will be delineated at 1:12,000 and not at 1:24,000. For example, a 1:24,000 scale survey might map alluvium and colluvium in the same unit a8 a complex. A 1:12,000 survey with the 8ame landfonn might separate them. Such situations will cause some correlation and joining problems. However, only a small proportion of map unit8 will be affected. Reasonable correlationand joining could be achieved.

Another option is to designate 1:12,000 a8 the mapping scale for the next generation of soil surveys. This would involve a phase-in program so that, at the end of, for example, five year8 all soil surveys would be mapped and compiled at a scale'of 1:12,000. There are several advantages to this. First, 1:12,000 allows one to show small area0 of contrasting soils. Although units between 1.5 and 5.5 acres in size are relatively few in number, they can be very important. For example, small alluvial areas often are either wetland or prime farmland. In soil survey area8 with etrong relief, most soil use and management occur8 on either ridge8 or alluvial/colluvial area8 less than 500 feet wide. It is important to use a scale that allows one to show these small area8 cartographically. Going to a univereal 1:12,000 scale for the next generation of soil surveys has the following advantages.

1. One common kale will expedite joining, and correlation among areas.

2. Much of the cartographic limitation8 to delineating small, but important soil areas will be eliminated. This will permit us to provide a better product by delineating small, contrasting area8 where needed.

3. Most delineations (those larger thdn about 5.5 acres) will not be affected. Therefore, mapping rates will not decrease significant1y, nor will there be a large increase in compilation time and cost.

SOIL SURVEY UPDATE/MAINTENANCE MANAGEMENT AND PROGRESS REPORTING

Issue

The approach to update/maintenance of soil survey information by major land resource area has been well received and several MLRA soil survey projects are being planned or, are in progress. In this approach the MLRA becomes the soil survey area and county or other selected entities within the MLRA are subsets which will be updated to the MLRA standard.

Inherent in the concept is that much effort will be required that does not immediately equate to acres mapped or updated. Many of the subset soil surveys will require a minimum of remapping. Most will require some special studies to fill data gaps or to develop new interpretations, and transects to improve documentation of composition and patterns of soil in map units. Similarly, much up front work is required to evaluate existing data and to better coordinate official series descriptions and soil interpretation records.

It is becoming apparent that new techniques for managing and for measuring progress of the projects are needed. This issue paper proposes a management matrix and method of monitoring overall survey progress. Overall survey progress can be equated to acres updated <u>if needed</u> for program administration.

Background

A soil survey is available for about 90% of the private lands in the United States. These surveys have been completed during the past 35 to 40 years, usually on a county-by-county basis, and represent the work of a large number of scientists. The surveys are some of the best, most detailed, resource data in the world but have become outdated to varying degrees and have the coordination problems that would be expected of such a large data base collected over such a time frame by so many people.

As more soil survey information has become available more effort has been directed toward updating and maintaining the data. These initial update efforts were again mainly along political boundary lines, usually counties, and often consisted of much remapping. This approach caused concern to many in the soil survey program in that it was essentially a repeat of past efforts.

About two years ago the idea of updating and maintaining soil survey information by major land resource area or other physiographic area was revived. This was not a new concept but it seemed its time had arrived and was a way to better coordinate soils data and improve the efficiency of the update **effort.** The tactic is not to redo each subset soil survey but rather to build on an already good product in order to **have** a joined, coordinated, and improved soil survey for the **MLRA.**

The procedure for developing an **MLRA** project plan provides the basis for developing a management matrix for both the **MLRA** survey area and for each included subset. Very briefly, the procedure for developing the project plan is:

The standard for the **MLRA** soil survey **is** agreed to by all states and cooperators that share the MLRA. The standard is set forth in a MLRA memorandum of understanding **.** The existing county or other subset soil surveys within the **MLRA** are evaluated to see what must be done in each to meet the defined standard. **Staff years needed for** update activities such as remapping, recorrelation, documentation, interpretations, map digitizing, and special studies are recorded on an evaluation work sheet for each subset soil survey. The evaluation work sheets from all subset soil surveys are combined to develop the project plan.

Propoaal

The information gathered to develop the project plan is used to develop a management matrix for a subset, a group of subsets, **or the MLRA** soil survey as per the following example.

A summary of an evaluation **work sheet for** subset soil survey **"A"** might contain -

Staffing ard Budgeting Needs by Update Item:

Update Items	Staff Years	% Total Staff Years
(a) Soil **Mapping**	1.5	0.23
(b) **Update** correlation	1.5	0.23
(c) **Transects**	1.0	0.16
(d) Investigations	0.8	0.12
(e) Digitizing	0.4	0.06
(f) **Manuscript**	**0.5**	0.08
(g) Other	**0.8**	0.12
Total	**6.5**	

The matrix for subset *A* would be__

[.23(a) + .23(b) + .16(c) + .12(d) + .06(e) + **.08(f)** + .12(g)] * **100 = %** subset **"A"** completed__

Where (a) = fraction % of Update Item (a) completed; (b) = fraction % of Update Item (b) completed; etc.

The manager may add other update items or subdivide update items to achieve the detail needed to judge progress. For a given time frame progress can be equated to acres, if needed. For example: Subset "A" has 500,000 acres and the above formula shows 10% of the total job is complete then 50,000 eguivalent acres are reportable.

This procedure can be used to monitor progress for a subset within the MLRA, for groups of subsets within the MLRA, or for the MLRA project soil survey.

ANOKA SAND PLAIN WATER QUALITY DEMONSTRATION PROJECT

by TIMOTHY A. KOEHLER

WATER QUALITY SPECIALIST, SCS, MINNESOTA

FOR THE NORTB CENTRAL REGION - WORK PLANNING CONFERENCE

The Anoka Sand Plain Water Quality Demonstration project (ASP) is an United States Department of Agriculture (USDA) funded effort which began in 1990. Three USDA agencies, the Agricultural Stabilization and Conservation Service (ASCS), the Minnesota Extension Service (MES) and the Soil Conservation Service (SCS) along with local Soil and Water Conservation Districts (SWCD) are working together on this cooperative project. The ASP project is located in parts of eleven counties in East Central Minnesota.

Between 1990 and 1995 the ASP project will conduct in-depth, whole farm demonstrations on up to 50 ASP farms. Through the cooperation of the farmers working with project staff and county personnel the latest in knowledge and technology will be adapted to each farm.

The ASP area is primarily made up of sandy outwash soils with shallow surficial aquifers. Depths to water tables are between eight and fifteen feet. Recently nutrients and pesticides have been detected in these shallow aquifers. The sources for these contaminants have not been determined but it is estimated that farm, rural non-farm and urban sources may all contribute to the problem.

The ASP project focuses on helping farmers voluntarily change management practices to reduce adverse impacts on water quality while maintaining farm profitability. The specific focus areas include:

- Nutrient Management
- Integrated Pest Management
- Erosion Control
- Water Management
- FARM*A*SYST
- Farmer Participation
- Information/Education Programs

Nutrient Management:

Although many nutrients essential to plant growth show up in water, a primary concern in the ASP area is Nitrogen (N), because of it's mobility. Improved management of N from fertilizers, livestock manure and crop residues potentially reduce the adverse impacts on water quality and increase farm profitability.

Integrated Pest Management (IPM):

IPM methods strive to keep peat numbers below economically damaging levels while reducing harmful impacts on the environment. When control is necessary, the pest is adequately identified and the control method chosen is of least damage to the crop and the environment. Control options include biological, cultural, mechanical and chemical methods. When chemicals are picked as a control method pesticide selection and rate are two important factors that are considered.

Erosion Control:

Surface water quality can be affected by water and wind erosion from crop fields, streambanks, lakeshores, and non-farm sites into ditches, lakes, rivers and wetlands. Through reduced tillage and the use of cover crops farmers are minimizing soil loss and potential movement of soil carrying nutrients and pesticides.

Water Management:

Irrigation of crops, sod, nursery plants and orchards from surface water and shallow aquifers is a common practice in the ASP area. Proper management and scheduling of irrigation applications controls water use, minimizes deep percolation of nutrients and pesticides and optimizes profitability.

FARM*A*SYST:

Farmers in the ASP area are voluntarily evaluating potential groundwater pollution risks from such sources as pesticide storage and handling, household waste and fuel storage. Landowners complete FARM*A*SYST worksheets with the assistance of project staff to identify potential problems. Farmers are provided information and voluntarily correct these situations to reduce contamination risks.

Farmer Participation:

Voluntary participation of farmers in the ASP project will maintain or improve profitable crop production and a safe food supply for customers while minimizing environmental impacts. These are accomplished using the before mentioned focus areas. Farmer cooperation **is** vital to the success of the program.

Information/Education Programs:

The ASP project is a demonstration project on farms in a sensitive soil/geologic area. The use of new and modified management practices is extended to farm and non-farm residents through the use of:

* On-Farm Demonstration
* Field Days
* Educational Meetings
* Media Participation
* Printed Materials
* Farmer-to-Farmer Contact
* Slide/Video Programs

This paper has been adapted from the ASP Demonstration Project brochure. For more information contact:

David Cooper
ASP Project Coordinator
U of M/ Ag. Eng. Dept.
1390 Eckles Ave.
St. Paul, MN 55108

612-625-2713

North Central Region
Work Planning Conference

Thomas E. Perlick
Manager, Laboratory Services

Cenex/Land O'Lakes Agronomy Company

North Central Region
Work Planning Conference

Future Needs

Soil Specific Field Mapping

North Central Region
Woik Planning Conference

Soil Specific Field Mapping

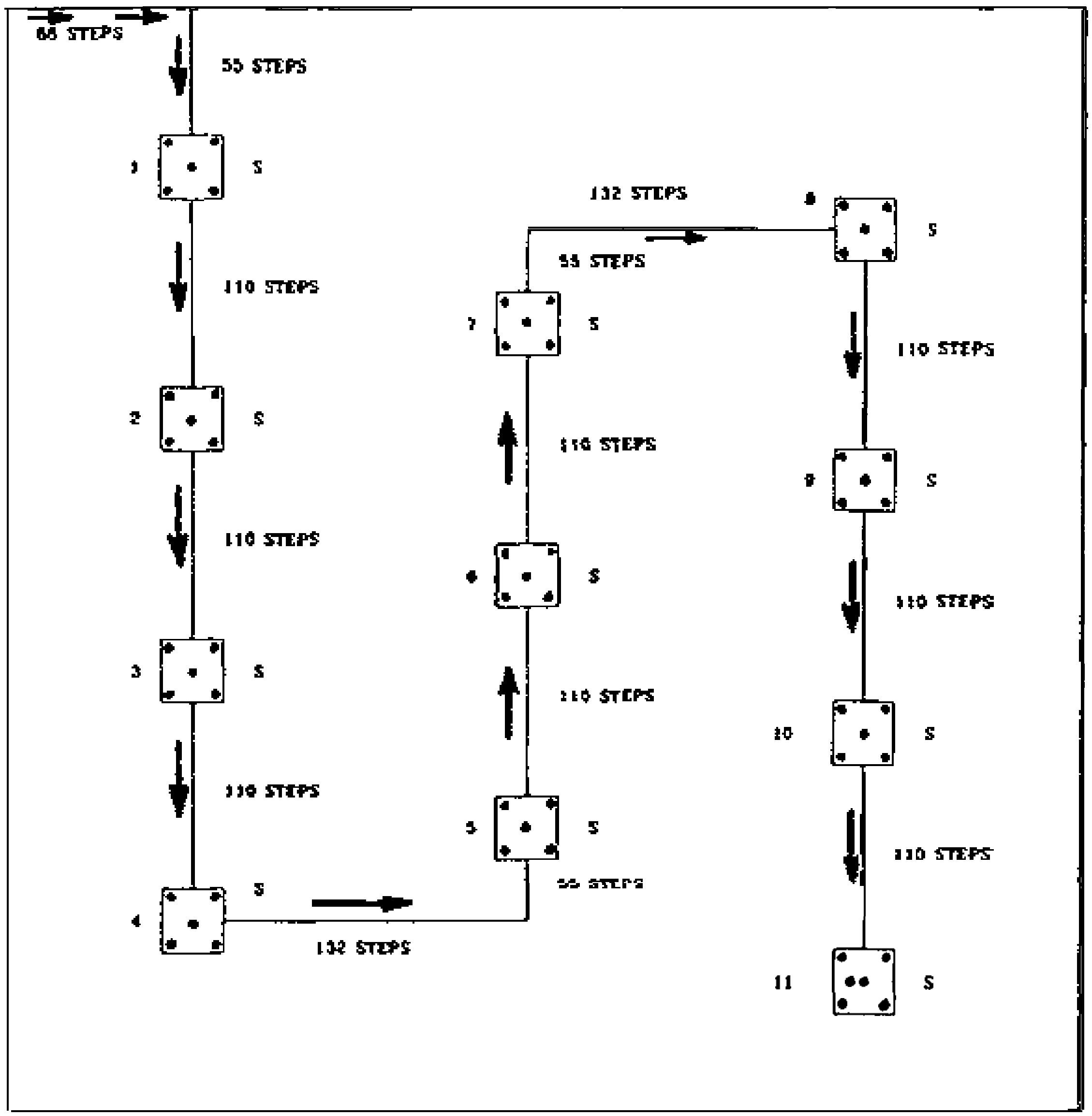
Composite Sample

Soil Type

Grid

DIRECTIONS FOR COLLECTING SOIL SAMPLES
FROM A 40-ACRE FIELD

Eleven locations where samples should be taken
(Each numbered square = I square rod)



A minimum of 5 cores per numbered location should be composited in each appropriately numered and labeled bag.

EFFECT OF SOIL SAMPLING INTENSITY ON FERTILIZER RECOMMENDATIONS

L.G. Bundy and E. E. Schulte[1]

ABSTRACT

University of Wisconsin recommendations specify that one composite soil sample consisting of at least five cores be taken per five acres when soils are sampled for lime and fertilizer recommendations. The need for this sampling intensity in apparently homogeneous fields that have been uniformly cropped and fertilized is sometimes questioned. In this paper, Wisconsin research dealing with the effects of sampling intensity on the reliability of soil test results were reviewed, and the effects of soil sampling intensity on fertilizer recommendations and subsequent crop yield were discussed. With current trends toward higher soil fertility levels and increased use of localized fertilizer placement (row, band, and dribble applications) proper sampling is essential to obtain reliable soil test values. Because these soil test results are usually used for planning lime and fertilizer programs for three or four years, use of adequate soil sampling methods is especially important.

[1]Extension Soil Scientists, Department of Soil Science, University of Wisconsin-Madison, Wisconsin

University of Minnesota Agricultural Experiment Station

Jerry Floren

209 West Mulberry Street
St. Peter, MN 56082
(507) 931-2530; fax (507) 931-4619

July 1, 1992

Using shells and the CAMPS database to generate estimated crop yields

Introduction

We are often unhappy with our estimates for yield data. It seems very difficult to keep consistent relationships between yields on various soils with various crops.

A UNIX shell was developed using data in CAMPS tables to estimate crop yields throughout the 13 counties in SCS Area 6 of south central Minnesota. Area 6 is a band a counties with the southern two counties, Martin and Freeborn, bordering Iowa and the northern most county, Kandiyohi, about 140 miles north of the Iowa border.

As a starting point it was assumed the very best soils in Faribault County would have a maximum corn yield of about 175 bushels per acre during an average year with a high level of management. The following five conditions were used to develop fractional factors used to reduce the maximum yield of corn down from 175 bushels.

1. Physical soil properties such as available water capacity, surface texture, drainage, organic matter, slope shape, and slope percent.

2. Chemical soil properties such as pH. In Area 6 saline soils are not a problem.

3. Location of the county relative to Faribault County.

4. External conditions such as flooding or ponding.

5. The SCS Land Capability Classification rating.

Purpose

The primary purpose of this project is to develop a model for predicting yields on all soils in Area 6. The model will be tested against actual yield data already collected and future data collected in ongoing yield studies. A second purpose is to help locate weaknesses in the CAMPS database tables.

Methods

It is assumed that most factors affecting yields follow a natural logarithmic curve. The curves for these factors were estimated by entering data in Lotus worksheets and generating graphs from the data. From the curves the factors used to reduce yields, and in a few cases increase yields, were determined.

The estimated yields for corn were determined first. The formula was: Corn yield = (175 BU/AC * the location factor * the land capability classification factor * the county factor * the percent slope factor * the slope shape factor * the available water capacity factor * the organic matter factor * the rock factor * the flooding factor * the topsoil factor * the lime factor * the drainage factor).

Soybean yields were determined from the corn yields. The primary difference was that the lime factor was adjusted to show a greater reduction in soybeans than in corn when the soils were poorly drained or very poorly drained with excess carbonates.

Likewise small grain yields were determined from the corn yields. The primary difference being there was less of a reduction in yields of small grains on soils with lower available water capacities, or on more sloping soils, or on soils with convex slopes.

The alfalfa-bromegrass yields were also determined from the corn yields. However, a greater percent reduction in alfalfa occurred on poorly drained and very poorly drained soils.

Some **ideas on developing a shell to predict crop yields.**

I. Define the region.

A. The larger the area the more difficult the project will be.
B. Decide whether you want to use political (county-state) boundaries or MLRA's.
C. Large regions, such as states, may need to be subdivided into smaller areas.

II. Determine the crops and their bask relationships.

A. The types of crops determine the factors and how they are used.
B. Determine ratios of different crop yields on similar soils using yield data and agricultural statistics.
C. Select the main crop for the region.

III. Select the factors.

A. Toggle switch factors. Toggle switch factors are either 1 or 0 and they are the easiest factors to determine. They are used to set yields to 0 on soils that generally are not used to grow crops. The toggle switch factor may be a single soil property or a combination of properties. Some likely toggle switch factors are steep slopes, frequent flooding, ponding, or high Land Capability Classification ratings.

B. Real number factors. The real number factors are generally fractional factors used to reduce the yields. In a few instances they may be used to increase crop yields.

1. Single real number factors. A factor based on a single soil property used to adjust the yield.
2. Multiple real number factors. Combining more than one factor in an attempt to handle the synergistic interrelationships of multiple soil properties. These are more difficult to estimate than the single factors.

IV. Some Ideas on setting the factors.

A. Select the map unit, component (soil series) name, and soil property from the appropriate tables. Sort the resulting table on the soil property. Group soils together based on the sort.

B. Send questionnaires to farmers, agronomists, party leaders, and researchers describing key soils and asking their opinions on yields or yield reductions based on different soils properties.

C. Graph predicted yields for individual soil properties. Using a spreadsheet such as Lotus makes it easier to visualize and calculate factors.

V. Testing the yields.

A. Sort county yield tables on yield. Ask party leaders and other local experts to review these sorted yield tables.

B. Print a report showing the soil properties and the corresponding factors you assigned to the properties. This report will help you determine if there is an error in the data in the tables, or if the error is in the factors you assigned to the various soil properties in the shell.

Discussion

Using a shell to automatically calculate estimated crop yields has a number of advantages. It provides a more consistent relationship between yields of similar soils in adjacent counties and also provides a more consistent relationship between yields on different crops on similar soils.

It is much easier to update yields when tables are edited or when farming practices or technology changes. The shell can also serve as a database editing tool. Often suspicious looking yields can be traced to flawed data-in the tables.

The shell serves as a model. It suggests areas where additional research would be most productive.

In addition to predicting crop yields it could be adapted to predict timber production. With further modification, and some additional tables, it could help set productivity indexes.

RELEVANCE OF SOIL SPATIAL VARIABILITY TO FIELD STUDIES[1]

Dan Long
Department of Soil Science
University of Minnesota
St. Paul, MN 55108

The Spatial Nature of Soil Variability

Soil spatial variability arises from the interaction of complex biological,. geological, pedological and climatological processes which operate over varying distances and scales of observation. Spatial variability in the strength and balance of these processes may be enough even over short distances to cause extreme soil variability within relatively small areas. However, this soil variability is neither uniform nor random. Instead, it forms patches or localized gradients. Like all geographic phenomena, soils obey a "first law of geography" (Tobler, 1970) where "everything is related to everything else, but near things are more related than distant things". Soil classification and survey would have little meaning if this law was false.

The first law of geography essentially reflects the regionalized variable theory proposed by Matheron (1963). A regionalized variable is one whose continuous geographic distribution is erratic yet consists of a systematic component which is spatially structured (Oliver, 1987: Knighton and Wagenet, 1987). This structured component is often characterized by autocorrelation which refers to correlation among the values of a single variable. Furthermore, this correlation increases with decreasing separation distance between pairs of values such that values which are close together are more similar than values spaced farther apart.

This presentation briefly reviews methodology based on regionalized variable theory in determining strategies for sampling and analyzing regionalized variables.

The *Semivariogram*

Regionalized variable theory forms the foundation for geostatistics. Geostatistics offers the semivariogram for modeling autocorrelation as a function of separation distance between sample points and kriging for exploiting autocorrelation in producing isarythmic contour maps. Semivariograms reveal spatial structure in variables by describing the expected value of a difference squared, or semivariance, for pairs of samples of the same variable. This semivariance is computed for these differences of sample pairs that correspond with different distances of separation (Figure 1). Providing that certain assumptions are met, the semivariogram gives quantitative information on the range, direction and magnitude of spatial variability.

An ideal semivariogram is presented in Figure 2. The lower value of the semivariogram is the nugget and is the variance attributable to sampling error and to correlation not detected within the shortest sampling interval. The rise in variance has an upper limit known as the sill. The sill value is commonly equal to the total variance of the sample data set. The separation distance corresponding with the sill along the distance axis refers to the range.

---

[1] This paper was presented to the North Central Regional Work Planning Conference, St. Paul, MN, June 16, 1992.

The semivariogram demonstrates the practical difference between a regionalized variable of geostatistics and a random variable of classical statistics. Sample pairs separated by distances within the range behave as regionalized variables and are autocorrelated. Beyond the range they behave as random variables and are spatially independent.

Sampling **Strategies**

The range of correlation is extremely important in selecting the correct sampling interval and the correct inferential statistical method. Your choice of the sampling interval depends on the ultimate use of the data. van Es (1992) distinguishes three data uses with consideration that most variables measured in the field are spatially correlated. The first two deal with observational studies such as soil survey and the third with experimental studies such as crop variety trials:

1) Characterization of the spatial structure of a variable to compute the semivariogram and perform kriging.

2) Characterization of a variable without regard to spatial structure in order to optimize sampling efficiency.

3) Quantification of treatment effects in an experiment.

If the aim is to characterize the spatial structure for kriging, then distances between samples must be within the range to allow calculation of a semivariogram. Initially, exploratory sampling is done to determine the optimal size and orientation of a secondary sampling grid in relation with the points to be estimated. This secondary sampling grid is optimal when it produces kriged estimates that give least estimation error, or kriging variance.

Numerous exploratory sampling configurations have been proposed including transect, grid and combination grid-transect designs. "an Es (1992) proposes sampling on a nested triangular grid to provide equal precision for semivariogram estimation and for evaluation of anisotrophy in three directions (Figure 3). Such a nested sampling design is more efficient than a square grid design because more sample comparisons can be made for an equal number of samples. Flatman et al. (1988) propose exploratory sampling consisting of a combination grid-transect design to compute an initial semivariogram and to determine range of correlation (Figure 4).

Orientation of a secondary estimation grid depends on whether the explored spatial variation is isotrophic or anisotrophic. Isotrophy refers to a lack of directionality in the spatial variance structure whereas anisotrophy refers to the existence of more spatial variation in one direction than in other directions. If isotrophic, then kriging variance can be minimized by sampling on a regular square grid (Webster, 1985). Anisotrophic variation requires a rectangular grid with the sides proportional with the ranges of corresponding directional semivariograms. The short side is oriented parallel with maximum spatial variation, or least spatial continuity.

Kriging variance is also reduced by increasing sampling intensity. Therefore, the size of the secondary sampling grid depends on the sampling budget and on determination of the maximum allowable kriging variance to be minimized. For example, if estimates of organic matter are required to be within a standard deviation of 0.2 percent, then an optimum sampling grid size is needed that limits the kriging variance to within 0.04.

The optimum grid spacing can be calculated from the exploratory semivariogram, because the kriging variance depends only on the semivariogram and the configuration of the measured points to the estimated points (Burgess and Webster, 1980). Papers by Webster (1985) and Di et al. (1989) describe how this calculation is done. Alternatively, Flatman et al. (1988) suggest basing the grid size on the range and nugget of the exploratory semivariogram (Figure 5). Generally, if the nugget of the exploratory semivariogram is greater than 50 percent of the sill, then diminishing returns occur if the sampling interval is within two-thirds of the range. Conversely, if the nugget is less than 50 percent of the sill, then diminishing returns occur if the sampling interval is within one-half of the range.

If the spatial correlation structure is not important, then sampling can be economized by sampling beyond the range of correlation. Clearly, the semivariogram must still be known in advance which is based on a" exploratory grid or transect. Such a" approach would be useful in environmental monitoring programs to assure independence among sampling stations.

The third use of data: quantification of treatment effects in a field experiment, can be approached through optimization of field design with geostatistical principles (van Es et al. 1989). Such a" approach recognizes that spatial dependency may exist among treatments and hence, treatment comparisons are equal in precision only if they are made at equal distances. Classical experimental design principles of randomization, replication and blocking which do not recognize this spatial dependency lead to treatment comparisons being made at variable distances. van Es and van Es (1992) found for short-distance contrasts, the experimental error term is inflated relative to the direct treatment variances. This causes underestimation of treatment effects and higher probabilities of Type II errors. For long-distance contrasts, the experimental error is deflated relative to the direct treatment variances thus causing overestimation of treatment effects and higher probabilities of Type I errors. They recommended incomplete blocks which are spatially balanced designs which insure equal distances-for all possible treatment allocations.

Statistical Analytical Strategies

For statistical inferential analysis of regionalized variables, Streitberg (1979) proposes the following three strategies:

1) Apply classical statistics without assuming any spatial dependency.

2) Apply classical regression analysis; then test to see if the residuals generated by this procedure exhibit any autocorrelation.

3) assume a particular dependency structure and modify classical methods to model this spatial structure.

Most scientists use the first strategy under a mistaken assumption of statistical independence. Unfortunately, when autocorrelation is present in georeferenced data, too much significance is attached to F and t statistics, standard errors for confidence intervals are deflated, and regression coefficients (R^2) are inflated. Inferential tests are more significant than they really are. Ultimately, violation of the independence assumption in classical statistics invalidates probability statements in inferential tests for analysis of (co)variance (Glass et al., 1972) and regression (Griffith, 1988). The classical design principles of blocking, randomization and replication do not effectively take spatial autocorrelation into account. This is because soil variability is usually too irregular for control by means of blocking, and too nonrandom to promote the equal likelihood of experimental material occurring in all possible soil environments by means of randomization and replication.

For the second strategy, spatial statistics are available to test data for autocorrelation. The popular ones include the Moran's I and Geary's C statistics. You can use these statistics directly on the variable in question without having to extract regression residuals. The semivariogram is another way but doesn't offer a means for testing significance. Some commercial software packages that provide these tests include:

GS+	Gamma Software Design P.O. Box 201 Plainwell, MI 49080	Semivariograms and Moran's I
SAAP	Exter Software Inc. 100 North Country Rd. Setauket, NY 11733	Moran's I and Geary's C
IDRISI	Clark University School of Geography Worcester, MA 01610	Moran's I

Clearly, another way is to simply restrict analysis to data that are sampled beyond the range of correlation. Refer to solution 2 of van Es (1992). While this may be an effective approach in soil survey, this solution will tend to increase experimental error in field experiments thus making it difficult to detect treatment differences.

The third strategy is modeling the autocorrelation. Some methods include nearest neighbor analysis (NNA), trend surface analysis, analysis of covariance, and spatial regression. NNA is currently popular for modeling experimental data from field trials. It uses a" iterative covariance adjustment from neighboring plots to reduce autocorrelation. It recognizes a covariance structure that is a function of distance but assumes this structure exists only for neighboring plots and that the degree of autocorrelation between plots is unity. The method, originated by Papadakis (1937), is recently discussed by Wilkinson et al. (1983) and Bhatti et al. (1991).

Trend surface analysis fits a polynomial response surface model to field trends in autocorrelated data (Kirk et al., 1980). However, the method does not guarantee that a" appropriate amount of variation will be removed from the data.

Analysis of covariance recognizes that autocorrelation in a data set may be due to a variable which is missing from a" analysis. The effect of this missing variable is manifested in the regression error term if this variable is partially related to both the response variable and the predictor variable(s). Inclusion of this variable as a covariate may reduce the autocorrelation in a regression model. Olson et al. (1985) provide a practical application in soil science of how analysis of covariance can be used to improve a" analysis. A practical disadvantage of analysis of covariance is that workers must perform the difficult task of identifying missing variable(s).

Spatial regressive techniques, introduced by Whittle (1954) and Mead (1967) and popularized by Cliff and Ord (1969, 1973). are potentially useful tools for analysis of autocorrelated data under a valid assumption of independence. Despite much literature and methodological developments, dissemination of spatial regression from research to the applied community is lacking (Anselin and Griffith. 1989). To alleviate this problem, Griffith (1989) and Anselin (1989) have provided the applied community with PC software for spatial regression analysis of autocorrelated data.

Spatial regression modeling has the advantage of being able to estimate a parameter of autocorrelation in a data set. The estimation method is based on maximum likelihood so the computations are numerically intensive. Essentially what spatial regression accomplishes is transformation of data from autocorrelated to unautocorrelated mathematical space in a procedure that is similar to computing orthogonal components in principle components analysis. This procedure filters autocorrelation from the data; then classical statistical methods are employed on the resulting unautocorrelated data.

Long et al. (1991) compared the performance of classical versus spatial regression analysis of grain yield data from a uniformity trial. As expected, the classical techniques resulted in underestimation of standard error3 and overstatement of regression coefficients, and inflation of the coefficient of multiple determination (R^2). Table 1 presents an example of these results for classical versus spatial estimation of a difference in mean grain yield between two areas that differed markedly in soil types (141 ± 11 g m^{-2} versus 164 ± 27 g m^{-2}). The regression coefficients are significant for a classical model estimating this difference whereas they are not significant for the spatial model.

Table 1. Regression coefficients and standard errors for classical and spatial regression models for a difference in average grain yield between two soil types.

	Classical		Spatial	
	Regression Coefficient	Standard Error	Regression Coefficient	Standard Error
ρ			.610 •	.114
Intercept	3.64 *	.0501	3.65 *	.102
Soil Type	-.227 *	.0501	-.0805	.0482
R^2	.186 *		.0310	

ρ = spatial autocorrelation parameter
R^2 = coefficient of determination.
* denotes parameters are significant at p = 0.05

Conclusions

Crop and soil variables behave as regionalized variables: not as random variables as assumed by classical statistics. Regionalized variables require special consideration in sampling and analysis. The semivariogram is a useful tool for describing the direction, range and magnitude of spatial variability in regionalized variables. This information is helpful in designing sampling strategies in observational studies, designing field experiments, and deciding on appropriate statistical methods. If classical statistical analysis is applied to regionalized variables, then serious complications arise concerning the validity of inferential tests of significance. Several different spatial statistical methods are available and include nearest neighbor analysis, trend surface analysis, analysis of covariance, and spatial regression. These methods open up new avenues of analysis for the agricultural community.

References

Anseiin, L. 1983. Spatial regression analysis on the PC: spatial econometrics using GAUSS. No. 2. Institute of Mathematical Geography, 2790 Briarcliff l-88, Ann Arbor, MI 48105

Anselin, L. and D.A. Griffith. 1989. Do spatial effects really matter in regression analysis? Papers of the Regional Science Association. 65:11-34.

Bhatti, A.U., D.J. Mulla, F.E. Koehler, and A.H. Gurmani. 1991. Identifying and removing spatial correlation from yield experiments. Soil Sci. Soc. Am. J. 55:1523-1528.

Burgess, T.M. and R. Webster. 1980. Optimal interpolation and isarithmic mapping of soil properties. I. The semivariogram and punctual kriging. J. Soil Sci. 31:315-331.

Cliff, A. and J. Ord. 1969. The problem of spatial autocorrelation. In London Papers in Regional Science 1. A. Scott (ed.), Pion

Olson, K.R., S.G. Carmer, and G.W. Olson. 1985. Assessment of effects of soil variability on maximum alfalfa yields, New York. Geoderma, 36:1-14.

Papadakis, J.S. 1937. Methode statistique pour des esperiences sur champ. Bull. Inst. Amel. Plantes a Salonique 23.

Streitberg, B. 1979. Multivariate models of dependent spatial data. In Exploratory and Explanatory Statistical Analysis of Spatial Data. C.P.A. Bartels and R.H. Ketellapper (eds.) Martinus Nijhoff Pub., Boston, MA.

Tobler, W.R. 1970. A computer movie simulating urban growth in the Detroit region. Econ. Geog. 46:234-240.

"a" Es, H.M., C.L. van Es, and D.K. Cassel. 1989. Application of

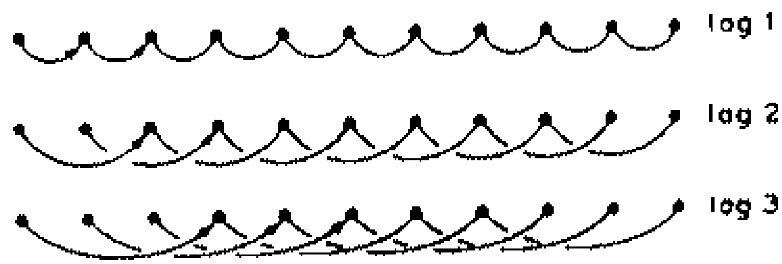


Figure 1. Comparisons of different lags, or separation distances, for calculating semivariance on linear transects (From R. Webster, 1985).

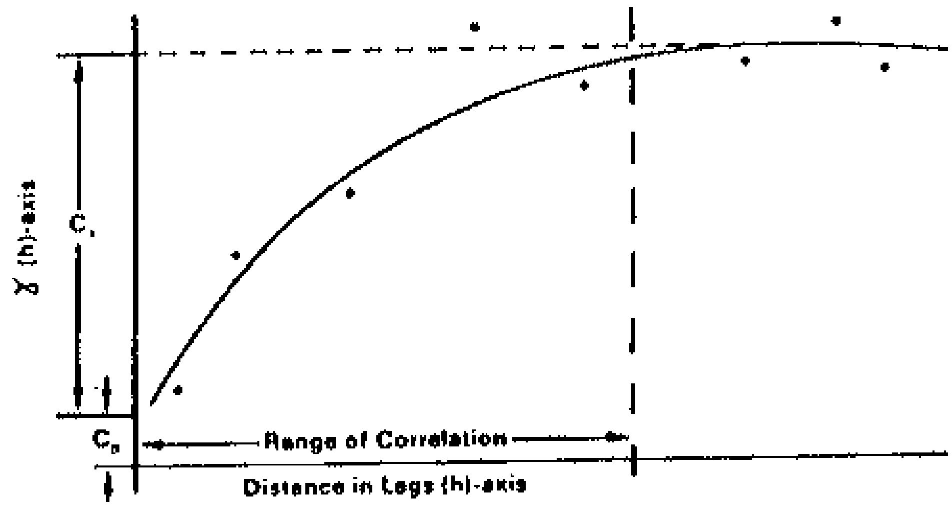


Figure 4. Idealized semivariogram where C_0 is the nugget variance and C_1 is the structural variance which increases with increasing lag distance (From Flatman et al., 1988).

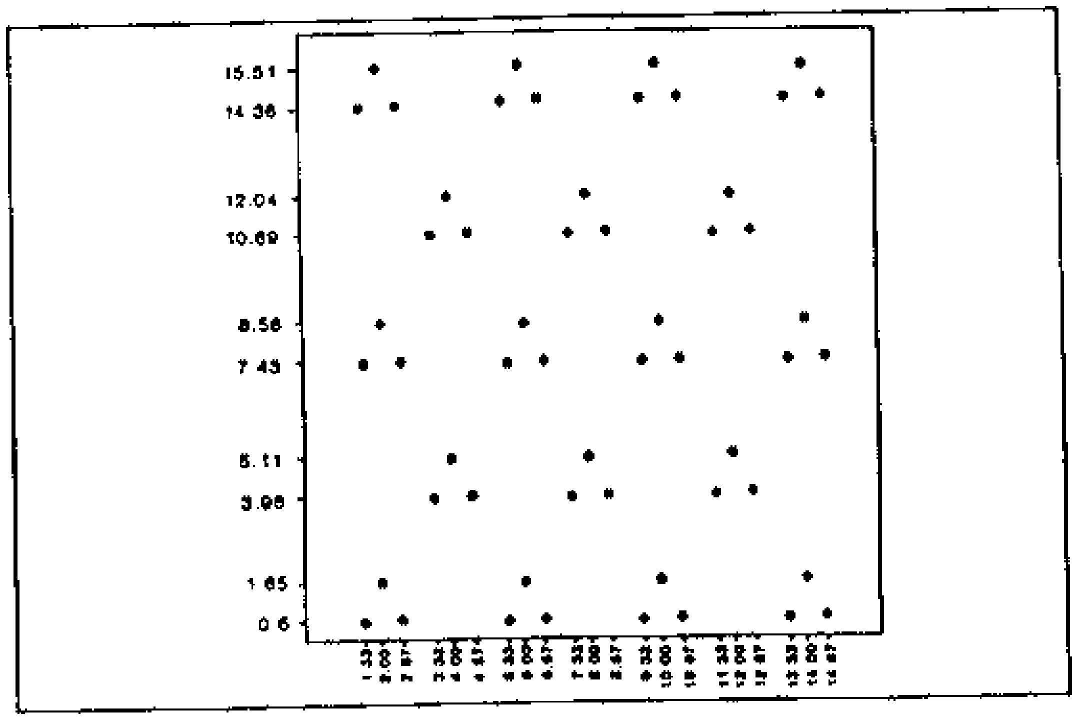


Figure 3. Nested triangular sampling scheme involving 54 locations. Numbers along axes indicate relative distances (From van Es, 1992).

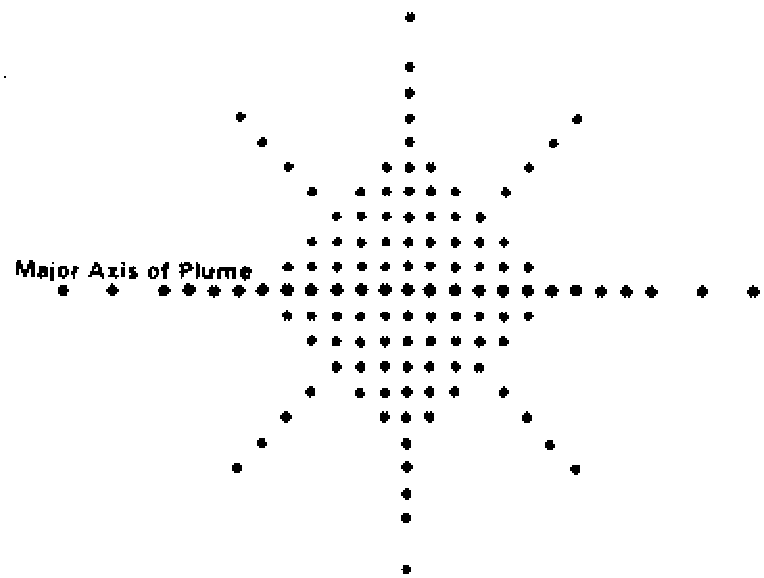


Figure 4. Combination transect-grid sampling scheme (From Flatman et al., 1988).

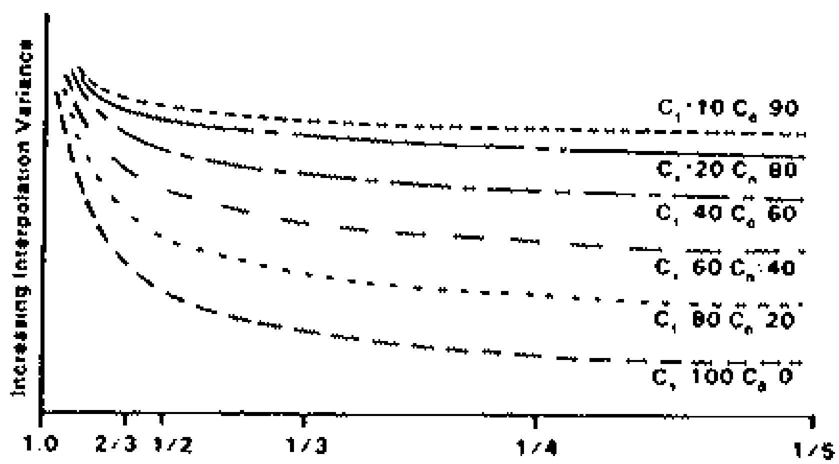


Figure 5. Diminishing returns in kriging variance reduction for a decrease in separation distance between samples (From Flatman et al., 1988).

North Central Cooperative Soil Survey Work Planning Conference - 1992
ROLE OF COOPERATING AGENCIES AFTER THE ONCE OVER MAPPING
PANEL DISCUSSION
June 16, 1992

USDA-FOREST SERVICE ROLE

by Walter E. (Walt) Russell
(Regional Soil Scientist, USDA-Forest Service, Milwaukee, WI)

The Forest Service role won't change drastically as a result of completion of the once-over soil survey, for two reasons. First, the once-over mapping has already been completed on most of the National Forests & Grasslands in the North Central States, as well as the Eastern Region. Secondly, the soil survey has not been the major activity of Forest Service soil scientists for several years.

We have been, and will be putting more emphasis on identifying needs for updating, revision & refinement, and on accomplishing the work to meet those needs. More and more Forest Service personnel are getting involved in cooperative efforts to collect and analyze data to define ecological relationships, develop Ecological Types, and Ecological Units. This is in response to information needs for our ecological approach to management.

We'll be putting more emphasis on developing interpretations. They'll go beyond the traditional "slight, moderate, severe" categories. There is need for more quantification of results of specific actions and management scenarios on specific Ecological units. The uses we'll be interpreting for will be significantly refined. We need, and will be doing a lot more work on developing interpretations for Wildlife habitat management. Some work has been done on developing Wildlife Habitat models by Ecological Unit. Lots more is needed. I expect we'll need to develop information needs for ecosystems management, and develop new interpretations accordingly. Our resource managers want and need information by mapping unit. For map units with significantly different components, they need to know about those interpretive differences, as well.

We'll put more emphasis on monitoring results of management practices. Monitoring results will be used to validate our interpretations, and as a basis for changing, refining, expanding, and developing new interpretations. Another use of monitoring results will be to identify updating, revision, and refinement needs for soil survey/ecological unit inventory.

I expect the trend toward more participation on interdisciplinary teams will continue. Our Forest Plans are 5 to 7 years old, and needs for revisions are being identified, Interdisciplinary teams are needed for Forest Plan revisions, Forest Plan implementation, developing management projects, monitoring results, and developing Environmental Analyses. I see the need for ID teams increasing, and I see the need-for soils expertise on these ID teams increasing.

Our soil scientists will continue to provide soil management support services. This is a professional consulting role of providing soils advice to resource managers. It overlaps several of the activities I've already mentioned. Soil management support services has been one of the primary sources of management support for having soil scientist positions on National Forests.

Finally, a great emerging need we have is for an automated, integrated relational data base to support our ecological approach to resource management. I expect our soil scientists will be heavily involved in this over the next several years.

ERODED MOLLISOL REPORT

by Earl Lockridge

NORTH CENTRAL REGION - Work Planning Conference
St Paul, MN

June 15-18, 1992

On March 24-25, 1992, representatives of eleven Midwest states, the Midwest National Technical Center (MNTC), and the National Soil Survey Center (NSSC) met in Des Moines, Iowa. The purpose of the meeting was to develop an approach for naming, classifying, correlating, and interpreting eroded Mollisols as we begin updating past soil survey information. Special emphasis was placed on the nearly 6 million acres of soils currently correlated as taxadjuncts to the Mollisol order. This meeting, however, will have impacts on how all soils manipulated by man in one form or another are classified and correlated.

Each state and national staff represented was given an opportunity to present their views and/or proposals for solving the problem. We then opened discussion using a consensus building framework guided by a neutral facilitator.

The group came to a consensus on the following items:

1. The problem is:

    a. lack of a method to maintain a genetic thread in soils that have lost all or part of diagnostic horizons due to accelerated erosion.

2. Any agreement should recognize that:

    a. The soils in question are the result of erosion.

    b. Humans influence soil degradation and/or formation.

    c. There is a need to find alternatives other than taxadjuncts for handling eroded Mollisols.

    d. The taxonomic system should reflect the genetic thread to Mollisols.

    e. Even if new series are established to define map units of eroded Mollisols (that do not classify as Mollisols), erosion needs to continue to be reflected in the name of the map unit.

f. We will classify soils on the basis of properties of the soil.

3. The approach to deal with the problem was as follows:

a. Define as a diagnostic property "accelerated erosion" based on soil properties.

b. Where it has been determined that accelerated erosion has occurred, mollic epipedon proposals will be prepared to allow soils with epipedons as thin as 18 cm to be classified as Mollisols.

c. Where the mollic epipedon is less than 18 cm, eroded would be used in the family name and another series would be proposed.

Two committees were appointed to address the above approaches. They are listed below.

Committee 1 - charged with writing the definition for "accelerated erosion" as a diagnostic feature.

IA - Fenton - Chair
NE - Helzer
OH - Gerken
MO - Vogt
IL - Olson
ND - Heidt

Committee 2 - charged with writing proposals for Soil Taxonomy to allow mollic epipedons as thin a 7 inches when accelerated erosion has occurred as identified by definition prepared by Committee 1 and a proposal to add "eroded" to family criteria.

NE - Kuzila - Chair
KS - Ransom
IL - Doll
IA - Boeckman
MO - Thompson
OH - Smeck

PROGRESS REPORT FOR THE COMMITTEE ON DIAGNOSTIC PROPERTIES TO DEFINE ACCELERATED EROSION BASED ON SOIL PROPERTIES

T. E. Fenton
Iowa State University

This committee was appointed at the Eroded Mollisols Workshop held in Des Moines on March 24 and 25, 1992. Members of the committee are: Rich Gehring, Cornelius Heidt, Norm Helzer, Ken Olson, Ken Vogt, and Tom Fenton, Chair. Our charge is to define accelerated erosion based on soil properties. At the March meeting there was general agreement that it was desirable to maintain the genetic thread in soils that have lost all or parts of diagnostic horizons due to accelerated erosion. It was also emphasized that the effect of accelerated erosion was important in other orders in addition to Mollisols.

The present data on correlated acres of eroded Mollisols in my experience underestimates the actual total area of these soils on the landscape in the Mid-West. The reason for this statement is that in the past when Taxonomy was being tested there was great pressure to classify the soils based on the surface thickness regardless of the influence of man through accelerated erosion. However, the presence of contrasting ecosystems-prairie, prairie-forest, and forest- and the fact that a change in thickness of one inch in the topsoil could change the classification of a soil at the highest category in the system were items of concern for many scientists and in many states erosion phases were mapped. The erosion phase decisions were based on soil properties observed in the field and the comparative morphology among polypedons within the same field and/or in adjacent areas that had not been affected by accelerated erosion. The erosion phases, in many cases, were correlated as taxadjuncts but to many this procedure was not acceptable. Therefore, the workshop was organized in an attempt to resolve the classification problems related to man's influence on soil properties.

The effects of accelerated erosion may be reflected in one or more of the following criteria depending on the kind of soil and profile characteristics of soil. Most of criteria are based on comparisons to similar kinds of soils and it understood that all other soil forming factors, landscape position-, and other landscape factors are similar except for the influence of man. Our committee will be considering the following factors as well as other properties that will aid in the identification of eroded conditions.

1. Decreased surface or surface plus subsurface horizon thickness.

2. Lower organic matter content.

3. Higher values and\or chroma.

4. Mixing of subsurface and/or subsoil with surface horizon.

5. Lack of transitional horizons between A and B.

6. Decreased solum thickness.

7. Shallower depth to the base of a subsurface diagnostic horizon.

8. Shallower depth to carbonates.

9. Concentration of coarse fragments in surface horizon.

10. Higher clay content in surface horizon.

11. Depth distribution of clay in profile.

12. Soil chemical subsoil properties similar to uneroded sites.

Another committee has the charge of modifying the key to Soil Taxonomy to recognize accelerated erosion in the classification system.

ERODED SOIL - SOIL TAXONOMY COMMITTEE

North Central Region Soil Survey Work Planning Conference
St. Paul, MN - June 15-18, 1992

Mark Kuzila, Chairman
Louis Boeckman
John Doll
Mickey Ransom
Neil Smeck
Bruce Thompson

If anyone has comments or additions to our committee charge, objectives and/or approaches please contact the chairman.

A definition of accelerated erosion is essential to the work of this committee and will be incorporated into proposed amendments to Soil Taxonomy. Preliminary work on proposals to amend Soil Taxonomy will likely parallel the development of a definition of accelerated erosion by the Accelerated Erosion Committee.

CHARGE

To develop proposals to amend Soil Taxonomy as it pertains to eroded soils primarily in, but not limited to, the Mollisol Order.

OBJECTIVES

To maintain the genetic thread of the eroded soil

To restrict taxonomic criteria to the properties of the soil being classified

To incorporate the definition of accelerated erosion into Soil Taxonomy

To eliminate the use of taxadjuncts in classifying eroded soils

APPROACHES

Allow "eroded Mollisols," meeting the criteria of accelerated erosion, into the Mollisol order with "mollic epipedons" as thin as 7 inches regardless of solum thickness by reducing the thickness requirements of the "eroded" mollic epipedon or by changing the key to soil orders to allow soils with a 7 to 10 inch thick, "eroded," dark colored, ochric epipedon into the Mollisol Order.

Add an "eroded" family class and criteria to Soil Taxonomy for soils that have accelerated erosion.

SC8 National Neadguartere Soil Survey Report

The Soil Survey Division is developing a strategic plan. This plan will provide the framework for the division as we move from completing the initial soil survey inventory to the improvement and modernization of both our spatial and attribute databases. A vision and mission statement have been written.

VISION

Quality Soil Resource Information for Science and Society.

MISSION

Provide leadership and service to produce and deliver scientifically based soils information to help society understand, value, and wisely manage global resources.

We have developed the following list of 15 Strategic Issues. This list may be revised as we continue to meet with our customers and review our strategic plan.

- Communicating to and educating our internal customers to get support for soil survey through a marketing plan.
- Automation system.
- Developing standards for data reliability to meet customers' needs.
- Team-building among our own soil scientists and other disciplines.
- Balance of technical services and soil survey program.
- Maintaining State Soil Scientists as Program Managers.
- How to address environmental issues.
- Funding alternatives.
- How to manage and fund soil surveys on MLRA basis.
- Program responsiveness and flexibility.
- R&D Strategies.
- How to get suitable digital imagery.

- International responsibilities
- Maintaining quality when users are inclined to do whatever is most convenient.
- How to manage and fund soil surveys.

We are getting a lot of requests for **STATSGO** data from other agencies. We should all do our part to make sure we have a certified coordinated joined soil survey of the United States at a scale of **1:250,000** by October 31, 1992.

During 1991, the Soil Conservation Service mapped 31.7 million acres and our cooperators mapped 5.8 millions acres. We now have as soil survey on 1.68 billion acres on 73 percent of the United States. Cur goal **is** to complete tine mapping of all privately owned land by 2,000.

The Soil Survey Division priorities for 1993 are:

Continue to develop and begin implementation of **NASIS**

- Data conversion to Informix.
- New data elements.
- Training.
- Generating manuscript tables from tailored MUIR data.

Continue to develop and **document** Soil Survey standards and procedures

- NCSS Standards Committee, complete networking with committees and work groups.
- Continue development of the **NCSS/FGDC** Data Dictionary.
- Review and finalize the National Soils Handbook.
- Revise Handbook of Soil Survey Field Investigation Procedures.
- Develop spatial data transfer standard.
- Distribute Guide to Authors of Soil Survey Manuscripts.
- National Soil Taxonomy Handbook revision - approving ICOMID recommendations.
- Develop Soil Survey Field Handbook.
- Distribute Guide for Soil Survey by **MLRA.**

National data bases, **structure, content,** implementation

- Implement automated pedon description program (PDP).
- Define & Develop tabular OSED data base.
- Complete **STATSGO** and develop procedures for generalizing, summarizing, and aggregating digital information to smaller scales.
- Continue cooperation with universities to input data into NCSS Soil Characterization Database,

Support to field operations

- **Develop a priority list of orthophotography** needs.
- Participate in NHQ interagency initiative to acquire current ADP capabilities
  - Digitizing initiative
  - Soil Survey Project Office hardware and software
- Complete landform description system.
- Develop scheme for electronic data transfer among locations, primarily at the MLRA level.
- Develop regional indicators of hydric soil and wetland hydrology.
- Selected states review and comment on soil interpretations rating for selected interpretive guides.
- Encourage development of long range soil investigations plans as part of MLRA-wide planning.
- Continued development for description, investigation, and interpretation of deep layers.
- Continue the input of Soil-8's.
- Continue to emphasize training, and conduct existing courses.
- Continue development of interpretive training modules.
- Complete 60 soil survey manuscripts for publication.
- Maintain laboratory production.

Qlobal climate change activities

- Develop and maintain a world soils data base to assist national and international efforts in systems modelling and other uses of soil information.
- Continue soil moisture and soil temperature monitoring.
- Distribute information about project activities, including maps of study locations and descriptions of activities.

International activities

- Assist Lesser Development Countries (LDC) in developing soil survey programs.
- Provide support services to the Agency for International Development (AID), and technology transfer and training to AID country missions, and other international and regional institutions in technical soil services and soils classification.
- Initiate international soil classification committee on soils with permafrost.

Continue preparation for Soil Survey Centennial

Host NCSS national meeting

Vermont, July 1993

Complete soil survey marketing plan

Complete draft Strategic Plan for Soil Survey Division

- Solicit information about training, other future needs in field, states, programs, and agencies.
- Expand strategic planning to the whole NCSS, through the national and regional Soil Survey Conferences and existing advisory committees.
- Adjust NSSC services, including participation in Soil Survey Conference Committees, in line with client indications of need.

Develop budget initiatives

- FY94 budget initiatives
  - easy access
  - native American
  - water
- Continue with 3-year state allowance implementation plan.

Develop policy and prooeduree for support and delivery of technical eoil eervioee at all levels

- Coordinate the Hydric Soil Committee.
- Complete electronic generation of hydric soils map unit lists using the State Soil Survey Database.

National Soil Survey Center Report[1/]
North Central Regional Cooperative
Soil Survey Conference
June 15-18. 1992

I appreciate the opportunity to share with you some highlights of current activities of the National Soil Survey Center. The leadership of the National Cooperative Soil Survey makes up an excellent cooperative working relationship, largely involving Federal Agencies and State Universities.

The challenges today from our respective agencies and the public are both exciting and demanding. As the concerns of tight budgets clash with the excitement of new opportunities, we must all look carefully at ourselves, our priorities, our products, and expectations of our customers. As a viable, dynamic Cooperative Soil Survey we must adjust to meet change and we must market ourselves more than previously.

One step in this process is a strategic vision of where we are end where we are going. Already, we know much of this, but it needs to be written in a form that allows us to share our visions and expectations among ourselves and with others. Coordination of a strategic plan for the Soil Survey Division is one of the current activities in the Soil Survey Division, which includes the Soils Staff at the Center and National Office. During several sessions this fiscal year involving personnel in the Soil Survey Division and the States began development of a strategic plan for our soil survey of the future.

A wide variety of excellent items on strategic planning have been identified and discussed in each of these sessions. A brief summary on the demand for more products and services by three broad categories is as follows:

Demand for more:

i related to data
- -- Current data
- -- Electronic data
- -- Soil research
- -- Soil monitoring
- -- In-house modeling
- -- Levels of generalization of our soils data

Activities related to aualitv soil survey
- -- Maintaining soil surveys (MLRA)
- -- Quality of our soil maps and data
- -- Kinds of soil interpretations

Activities related to assistances
- -- Training for users
- -- Improve accessibility of expert systems
- -- International activities
- -- Soil consultations
- -- Multiple discipline involvement

1\ Jim Culver, National Leader, Soil Survey Duality Assurance Staff

Several broad strategic issues to address the demand for products and services in the future were discussed. These include: Program responsiveness and flexibility; Staff technical capabilities; Delivery and automation systems; International responsibility; and Funding alternatives

As a start, a plan is in preparation which will outline the Soil Conservation Service - USDA perspective. Some of the factors and developments in this process are outlined below.

SOIL SURVEY IN THE FUTURE:

The concept of "finishing the once-over" no longer fits what we are doing. The reason is at least three-fold 1) the once-over keeps changing as human activities change, 2) older soil surveys fail to provide needed data and interpretations (wearing out) at accelerating rates, and 3) the increased need for soil maps to join and interpretations coordinated between survey areas.

Dr. Randy Brown, University of Florida, had an interesting article entitled "The Need for Continuing Update of Soil Surveys" in Soil and Crop Science Society of Florida Proceedings. Volume 44, 1985. He related the quality of a Soil Survey is a function of five items: 1) accuracy of the mapping, 2) precision of the mapping, 3) correctness of statements made in the survey concerning mapping accuracy and precision, 4) correlation ftaxonomic and interpretations) between the survey and nearby surveys, and 5) forthrightness of the soil survey report regarding the limitations of the soil survey.

This means that the focus of soil survey will shift from emphasis on mapping and publications to what we have called update and maintenance. The leadership of the states within this conference toward the Major Land Resource Area (MLRA) concept in maintenance of soil surveys has set a national trend on this issue.

We have to prepare soils information to stand alone as it has in the past, and also to serve much more frequently as one layer in Information Systems that will be operated by a variety of public and private people, with differing amounts of assistance from SCS and NCSS cooperators.

We have to create a quality uniform information suitable for Geographic Information Systems (GIS) and other applications, independent of political boundaries. This will require cleaning up the patchwork of ages and presenting soils information in a variety of formats.

This requires a National Soil Survey Information System (NASIS), regionally (generally MLRA) planning, and some shifts in capabilities among our soil scientists.

ROLES OF SOIL SCIENTISTS

Soil scientists in SCS will continue to: 1) produce and deliver information, including making soil maps and 2) serve on interdisciplinary and interagency teams to help in the use of information.

We will need people who know the information systems and how to use them, the quality control procedures, and their opportunities and limitations. They will have to be increasingly more knowledgeable about applications of information, and will have to work **in teams with others outside of soil survey to remain acquainted with needs of customers.**

SOME IMPORTANT DEVELOPMENTS

-- The way we do business (focus on total quality in terms of customer expectations).

-- Greater competition for funds.

-- Maintaining or modernizing soil surveys by MLRA instead of by county.

-- Geographic Information Systems.

-- Documentation and validation of information.

-- Global perspective to environmental concerns.

NATIONAL SOIL SURVEY CENTER

Location: Lincoln, Nebraska

Established: 1988

Personnel: 100 Full-Time Employees
50 soil scientists (approximate)
50 other

Staffs:	Quality Assurance	(40 approximate)
	Laboratory	(40 approximate)
	Classification +	
	Interpretations +	
	Soil Geography and Information	(20 approximate)

Facilities: Offices, soil characterization laboratory, training facilities, GIS, databases, editorial section w/desktop publishing access to university instruments, mainframe computers, statistical packages.

<u>Prime responsibilities include</u>:

1. Technical quality of the National Cooperative Soil Survey

   - Making soil surveys
   - Maintaining and updating the soil survey information base
   - Delivering knowledge about how to use soil information

2. Technical evolution of the National Cooperative Soil Survey

- Defining and orchestrating needed change (maintaining the scientific and technical capability to orchestrate needed change
- Logistical and organizational support to the processes of technology transfer, research and development, implementation

3. Solving technical problems involving soil resources (international, national, and SCS priority)

- interdisciplinary and interagency consultations, research and development, technology transfer
- International consultations, technology transfer

A wide variety of ongoing activities at all stages of development always sems to be occurring within the National Soil Survey Center. Shared seminars, interaction with various staffs, and cooperative work on projects present excellent opportunities to improve professional skills in producing quality products.

A brief summary of selected activities at the National Soil Survey Center can be grouped into several broad categories:

DOCUMENTS
-- National Soils Handbook (NSH)
-- Soil Survey Manual
-- Keys to Soil Taxonomy
-- Guide to Authors of Soil Survey Manuscripts
-- Field Procedures Manual
-- Laboratory Procedures Manual
-- MLRA Handbook

MLRA
-- 20 plus MLRA's with some activity
-- Numerous multiple state sessions to develop MLRA MOU plans

CORRELATION
-- Eroded Mollisols
-- Dense Till
-- Andisols
-- Fragipans

NASIS
-- Programming at Ft. Collins
-- Soil Survey Business Analysis Group, interact between NSSC and Ft. Collins
-- Conversion of data to informax format
-- Soil Survey Schedule
-- Soil Net
-- Hydric module

ADVISORY GROUPS
-- State Conservationists
-- Technical - University
-- State Soil Scientists - Manuscripts
-- Soil Survey Business Analysis Group
-- Numerous project groups within the National Soil Survey Center - i.e., Transects

LABORATORY DATA
-- Soils-8: Excellent progress toward completion
-- Soil Investigation and Sampling Projects

RESEARCH AND DEVELOPMENT
-- Soil Gensis
-- WEPP, DRAINMOD, etc.
-- Permeameter Measurements and Studies
-- Water Dispersible Clay Studies
-- Near Surface Soil Properties Characteristics

GLOBAL PROJECTS
-- Monitoring Sites
-- Wet Soils
-- EMAP
-- National Soil Moisture and Temperature Map
-- Geomorphology Studies, MLRA 77

PUBLICATIONS
-- color photographs
-- manuscript tables prepared from edited 3SD
-- 2-part manuscript

BUDGET INITIATIVES
-- Aerial photographs
-- Computers - Project Soil Survey Offices

TECHNICAL - INTERPRETATIONS
-- Water Quality
-- Crop Yield Models
-- Hydric Soils
-- FOCUS

SOIL GEOGRAPHY
-- STATSGO
-- MLRA update map

TRAINING
-- Soil Correlation
-- Basic Soil Survey - Field and Lab
-- Laboratory Data and Use
-- National Soil Correlation Workshop
-- State Soils Workshop
-- Soil Scientists to NSSC
-- 3SD end Data Bases

A draft of Soil Survey Division priorities for Fiscal Year 1993 has been prepared and is included as a handout. Based on current staffing and budget projections, it is apparent we will need to revisit this draft and determine activities what we will be able to do and what cannot be done.

I personally feel the National Soil Survey Center has an excellent mix of professional staff collectively working toward a common objective and goal. We are now starting to identify our needs and develop our schedules for next fiscal year. This past year we began to shift from our traditional field assistance on final field reviews to more emphasis on soil survey operations in the early part of the project soil survey, special field studies, and multiple state MLRA activities. We will appreciate your consideration in giving priority to those activities which will contribute to our emphasis in some redirection of the kinds of assistance previously provided by the Soil Survey Quality Assurance Staff. Please feel free to visit with our staff on any issues where we may be of assistance.

I have enjoyed discussing some of the National Soil Survey Center activities with you today. I am looking forward to a very productive conference. Based on the contents of the agenda and the planned field trip, I compliment Minnesota on being an excellent host for this conference.

RECENT DEVELOPMENTS IN BOIL TAXONOMY
Soil Classification Staff
June, 1992

During the past year the chairs from 3 international committees: ICOMAQ, ICOMOD, and ICOMERT; submitted their recommendations to Dr. John Witty, National Leader for Soil Classification. The charges and summary of the major changes from each committee are outlined below.

ICOMAQ

The International Committee on Aguic Moisture Regime (ICOXAQ) was established in 1982 and chaired initially by Frank Moormann, then by Johan Bouma (since 1985). The main classification problems which the committee undertook to solve were the inadequate definition of the term aguic soil moisture regime, the lack of distinction between soils with perched and ground watertables, and the question of wetness induced by rice culture (paddy soils).

The following is a summary of the major changes in terminology proposed by ICOMAQ that will be implemented by the soon to be released amendment, NSTH issue 16:

1. The concept of aguic conditions will replace that of the aguic moisture regime. Aguic conditions in a soil or horizon require saturation, reduction, and redoximorphic features. The new term aguic conditions has a wider range of application than the term aguic moisture regime and will be used extensively in Soil Taxonomy.

2. Use of the term mottles that have chroma of 2 or less will be discontinued, and so is the use of the term mottles, with few exceptions. The following terms are introduced as replacements:

   a. Redoximorphic features, which essentially includes all wetness mottles:

   b. Redox concentrations, which are concentrations of Fe and Mn and include the high-chroma wetness mottles;

   c. Redox depletions, which represent low-chroma wetness mottles (mottles with a chroma of 2 or less) where Fe and Mn have moved out; and

   d. Reduced matrix, which represents reduced soil materials that change in color when exposed to air.

3. The new term endosaturation means the saturation of a soil with water in all layers from the upper boundary of

saturation to a depth of 200 cm or more from the mineral soil surface.

4. Episaturation means a saturation with *water* of one or more layers above a depth of 200 cm from the mineral soil surface in a soil that also has one or more unsaturated layers below the saturated layer.

5. The term anthric saturation characterizes a variant of episaturation which is associated with controlled flooding, e.g., of rice paddies.

Also included are changes in criteria for acid sulfate soils. Although ICOMAQ has not emphasized the revision of acid sulfate soils, Circular Letter No. 4 presented an update following the third International Symposium on Acid Sulfate Soils held in Senegal in January of 1986. The revisions included in this amendment were reviewed by the International Symposium on Acid Sulfate Soils held in Ho Chi Minh City, Vietnam, in February of 1992, and included in a paper "Fanning, D.S., and J.E. Witty. 1992. Revisions of Soil Taxonomy for acid sulfate soils," which was presented by Fanning at that symposium.

ICOMOD

The International Committee on Spodosols (ICOMOD) was established in 1981 and chaired initially by F. Ted Miller, then by Robert V. Rourke (since 1986). The committee's mandate was to:

1. Evaluate chemical criteria for defining spodic horizons;

2. Evaluate thickness requirements;

3. Improve the classification of Aguods;

4. Propose criteria that would adequately distinguish Spodosols from Andepts (Andisols); and

5. Recommend changes in the classification of Spodosols and define appropriate taxa as well as the diagnostic properties required for their definition.

The following is a summary of the changes proposed by the committee that will appear in the next National Soil Taxonomy Handbook issue.

1. The new criteria adds emphasis to the spodic morphology. Most soils presently classified as Spodosols will meet the new morphology, pH, and organic carbon requirements.

2. The albic horizon is used to separate most Spodosols from Andisols.

3. Spodic materials are introduced to allow more flexibility in defining the spodic horizon.

4. Iron and aluminum extracted by ammonium-oxalate rather than pyrophosphate and dithionate-citrate are used for the chemical criterion.

5. The "Al" great groups of Aguods and Orthods are added to capture the soils with low ammonium-oxalate-extractable iron contents.

6. The suborder of Cryods is added and "Trop" great groups are deleted.

ICOMERT

The International Committee on Vertisols (ICOMERT) was established in 1980, with Juan Comenna serving as chair. The objectives of the committee were to:

1. Identify those criteria in the classification of Vertisols that have resulted in taxa

In addition to the changes mentioned above, the 5th edition of "The Keys to Soil Taxonomy" has had an English edit and should be easier to use. The 5th edition should be available in the fall.

Other Committees

The International Committee on Aridisols (ICOMID) has submitted their recommendations to John Witty. The Soil Classification Staff will evaluate these recommendations later this summer and early this fall. The International Committee on Families (ICOMFAW) made excellent progress this spring and should have their final recommendations available in about a year. The International Committee on Soil Moisture and Temperature Regimes (ICOMMOTR) has one of the biggest challenges and has made good progress. However, this committee will need a couple years to complete their task.

NORTH CENTRAL REGIONAL COOPERATIVE SOIL SURVEY WORK PLANNING CONFERENCE
St. Paul, Minnesota
USDA-FOREST SERVICE REPORT
June 15, 1992

by Walter E. (Walt) Russell
(Regional Soil Scientist, USDA-Forest Service, Milwaukee, WI)

It's great to be here! Our relationship with the cooperative soil survey program is a very important and mutually beneficial one. The USDA-Forest Service has been a participant in the National Cooperative Soil Survey for more than 30 years. I believe the first "Pilot" soil survey on National Forest System lands was started in 1959. The original Memorandum of Understanding at the National level was signed by the Chief of the Forest Service and the Administrator of the Soil Conservation Service in 1961. The amendment, signed in 1981, is still in effect.

The Forest Service manages about 191 million acres Nationally, including about 12.8 million acres in the North Central States. The 12.8 million acres in the North Central States includes 15 National Forests and 8 National Grasslands located in all of the North Central States except Iowa.

In addition to the Public lands we manage, the Forest Service also has several research facilities in the North Central States, including the North Central Forest Experiment Station headquarters here in St. Paul. Also our State and Private Forestry branch has several field offices in the North Central Region.

I might mention here for clarification, that our administrative boundaries do not match the National Cooperative Soil Survey Regional boundaries. The Forest Service Eastern Region (Region 9), which I represent, includes most of the Midwest and most of the Northeast - 20 States from Minnesota, Iowa, and Missouri on the west, to and including the New England States. The western tier of the North Central States (North Dakota, South Dakota, Nebraska, and Kansas) are in the Northern and Rocky Mountain Regions of the Forest Service.

Of the 12.8 million acres of National Forest System lands in the North Central Cooperative Soil Survey Region, about 11 million acres have been mapped with a once-over soil survey, and between 6.5 and 7 million acres have been correlated. We've been identifying needs for updating, revision and refinement for some time, and are actually doing updating, revision, and/or refinement in several places.

Just 11 days ago, our Chief, Dale Robertson, issued a major policy statement, firmly and inequivocably committing us to an ecosystems approach to resource management. What does this mean? Over the past 50 years or so, the Forest Service has been dedicated to managing the National Forests and National Grasslands using a Multiple Use-Sustained Yield approach. However, an emerging global awareness about ecological and environmental matters, along with changes in Society's expectations have challenged us, and are challenging us to re-examine our approach to resource management. And so, we have a shift in focus from management of individual natural resources, such as timber, recreation, wildlife, etc., to management of the ecosystem, and ecological landscapes, of which those resources and species are a part.

We've been evolving toward this ecosystems approach to management for some time now. The National Forest Management Act (NFMA) was passed in 1976, requiring integrated management plans for each National Forest, with increased emphasis on public **involvement.** Most of our Forest Plans were promulgated in the mid 80's. As these Forest Plans are implemented, we've been receiving more and more public input. The public, collectively, is telling us that they want, need, and expect an ever wider array of uses, services, products, and values from their National Forests and National Grasslands.

Two years ago, Chief Robertson introduced an effort called "New Perspectives", to take a look at how we might better address these growing demands and expectations. Our new emphasis on Ecosystems Management is an outgrowth of New Perspectives.

In his policy letter of June 4, Chief Robertson emphasized the following three points:

1. Public Involvement

2. Conservation Partnerships
   - -With State and local governments
   - -With the Private Sector
   - -With other Federal agencies
   - -With Conservation organizations
   - -With anyone else with a shared interest in the National Forests and/or National Grasslands.

3. Collaboration between Scientists and land managers

A Definition of Ecosystem Management: Ecosystem management is the careful and skillful use of scientific methods with ecological, economic, social, and managerial knowledge to improve understanding, renew and sustain land health, and produce desired products, uses, conditions, values, and services of the land over the long term.

Ecosystem Management is an evolution of, not a repudiation of nor a replacement for Multiple Use-Sustained Yield.

This leads me to talk about our approach to soil survey, which we call Ecological Classification and Inventory (EC & I). Our new Ecosystem Management policy increases our emphasis on EC & I.

Ecological Classification and Inventory is the process of segmenting ecosystems into relatively homogenous landscape units that are meaningful to management, for management and/or study. The mapping units are called Ecological Units. Criteria for delineating Ecological Units include multiple factors of soils, landform, geologic materials, climate, and Potential Natural Vegetative Community. We have a hierarchical framework so we can design and map Ecological Units at different levels of resolution, to respond to different managment needs. Just as our resource management has evolved to Ecosystems Management, our approach to soil survey has evolved to the Current Ecological approach that we call Ecological Classification and Inventory.

We don't do it this way just to be different, nor to cause headaches for Soil Correlators. Our purpose is to satisfy our users' needs. We have a lot of opportunities to work closely with our users. From them we get a lot of multi-disciplinary advice, and interdisciplinary input into designing our mapping units, and developing management interpretations.

The need for Ecological Classification and Inventory across political and ownership boundaries is becoming more apparent as partnerships are being developed to manage ecosystems across landscapes. Ecosystems management, and the forces that brought it about, and cause its evolution to continue, are not limited to National Forest System land. Much of the public is demanding this type of management approach on other public lands as well. Management of Privately owned lands is also influenced. A need for Ecological Units on other than National Forest System lands is already being expressed in some quarters, and this trend is growing. I'm hopeful that Ecological Classification and Inventory outside of National Forest lands can be accomplished within the organized framework of the National Cooperative Soil Survey, as we're doing on National Forest System lands.

In order for this to happen, we need to work toward making soil mapping units more synomous with natural landscape units. One way to help bring this about would be to change the status of Soil Series as a part of the Soil Taxonomy. We need to look again at proposals to remove the rigid class limits for soil series, and allow soil series to range across limits of higher categories, as they occur on the natural landscape. I realize this is controversial, and has been discussed and argued before. I beleive strongly that it merits further consideration. The PROBLEM with rigid class limits for soil series, & not allowing them to cross family limits, is that these are artificial, not natural limits - and they encourage soil map unit design biased toward these artificial limits. People do tend to get into a mind-set of mapping soil series, rather than natural landscape units. It also tends to be confusing to soil survey users, when they learn that only a small percentage of a soil mapping unit really fits into the soil series that it is named for.

I really appreciated the opportunity to attend the National Soil Correlation Workshop a few weeks back. This was an excellent workshop. I'd like to compliment the Quality Assurance Staff on the new direction to correlate soils by Major Land Resource Area (MLRA), rather than by political boundaries. This moves soil survey toward more of a natural hierarchy, which is more compatible with the ecological approach. I'd like to put in a plug here for getting Forest Service folks involved on MLRA committees whenever survey updates are considered for MLRAs that include either National Forest System lands, or other lands with a significant forest or rangeland component.

I'd like to shift gears a bit here, and tell you about a significant Nation-wide study that we're involved in, called the Long Term Soil Productivity Study (LTSPS).

One of the very basic things we are required to do is protect the long term productivity of National Forest System lands. To attempt to fulfill this requirement, each Forest Service Region, and each National Forest is developing, or has developed soil quality standards, to prevent or minimize threats to long term soil productivity by management activities. However, these soil quality standards are currently based on "best professional judgement", or limited case studies. Very little in the way of "hard" research data to answer questions to address these standards is available.

And so, a team of soil scientists from the National Forest System, and Forest Service Research developed an idea for a National, long-term study to generate a predictive model of soil productivity. Analysis of available studies showed that most changes in forest soil productivity boil down to two factors -- soil porosity and organic matter content. **And so** a study plan, based on inducing controlled changes in these two properties was developed. the study plan was widely reviewed, and after several iterations, was finally approved in September of 1989, by the Deputy Chiefs for Research and National Forest System.

The study plan calls for study sites to be stratified by vegetation type and Ecological Unit (which includes soil). Each installation is to have a basis of nine l-acre plots where all vegetation is removed, and 3 levels of organic matter removal is crossed with 3 levels of compaction. Additional plots may be included for ancillary studies. Vegetation regrowth and changes in soil productivity are then measured over time. Three replications of each set of 9 plots (or at least the plots on "benchmark" sites) are recommended for statistical validity.

I always emphasize that, although installation of a set of plots for this study requires removing all vegetation from the immediate plot area, this is not, repeat not a study of effects of clear-cutting. It is a study of effects of specific induced soil property changes. Further investigations will subsequently be needed to relate actual management practices to the soil property changes.

The first LTSPS study plots were installed in 1990 on the Kisatchie National Forest in Louisiana, in a Malbis soil (Fine-loamy siliceous thermic plinthic paleudult), under a Loblolly Pine forest type. The second and third study sites were installed in 1991 in California and Minnesota. The Minnesota site is on the Marcell Experimental Forest on the Chippewa National Forest, on a Graycalm loamy sand under an Aspen forest type.

In the Northern Lake States, the decision was made to study a range of soils across the Aspen cover type. The second Lake States site was installed this year on the Ottawa National Forest in the western Upper Peninsula of Michigan, in a Very fine mixed Glossic Eutroboralf on a lake plain. We anticipate installing another site on the Chippewa National Forest next year, probably on a Warba soil, and in 1994 on the Huron-Manistee National Forests in lower Michigan, on a Sandy Entic Haplorthod. We hope to eventually have a site on a compact glacial till in Northern Wisconsin, and perhaps on a clay site on the Superior National Forest in Northern Minnesota.

Plans are being formulated to install study sites across the Central Hardwoods cover type in Southern Missouri, Illinois, and Indiana. Meanwhile more study sites are being installed and planned in California, Oregon, Idaho, North Carolina, Mississippi, Louisiana, and Texas.

The Long Term Soil Productivity Study is a partnership effort between the National Forest System and Forest Service Research. Several Universities are also cooperating, as is the Soil Conservation Service in some places (Missouri, for **example), and some State** agencies. The study design has caught interest internationally. Studies of similar design are being planned and/or installed

North Central Work Planning Conference
St. Paul, Minnesota
June 15-18, 1992

WORLD SOIL RESOURCES: CURRENT AND FUTURE ACTIVITIES

Benjamin F. Smallwood, USDA-SCS, NHQ, Washington, D.C.

I Benjamin Smallwood, bring you greeting from the National Headquarters, World Soil Resources Staff (WSR). Dr. Hari Eswaran, Staff Leader for WSR could not be here this week due to international travel in the southwestern part of Africa. I gladly accepted the opportunity to give an overview of WSR activities.

World Soil Resources mission, "WSR is dedicated to assist U.S. and Less Developed Countries (LDC) to improve the quality of their soil resource inventories to enhance their abilities in attaining a sustainable agriculture and have the capability to address the problems of poverty, hunger, and environment". To implement this mission, WSR have initiated a goal to assist LDCs in implementing policies and commitment to sustainable land management for food and fiber production and conservation of natural resources.

WSR Staff:

Hari Eswaran - National Leader
He is responsible for coordinating WSRs activities in providing services to SCS, and domestic and international organizations in the of evaluation, use, and management of soil resources of the world.

Lorraine Jamison - Secretary

Dave Yost - World Soil Data Specialist
Dave provides service as a liaison to other Federal agencies, private companies and universities. He provides technical assistance in assisting users utilize soil data. He is currently working on developing attribute data for a soil database of Africa.

Ben Smallwood - Soil Resources Evaluation Specialist
Presently, I am preparing a map of soil moisture and temperature regimes of North America. Established collaboration with Economic Research Service in developing a map utilizing data layers of soil, physiography, and climate with the purpose of developing productivity indices of the world. One other additional project with ERS is preparing a Major Land Resource Area map of Mexico.

Russell Almarez - GIS Specialist
He is a new member on our staff and will start working with us in early August.

- Geographer
Paul is responsible for maintaining databases and using GIS to create maps for various project. Some current projects include: using GRASS GIS to create maps to assess constraints to sustainable land management for a watershed area in Java, Indonesia; and using statistical techniques in an analysis of how
Newhall model estimates soil
temperature from climatic data.

Everett Van Den Berg -

Newhall

(SMTR) moisture and temperature regime dies
-World soil maps and databases
(GCC)

SMTR studies of world we have compiled a
database of approximately 15,000 stations which were
Newhall model which was modified and
rewritten in PASCAL by E. Van Den Berg. Some results of the study will include: a world map of SMTR with a database showing their extent, possible modifications to soil

mesic, is classified as 31% is
thermic, 5.6% frigid, 5.6% hyperthermic, and 2.8% cryic with percentages under 1% for the isomesic and isothermic regimes. For the soil moisture regimes in the U.S. roughly
udic, 18 aridic, ustic, 9.3%
xeric ar.6% perudic.

are to evaluate the
magnitude and variability of carbon in the soils of the world and to relate carbon to variables controlling its sequestration. World Soil Resources staff have a global database on organic carbon containing about 2,000 pedons from around the world.

A definition of sustainable land management (SLM) was developed by Hari and Richard Arnold and reads as follows:

"Sustainable Land Management is a system of technologies that aims to integrate ecological and socioeconomic principles in the management of land for agricultural and other uses to achieve intergenerational equity".

The activities WSR are performing related to SLM are developing basic concepts, creating an awareness for the role of soils information in SLM, developing and providing

NATIONAL SOIL INFORMATION SYSTEM

INTERPRETATION MODULE SUMMARY

MIDWEST WORK PLANNING CONFERENCE, JUNE, 1992

Bob Nielsen, Soil Survey Interpretations Staff,
National Soil Survey Center
Lincoln NE

NASIS interpretation module generates soil interpretations from localized field or map unit interpretative date. This software is currently under development at Fort Collins, CO and will be a functional component of the National Soil Information System (NASIS). This paper briefly discusses the Approach (Types and Concepts), Application, Status, and Implementation of the NASIS INTERPRETATIONS MODULE.

Purpose: To create, store, maintain, and apply soil interpretive criteria using automated data processing principles and technics.

APPROACH - TYPES

National: These interpretations are those which have national application and are developed by NSSC, NTC'S, State Soil Scientist(s), or NCSS cooperators. NSSC maintains and documents these interpretations in the National Soils Handbook. NSSC will be responsible for peer review.

(NOTE: All new or revised interpretations and/or interpretive criteria will receive peer review prior to inclusion in soil survey manuscript, FOTG, or soil databases. Peer review responsibilities for soil interpretations reside with the National Leader for Interpretations. Potential(s) are the exception.)

Regional: These interpretations are those which have interstate or NTC(s) application and are developed, documented, and maintained by NTC's, or State Soil Scientist(s). NSSC provides for peer review and archives the documentation.

State/Local: These interpretations are those which have intrastate, MLRA(s), or soil survey area(s) application. They are developed, documented, and maintained by the State Soil Scientist(s). NTC'S and NSSC provide peer review and NSSC archives the documentation.

Potentials: These are interpretations which include management, economic, or social considerations. They are developed, documented, and maintained by the State Soil Scientist(s) and are applied to a specified state(s), MLRA, or local soil survey area(s). NTC's provide for peer review and archive the documentation. Potential(s) may be published in soil survey manuscripts upon approval of the National Leader Soil Survey Interpretations and the National Leader Soil Survey Quality Assurance.

APPROACH - CONCEPTS

	CURRENT	NASIS
1.	SIR DATA	MUIR (LOCAL DATA)
2.	MODIFIED BY AMES	MODIFIED BY USER
3.	NON-MODULAR DESIGN	MODULAR DESIGN
4.	NO TRACKING	TRACKING
5.		DEVELOPMENTAL TOOL

1. Interpretations are generated from tailored local data and reflect local conditions. Will eliminate conflicts and cross-checking between local data and SIR based interpretations.

2. Interpretations criteria will be user modifiable and easily adjusted to meet local, regional, and national needs.

3. Modular design enhances interpretation editing. Criteria is stored and used in multiple interpretations. Requires maintenance to insure that any change is applicable to the interpretations using that criterion. The maintenance component of the interpretations module will be the first to be developed.

4. Offers tracking of interpretive criteria, modules, data, and interpretations. Previously errors and interpretive inconsistencies were manually over written in the manuscript editing process. Tracking will allow identification of interpretation logic errors and short comings, data errors and inconsistencies, and interpretive criteria inconsistencies. This feature will make soil survey maintenance and updating easier and much more uniform.

5. Can be used as a developmental tool. The user will be able to easily develop and test an interpretation(s) or interpretive criteria in house.

APPLICATION

Area:

FOTG: Provides functional and timely update capabilities

FOCS: Provides functional and timely update capabilities

Manuscripts: Currently requires pen and ink edits to interpretive data tables and corresponding pen and ink changes to interpretive tables. Interpretations module will provide electronic revision and update capabilities when the interpretive data is adjusted to fit local conditions. This capability reduce inherent conflicts between edited data and computer generated interpretations.

Site:

User Defined Area: Interpretations from a user defined area could be a defined area within a soil survey area and the interpretations would be generated from an interpretive data subset the area. It could also be a MLRA where the interpretive data is an aggregations of the soil survey interpretive data within that MLRA.

Map Unit: The ability to generate an interpretation based on interpretive data collected from a specific map unit in a specified area.

Map Unit Component: The ability to generate an interpretation based on interpretive data collected from a specific map unit component within a specific map unit in a specified area.

Pedon: The ability to generate an interpretation based on pedon data collected from a specified site.

STATUS

Analvsis: Analysis occurs at all stage of development to insure that the programmers develop and deliver what was asked for. The initial analysis of the system is basically complete. However, analysis is an important part of programing, testing, and implementation and will be an ongoing activity. The outline Physical Design (OPD) and Total Requirement Statement (TRS) are nearly complete.

Design: Is partitioned into 3 parts.

1. MAINTENANCE/CREATION: Enter and maintain interpretive criteria and interpretations. Programming to commence about late summer 92.

2. QUERY DISSEMINATE: Is the query function of the module and will provide for reporting, tracking, execution, creation views, and user queries.

3. DATA DICTIONARY: Contains the necessary elements that maintain interpretive criteria data and interpretation data consistency within the data base.

Construction: Actual programming will begin as soon as the NASIS data structure is set and the OPD and TRS have been submitted to Division. Programming is projected to start late summer of 1992 with completion the-summer-of 1993.

Testing: NSSC will do the initial testing and will rely on the NTC and selected states to assist with more intense testing as soon as initial testing is complete.

IMPLEMENTATION

National Guides:

Conversion: Soil Interpretation Staff, NSSC

Testing: Soil Interpretation Staff, NSSC; **NTC's,** and selected states.

Installation: Inclusion into soil information software.

Training: AT NSSC, NTC, and States

Use of software.
Developing interpretive criteria and interpretations.
Boolean logic as applied to interpretive criteria relationships.
Training delivery methods or schedules have not bee developed at this time.

Other Interpretations: NSSC and NTC will assist users in the development, testing and implementation of regional, state, and local interpretations.

North Central Soil Survey Conference
St. Paul, Minnesota
June 17, 1992

Typical (?) Minnesota weather (in the 50's with wind and rain) provided a refreshing but pleasant field trip to the Anoka sand plain in central Minnesota.

The informative field trip started at farming by soil site which was described by P.C. Robert and J. Vetsch. Featured was nitrogen specific management by soil condition which has the potential to increase crop yields, lower inputs and improve water quality by reducing potential N loss. We then traveled to the Sherburne National Wildlife Refuge where M. Tomer described lamellae formation and S. Eggers discussed wetland identification.

After lunch, we visited the Management System Evaluation area (one of 5 MSEA sites in U.S.). J. Anderson and J. Lamb described ongoing research and demonstrations. We then visited a Long Term Ecological Research (LTER) site. P. Bates described the Cedar Creek Natural History Area and the opportunities it provides the environmental biology research community.

NORTHCENTRAL SOIL SURVEY CONFERENCE
K. R. Olson, June 1992
Illinois Report

The Soil Conservation Service provides most of the field work and supervision for the soil survey program. The University of Illinois assists in field reviews, correlation, laboratory support and research support. The University now has a three man professorial staff in pedology.

To date, 35,000,000 acres have been mapped with approximately 1,000,000 acres remaining. Sixty-six counties have published reports, 29 are waiting to be published, and the remaining 7 surveys are being surveyed. We anticipate re-mapping and/or updating 34 counties which were completed in the 1940's, 1950's and 1960's. Two update soil surveys are in progress. A number of soil scientists have been assigned to area offices with additional soil scientists working on GIS as the 1st phase of the soil survey mapping is completed. Most of the initial mapping will be completed by our next meeting and 4 to 6 counties will be in some phase of the re-mapping process.

We have stored the last 65 years of soil characterization data in computer files. To date, we have been able to compile copies of the data and descriptions in 23 (3") binders, prepare a listing of the data, sort all the data to determine which pedons should be stored, and check the data against the series concepts to verify the taxonomic placement. This listing of the data was stored by a unique code number on a LOTUS spread sheet end sorted by correlated soil name. This enables us to know what kinds of data (particle size, bulk density, or CEC) is available for each series. The listing contains approximately 2200 pedons. Dr. Joe Fehrenbacher and Earl Voss have each worked over 400 hours on the project with emphasis on checking the pedon classifications. The actual pedon data has been entered by pedon and horizon on LOTUS spread sheets with 58 columns and 15,000 rows. The edited data has been transfered to the National Pedon Data file.

The following research is being conducted by faculty members in the pedology area:

I continue to teach soil conservation and management (Soils 304) and the soils section of a land appraisal course (Soils 312). Starting this fall, I will teach Soils 403 (Pedogenesis and Soil Taxonomy). My research includes erosion-productivity, soil productivity, soil porosity, conservation tillage, and erosion-sedimentation studies.

Dr. Tom Bicki. our extension pedologist, has developed extension education programs to assist farmers in the selection of soil management and tillage practices that reduce environmental impact and enhance production. His research includes the development of soil suitability ratings for alternative sewage disposal systems and monitoring the leaching of pesticides in sandy soils under various tillage and irrigation practices.

Dr. Bob Darmody continues to teach Soils 301 (Soils of Illinois). His research relates to mine subsidence and surface mine reclamation. He has been working with SCS on a soil-landscape relationships project in south-central Illinois.

Listed below are some of our recent pedology publications:

Journal Articles (June, 1990 to Hay. 1992)

Agbu. P. A., D. J. Fehrenbacher and 1. J. Jansen. Soil property relationships with SPOT satellite digital data in East Central Illinois. Soil Science Society of America 54:807-812.

Agbu, P. A., D. J. Fehrenbacher and I. J. Jansen. Statistical comparison of SPOT spectral maps with field soil maps. Soil Science Society of America 54:812-818.

Agbu, P. A. and K. R. Olson. 1990. Spatial variability of soil properties in selected Illinois mollisols. Soil Science 150:777-786.

Agbu, P. A. and K. R. Olson. 1992. Predicting soil parent material underlying a loess mantle in Illinois from satellite data. Soil Science 153:142-148.

Bicki, T. J. and R. B. Brown. 1990. Importance of the wet-season water table in on-site sewage disposal. Journal of Environmental Health 52:277-279.

Bicki, T. J. 1991. Promoting the use of soil survey through the use of improved delivery systems. Journal Agronomic Education 20:43-46.

Bicki, T. J. and R. B. Brown. 1991. On-site sewage disposal - the influence of system density on water quality. Journal of Environmental Health 53:39-42.

Bicki, T. J. and L. Guo. 1991. Tillage and simulated rainfall intensity affect on bromide movement in an Argiudoll. Soil Science Society of America Journal 55:794-799.

Darmody, R. G. 1991. Plotting data on a soil textural triangle with a microcomputer. Journal of Agronomic Education 20:149-150.

Jones, R. L. and K. R. Olson. 1990. Use of fly ash as a time marker in sediment studies. Soil Science Society of America Journal 54:855-859.

Kreznor, W. R., K. R. Olson, and D. L. Johnson. 1992. Field evaluation of methods to estimate soil erosion. Soil Science 153:69-81.

Kreznor, W. R., K. R. Olson, D. L. Johnson and R. L. Jones. 1990. Quantification of post-settlement deposition in a northwestern Illinois sediment basin. Soil Science Society of America Journal 54:1393-1401.

Nizeyimana, E. and T. J. Bicki. 1992. Soil and soil-landscape relationships in the north central region of Rwanda, East-Central Africa. Soil Science 153:225-236.

Olson, K. R. and W. R. Kreznor. 1991. Methods to estimate soil erosion and sedimentation. Trends in Soil Science 1:63-69.

Olson, K. R. and S. G. Carmer. 1990. Corn yield and plant population differences between eroded phases of Illinois Soils. Journal of Soil and Water Conservation 45:562-566.

NCR-3 REPORT-JUNE 18, 1992
IOWA AGRICULTURAL EXPERIMENT STATION

T. E. FENTON

We have soil surveys in progress in 4 counties-Humboldt, Monona, Polk, and Van Buren. Thirteen other surveys are completed but not yet published. Nineteen surveys have been classified as "out of date". Due to budget cuts and transfers the number of field soil scientists is at the lowest point in recent (and probably ancient) history. Presently there are 10 field soil scientists (probably 9 if a transfer offer is accepted) including party leaders. There are 9 area resource soil scientists. We also received a reduction in the state funds for the soil survey program.

In cooperation with the SCS, we have been reviewing MLRA agreement and legends. Recently completed counties have been coordinated with the MLRA legends. Our state legend will be revised so as to provide a unique symbol for each soil map unit.

Our soil digitizing project is continuing. We have completed and released 45 counties as of June 11, 1992. Seven counties have been geo-referenced using ARC-INFO.

Current research projects include:

Soil productivity and erosion
Effect of closure of drainage wells on soil-landscape characteristics
Soil-landscape relationships in Lucas County
Soil-landscape relationships in Humboldt County
Environmental effects of two contrasting far-ming system in the CNW soil association area

Don Patterson has retired and is working on the North Dakota map. He will send it to me in July so we can proceed with the regional map project.

Michigan Report

NCR - 3

June, 1992

Soil surveys are in progress in 8 counties. Ten counties are waiting for soil surveys to be initiated. These 18 counties are located in the northern part of the state with forestry being the primary land use. Eleven soil surveys have been completed but have not been published.

Reductions in the state budget has impacted soil survey activities. Two field soil scientists (Michigan Department of Agriculture employees) were terminated, thereby reducing the number of MDA field soil scientists to form. Monies for Michigan Technological University to characterize pedons has also been eliminated.

Michigan is slowly entering MLRA modernization activities. Top priority is to complete modem soil surveys of all counties. The projected completion date is 2000. Michigan will work with Indiana and Ohio in MLRA 99. Several soil surveys in the northern part of the Lower Peninsula are in MLRA 94A and will have a common legend. Hopefully, these surveys will not require modernization in the near future.

Report to NCR-3
Minnesota Agricultural Station
P.C. Robert
June 1992

Soil survey operations

In fiscal year 1990-1991, there were 16 soil surveys in progress. On 1/1/92, there were 4 counties without contracts. There are 10,8822,369 remaining acres. MAES has supported 14 field soil scientists and 2 contractors. Laboratory support has been maintained.

Soil survey updating is in progress in 3 counties. To the extend possible. soil survey update work is being done with the concept of the larger geomorphologic or MLRA area that each county is within.

Soil survey utilization

Development of a revised Crop Equivalent Rating Index (CER) for all principal soils in Minnesota Developed with help from the State Department of Revenue to assist county assessors and others in agricultural land evaluation.

Development of computer software to assist in interpretations of soil survey for:
a) ground water pollution susceptibility for nitrogen and some common pesticides.
b)forest soil management for site preparation, productivity and regeneration.

Development of an expert system for pesticide management based on the Soil Survey Information System (SSIS). Forty five counties now are operational with the SSIS. Three additional counties have requested systems and these are in various stages of implementation.

Research

Areas of research under present investigation:

> Study of landscape developmdnt in the loess-covered landscapes in southeastern Minnesota. This study focuses on loess distribution and sources, the development of the pre-loess landscape, and the effects of changes in loess particle size on soils. A continuation of this study will look at the effect of sub-loess material on soil hydrology.

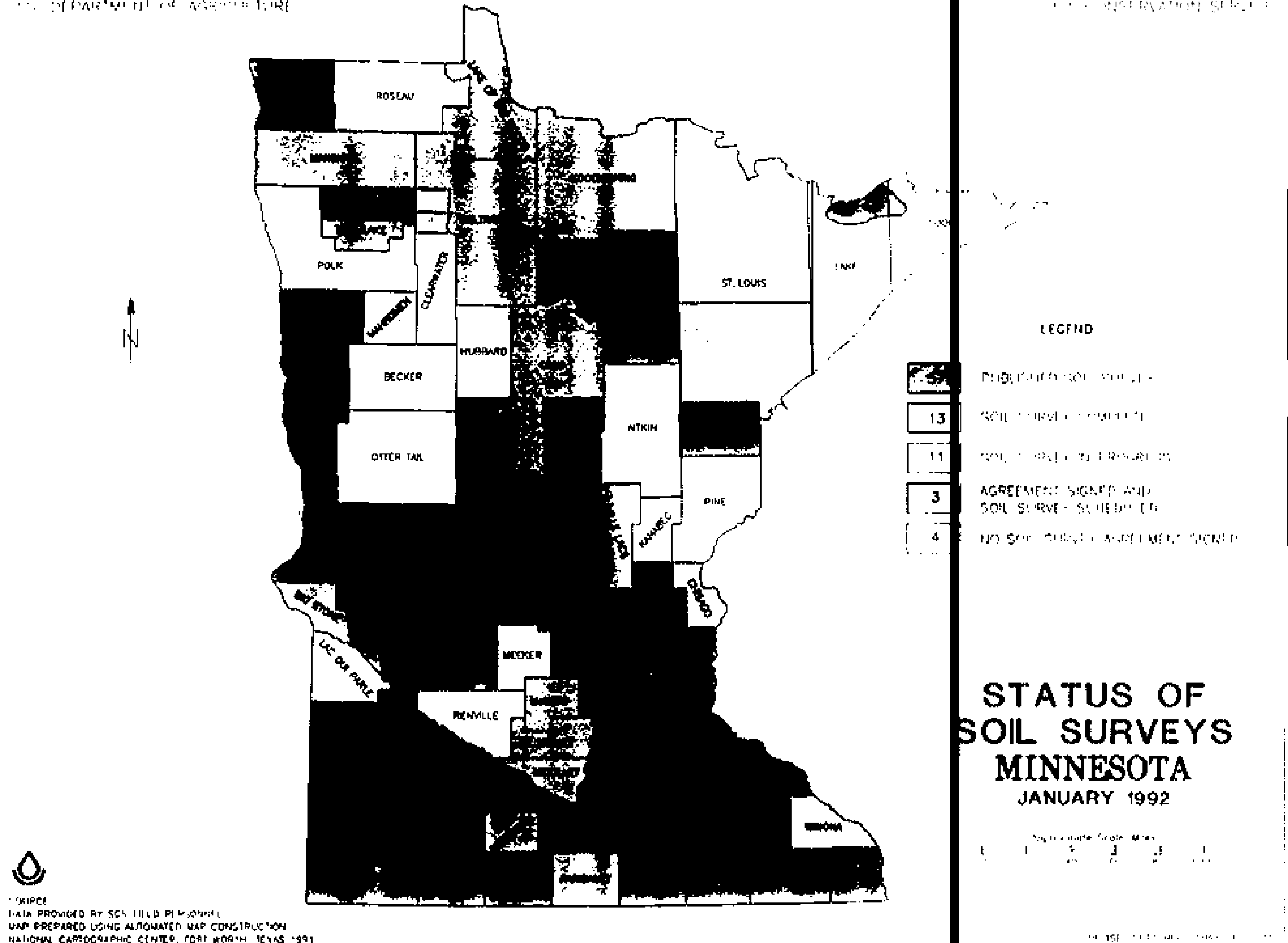
> Study of Ca release by forested soils in northern Minnesota and northern Wisconsin. This study attempts to determine which soils and map units are most susceptible to Ca depletion by whole tree harvest of aspen.

> The wet soil monitoring project in Minnesota is designed to promote understanding of the relationship between soil water fluxes and soil morphology from a landscape as well as a pedon perspective. Consequently, the basic unit of study is a soil catena. This approach elucidates the pedological and landscape processes occuring within the soil continuum as they relate to soil water fluxes and associated changes in soil morphology. The project is designed to accommodate studies of hydric soil hydrology and associated soil morphological characteristics in a variety of landscapes across considerable climatic gradients.

> DEM applications for soil survey. a) Evaluation by field mappers of suitability of slope class maps derived from DEM for portions of St. Louis and Otter Tail Counties to delineate slope phases and landforms. b) Evaluation of the cell size on

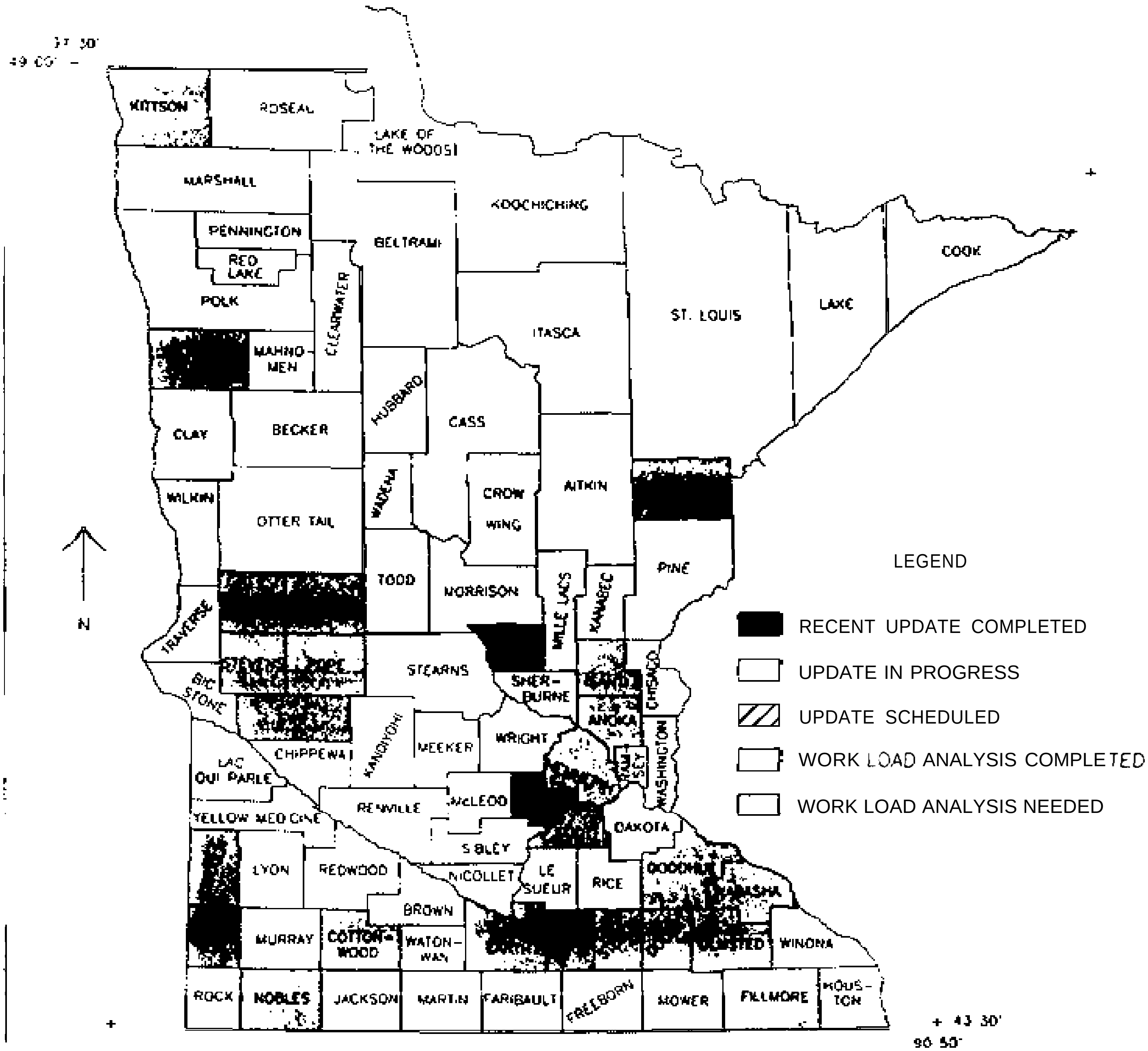
DEPARTMENT OF AGRICULTURE

CONSERVATION SERVICE



U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



STATUS OF SOIL SURVEY UPDATING MINNESOTA

OCTOBER 1991

0 25 50 75 100 MILES

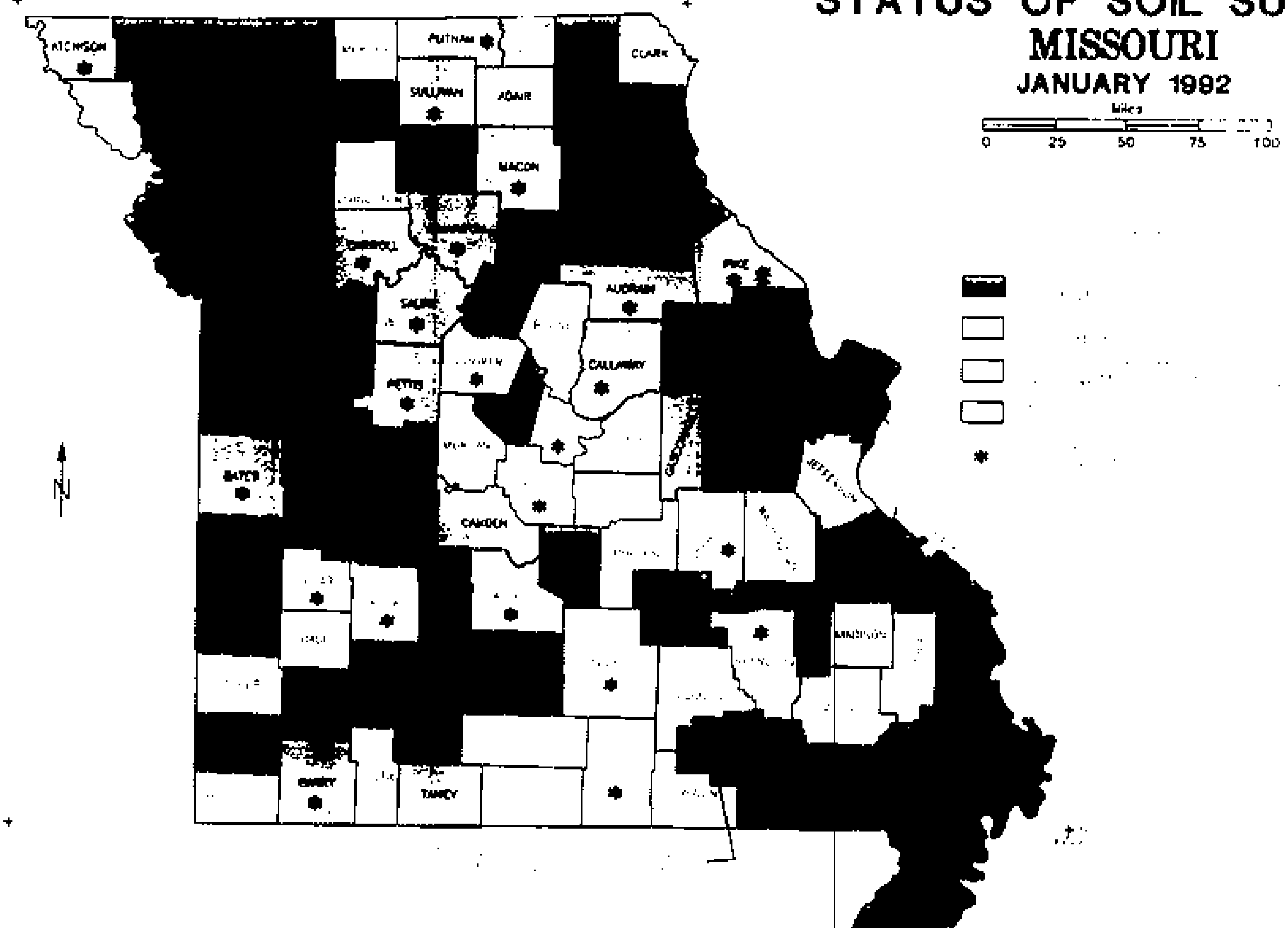
SOURCE:
DATA PROVIDED BY SCS STATE PERSONNEL. MAP PREPARED USING AUTOMATED MAP CONSTRUCTION. NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS 1990

OCTOBER 1990 1006617

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT. WORTH TX 1990

97

STATUS OF SOIL SURVEYS
MISSOURI
JANUARY 1992



1992 NCR-3 MEETING
NEBRASKA STATE REPORT

SECOND GENERATION SURVEYS

Cherry County (3,845,197 acres) completion 1995
Garden County (1,107,584 acres) completion 1993
Sioux County (1,324,876 acres) completion 1993

THIRD GENERATION SURVEYS

Dundy County	completion 1992
Hal 1 County	completion 1996
Saunders County	completion 1994
Washington County	completion 1996

MLRA UPDATES

MLRA 71 central Nebraska
MLRA 72 southwest Nebraska, northwest Kansas and northeast Colorado
MLRA 106 southeast Nebraska and northeast Kansas

SOIL SURVEY DIGITIZING

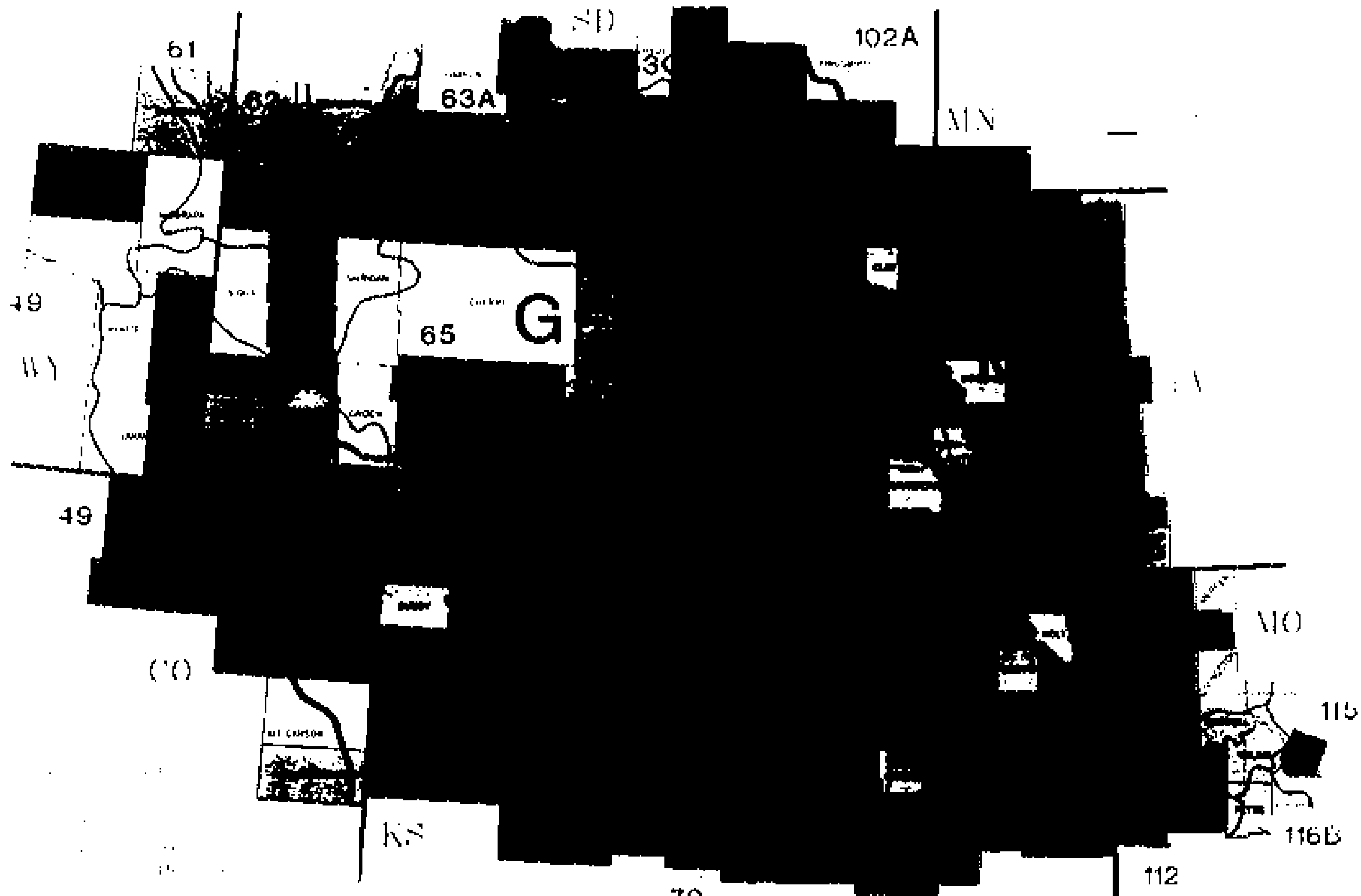
Second generation surveys will be recompiled on 7.5 minute quadrangle sheets and digitized by the Nebraska Natural Resources Commission.

Third generation surveys will be mapped on orthophotos and digitized by the Conservation and Survey Division prior to publication.

STAFF

Soil Conservation Service (19)
- State Soil Scientist - 1
- Assistant State Soil Scientists - 3
- GIS Specialist - 1
- Cartographic Technician - 1
- Area Soil Scientist - 4
- Field Soil Scientist - 9

Conservation and Survey Division (9)
- Research Soil Scientist - 7
- Data Base/Digitizing Specialist - 1
- Cartographer - 1



STATUS OF SOIL SURVEYS

NEBRASKA

AND PORTIONS OF COLORADO, IOWA,
KANSAS, MINNESOTA, MISSOURI,
SOUTH DAKOTA, AND WYOMING

MAY 1991

North Dakota Soil Survey Activities
NCR3 - 1992

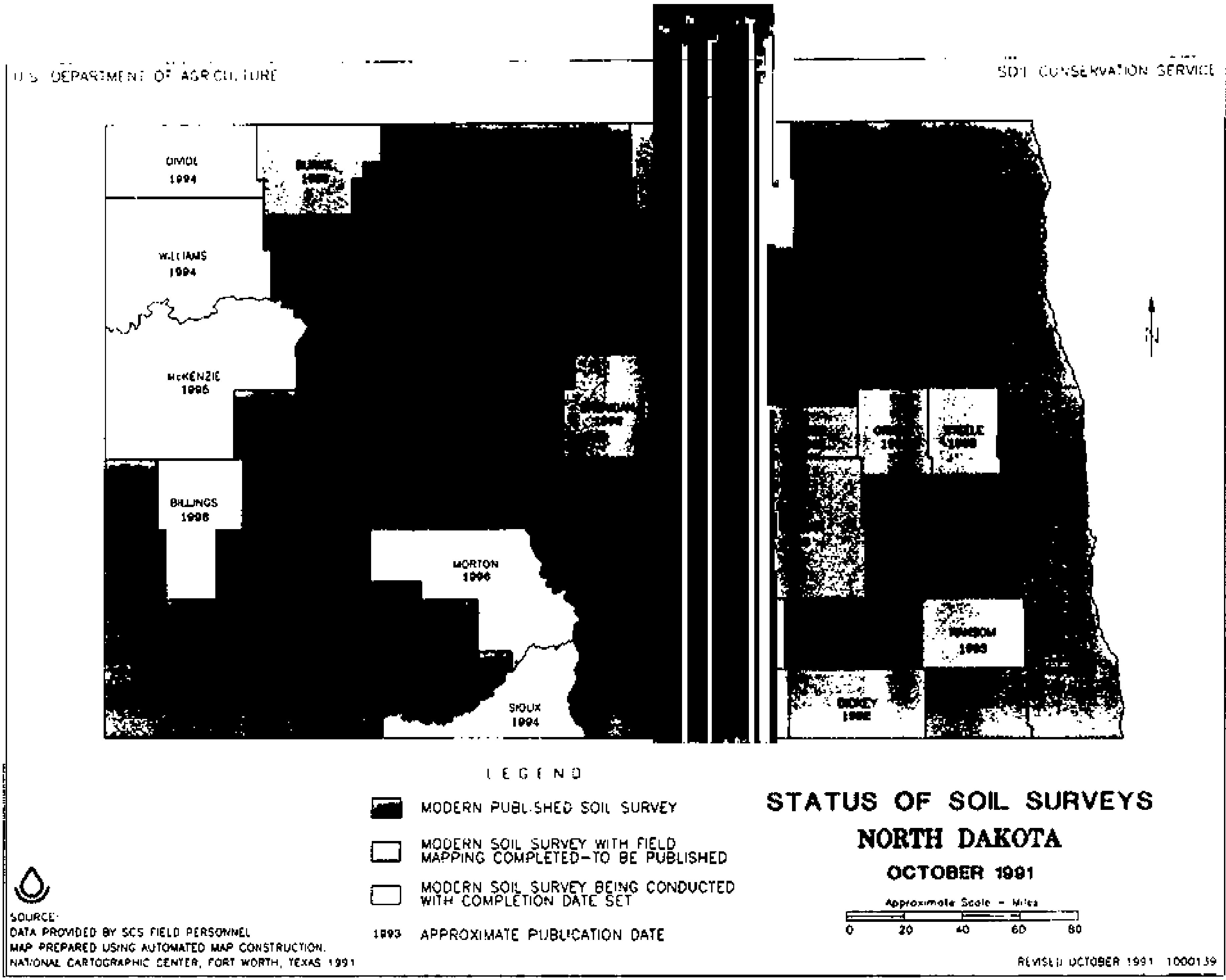
North Dakota soil scientists and friends will celebrate the "last acre" on September 15, 1992 in Bismarck. The activity will mark completion of the initial soil survey for the state excluding Billings, McKenzie and Morton counties which were mapped in the 1920's and 1930's by Charles Kellogg and crew.

Unfortunately, the number of soil scientists mapping in the field has dropped from 32 in August 1990 to 17 presently. Personnel reductions are due to proposed budget projections from SCS National Headquarters. The majority of the current field staff are active west of the Missouri River.

The reduction in field expertise is occurring simultaneously as requests for soil survey updates increase. There are a number of valid reasons for updates ranging from salinity and sodicity problems in the Red River Valley to classification problems along the Ustic/Aridic break in western North Dakota. Soils having natric conditions that were not recognized in earlier mapping are a common theme at the county level. Presently, the State Office is prioritizing the update needs, assessing "firmness" of financial support and determining which counties will head the list.

Soil Survey digitization is currently ongoing at digitizing centers located in the SCS State Office in Bismarck, the State Soil Conservation Committee office in Bismarck and at the North Dakota State University Soil Science Department. The soils maps for Golden Valley county (640,000 a) have been digitized and land use maps are currently being encoded. A scanner is being used to capture land use data at the State Conservation Committee Office but there are sill problems differentiating

Research efforts in the Department of Soil Science that will complement NCSS activities are the ongoing soil landscape studies. Hydric soil research is being conducted on till parent materials on the Missouri Coteau in the udic and ustic soil moisture zones. Soil sodicity is being investigated on tills with high Cretaceous shale contents at the Langdon Research Center in northeastern North Dakota. Soil/vegetation research is also ongoing in areas with sandy parent materials in the Sheyenne National Grasslands of southeastern North Dakota. Groundwater flow patterns, seasonality, and groundwater chemistry are being monitored at all of the above mentioned research sites, though at different levels of intensity.


U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
DIVIDE 1994
WILLIAMS 1994
McKENZIE 1996
BILLINGS 1996
MORTON 1996
SIOUX 1994
N
LEGEND
MODERN PUBLISHED SOIL SURVEY
MODERN SOIL SURVEY WITH FIELD MAPPING COMPLETED—TO BE PUBLISHED
MODERN SOIL SURVEY BEING CONDUCTED WITH COMPLETION DATE SET
1993 APPROXIMATE PUBLICATION DATE
STATUS OF SOIL SURVEYS
NORTH DAKOTA
OCTOBER 1991
Approximate Scale - Miles
0 20 40 60 80
SOURCE:
DATA PROVIDED BY SCS FIELD PERSONNEL
MAP PREPARED USING AUTOMATED MAP CONSTRUCTION.
NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS 1991
REVISED OCTOBER 1991 1000139

NCR-3
Ohio Progress Report

June **15-18,** 1990

St. Paul, **Minnesota**

Mapping for the first generation of soil surveys was completed in Ohio during the spring of this year. A "Threshold Acre Ceremony" is planned during September to Commemorate the accomplishments of the Ohio Soil Survey. Soil survey reports for 18 of Ohio's 88 counties are awaiting publication. Ohio's soil scientists are now involved in modernization projects and/or soil services. Five resource soil scientists are located about the state. Modernization projects are underway in ten counties. County **cost-sharing** funds are provided for all **modernization** projects. It is anticipated that all modernization projects will be conducted within the framework of an MLRA project. Currently Ohio is active in four MLRA projects: MLRA 99 with Michigan and Indiana, **MLRA's** 139 and 126 with Pennsylvania, and MLRA 121 with Kentucky.

Although the work load has decreased, the Ohio Soil Characterization Lab is still analyzing approximately 15 pedons per year. All data currently being generated are stored electronically but the compilation and electronic storage of old data and the transfer of data to the National Soil Data Base is on hold due to a lack of personnel and funds.

Current research efforts include:

1. A geomorphic study of Pleistocene landscape degradation and the soils of the associated valley fills in eastern and southeastern Ohio.

2. The origin and characteristics of polygonal patterns visible in aerial photographs of ground moraines in western Ohio.

3. The origin of smectites in soils of western Ohio.

4. The genesis of soils formed in a loess mantle welded to a Sangamon soil derived from Illinois **outwash** on terraces in south-central Ohio.

NCR-3 REPORT - WISCONSIN

JUNE 1992

Status of Soil survey

Pour counties n the northwestern portions ofthe sStae areI

NORTH CENTRAL SOIL SURVEY CONFERENCE
COMMITTEE 1 REPORT

SOIL SURVEY IN THE 1990's

Charge 1: There is a continuous need for the NCSS to improve operations and products. What strategies can be used to accomplish this?

Priority	Strategy
1	Develop and support alternative means of soil survey information delivery. a) Digitized soil surveys b) Two or three part publication formats
2	Involve participants in the development and periodic updating of long-range objectives for the NCSS. One recommended strategy is the establishment of advisory committees.

Charge 2: What strategies can be used to maintain and improve working relations vlthln the NCSS?

Priority	Strategy
1	Improve communication among participants through regularly scheduled meetings and the use of national, regional and state advisory committees.
2	Jointly develop cooperative local, state and regional projects, such as: a) Cooperative research projects b) Soil potentials c) LESA

Charge 3: What additional strategies can be used to develop and implement committee recommendations?

Priority	Strategy
1	Report progress on committee action items to the regional membership at subsequent North Central Soil Survey Conference.
2	Improve effectiveness of regional and national soil survey conferences by coordinating committees and charges.
3	Steering Committees must commit adequate time to the development of committee charges which can be addressed by recommendations for action and ensure that recommendations are forwarded to the appropriate body or individual for action.

Charge 4: What educational approaches are needed to address users needs such as producers, consultants and county and state governments?

Priority	Approach
1	Identify and coordinate user needs for soil survey information at the local and state levels. Ask states to report accomplishments in identifying and serving users needs at the 1994 conference.
2	Develop environmental soil science college curriculums to meet the needs of the public and private sectors.
3	Develop new training courses for soil scientists and consultants to expedite the use and understanding of soil surveys.

Charge 5: What future direction and charges should this committee pursue?

Priority	Approach
1	Recommend that the committee be continued.
2	Recommendations for facilitating MLRA Soil Surveys.
3	Develop strategy for coordinating lnterdisplinary input into soil surveys.

In summary, two recommendations that need special attention are:

1. Report progress on committee action items to the regional membership at subsequent North Central Soil Survey Conference.

2. Identify and coordinate users needs for soil survey information at thg local and state levels. Ask states to report accomplishments in identifying and serving users needs at the 1994 conference.

Committee

Neil Smeck, Chairperson, Ohio
Larry Tornes, Vice Chairperson, Michigan
Jim Culver, Nebraska
Alice Geller, Missouri
Tim Gerber, Ohio
Norman Helzer , Nebraska
K. K. Huffman, Ohio
Ken Lubich, Wisconsin
Delbert Mokma, Michigan
Ken Olson, Illinois
William Pauls, Missouri
Gregg Schellentrager, Iowa
Ray Sinclair, Nebraska
Jim Thiele, North Dakota
Bobby Ward, Indiana

7400E

NORTH CENTRAL REGION-WORK PLANNING CONFERENCE
ST. PAUL, MINNESOTA
June 15-18, 1992

COMMJTTEE REPORT

COMMJ'JTEE No. 2 GEOGRAPHIC INFORMATION SYSTEMS

COMMITTEE MEMBERS

*Bruce Thompson, SCS, 555 Vandiver Drive, Columbia, MO 65202
*Al Gieocke, SCS, 375 Jackson Street, Suite 600. St. Paul, MN 55101
*Tom D'Avello, SCS, 1902 Fox Drive, Champaign, IL 61820
*Jerry Schaar, SCS, 200 4th Street SW, Huron, SD 57350
*lay Bell, MAES, U of M, 501 Soils Bldg. St. Paul, MN
*Dale Ceolla, SCS, 63 Federal Building, Room 693, Des Moines, IA 50309
*Kevin McSweeney, U of W, 1525 Observatory Dnve, Madison, MN 53706
Ron Luethe, SCS, 220 E. Rosser Ave., Room 278, Bismark, ND 58504
Kim Steffen, SCS. 6120 Earle Brown Drive, Brooklyn Center, MN 55430
Mon Yee, SCS, NHQ, P.O. Box 2890. Washington, DC 20013
Bobby Ward, SCS, 6013 Lakeside Blvd., Indianapolis, IN 46278
Carl Wacker, SCS, 6515 Watts Road, Suite 200, Madison, WI 53719
Jerry Floren, MAES. 209 Mulberry St. St. Peter, MN
Gregg Schellentrager, SCS, 63 Federal Building, Des Moines, IA 50309
Norm Helzer, SCS, 100 Centennial Mall North, Room 152, Lincoln, NE 68508
*Denotes primary committee responsibility

Charge 1 - How should members of the NCSS provide quality control assurance of soil survey databases used in GIS by non-cooperators.

1. Through the use of MOU's and Cooperative Agreements. It is easy to work with cooperators. "Take advantage of this opportunity." Increase communications.

2. When data is released, it should be dated and archived to be able to determine who got what and when (quality control and liability potential)

3. It should be the responsibility of the user to request **periodic** updates if more than a "single shot" application. We cannot automatically send everyone updates.

4. Work with users to get them to request only what they need from 3SD. Avoid "send me **verything" mentality.**

5. Could draw from the experience of USGS in distribution of data (procedural matters).

6. STATSGO should be requested by non-cooperators from NCC with a $500.00 fee.

7. The revised NSH contains guidance and direction on the release of data bases.

RECOMMENDATION: distribution of this part of the NSH should be released as policy prior to NSH being printed and released.

Charge 2 - What type of hardware is needed for future GIS applications and what storage **needs will there be.**

"What we buy is out of date as soon as we receive it due to rapid technology changes."

1. **Storage** needs expanding rapidly. Digital ortho -- 1 to 2 gigabytes for average county at l-**12,000.**

2. Need to go to CD ROM or optical read/write technology.

3. Need to get correct hardware designed for specific task. Inefficiencies arise from make-do efforts. Beefed up PC's not making it to run UNIX.

4. Get maximum storage available now with expansion capability.

RECOMMENDATION: Design purchase contracts for intended use. Get correct platform to match the task. Don't expect a 10 megahertz to be efficient in GRASS. Make sure current contracts can meet future needs.

Charge 3 - What strategies **would improve the quality and utility of soil survey information through use of GIS and allied technologies.**

1. **DEM's** have excellent potential, Accuracy limited by 30 meter pixel size. Will have 10 or 15 meter resolution in future.

2. DTM are good in expressing geomorphic landforms at a larger scale.

3. **Need** statistical software to analyze map unit composition better. Need a standard transect method for MLRA updates.

4. Applications of **GIS** in soil interps will improve utility of soil survey information.

5. Use of GPS to locate data points and documentation.

RECOMMENDATION: Use this advance technology to support and enhance our knowledge and not replace it. Technology could be a crutch that could hamper sound development of geomorphic and landscape analysis. Sound analysis comes first/technology support, this.

Charge - What technique can be used to assure SSURCO standards are met and certification can be achieved with various vendors providing services.

1. Ensure that National Instruction 170-303 Second Addition is adhered to: Put standards and specifications in the contract for digitizing.

2. State needs to play quality assurance role with vendors.

3. Need a sheet by sheet review not just random sample. Some errors on "all" sheets reviewed.

RECOMMENDATION: Establish an MOU with key State and Federal agencies that are leaders in GIS to spell out that any joint project with sponsors will meet SCS SSURGO standards

It is recommended that this committee continue to be functional at the next WPC in 1994. However, the scope of the committee should be narrowed to avoid duplication with the database and interpretation committees.

FUTURE CHARGES FOR THE NEXT COMMITTEE TO CONSIDER

1. Where should digitizing (scanning) best take place for soil surveys in the future -- Field/state office, Universities -- vendors or combination.

2. What additional software is needed to improve use and interpretation of data and assist soil scientists do a better job.

3. Who maintains the MLRA database for MLRA updating and provides quality control.

4. What type of symbolization is needed in an MLRA update to assure a seamless map.

5. What strategies could be used to expedite the delivery of digital ortho for GIS application.

NORTH CENTRAL SOIL SURVEY CONFERENCE
COMMITTEE 3
SOIL CORRELATION AND CLASSIFICATION
JUNE 15-18, 1992

Participants:

Tom Fenton, Iowa Chairperson
Louis Boeckman, Iowa Vice-Chairperson
Jim Culver, Nebraska
Bob Engel, Nebraska
Jim Fortner, Nebraska
Richard Gehring, Ohio
Comeilius Heidt, North Dakota
Mark Kuzila, Nebraska
Clayton Lee, Nebraska
Ed Miller, Ohio
Dick Paulson, Minnesota
Dennis Potter, Missouri
M. D. Ransom, Kansas
Larry Ratliff, Nebraska
Dennis Robinson, Michigan
Ken Vogt, Missouri

Note: Bob Darmody, University of Illinois was not able to be present. So Tom Fenton represented him as chairperson of this committee.

Charges:

1. How series control section will impact on series differentiae.

It was the consensus of the committee that expanding the series control section will offer:

- It will offer more flexibility in establishing and differentiating new series.

- It will provide the opportunity to split existing series, especially those with different substratum phases and contrasting surface textures. The decision to split existing series must be coordinated very closely among user states in order to make corrections in the Mapping Unit Use File(MUUF). The major land resource area approach to maintaining the soil survey information may help in this coordination.

- Judgement must be used by soil scientists to determine when substratum and/or surface layer characteristics become series criteria. A rule of thumb might be to use them as needed to capture interpretation or genetic relationships. For example, some suborders recognize mollic subgroups, and this genetic and interpretative feature can be recognized at the series level.

It is also the consensus of the committee that there is a need to flag new series or substratum phases from the MUUF between states for consistency. MLRA activities mny help in this regard. Also need to note any change of substratum phases into new series.

1. How **series control section will impact on series differentiae.(Continued)**

- **NOTE: Series** and phases are different
  Series have wide range of characteristics
  Phase may become series under new series control section criteria

2. **How do we need to change correlation procedures to address MLRA correlations.**

It is generally believed that present correlation techniques are applicable to the **MLRA** if they are adjusted to accommodate a larger survey area. Progressive correlation must be applied promptly at all levels whether dealing with a county subset, a soil resource area, or a **photoquad.** Improved communications, a common standard of documentation, and better ways of tracking and exchanging information between states and survey are needed. Some suggestions of the committee include:

- Require each survey party within the MLRA to develop map units for the subset being updated for comparison against the **MLRA** standard.

    - For MLRA report, one description of a map unit is sufficient. However if subset is published **(ie.** county report of **MLRA),** we will need one series description for each county subset. This series description could be from another county within the **MLRA.** We **would need to reference** in each soil map unit description of **a county** subset to the legal location of a typical area.

- Track and exchange information on composition of map units. These are the named components, similar components, and dissimilar components. Documentation is needed for development of the MLRA Legend for the map unit component name. Transects and lab data are helpful documentation for this.

- Route proposed correlations to all states sharing the MLRA prior to their approval

- Provide mechanism to maintain uniformity within states and MLRA.

- Plan for long term maintenance program and provide for continuing update as new information becomes available. **An** example of this could be done by soil association areas, hydrologic units, watershed drainage systems, etc.

3. How **can we better coordiite interpretations during the correlation process.**

It was the consensus of the committee that coordination of interpretations must begin early in the survey. Exiting interpretations should be compared with available data. Potential problem areas and special needs should be identified and plans made to collect and analyze new data.

The ides of developing central crop yields for each map unit and allowing a range of about plus or minus 15% around the central value was discussed. There was some concern that a state yield system may be affected. However, it was generally felt that some flexibility in the presentation of yield data was needed and the exact approach should be determined by the steering committees for **MLRA's.**

There is still some question as to who has the final Soil Interpretation Record(SIR) approval especially when new SCS programs are involved. This needs to be addressed soon. Also, the concept of making interpretations directly from the estimated soil properties was discussed. It was believed that there will continue to be a need to evaluate the interpretations especially as to their relationship to other soils.

4. Series **differentiae - subdividing the series control section as a means of separating competing series.**

There was limited discussion on subdividing the series control section for series differentiae. The consensus seemed to be that one should be as general or specific as needed to quantitatively differentiate competing series. Specifying different parts of the series control section may be helpful when differentiating within a soil family hat has a large number of series. The particle size control section may also be used.

5. Develop subgroup criteria to help reduce the number of series in families tbat have large populations. (Mollic subgroups in fine-silty, mixed, mesic Hapludalfs have 25 series).

There was general agreement that new subgroups are needed in some families. The "Alic" proposal was mentioned as an example. The use of clay mineralogy criteria in tine-silty and fine-loamy families was proposed as an alternative way of subdividmg some families with large number of series. May consider subdividing senes that narrow the clay ranges within family classes. Landscape. subgroups may also be useful. The goal is to ensure each series is a valid and devise additional criteria that would result in more series but reduce the number of series within those families which have large populations.

6. **What future direction and charges should thii committee pursue.**

- Better define MLRA operating procedures.

- Develop proposals for improve communications and data share between project offices.

- Establish a "super steering committee" for land resource regions that will keep abreast of ongoing activities. Tt will track uniformity between MLRA's and inform others of what is going on in all M RA's

- Develop methods for better coordination of interpretations and resource groupings such as drainage class, water tables, capability subclass, slope groups, etc.

- These methods should also include ways to coordinate the use of term with other professional groups. The soil scientist needs to stay involved because they are conducting the business of classification and correlation.

The committee proposed the following question should be addressed in regard to interpretations and use of terms:

- Do we have some flexibility for local users?
- How do we monitor the history?
- How will changes impact old and new interpretations?
- How will these changes affect the past data.

North Central Soil Survey Work Planning Conference

Committee 4 -- Water Quality--Report

Chair: Robert D. Nielsen, Soil Scientist, Soil Survey Interpretations Staff, NSSC, Lincoln, NE.

COMMITTEE CHARGES

1. How can we improve our data bases to better interpret soils for water quality concerns. What additional or new data is needed.

Responses and Recommendations:

-- Organize publish spatial and tabular soil map unit data according to their geomorphic and stratigraphic unit occurrence. Provide soils spatial and tabular soil map unit data by watershed.

-- Validate and verify the soil tabular data (MUIR) and provide data reliability information. Need to validate data model against measured soil data. Establish a test area were there is sufficient lab data to verify and validated MUIR data.

-- Provide a mechanism for storing and retrieving state and local data into data set for water quality interpretations and information.

-- Acquire services of a soil chemist to help improve the organic matter information in the MUIR.

-- Identify relationships that may be useful for water quality and other interpretations.
    Iron Oxide relationships to hydraulic conductivity
    Clay mineralogy to basic soil properties related to
      water quality interpretations.

-- New Data Needs

Soil surface layer temporal and use dependent data and information to include porosity, bulk density, organic matter content, structure, infiltration, and runoff.

Subsurface layers data and information to include organic matter content for all layers, reliable estimates of water table depth and duration, porosity, and hydrologic conductivity.

Collect soil data and information needed to drive water quality models. (GLEAMS, EPIC, SPISP, NPURG, etc.)

Collect hydrologic conductivity data by horizon.

-MORE-

2. Based on individual state experiences, what new or additional interpretations are needed to address water quality concerns.

Responses and Recommendations:

-- Agricultural Waste Management
-- Municipal Sludge Disposal
-- Include water quality and waste management interpretations and information in published soil survey manuscripts.

3. How cautious should we as soil scientists be in providing investigations or interpretations for zones deeper than two meters. What depths should we be comfortable with.

Responses and Recommendations:

-- Provide only the information that is sufficiently documented and identify as to where it is applicable.

-- Include that information in technical descriptions and publications and database appendixes.

4. What future direction and charges should this committee pursue.

RECOMMENDATION: Soil Survey **Interpretative needs for Water Quality are the same or similar to the interpretative needs for other soil survey interpretations.**

Thus, the consensus of those attendins the committee sessions is to merqe this committee with the interpretation committee.

Robert D Nielsen

Robert D Nielsen, Chair

1992 North Central Soil Survey Work Planning Conference
St. Paul, Minnesota, June 15-18, 1992

Report of Committee No. 5: Soil Interpretations

Committee Members:

Richard L. Schlepp, SCS, Salina, KS, Chm.

Wayne Bachman, SCS, Huron, SD

Loren Berndt, SCS, East Lansing, MI

Clayton Lee, SCS, Lincoln, NE

Paul Minor, SCS, Columbia, MO

Richard Tummons, SCS, Columbia, MO

Nine additional people attended the meeting.

COMMITTEE CHARGES

1. What criteria and/or interpretations need to be revised and why?

2. Should soil interpretation records be separated by MLRA's in order to more accurately describe soil properties and interpretations?

3. Should the 2 to 10 meter zone be examined using data from other sources to address water quality concerns?

4. What new data elements need to be added to the SIR?

5. What future direction and charges should this committee pursue?

COMMITTEE RECOMMENDATIONS

CHARGE 1. What criteria and/or interpretations need to be revised and why?

The land capability classification needs to be reviewed. No revision may be needed, however, a specific set of criteria needs to be developed for assigning classes and subclasses. As an example, should we use the "c" subclass in the lake states? Also, there needs to be criteria for reducing the class on wet soils because of the short growing season.

The committee recommended that capability class and subclass be coordinated between states during the MLRA update process.

CHARGE 2. Should soil interpretation records be separated by MLRA's in order to more accurately describe soil properties and interpretations?

A consensus of the committee was that separate SIR's for MLRA's is a good idea. Too much data on a given SIR makes it difficult to manage. However, the following concerns were expressed:

1. There should be a need for different properties that effect interpretations.

2. That they do not create a join problem between MLRA's.

3. There should be an allowance for some overlap, if practical.

CHARGE 3. Should the 2 to 10 meter zone be examined using data from other sources to address water quality concerns?

The committee agreed that the 2 to 10 meter zone should be examined from other sources and as part of the MLRA update procedure. One individual thought that it should be a part of the MLRA soil survey manuscript and that guidelines and methodology should be developed for data collection. Another individual suggested a supplemental report.

(See attached paper on vadose zone data from Kansas.)

The committee recommends that the 2 to 10 meter zone be examined from other sources as part of an MLRA update with guidelines developed by NSSC on what level of data collection would be needed to provide water quality interpretations.

Assemble for soil survey areas, hydrologic units, and other areas the point information on 2 to 10 meters that is applicable to water quality for the vadose zone, prediction of engineering properties, and the understanding of soil and landscape evolution. The information should include water transmission rates, engineering index test results, and morphological stratigraphic information. The location of the point sites should be recorded on detailed soil maps. The data should be made for the immediate locale. Caution should be exercised in extension of point data to map unit components throughout a survey area. A geologist or a soil scientist with a strong background in geology should participate in any extension of the point data if publication is planned.

CHARGE 4. What new data elements need to be added to the SIR or SSSD?

There needs to be a better way to show aspect differences on the woodland tables. It is not easy to show two plant communities for a consociation on the woodland tables. An option that would print woodland information for both North and South aspects would be useful.

More room is needed for textures and coarse fragment modifiers in the estimated properties section. Soils that formed in parent materials with a wide range in coarse fragment size and amount have more textures than can be placed on the SIR.

The committee recommends that the information that we provide should not be limited by the forms we use.

Soils with stones on the surface are difficult to work with on SIR's. A method to recognize surface stoniness on the SIR or in SSSD needs to be developed.

It is recommended that structure and consistence below the surface horizon be incorporated into the NASIS data base to provide interpretations for root penetration and water movement.

There needs to be a review of the way specific criteria for defining free water is documented on the SIR. Users are manipulating our SIR data and making interpretations that are not consistent with the data on specific OSD's.

Free Water						
Surface				Subsurface		
Type	Freq	Duration	Months	Type	Depth	Duration
Flooding				Perched		

SIR's need to be open-ended for entering soil properties. Mechanics for obtaining criteria difficult with current property limitations.

In order to provide correct interpretations to the user and with the use of computer models, it is important to keep the range of soil properties as narrow as possible while still addressing the variability that occurs in map units. Use and management have a significant effect on many soil properties. Consideration should be given to developing soil property ranges for different land uses, such as cropland, rangeland, woodland, etc.

Other new elements should include:

1. Water Quality leaching and runoff ratings.
2. Uniform windbreak sites to the SIR.
3. Representative Values for soil properties with wide ranges.

The SIR is becoming, or has the potential to become, a complex document that is a duplication of State Soil Survey Database (SSSD) information. It may be approaching the time when we should develop reports for desired information from SSSD and discontinue the use of SIR's as the official soils record for properties and interpretations. SIR's have become, or should be considered, an input form for SSSD.

CHARGE 5. What future direction and charges should this committee pursue?

Committee comments:

1. Examine better and different ways to present soil-woodland interpretations.

2. Examine ways to emphasize to users of septic tank systems and other related interpretations about the need for onsite investigations and proper installation procedures.

3. Defined follow-up by the committee chair on status of past recommendations in order for the committee to evaluate the need for additional actions.

4. Phasing out SIR's. Official soil series data should be documented on a open ended form to account for expanding user needs.

5. The committee recommends that the steering Committee develop specific charges on criteria of interpretations that need to be revised.

STUDY IN THE USE OF WATERSHED DAM SITE GEOLOGIC DATA TO ESTIMATE PESTICIDE AND NUTRIENT MOVEMENT THROUGH THE VADOSE ZONE

This presentation is intended to provide ideas on using data collected in the PL-566 Watershed program to develop pesticide and nitrate movement potentials for vadose zone materials. The vadose zone is considered to be the region between the root zone (2 m) and the water table (10 m).

Kansas has a total of 116 watersheds covering 11,402,081 acres (figure 1). The data collected during the development of a watershed has potential for use in providing basic information concerning the vadose zone materials. The information presented in this paper is from two watershed dam sites located in Northeast Kansas (figurel):

A. Dam Site 50 in Watershed 61, Upper Black Vermillion Watershed located in Nemaha County, and

B. Dam Site 61 in Watershed 43, Elk Creek Watershed in Jackson County.

The Upper Black Vermillion Watershed has a total of 34 structures planned on 54,886 acres (figure 2). To date 27 structures have been completed. Dam site 50, located 1.5 miles south and 2 miles west of the city of Centralia, Nemaha County, Kansas. The drainage area consists of 8,016 acres.

The Elk Creek Watershed has a total of 61 structures planned on 89,063 acres (figure 3). To date 7 structures have been completed. Dam site 61, located 0.5 miles east of Circleville, Jackson County, Kansas. The drainage area consists of 538 acres.

location of borings marked. As shown on the soil survey map (figure 5), the soils in the area are:

Bs--Burchard-Steinauer clay loams, 6 to 12 percent slopes

Burchard-- Fine-loamy, mixed, mesic Typic Argiudoll

Steinhauer-- Fine-loamy, mixed, (cal) mesic, Typic Udorthent

Kb-- Kennebec silt loam-- Fine-silty, mixed, mesic Cumulic Hapludoll

Ch-- Chase silty clay loam-- Fine, montmorillonitic, mesic Aquic Argiudoll

The hydrologic group, pesticide leaching potential and land capability subclass for each soil is shown in the following table:

Burchard	hydgrp= B	LEA= Intermediate	LCC= IIIe
Chase	hydgrp= B	LEA= Nominal	LCC= IIw
Kennebec	hydgrp= B	LEA= Nominal	LCC= IIw
Steinauer	hydgrp= B	LEA= High	LCC= IIIe

On the Dam and Emergency Spillway Profile for site 50 (figure 6), the boring logs provide information concerning the Unified Classification, the depth to water tables (if any), depth to bedrock (if any), and horizons sampled for lab analysis.

The SCS-ENG-127, Materials Testing Report (figures7 and 8), records the density, void ratio, permeability, percolation, and specific gravity along with other pertinent data. Permeability is recorded as feet/day.

Sample B-15 was taken from the Kb- Kennebec silt loam map unit. The soil is logged as CL to a depth of 35 feet with a water table at 20 feet. Limestone bedrock was encountered at 45 feet. A sample was then taken at a depth of 13 to 14.7 feet. The permeability of the sample, based on lab results, (figure 7), is 4 x 10 -4 feet per day (.0002 in/hr). No loading pressure was stated on this test.

Sample B-202 was taken from the Bs--Burchard-Steinauer clay loams, 6 to 12 peraent slopes map unit. The soil was logged as CL and CH to a depth of 15 feet. This boring was sampled at a depth of 8 to 10 feet. The permeability of the sample, based on lab results, (figure 8) is 1 x 10 -5 feet per day (.00005 in/hr). No loading pressure was stated on this test.

ELK CREEK WATERSHED

Dam site 61 was built in section 22 T16S R14E (figure 3). Figure 9 is a topographic map of the site with the dam center line and the

Sample 304-l (figure 12) was taken at the 4 to 6 foot depth. The permeability was determined by the lab to be .5405 feet per day (.270 in/hr) under a loading pressure of 4000 lbs and 18 x 10 -5 feet per day (0.00009 in/hr) under a 16,000 pounds load.

Sample 304-2 (figure13) was taken from the same hole at a depth of 8 to 9.7 feet. Permeability was reported as 4.9 x 10 -4 feet per day (2.45 x10-4 in/hr) under 8000 pounds load.

And Sample 304-3 (figure 14), taken below the water table at 17 to 19 feet, had a permeability of 1.8 x 10 -3 feet per day (9x10-4 in/hr). Note the high initial void ratio of this sample. This sample is very permeable with no apparent consolidation.

Samples 304-l and 304-2 were naturally preconsolidated prior to testing. This was determined by consolidation tests and reflected by the lack of permeability results in the 2000 and 4000 pounds load columns.

DISCUSSION OF PERMEABILITY BATES AND PESTICIDE AND NITRATE MOVEMENT

How can the use of PL-566 boring data be useful in the development of a pesticide and nitrate management plan?

The Unified Classification can assist in determining pesticide and nitrate movement (i.e. correlation of permeability rates to pesticide and nitrate leaching), and locate strata6 of high permeability materials and low permeability materials.

When present, the depths to water tables, depths to bedrock, and the types of **bedrocks**

thocumresation for use in modelsof

COMMITTEE 6 - SOIL SUBVEY DATABASES (CHARGES)

1. What are the future software database needs that would benefit either the State Soil Survey Database (SSSD) or soil survey programs available to field soil scientists (DOS or UNIX)?

1) Easy transfer capability with other UNIX and non UNIX databases (DOS).
2) Ceoreferenclng of observations.
3) A working Pedon Program and the computers to run the program.
4) Analysis of laboratory characterization data through SSSD/NASIS (need data in relational database format).
5) Storage of site specific observations and information.

- Program to determine land capability classlflcatlon to eliminate discrepancies between states.
- Support, uhlch eliminates hardware compatibility problems, with the release of new software that uses utllltles such as Vermont Views.
- DOS version of the Pedon Program (field documentation and analysis).
- Incorporation of the crop yield database (SOI-1) into SSSD/NASIS.
- Incorporation of Soil Potential Indexes (SPI) into SSSD.
- Transect module with statistics package,
- Explore improved data input hardware/software.
- Improved teleconknunlcatlon capabilities for all users.

2. Outside of cooperating agencies, who are the users of the soil survey information in your state, and what lnfonnation is being requested?

- Consulting firms wanting both digital and attribute data for STATSCO.
- Loan offices, private assessors, and land management firms, requesting yields, capability class, and texture.
- Consultants and state regulatory agencies, requesting MUIR data, California Bearing Ratio. trace minerals, and heavy metals.
- Planning agencies or bureaus, assessors and appraisers, agrlconsultants, producers, engineering flrms, environmental agencies, and private companies.
- COE - MUIR data, FB - hydrlc data. munlclpalltles - attribute data and soils for taxation, and U. of I. Dept. of Engineering - index properties for hlghuay design (thesis).

3. Yhat are the future anticipated needs for storing database lnfonnatlon? What systems (hardware) would be best to use?

1) Network access to the database not only for NCSS but for all users for data access and for selected users data addition and

correctlon. Thls could be done using text oriented, hierarchical (hypercard) filing software and email type system.
2) Read/write optical disks.
3) Faster computers vlth more RAM and larger mass storage capability. Better back-up routines and equipment vhlch produces trustable restores.
4) CD ROM for more permanent data.
5) Automatic update of all levels of databases.

4. **Are the users of soil survey software programs receiving the needed training to use database programs? Uhlch training** programs have worked and vhich have not?

- Initial training for area soil scientists on SSSD has been sufficient.
- One on one training vith hands on experience is best form of training.
- With the release of FOCS, soils training needs to be better for field office personnel.
- Training for most field, area, and state office people Is inadequate. Training has been given to the administrators.
- Some trainers are poorly trained and/or are poor Instructors.
- Training seems to have become a 'TURF' battle between the state office and area office. Area office wants to do the training in the area, but are not alvays qualified.
- Best form of training is one day sessions vlth user working vlth their data, not a generic data set.
- Training has been limited vithin state, but that vhlch has been given has been In small groups or one on one as softvare Is distributed.
- CAHPS training, at least in IL. vas a fiasco.
- Softvare training should be user friendly to the point that training on the softvare is not needed.
- Soil survey training (softvare) should be on the state "core" program for specified employees, i.e. first or second year employees.

5. **What future direction and charges should thle committee pursue?**

1) Hust continually address current and future softvare and hardvare needs.
2) Revlev past recommendatlons and Implementations: needed changes to insure follov-up. May be need to revlev only one or tvo charges In more detail.
3) Need to promote more training In use of soils data, basic computer operations, and softvare use (DOS. MS-Word, Prelude, UNIX, etc,).
4) Gather and distribute information on types of data needed, need for application softvare. and Innovations In SSSD applications being used,

5) Needs to provlde access of the soil database to users outside NCSS.

- With release of NASIS, this committee could become a useful instrument to help address any problems with NASIS or Its use in the field.
- Opening of the system. Need to have ability to extract data and interpretations applicable to the local geographic unit (farm, forest parcel, urban site).
- Liaison or representative with database gurus (Ft. Collins). Current is by default rather than design.

6. A standards **committee (chaired by C. Steve Holzhey, Assistant Director, NSSC,** Lincoln, **Nebraska) was established at the 1991 National Cooperative Soil Survey (NCSS) meeting. Part of this group's charge is the additions/changes/deletions of data elements and/or their properties for use by NCSS members. What issues need to be addressed before this group can become functional? What procedure should be established to ensure the timely enhancement and/or additions of data elements?**

- **I'm** not sure what issues need to be addressed, however I believe the membership of this committee needs to be broad enough to insure that any standards being proposed by groups or individuals outside of SCS have an opportunity to be funnelled to the group. There may be Important groups that this committee is missing, because they are not represented on the committee. All cooperators of the NCSS should be made aware of this group and its responsibilities In order for this group to work effectively.
- A complete list of current data elements and definitions could be sent to all cooperators with comments. One way this group could function would be to have all future additions, deletions, or changes to data elements come before this committee at set perlod of time (either two, three, or four times per year) for action. Results of actions would be sent to all cooperators,
- The new ccnnmittee needs line of communication to funnel needs to proper database staff.
- A streamlined process with a check by Quality Assurance and a check for compatibility with SSSD modules needs to be established or promoted.
- A standing national committee is needed with representatives from: a) NSSC. (NSSL, SQA, SGIS); b) state labs; c) state cooperators; and d)

Record of North Central Soil Survey Conference

Year	Location of Meeting	Chairman
1955	Missouri	Ableiter, Aandahl
1956	Michigan	Westin
1957	Illinois	Bartelli
1958	Wisconsin	Bidwell
1959	Kansas	Rogers
1960	Indiana	Elder
1961	North Dakota	Engberg
1962	Ohio	Riecken
1964	Nebraska	Nelson
1966	Iowa	Ulrich
1968	Minnesota	Mitchell
1970	Illinois	Fehrenbacher
1972	South Dakota	Bannister
1974	Missouri	Scrivner
1976	Michigan	Harner
1978	Wisconsin	Hole
1980	Indiana	Sinclair
1982	North Dakota	Patterson
1984	Kansas	Roth
1986	Ohio	Smeck
1988	Nebraska	Culver
1990	Iowa	Fenton
1992	Minnesota	Giencke

MAILING LIST FOR NORTH CENTRAL REGION 3
July 7, 1992

Hugh Allcon
USDA-SCS- P.O. Box 6567
National Cartographic Center
Fort Worth- TX
76115

Dr. James Anderson
Department of Soil Science
501 Soil Buildin
1991 Upper Buford Circle
University of Minnesota
St. Paul-MN
55108

Wayne J. Bachman
Soil Conservation Service
200 Fourth Street- SW
Huron- SD
57350
605=353=1810

Steve R. Base
SCS- USDA- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Otto W. Baumer
SCS- USDA- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Albert Beaver
616 Van Hise
University of Wisconsin
Hadison- WI
53706

Francis Belohlavy
Federal Bldg.- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5322

Loren Berndt
Soil Conservation Service
1405 S. Harrison Rd.- Room 101
East Lansing- MI
48823-5202
517=337-6679

Dr. Thomas Bicki
Turner Hall- Dept. of Agronomy
1102 S. Goodwin Avenue
Urbana- IL
61801

Jerry **Bigham**
Department of Agronomy
Ohio State University
Columbus- OH
43210

Ricky Bigler
SCS- USDA- SSIG- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

James G. Bockheim
Department of Soil Science
University of Wisconsin
Madison- WI
53706

William D. Broderson
SCS- **USDA-** SSQA
100 Centennial Mall North
Lincoln **NE**
68508-3866
402=437=5353

Louis **Boeckman**
Soil Conservation Service
210 Walnut Street
693 Federal Building
Des Moines- IA
50309
515=284=4354

Jeffrey Bruggink
Huron-Manistee National Forest
421 South Mitchell Street
Cadillac- MI
49601
616=775=2141

Lester J. **Bushue**
Soil Conservation Service
1902 Fox Drive
Champaign- IL
61820

John Cain
Dept. of Natural Resources
Box 7921
Madison WI
53707

Tom D'Avello
Soil Conservation Service
301 North Randolph Street
Champaign- IL
61820
217-398-5293

Dale Ceola
Soil Conservation Service
210 Walnut Street
693 Federal Building
Des Moines- IA
50309
515-284-4354

Don Deal
USDA-SCS- P.O. Box 6567
National Cartographic Center
Fort Worth- TX
76115
817-334-5292

Terence H. Cooper
Department of Soils
University of Minnesota
St. Paul- MN
55455

John C. Doll
soil Conservation Service
1902 Fox Drive
Champaign- IL
61820

James Crum
Dept. of crop & Soil Sciences
Michigan State University
East Lansing- MI
48824
517-355-0213

Bob Engel
SCS- USDA- SSQA- Rm 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402-437-5659

James R. Culver
SCS- USDA- SSQA- Rm 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402-437-5353

T. E. Fenton
Department of Agronomy-ISU
2407 Agronomy Hall
Ames- IA
50011

Robert Darmody
Department of Agronomy
University of Illinois
Urbana- IL
61801

Paul Finnell
USDA-SCS
760 S. Broadway
Salina- Kansas
67401
913=823=4555

Earling E. Gamble
SCS- USDA- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Jerry Floren
MAES
209 B. Mulberry St
St. Peter- MN
56082
507=931=2530

Richard Gehring
200 N. High Street
Room 522
Columbus- OH
43215
614546916914

W. Richard Folsche
SCS- USDA
P.O. Box 6567
Fort Worth- TX
76115

Alice W. Geller
DNR - Div. of Env. Quality
P.O. Box 176
Jefferson City- MO
65102

Jim Fortner
SCS- USDA- SSQA- Rm 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5353

Tim Gerber
Ohio Dept. of Natural Resources
Fountain Square- Bldg. E-Z
Columbus- OH
43224

Don Franzmeier
Department of Agronomy
Purdue University
Lafayette- IN
47907

Jon C. Gerken
Soil Conservation Service
200'North High Street- Room 522
Columbus- OH
43215
614=469=6914

William E. Frederick
Soil Conservation Service
1405 South Harrison Rd.- #101
East Lansing- MI
48823-5202
517=337=6673

A. R. Gilmore
Department of Forestry
University of Illinois
Urbana- IL
61801

Robert B. Grossman
SCS- USDA- NSSL- Room 152
100 Centennial Mall North
Lincoln- **NE**
68508-3866
402=437=5363

Allan G. Giencke
Soil Conservation Service
600 PCS **Bldg.-** 375 Jackson St.
St. Paul- MN
55101
612=290=3679

Howard F. Gundlach
soil Conservation Service
6515 Watts Road- Suite 200
Madison- WI
53719-2726

Carl L. **Glocker**
SCS- USDA- SSQA- **Rm** 152
100 Centennial Mall **North**
Lincoln- NE
68508-3866
402=437=5353

Roger Habenuan
SCS- USDA- **MNTC-** Room 152
100 Centennial Mall North
Lincoln- **NE**
68508-3866
402=437=5353

Jerry D. Gott
Mark Twain National Forest
401 Fairgrounds Road
Rolla- MO
65401

George F. Hall
Department of Agronomy
Ohio State University
Columbus- OH
43210
614=292=2001

David F. **Griqal**
Department of Soil Science
University of Minnesota
St. Paul- MN
55455

R. David Hammer
Department of Agronomy
23 Mumford Hall- Univ. of Missouri
Columbia- MO
65211

Renee D. Gross
SCS- USDA- Room 152
100 Centennial Mall North
Lincoln- NH
68508-3866
402=437=5322

Milo Harpstead
College of Natural Resources
University of WI-Stevens Point
Stevens Points- WI
54481

Corneilius J. **Heidt**
Soil Conservation Service
P.O. Box 1458
Bismarck- ND
58502
701=250=4435

Gary **Heitman**
Bureau **of** Indian Affairs
1154th Avenue SE
Aberdeen- SD
57401

Norman P. **Helzer**
SCS- USDA- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5322

Mack S. Hodges
Soil Conservation Service
1902 Fox Drive
Champaign- IL
61820

Hubert Holdorf
U.S. **Forest** Service
P.O. Box 7669
Missoula- MT
59807

C. Steven Holzhey
SCS- USDA- NSSC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

David Hopkins
Soil Science Department
North Dakota State University
Fargo- ND
58102
701=237=8948

David Hoppe
Nicolet National **Forest**
68 South Stevens Street
Rhinelander- WI
54501

William D. Hosteter
Soil Conservation Service
6013 Lakeside Blvd.
Indianapolis- IN
46278

Berman D. Hudson
SCS- USDA- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5353

Keith Huffman
Soil Conservation Service
200 North High Street- Room 522

Clayton Lee
SCS- USDA- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5322

Christine Lietzau
Michigan Dept. of Agriculture
P.O. Box 30017
Lansing- MI
48909

Dave Lewis
Department of Agronomy
Univerity of Nebraska
Lincoln- NE
68583

Earl D. Lockridge
SCS- USDA- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5353

J. Cameron Loerch
SCS- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5353

Charles L. Love
USDA- SCS
528 S. 5th St.
Suite #210
Springfield- IL
62701
217=492=4156

Kenneth W. Lubich
Soil Conservation Service
6515 Watts Road- Suite 200
Madison- WI
53719-2726
608=264=5589

Barbara

Doug Ma10
Department of Plant Science
South Dakota State University
Brookings- SD
57007

Nathan McCaleb
MNTC-ESSP
100 Centennial Mall North
Lincoln- Nebraska
68508-3886
402-437-5315

Joseph McCloskey
Soil Conservation Service
600 FCS Bldg.- 375 Jackson St.
St. Paul- MN
55101
612-290-3679

Robert L. McLeese
Soil Conservation Service
1902 Fox Drive
Champaign- IL
61820

Vic McWilliams
USDA-SCS- P.O. Box 6567
National Cartographic Center
Fort Worth- TX
76115
817-334-5292

Kevin McSweeney
Department of Soil Sciences
203 Soils Building
Madison- WI
53706

Patrick C. Merchant
USDA- Forest Service
811 Constitution Avenue
Bedford- IN
47421

Steve Messenger
Department of Geography
Northern Illinois University
DeKalb- IL
60115

N. Larry Meyers
Plant & Earth Sciences Dept.
Univ. of Wisconsin-River Falls
River Falls- WI
54022

Randall J. Miles
Dept. of Agronomy- Univ. of MO
138 Mumford Hall
Columbia- MO
65201

Ed Miller
Ohio Dept. of Natural Resources
Fountain Square Drive
Columbus- OH
43224
614-265-6683

Gerald A. Miller
2104 Agronomy Hall
Iowa State University
Awes- IA
57350

Paul E. Minor
Soil Conservation Service
Parkdale Center
Suite 250
601 Business Loop 70 West
Columbia- MO
50011
314-876-0907

Delbert L. Mokma
Dept. of Crop & Soil Science
Michigan State University
East Lansing- MI
48824
517-353-9010

Byron Nagel
Soil Conservation Service
6013 Lakeside Blvd.
Indianapolis- IN
46278
317-290-3203

Robert Nielsen
Soil Conservation Service- NSSC
100 Centennial Mall North
Lincoln- NE
68508-3866
402-437-5423

Wiley D. Nettleton
SCS- USDA- NSSL- Rm 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Thomas O'Connor
soil Conservation Service
600 FCS Bldg.- 375 Jackson St.
St. Paul- MN
55101

Douglas Oelmann
Soil Conservation Service
693 Federal Bldg.- 210 Walnut St.
Des Moines- IA
50309
515-284-4353

Carolyn Olson
SCS- USDA- NSSL- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Ken Olson
Department of Agronomy
University of Illinois
Urbana- IL
61801
217-333-9639

Sam Orr
DRN- Div. of Environmental Qualit
P.O. Box 1116
Jefferson City- MO
65102

Eunice Padley
Hiawatha National Forest
2727 North Lincoln Road
Escanaba- MI
49829
906=786=4062

Felix Pender- Jr.
USDA Forest Service- Univ. of MC
For. Exp. Station- l-26 Agr. Bldg.
Columbia- **MO**
65211

Robert J. Parkinson
Soil Conservation Service
200 North High Street- ***Room*** 522
Columbus- OH
43215
614=469=6914

Dennis X. Potter
Soil Conservation
Parkdale Center
Suite 250
601 Business **Loop** 70 West
Columbia- MO
65202
314=876=0907

Donald D. Patterson
Soil Science Department
North Dakota State University
Fargo- ND
58102

Larry **Ragon**
SCS- USDA- Room 152
100 Centennial Mall North
Linooln- NE
68508-3866
402=437=5322

William R. Pauls
Soil Conservation Service
Parkdale Center
Suite 250
601 Business **Loop** 70 West
Columbia- MO
65202

M. D. Ransom
Department ***of*** Agronomy
Kansas State University
Manhattan- XS
66506

Richard D. Paulson
Soil Conservation Service
600 FCS **Bldg.-** 375 Jackson St.
St. Paul- **MN**
55101
612=290=3679

Larry F. Ratliff
SCS- USDA- **Rm** 152
100 Centennial Mall North
Lincoln- NE
68508-3866
402=437=5353

Lee Sikes
USDA-SCS- P.O. Box 6567
National Cartographic Center
Fort Worth- TX
76115

H. Raymond Sinclair- Jr.
SCS- USDA- MNTC- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Ben F. Smallwood
USDA- SCS
Soil Division
P.O. Box 2890
Washington- D.C.
20013

Neil E. Smack
Department of Agronomy
Ohio State University
Columbus-

Pamela J. Thompson
Soil Conservation Service
301 North Randolph Street
Champaign- IL
61820

Michael G. Ulmer
Soil Conservation Service
Box 1458
Bismarck- ND
58502
701=250=4435

L. A. Tornes
Soil Conservation Service
1405 S. Harrison Rd.- Room 101
East Lansing- MI
48823-5202
517=337=6680

Kenneth D. Vogt
Soil Conservation Service
Parkdale Center
Suite 250
601 Business Loop 70 West
Columbia- MO
65201
314=876=0907

Dale Trenda
Shawnee National Forest
901 South Commercial Street
Harrisburg- IL
62946

Carl E. Wacker
Soil Conservation Service
6515 Watts Road- Suite 200
Hadison- WI
53719-2726
608=264=5589

Richard Tummons
Soil Conservation Service
Parkdale Center
Suite 250
601 Business Loop 70 West
Columbia- MO
65202

Bobby J. Ward
Soil Conservation Service
6013 Lakeside Blvd.
Indianapolis- IN
46278
317=290=3203

E. Jerry Tyler
Department of Soil Science
Soils Bldg.- University of Wisconsin
Madison- WI
53706

Cleveland Watts
Soil Conservation Service
760 South Broadway
Salina- KS
67401
913=823=4555

Joseph E. Yahner
Department of Agronomy
Purdue university
West Lafayette- IN
47907

Ronald D. Yeck
SCS- USDA- NSSL- Room 152
100 Centennial Mall North
Lincoln- NE
68508-3866

Won S. Yee
USDA- SCS
Soil Division
P.O. Box 2890
Washington- D.C.
20013
202=690=0856

Thomas R. Ziegler
USDA-SCS
6013 Lakeside Blvd
Indianapolis- IN
46278

Responses

Question 7: Should the MNTC staff address the status of current NCSSC recommendations and action items at the next meeting?

YES: 49
NO: 0
No answer: 1

Question 8: Suggestions for change:

Summarized by subject area (including overlapping and conflicting views).

NCSSC Structure

- More time is needed for committee work.
- Charges should be sent to committee member sooner.
- NCSSC should be where we discuss the NCSS program and process.
- MNTC staff should address recommendations, follow-up, and follow through.
- Make sure all attendees are assigned a committee in advance.
- All participants should be able to comment on all committee charges in advance.
- Other cooperators and users should be invited to participate in meeting.
- Charges should include more description of problems.
- A presentation or overview of the problems associated with each charge would be helpful.
- Many committee members were concerned about the apparent lack of implementation of recommenced actions.
- Committee sessions are the heart of the meeting.
- If more specifics were discussed, more valid or practical resolutions or action statements could be produced.
- Less discussion of the "status of various staffs."

- Consider using TQM or nominal group setting approach with firm charges.
- Less time for special speakers.
- More time to discuss specific charges, more direct time for recommendations to become action items.
- Have staff report back on actions taken related to previous committee recommendations and distribute follow-up information to all in "off' year.
- Less time on presentations.
- Rotate schedule of presentations so you can attend those sessions of interest to you.
- Need break-out of state cooperators.
- Need 5 to 10 minute breaks every hour.
- More time needed for brainstorming on issues.
- Explore possibility of a joint meeting with another region.
- Follow-up needed on status of previous NCSSC recommendations.
- Current meeting format should stress identification of problems, proposals for resolution and presentation of proposal to appropriate staff.
- All participants should be given an opportunity to suggest charges for all committe es early in process.
- Let all participants respond to charges of all committees.
- Let planning committee sift through suggested charges and forward to committee chairs.
- Let the committees have time to discuss and sort out comments to develop proposals to forward to appropriate staff.

- Representatives of MNTC and NSSC should be on steering committee.
- Select a theme and have speakers address that theme or issue.
- Report progress on charges.
- Several charges (this year) were addressed by committees outside of the pertinent committee. Re-direct these responses to the pertinent committee.
- Need follow-up and reporting of results of committee recommendations.
- More thought and time needs to be spent on committee charges.
- Shorten field trip by reducing repetition. One or two pits are sufficient with more information provided on soil resources and management.
- Issue committee charges to committee member earlier so members may respond in a timely manner.
- Have a state conservationist in the region attend.
- Invite ARS Hydrology and Tilth laboratory staff as well as any field type researchers.
- Need to wrap up by noon on final day.
- Conference was well organized and coordinated.
- Less presentations and more active committee work.
- Have an annual meeting and a follow-up of committee recommendations.
- Limit the number of charges but take them seriously and implement.
- Continue meeting and exchanging views even without committee work. Could still make recommendations.
- Have an annual meeting to help keep members better informed and providing input.
- Follow recommendations of Committee 1.

- Extend the program to 4 or 4.5 days to permit discussion and work by committee.
- Each regional SS conference should have 3 of the 6 committees that are identical. Use committee reports to encourage action by National SSC.
- Have National SSC address NCSSC recommendations.
- If Ag. Exp. Stations are to continue to be a part of National Cooperative Soil Survey, it would seem appropriate for AES to budget for this meeting on a bi-annual basis.
- Committee charges would be action items. Most charges are very shallow and too broad to address in short time available to the committees.
- NCR-3 breakout should be scheduled at a time not conflicting with people who ha ve planes to catch (evening?).
- Time for committee meetings should be doubled.
- Thursday morning committee report session was excellent. A full day field trip is too inefficient.
- Continue focus on developing and implementing committee charges.
- Highlight development of pro-active approach for (1) communication among cooperators, (2) basic and applied research program to refine and extend use of the extensive body of soils information, and (3) identify contributions NCSS can make to issue beyond traditional domain of operations.
- Follow through on what actions were taken on committee recommendations would be an improvement.
- Have meetings between cooperators on MLRA updates with the NC region (at this conference).

- This conference is not a "work planning conference." It used to be. It has evolved into a display of agency activities.
- Committee charges should have the majority of time. "General session" topics should be held to a minimum.

Suggested Subjects for Next NCSSC

1. Erosion
2. GIS
3. Digitizing tools
4. Panel on MLRA procedures
5. Committee to address our effectiveness with users.

NORTH CENTRAL SOIL SURVEY CONFERENCE

OF THE NATIONAL COOPERATIVE SOIL SURVEY

PURPOSE, POLICIES, AND PROCEDURES

1986 (REVISED)

I. Purpose of Conference.

The purpose of the conference is to bring together North Central States representatives of the National Cooperative Soil Survey for discussion of technical questions. Through the actions of committees and conference discussions, experience is summarized and clarified for the benefit of all; new areas are explored; procedures are proposed; and ideas are exchanged and disseminated. The conference also functions as a clearinghouse for recommendations and proposals received from individual members and state conferences for transmittal to the National Cooperative Soil Survey Conference. It also acts on recommendations from the national conference and other regional conferences.

II. Membership.

Participants of the conference are the soil scientists of the North Central Region (Ill., Ind., Iowa, Kans., Mich., Minn., MO., Nebr., N. Dak., Ohio, S. Dak., and Wise.) which the cooperating agencies wish to send (each agency shall notify the Head, MNTC Soils Staff, of any changes in its representatives), and a representative of the SCS National Headquarters Soil Survey Division. Any soil scientist or other technical specialists of any state or federal agency or private enterprise whose participation would be helpful for particular objectives or projects of the conference may attend. Interested persons in the host state are also welcome to attend.

III. Meetings.

A. Time of Meetings.

The conference will ordinarily convene every 2 years in even-numbered years. Time of year is determined by the conference chairman. Additional meetings may be called by request of the steering committee or the conference with the administrative approval of the participating agencies.

B. Host State.

The host state is determined two meetings in advance: (e.g., the 1986 conference selects the host state for 1990, the 1988 conference selects the host state for 1992, etc.). During the conference business meeting invitations from the various states are considered and voted upon. A simple majority vote decides the host state. The conference may be held at any suitable location within the host state.

C. Separate Meetings.

The North Central Regional Committee No. 2 (NCR-3) on soil surveys generally will meet during the conference. Concurrently, soil scientists of the other cooperating agencies will meet to discuss their problems.

IV. Officers and Steering Committee.

Officers rotate among agencies. That is, the chairman must be of a different agency than the past chairman. Similarly, the secretary must be of a different agency than the past secretary. At each biennial conference a secretary is elected for the succeeding conference. The secretary becomes chairman when their successor is elected. When an officer is unable to complete their term of office, the steering committee shall appoint a successor.

A. Chairman.

The chairman is from the host state. Responsibilities include the following (specific tasks may be delegated to the secretary):

1. Functions as head of the Steering Committee.

2. Plans and manages the biennial conference.

3. Determines, with assistance of the steering committee, the kinds of committees, selects the committee chairmen and assistant chairmen, formulates and transmits charges to committees, and appoints committee members.

4. Issues announcements of and invitations to the conference.

5. Writes the program and has copies prepared and distributed to the membership.

6. Makes necessary arrangements for: food and lodging accommodations; special food functions; meeting rooms (including committee rooms); and local transport for official functions.

7. Provides for appropriate publicity for the conference.

8. Presides at the business meeting of the conference.

B. Secretary.

The secretary is from the state that will host the succeeding biennial conference. The secretary for the succeeding conference is elected by simple majority vote after the host state is chosen for the meeting to be held in 4 years. Nominations for secretary come from the floor.

Responsibilities of the Secretary Include the Following:

1. Assists in the planning and management of the conference.

2. Assists in the selection of committee chairmen and assistant chairmen and in the selection of committee members.

3. The committee will meet once after the business meeting of each conference and may meet at other times if necessary.

4. Most of the committee's communications will be in writing. Copies of all correspondence between members of the steering committee shall be sent to each member of the committee.

5. The steering committee assists in the selection of special participants in a specific regional conference.

6. The steering committee assists in the formulation of charges to committees.

7. The Head, Soils Staff, maintains the conference membership list and distributes it to the incoming chairman.

D. Advisors,

Advisors may be selected by the steering committee or the conference.

E. Committee Chairmen.

The chairman of each committee is selected by the conference chairman.

V. Committees.

A. Most of the technical work of the conference is accomplished by duly constituted committees.

B. Each committee has a chairman (committee chairmen are selected by the conference chairman). A secretary, or recorder, will be selected by the committee chairman.

C. Each committee has an assistant chairman who succeeds to the position of chairman for the following conference.

D. The kinds of committees, and their members, are determined by the conference chairman. In selecting committee members consideration is given to expressions of interest filed by the members, suggestions of the steering committee, efficient continuity of the work, and the technical proficiency of the members of the conference.

E. Each committee chairman shall give a verbal summary at the designated time at each biennial conference. These committee reports shall be written by the committee chairman as per instructions from the steering committee. The report shall have a statement on the action taken on it by the conference. Chairmen of committees are responsible for submittal of one camera-ready copy of committee reports to the secretary within 30 days of the conference.

F. Much of the work of committees will, of necessity, be conducted by correspondence between the times of biennial conferences. Committee chairmen are charged with responsibility for initiating and carrying forward this work. They shall provide their committee members with the charges as directed by the steering committee, and whatever additional instructions they deem necessary for their committees to function properly. Chairmen should initiate committee work at the earliest possible date.

VI. Representation to the National Soil Survey Conference.

Representatives to the steering committee for the National Cooperative Soil Survey Conference will be the Head, Soils Staff, MNTC, and a state delegate from the previous host state for the North Central Soil Survey Conference. the state delegate will be chosen during the NCR-3 separate session. Delegates to the National Cooperative Soil Survey Conference will be the Head, Soils Staff, MNTC, one state soil scientist, and two state representatives (with appropriate administrative approval). The state soil scientist and state representatives will be chosen by simple majority vote during the separate sessions.

VII. Historical Record.

A cumulative file of conference programs shall be turned over to each incoming conference chairman.

VIII. Amendments.

Any part of this statement of purposes, policy, and procedures can be amended at any time by simple majority vote of the participants attending the business meeting.

1992 CONFERENCE SPONSORS

BRAUN INTERTECH Environmental, Inc.

CARGILL, Central Research

CENEX/LAND-O-LAKES

CENTROL, Cottonwood, Minnesota

MINNESOTA PLANT FOOD AND CHEMICAL ASSOCIATION

PIONEER HI-BRED INTERNATIONAL, North Central Sales Region

SPECTRUM RESEARCH INC.

TYLER, Benson, Minnesota

TABLE OF CONTENTS

FIELD TOUR SCHEDULE/STOPS

WPC-North Central Region

June 17, 1992

8:00 AM	Board busses at Radisson Hotel
9:00 AM	Arrive at Farming by Soil Site-P.C. Robert, J. Vetsch
10:00 AM	Leave for Sherburne National Wildlife Refuge
10:30 AM	Arrive at Sherburne Refuge Lamellae Formation-M. Tomer Wetland Vegetation-S. Eggers
11:30 AM	Leave for Park to have lunch
12:oo	Lunch at Zimmerman-Lions Park
1:00 PM	Board bus for Management System Evaluation Area
1:30 PM	Discuss MSEA site and project, J.Anderson, J. Lamb
2:30 PM	Board bus for Long Term Ecological Research site
3:00 PM	LTER Site-P.Bates
4:00 PM	Board bus for Bunker Hill-Shelter # 5
4:30-5:30	Social Hour/refreshments
5:30-6:30	Deep fried Walleye Dinner
7:00 PM	Return to Radisson Hotel

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Some symbols without a slope letter are for nearly level soils or land types, but some are for soils or land types that have a considerable range in slope. The number, 2 or 3, in a symbol indicates that the soil is eroded or severely eroded.

SYMBOL	NAME
Ad	Alluvial land
Af	Alluvial land, frequently flooded
Ap	Adolph loam
Ba	Beach sand
BeA	Becker loam, 0 to 2 percent slopes
BeB	Becker loam, 2 to 6 percent slopes
BrA	Braham loamy fine sand, 0 to 2 percent slopes
BrB	Braham loamy fine sand, 2 to 6 percent slopes
BrB2	Braham loamy fine sand, 2 to 6 percent slopes, eroded
BrC	Braham loamy fine sand, 6 to 12 percent slopes

[redacted]

SYMBOL	NAME
ChA	Chetek sandy loam, 0 to 2 percent slopes
ChB	Chetek sandy loam, 2 to 6 percent slopes
ChB2	Chetek sandy loam, 2 to 6 percent slopes, eroded
ChC	Chetek sandy loam, 6 to 12 percent slopes
ChC2	Chetek sandy loam, 6 to 12 percent slopes, eroded
ChC3	Chetek sandy loam, 6 to 12 percent slopes, severely eroded
Du	Dundas loam
EgC	Emmert gravelly loamy sand, 6 to 12 percent slopes
EgE	Emmert gravelly loamy sand, 12 to 35 percent slopes
ElA	Emmert loamy sand, 0 to 2 percent slopes
ElB	Emmert loamy sand, 2 to 6 percent slopes
ElB2	Emmert loamy sand, 2 to 6 percent slopes, eroded
ElC	Emmert loamy sand, 6 to 12 percent slopes
ElC2	Emmert loamy sand, 6 to 12 percent slopes, eroded
ElC3	Emmert loamy sand, 6 to 12 percent slopes, severely eroded
EmD	Emmert and Chetek soils, 12 to 18 percent slopes
EmD2	Emmert and Chetek soils, 12 to 18 percent slopes, eroded
EmE	Emmert and Chetek soils, 18 to 25 percent slopes
EmE2	Emmert and Chetek soils, 18 to 25 percent slopes, eroded
ErB2	Emmert–Hayden complex, 2 to 6 percent slopes, eroded
ErC2	Emmert–Hayden complex, 6 to 12 percent slopes, eroded
ErD2	Emmert–Hayden complex, 12 to 18 percent slopes, eroded
ErE2	Emmert–Hayden complex, 18 to 25 percent slopes, eroded
EsA	Estherville sandy loam, 0 to 2 percent slopes
EsA2	Estherville sandy loam, 0 to 2 percent slopes, wind eroded
EsB	Estherville sandy loam, 2 to 6 percent slopes
EsB2	Estherville sandy loam, 2 to 6 percent slopes, eroded
EsC	Estherville sandy loam, 6 to 12 percent slopes
EsC2	Estherville sandy loam, 6 to 12 percent slopes, eroded
FaA	Fairhaven silt loam, light-colored variant, 0 to 2 percent slopes
FaB	Fairhaven silt loam, light-colored variant, 2 to 6 percent slopes
HaA	Hayden fine sandy loam, 0 to 2 percent slopes
HaB	Hayden fine sandy loam, 2 to 6 percent slopes
HaB2	Hayden fine sandy loam, 2 to 6 percent slopes, moderately eroded
HaC	Hayden fine sandy loam, 6 to 12 percent slopes
HaC2	Hayden fine sandy loam, 6 to 12 percent slopes, moderately eroded
HaC3	Hayden fine sandy loam, 6 to 12 percent slopes, severely eroded
HaD	Hayden fine sandy loam, 12 to 18 percent slopes
HaD2	Hayden fine sandy loam, 12 to 18 percent slopes, moderately eroded

SYMBOL	NAME
HaD3	Hayden fine sandy loam, 12 to 18 percent slopes, severely eroded
HaE	Hayden fine sandy loam, 18 to 35 percent slopes
HuA	Hubbard loamy sand, 0 to 2 percent slopes
HuA2	Hubbard loamy sand, 0 to 2 percent slopes, wind eroded
HuB	Hubbard loamy sand, 2 to 6 percent slopes
HuB2	Hubbard loamy sand, 2 to 6 percent slopes, eroded
HuB3	Hubbard loamy sand, 2 to 6 percent slopes, severely eroded
HuC	Hubbard loamy sand, 6 to 12 percent slopes
HuC2	Hubbard loamy sand, 6 to 12 percent slopes, eroded
HuC3	Hubbard loamy sand, 6 to 12 percent slopes, severely eroded

[redacted]

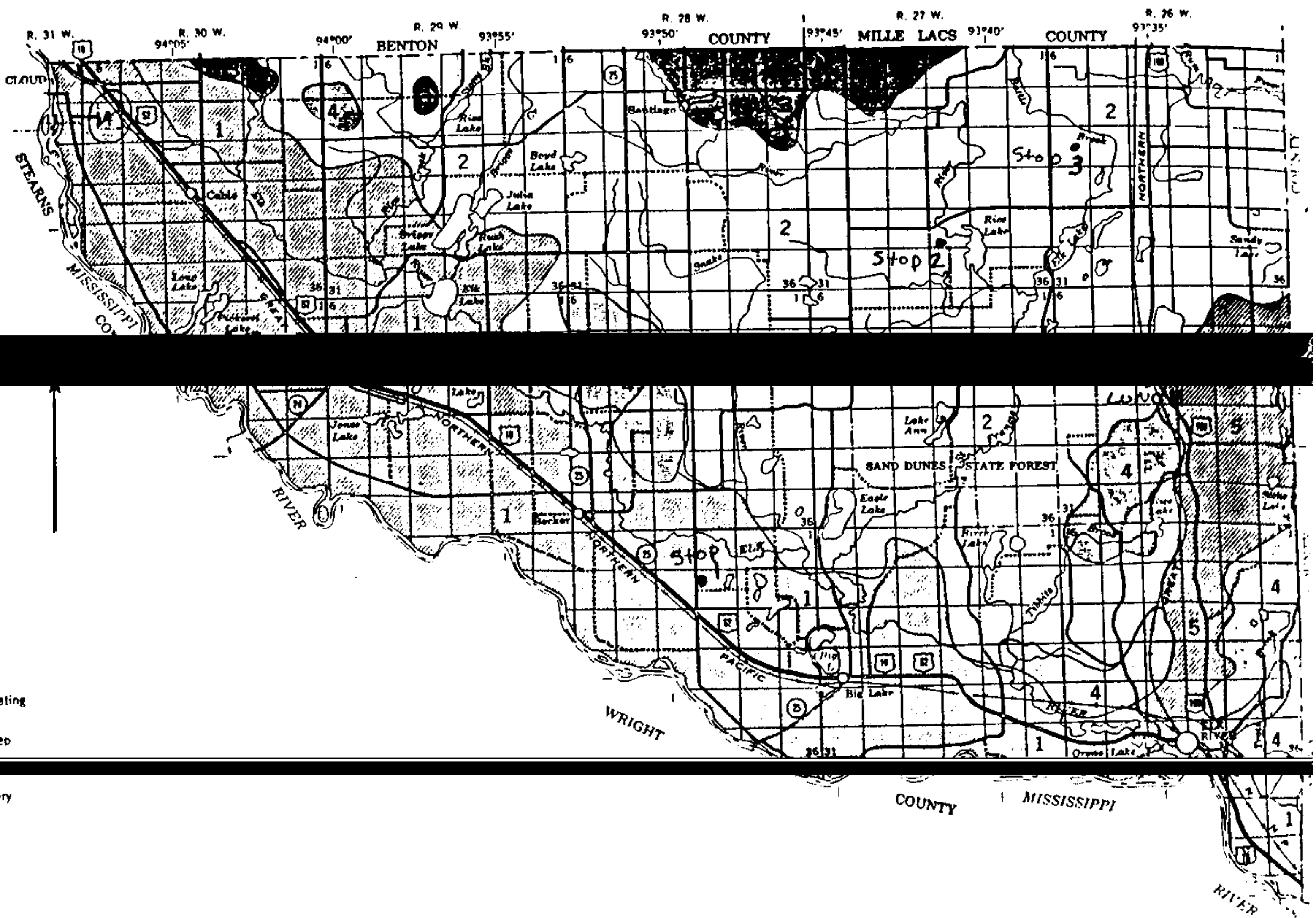
SYMBOL	NAME
HyC2	Hubbard sandy loam, 6 to 12 percent slopes, eroded
Is	Isanti loamy fine sand
LnA	Lino loamy fine sand, 0 to 2 percent slopes
LnA2	Lino loamy fine sand, 0 to 2 percent slopes, wind eroded
LnB	Lino loamy fine sand, 2 to 6 percent slopes
LsA	Lino loamy fine sand, loamy substratum, 0 to 2 percent slopes
Lw	Loamy wet land
Ma	Marsh
MlA	Milaca fine sandy loam, 0 to 2 percent slopes
MlB	Milaca fine sandy loam, 2 to 6 percent slopes
MlB2	Milaca fine sandy loam, 2 to 6 percent slopes, moderately eroded
MlC2	Milaca fine sandy loam, 6 to 12 percent slopes, eroded
MlD	Milaca fine sandy loam, 12 to 18 percent slopes
MlE	Milaca fine sandy loam, 18 to 25 percent slopes
MoA	Mora loam, 0 to 2 percent slopes
MoB	Mora loam, 2 to 6 percent slopes
Pa	Peat and muck, deep
Pc	Peat and muck, shallow, over loam
Pd	Peat and muck, shallow, over sand
Pn	Peat–Lino complex
PoA	Pomroy loamy fine sand, 0 to 2 percent slopes
PoB	Pomroy loamy fine sand, 2 to 6 percent slopes
Ro	Ronneby loam
SaB	Solida complex, 0 to 6 percent slopes
SaB2	Solida complex, 0 to 6 percent slopes, eroded
SaC	Solida complex, 6 to 12 percent slopes
SaC2	Solida complex, 6 to 12 percent slopes, eroded
SaE	Solida complex, 12 to 25 percent slopes
WaA	Wadena loam, 0 to 2 percent slopes
ZfE	Zimmerman fine sand, 12 to 25 percent slopes
ZmA	Zimmerman loamy fine sand, 0 to 2 percent slopes
ZmA2	Zimmerman loamy fine sand, 0 to 2 percent slopes, wind eroded
ZmB	Zimmerman loamy fine sand, 2 to 6 percent slopes
ZmB2	Zimmerman loamy fine sand, 2 to 6 percent slopes, eroded
ZmC	Zimmerman loamy fine sand, 6 to 12 percent slopes
ZmC2	Zimmerman loamy fine sand, 6 to 12 percent slopes, eroded

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GENERAL SOIL MAP
SHERBURNE COUNTY, MINNESOTA

SCALE IN MILES

1 0 1 2 3 4



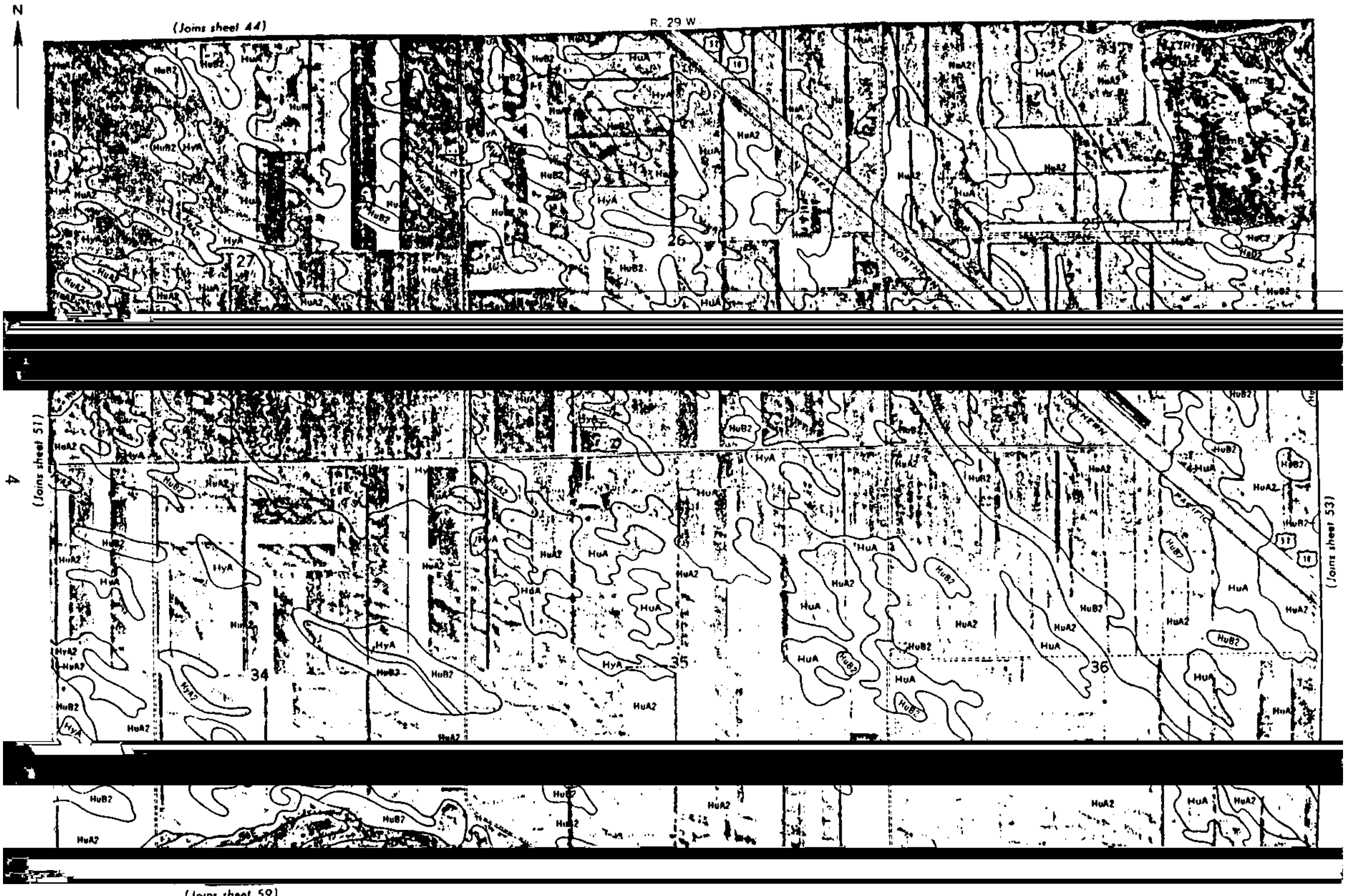
SOIL ASSOCIATIONS

1	Hubbard-Estherville-Salida association: Nearly level to gently rolling, sandy soils over deeply leached sand or calcareous gravel
2	Zimmerman-Lino-Isanti-peat association: Nearly level to undulating, acid, windblown, sandy soils
3	Milaca-Mora-Ronneby association: Nearly level to undulating soils over slightly acid, red glacial till
4	Hayden-Braham-Emmert association: Undulating to steep [illegible] till or gravel or capped with fine sand
5	Burkhardt-Chetek-Emmert association: Undulating to very steep, shallow soils over acid gravel

December 1966

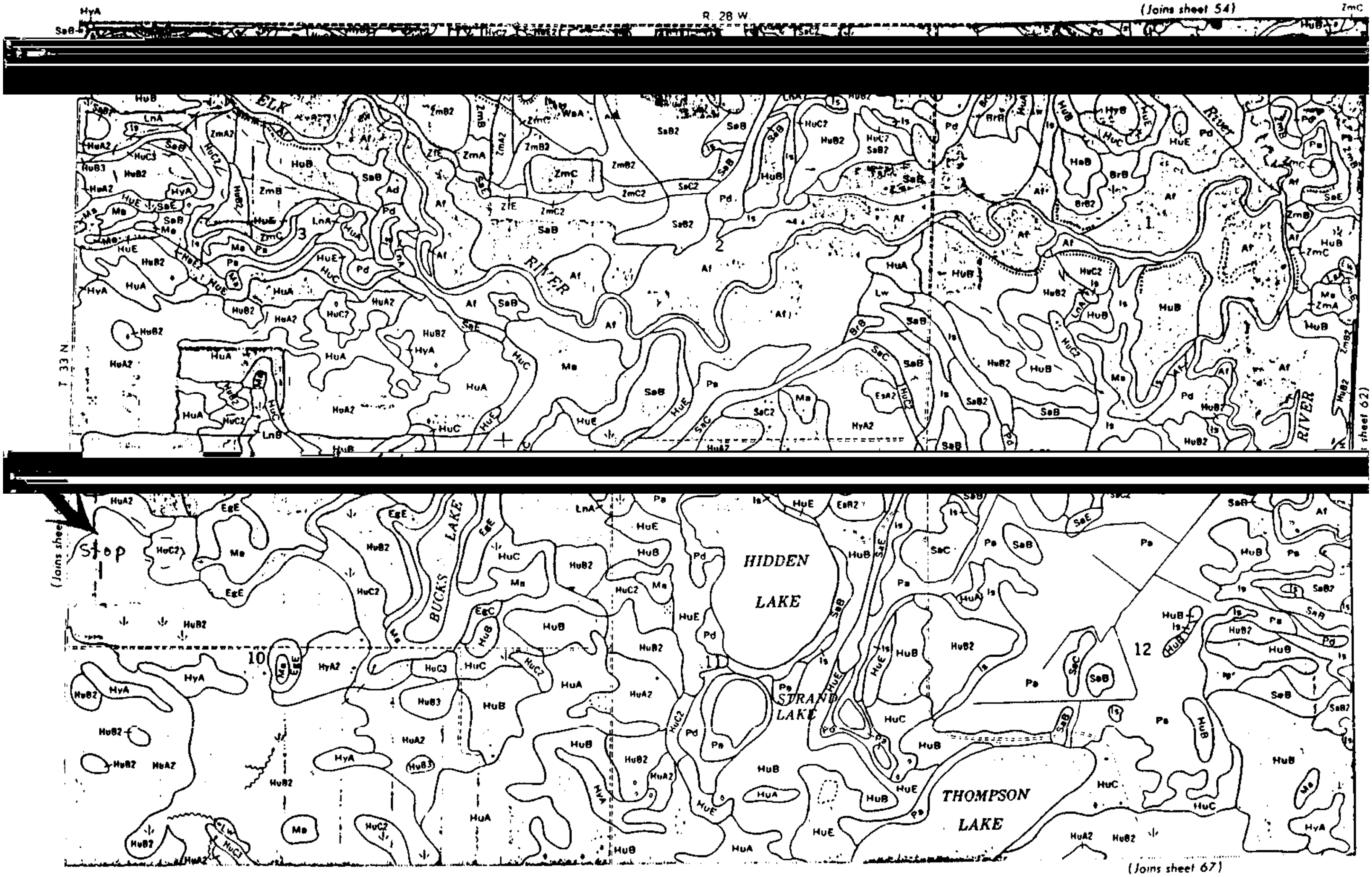
SHERBURNE COUNTY, MINNESOTA — SHEET NUMBER 52

(52)



Typical mapping in the Anoka Sand Plain. Notice the braided stream pattern with a NW/SE orientation.

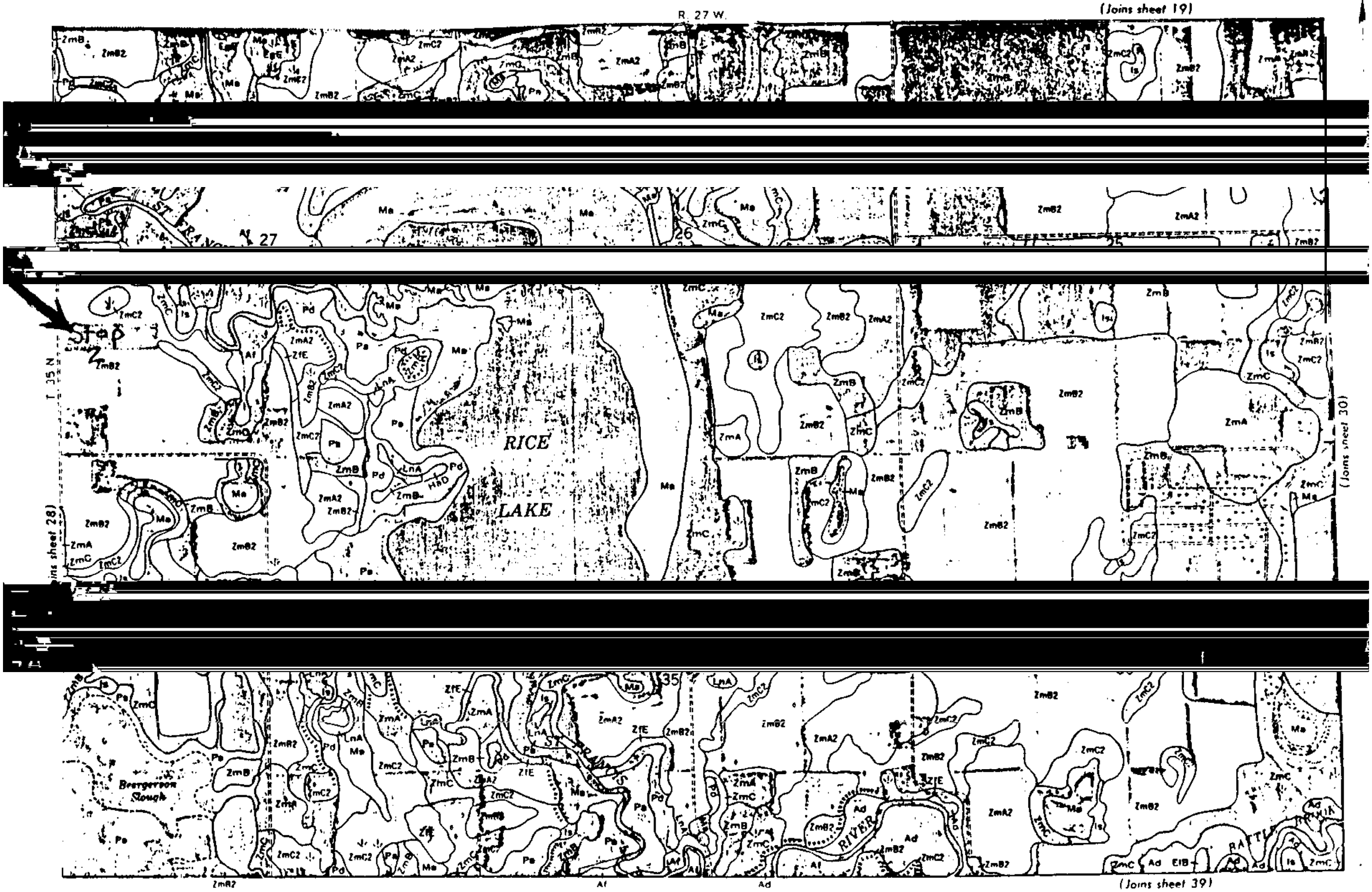
0 ½ Mile Scale 1:15840 0



5

Scale 1:15840

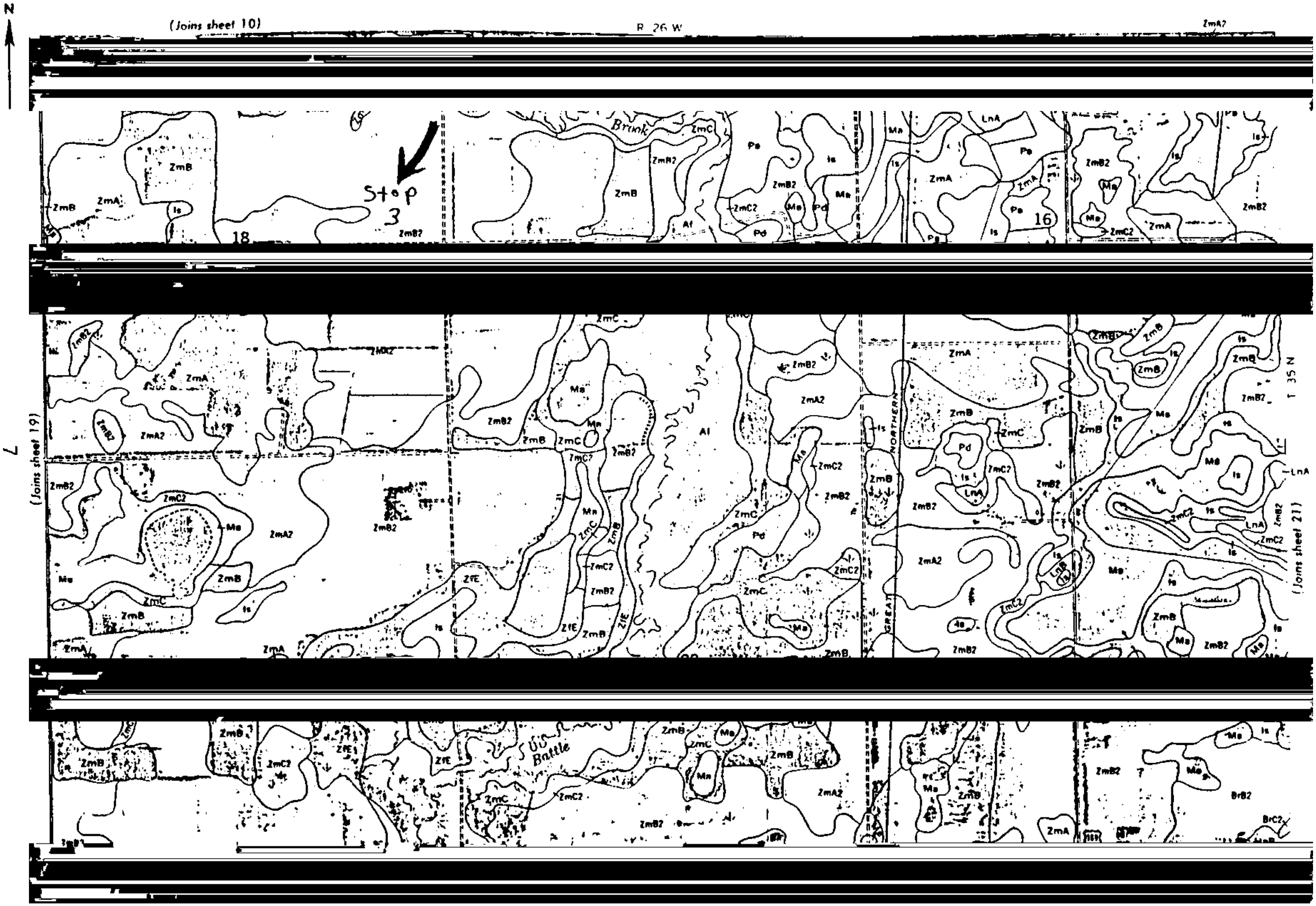
SHERBURNE COUNTY. MINNESOTA — SHEET NUMBER 29



Scale 1:15840

⑳

SHERBURNE COUNTY, MINNESOTA — SHEET NUMBER 20



0 ½ Mile Scale 1:15840 0 3000 Feet

GEOLOGY AND WATER-SUPPLY POTENTIAL OF THE ANOKA SAND-PLAIN AQUIFER, MINNESOTA

By J. O. Helgesen and G. F. Lindholm

ABSTRACT

Intensified land development on the Anoka sand plain necessitates a better understanding of the hydrogeology of the surficial outwash deposits of the area. The Pnoka sand-plain aquifer consists of outwash attributable to two different ice lobes. Predominant grain size of the upper outwash decreases and sorting coefficient increases from west to east. Till or lake deposits underlie most of the surficial outwash. In some areas, these deposits are absent and the aquifer is directly underlain by bedrock, mainly sandstone. Preliminary study indicates that parts of the aquifer may yield several hundred to more than 1,000 gallons of water per minute to properly developed large-diameter wells. Storage in the aquifer is estimated to be 2,000 billion gallons and annual withdrawals approaching 250 billion gallons may be sustained. More detailed analysis is essential for proper management and optimum use of the resource.

INTRODUCTION

The Anoka sand plain (of Cooper, 1935 and Farnham, 1956) and associated valley-train deposits along the Mississippi River constitute an area of about 1,300 square miles of surficial outwash in east-central Minnesota (fig. 1). Being a hydrogeologic unit, the outwash is herein referred to as the Anoka sand-plain aquifer. As used in this report, the name "Anoka sand plain" includes the valley-train deposits. Because of the proximity of the sand plain to the expanding Minneapolis-St. Paul metropolitan area, Its hydrogeologic significance merits consideration.

Water withdrawals from the Anoka sand-plain aquifer are largely from small-diameter wells, 20 to 50 feet deep, which yield less than 20 gpm (gallons per minute). Yields of up to several hundred gallons perminute are generally obtained from confined drift aquifers, which underlie the surficial outwash (drift thickness ranges from about 50 to 300 feet), or from Paleozoic and Precambrian sandstones, which underlie the eastern two-thirds of the study area.

Intensified land use on the Anoka sand plain will increase water requirements. As this area is subjected to the inevitable stresses of development, the appraisal and wise management of its water resources becomes increasingly important. The Anoka sand-plain aquifer, being unconfined, requires particularly careful attention to protect It against uncontrolled storage depletion, diminution of recharge, and pollution by man's activities.

The purposes of this study are to describe the geology of the Anoka sand-plain aquifer and to provide a first approximation of its water-yielding capability. The report is based

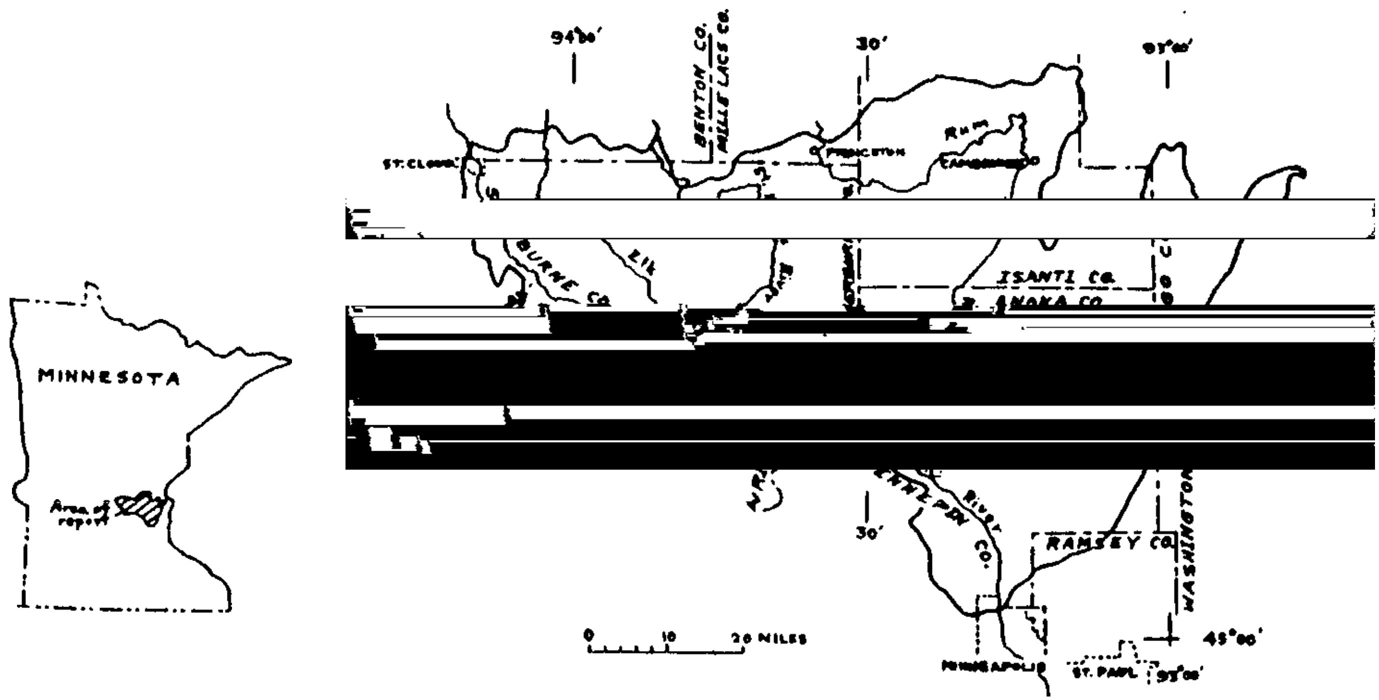


Figure 1. - Location and extent of the Anoka sand plain.

primarily on about 200 test holes augered by the U.S. Geological Survey as a part of regional water-resource investigations (Lindholm and others, 197_). Some auger-hole data in the extreme southern part of the study area were obtained from Minnesota Highway Department records. This study is not a comprehensive evaluation of the aquifer but provides basic geologic and hydrologic information for future investigators, water planners, users, and managers.

GEOLOGY

East-central Minnesota was subjected to several ice advances during Pleistocene glaciation (Wright and Ruhe, 1965), resulting in a variety of glacial deposits and geomorphic features. The Anoka sand plain was recognized by Cooper (1935) as being primarily of glacio-fluvial origin. The surface of the sand plain is flat to moderately undulating and slopes generally southward. Major topographic highs are "till islands" protruding above the general outwash surface, whereas lows are typically areas mantled by organic soils.

The sand plain is bounded in large part by red-brown or gray till (fig. 2). Red-brown sandy till was deposited by ice of the Superior lobe, which entered the area from the northeast. Gray silty till was deposited by ice of the Grantsburg sublobe, which later entered the area from the west.

For purposes of defining the Anoka sand-plain aquifer, its lower limit is chosen as the uppermost relatively

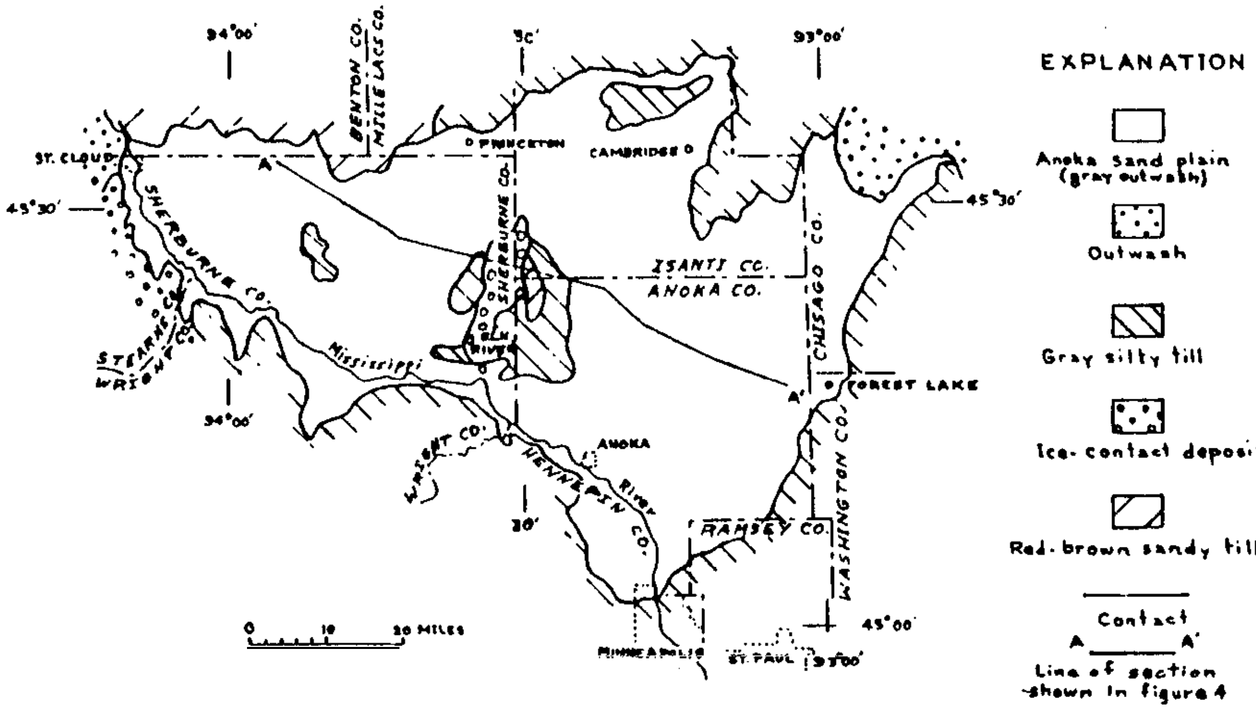


Figure 2. - Surficial geology of the Anoka sand-plain area.

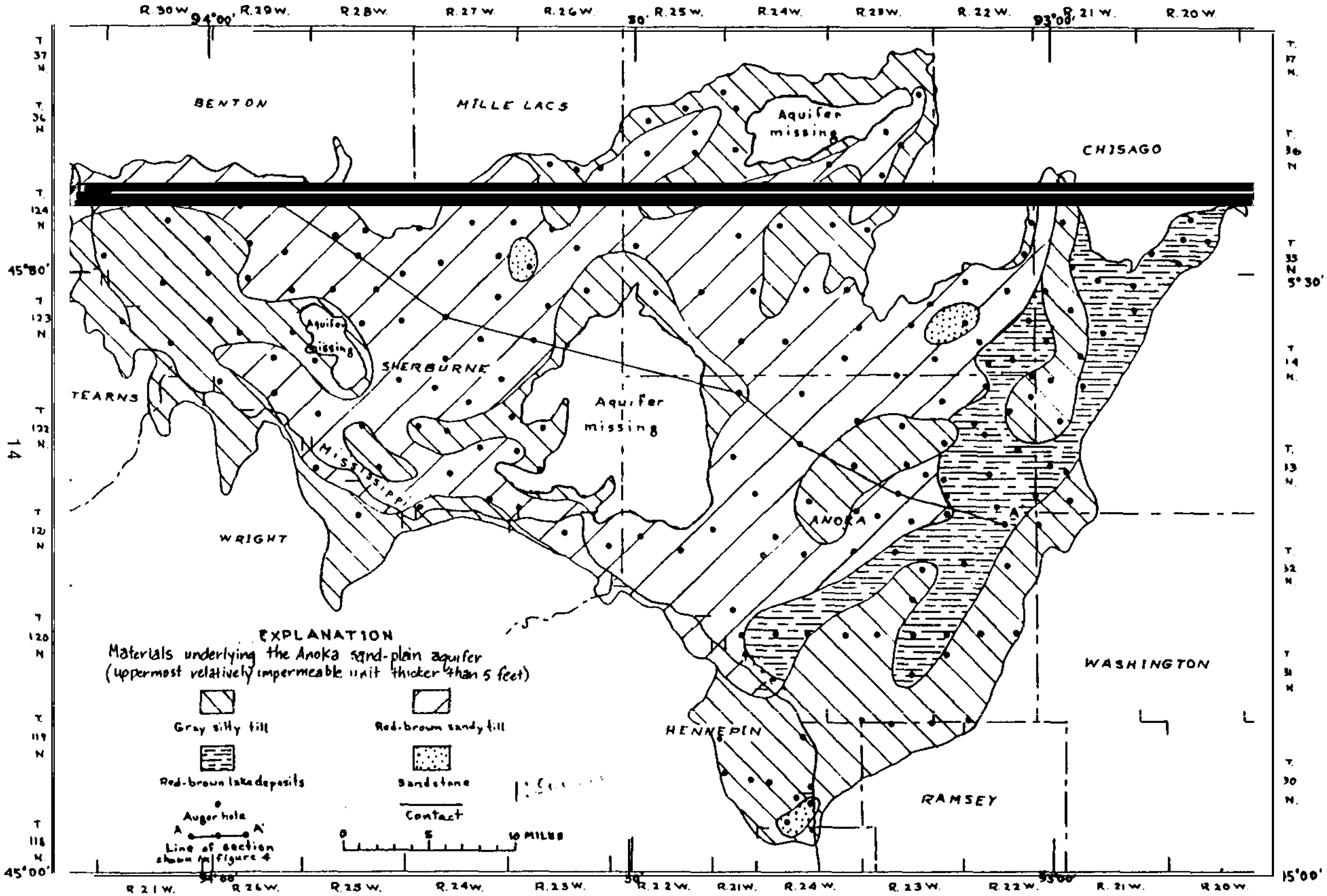


Figure 3. – Distribution of materials underlying the Anoka sand-plain aquifer.

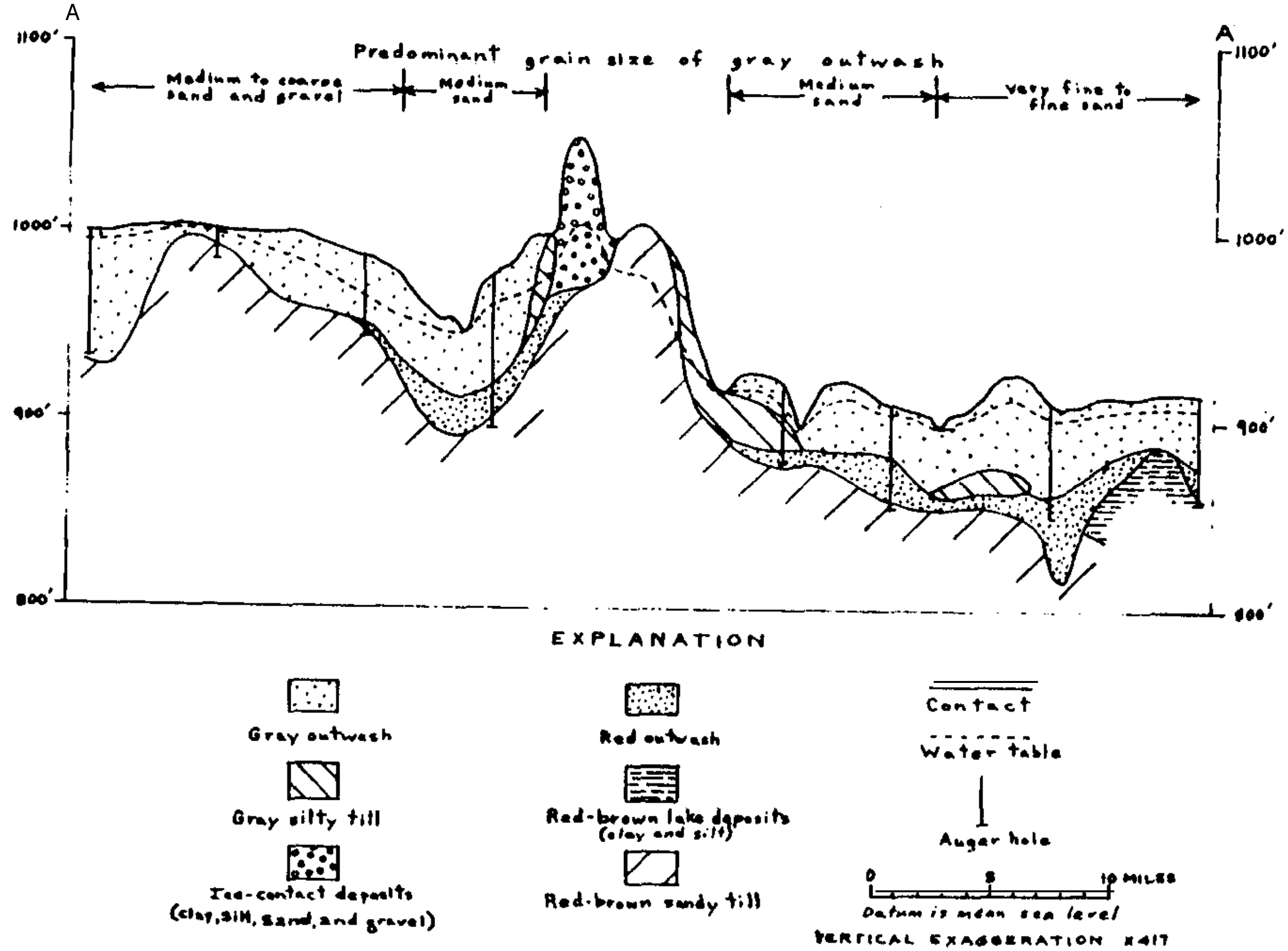
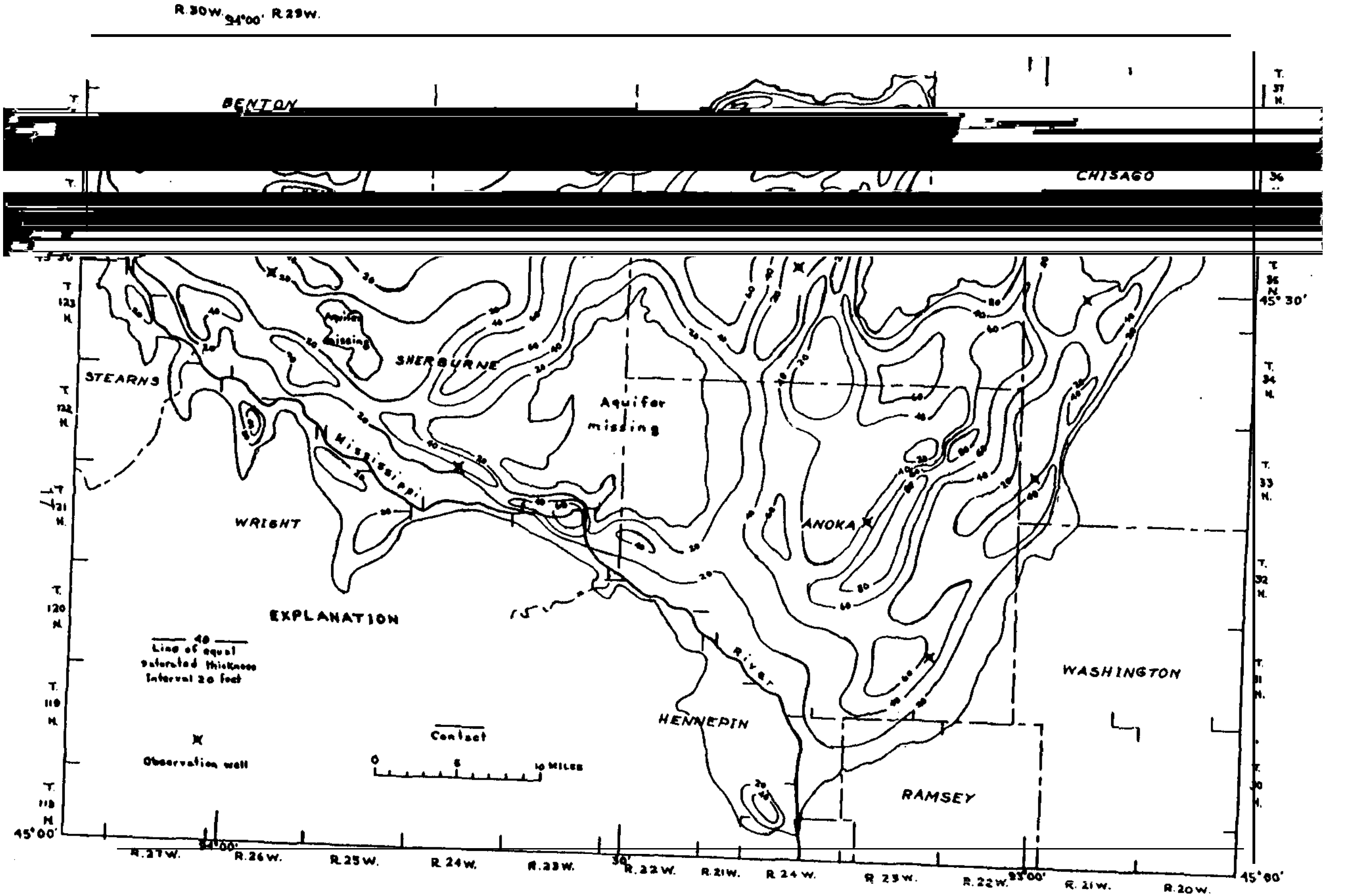


Figure 4. - Section illustrating stratigraphic relationships of the Anoka sand plain.

the water table, it is generally oxidized to a yellow-brown color. Although surficially the outwash is predominantly very fine to fine sand over most of the area (Cooper, 1935; Farnham, 1956), distinct textural variations are evident in the subsurface (fig. 4). Test augering and sieve analyses indicate that the gray outwash in the western third of the area and along the Mississippi River is predominantly medium to very coarse sand (diameters 0.25 to 2.0 mm) and contains considerable amounts of gravel. The sorting coefficients of nine samples range from 1.30 to 3.36 and have a median of 1.93. Sand in the central third of the area is predominantly medium (diameters 0.25 to 0.50 mm). The sorting coefficients of 11 samples range from 1.11 to 2.74, and have a median of 1.40. In the eastern third of the area, sand is predominantly very fine to fine (diameters 0.125 to 0.25 mm). The sorting coefficients of 19 samples range from 1.05 to 1.71 and have a median of 1.30.

WATER-SUPPLY POTENTIAL

Area1 variations in saturated thickness of the Anoka sand-plain aquifer (vertical distance between the water table and the uppermost relatively impermeable unit thicker than 5 feet) are delineated in figure 5. Elongate trends of the thicker outwash areas probably indicate the location of major late Pleistocene drainageways. Based on saturated thickness and an overall specific yield of 0.25, the aquifer is



R.30W.
94°00'
R.29W.
BENTON
CHISAGO
STEARNS
SHERBURNE
Aquifer missing
Aquifer missing
Mississippi
River
WRIGHT
ANOKA
HENNEPIN
RAMSEY
WASHINGTON
EXPLANATION
40
Line of equal saturated thickness
Interval 20 feet
Contact
Observation well
0
5
10 MILES
45°30'
45°00'
93°00'
R.27W.
R.26W.
R.25W.
R.24W.
R.23W.
R.22W.
R.21W.
R.24W.
R.23W.
R.22W.
R.21W.
R.20W.
T. 123 N.
T. 122 N.
T. 121 N.
T. 120 N.
T. 119 N.
T. 118 N.
T. 37 N.
T. 36 N.
T. 35 N.
T. 34 N.
T. 33 N.
T. 32 N.
T. 31 N.
T. 30 N.

in the aquifer, effects of hydrologic boundaries, and well efficiencies of less than 100 percent. Few large-yield wells are completed in the aquifer to substantiate these estimated yields. However, the method of determination used in this study has proved valid in appraising other surficial outwash aquifers in Minnesota (Lindholm, 1971).

Sustained yield from the Anoka sand-plain aquifer depends upon the amount of natural recharge and discharge in the ground-water system, as well as its capability to yield water to wells. Recharge to the aquifer is from precipitation, whereas discharge is largely as base flow and evapotranspiration. Water-level records for 1970-71 (long-term records not available) from eight observation wells completed in the aquifer (fig. 5) were used to estimate recharge. Precipitation during those years at the Cambridge State Hospital station was 12 percent above normal, based on the period 1932-71. The average annual sum of water-level rises, derived from the differences between peaks and extrapolated recession limbs of system, detailed analysis of the system would be needed to optimize development of the aquifer.

In addition to its own water-supply potential, the Anoka sand-plain aquifer is important with regard to underlying aquifers. Underlying sandstone units form part of the north-western flank of the Twin Cities artesian basin, from which large quantities of water are withdrawn. Direct hydraulic connection between the surficial and bedrock aquifers occurs in some areas. Although the red-brown sandy till in much of the area forms the lower boundary of the surficial aquifer, it may be sufficiently permeable to permit a significant amount of vertical leakage down to underlying aquifers. Any development affecting the quantity or quaiity of water in the Anoka sand-plain aquifer could, therefore, affect quantity or quality in underlying aquifers. Because of the complexities of the total hydrologic system, additional data and a model study might be necessary to adequately evaluate the response of the system to ground-water development.

CONCLUSIONS

The Anoka sand-plain aquifer consists largely of gray outwash (Grantsburg sublobe origin) directly underlain in much of the area by red outwash (Superior lobe origin). Although the gray outwash is generally well sorted, it is progressively better sorted and finer grained from west to east. The sub-surface textural variations suggest a western source of the

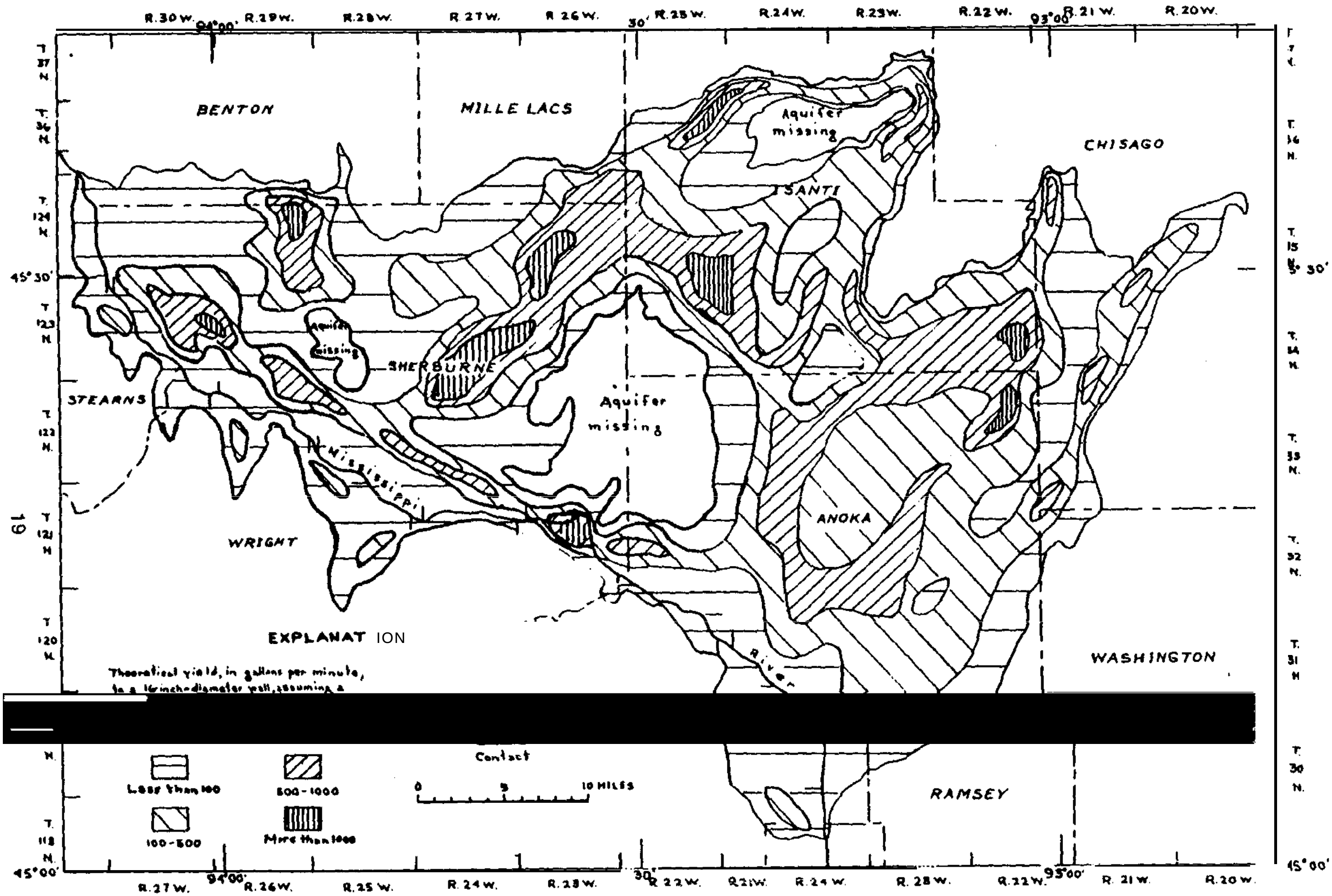


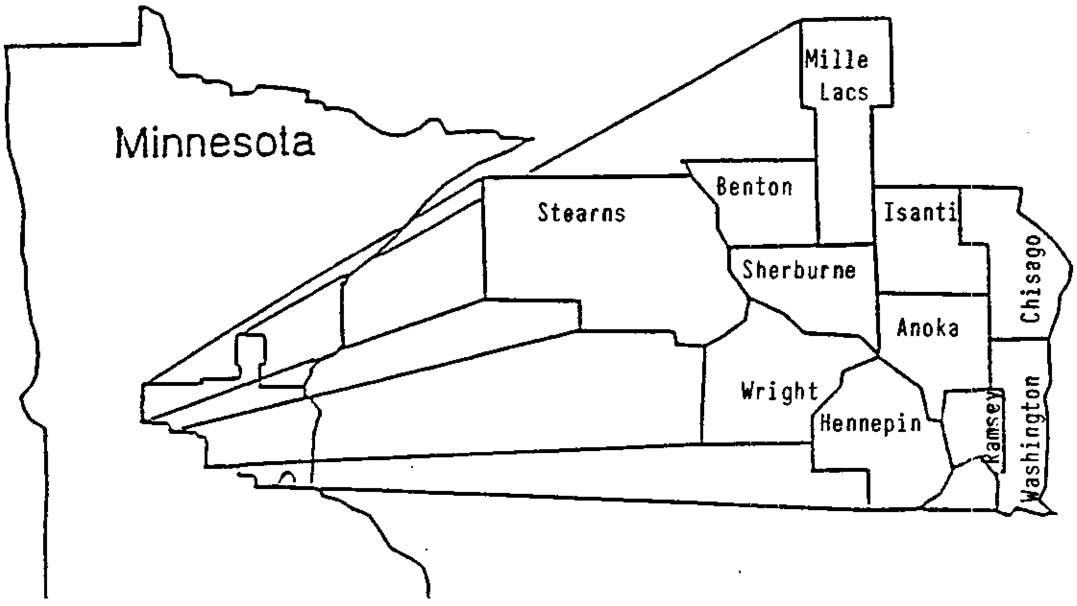
Figure 6.--Theoretical yields to a well completed in the Anoka sand-plain aquifer.

gray outwash and support a glacio-fluvial origin, as described by Cooper (1935). Red-brown till, gray till, and red-brown lake deposits, form the lower boundary of most of the Anoka sand-plain aquifer. Some areas of direct hydraulic connection exist between the surficial outwash and underlying bedrock aquifers.

In places, large quantities of water are potentially available from the aquifer. Although saturated thickness and estimated well yields vary widely throughout, the aquifer as a whole is a valuable, little developed, source of water.

Additional, more detailed, study of the hydrologic system is necessary to best develop the Anoka sand-plain aquifer. Basic to further study would be the acquisition of more data concerning hydraulic properties of the aquifer and adjacent geologic units; location and effects of hydrologic boundaries; ground-water recharge, discharge, and movement; and ground water - surface water relationships. With this information, the hydrologic system could be analyzed by a model to aid in its practical development and management.

ANOKA SAND PLAIN



a. Cooperation with Agencies and Organizations

A key success of the Anoka Sand Plain Demonstration Project during the past year has been the excellent cooperation that has occurred between the project and many local, state, and federal agencies and organizations. Listed below are the groups and agencies that the project has worked with during the past year:

Federal-

Agricultural Research Service **(ARS)**
Agricultural **Stabilization** and Conservation Service **(ASCS)**
Management System **Evaluation Area (MSEA -** Northern **Cornbelt** Sand - Plain)
Soil Conservation Service **(SCS)**
U.S. Geological Survey **(USGS)**

State-

Anoka Sand Plain Research Farm
Board of Water and Soil Resources (BWSR)
Minnesota Department of Agriculture (MDA)
Minnesota Department of Health (MDH)
Minnesota Department of Natural Resources (DNR)
Minnesota Department of Transportation (MNDOT)
Minnesota Extension Service (MES)
Minnesota Geological Survey (MGS)
Minnesota Independent Crop Consultant Association (MINCCA)
Minnesota Irrigators Association
Minnesota Pollution Control Agency (MPCA)
State Planning Agency (SPA)
University of Minnesota (U of M)

Local-

Anoka Sand Plain Association of Soil and Water Conservation Districts (ASP - SWCD's)
East Central Minnesota Irrigators Association
Independent Crop Consultants
Isanti City Public Works
Minnesota Potato Growers Association
Sherburne/Wright Counties Soil Survey Update
Soil and Water Conservation Districts (SWCD's)
- Benton
- Isanti
- Sherburne
- Stearns
- Wright

The preceding list of agencies and groups represent those that the project has had a direct working relationship with. There are agencies that have devoted a significant amount of time and energy to the project (ASCS, MES, SCS and the SWCD's). Others have either included the project in their activities or have been included specifically in project activities.

b. <u>Informational and Educational Activities</u>

Information and educational activities played a major part of project activities during the year. An interagency information and education committee was formed and helped to organize and complete many programs. The Plan of Operations has many items that directly relate to informing and educating producers, agencies and the general public.

Some specific informational and educational activities include:

1. Tours

i. The project directly sponsored 10 tours in cooperation with MSEA, the Tri-County Conservation Project, the Minnesota Association of Professional Soil Scientist (MAPPS) and local MES, SCS and SWCD staffs.

ii. On 3 tours the Anoka Sand Plain Association of SWCD's provided monetary support.

iii. The Sherburne Soil Survey Office and the project jointly conducted 2 *tours.*

iv. *A total* of 550 people attended the tours listed above.

2. Informative Talks

There were 7 presentations given to agricultural related groups.

3. Slide Show

A twenty minute slide presentation was created jointly by the project staff, MES and SCS. A brochure to accompany the slide show is being prepared.

4. Newsletter

A project newsletter was initiated and there were 3 issues published. 2 directories of project participants involved in demonstration activities and related research projects *were* published.

5. Media Coverage

i. Local media coverage involved 1 television station, 2 radio stations and 7 newspapers.

ii. Road signs were developed and printed to be installed at each demonstration project participants farm.

6. Data Transfer

1. An automated weather station site (Snotel) was established to act as a pilot to determine the applicability of this technology for global warming and water quality related programs.

ii. Weather stations located at Rice and the Snotel site near Becker collected data and this information was disseminated to cooperative agencies and project participants for irrigation water management activities.

7. Farm*A*Syst

i. **Farm*A*Syst** is being used as an assessment and educational tool to determine potential vulnerability of farmstead activities to groundwater contamination.

ii. The project cooperated with Extension Service of both Minnesota and Wisconsin, Environmental Protection Agency, and SCS to field test **Farm*A*Syst.**

iii. Due to completed **Farm*A*Syst** assessments 6 producers have made changes and 1 is planning a change in farmstead activities related to potential contaminants and groundwater quality.

c. **Farming Practice and Land Treatment Implementation**

In this the first full year of project activity for the project there were major accomplishments made by participating producers in the implementation of Best Management Practices. Tables V-c.1, V-c.2, V-c.3, V-c.4, V-c.5, V-c.6 and V-c.1 which are attached to this report in Appendix I, list the numbers and acres of activities related to specific areas of concern.

Complete nutrient management plans were developed and implemented on 52 farms for 7851 acres. Project staff, county office personnel and consultants assisted with these plans. The plans that were implemented used University of Minnesota (U of M) recommendations for nitrogen, phosphorus and potassium. All of the sites represented a high leaching potential soil. Trace element management was practiced on 29 farms for 4357 acres. This practice included assisting farmers with interpreting soil test results for micronutrients and recommending individual elements according to University of Minnesota guidelines.

Pest management plans were developed and implemented on 48 farms for 7903 acres. Project staff, county office personnel and consultants assisted with these plans. These are truly pest management plans (not just pesticide management) combining all of the Integrated Pest Management concepts and strategies. Both ground and surface water potential concerns were addressed.

A large percentage of the participating producers utilize animal manures on their cropland fields. Listed below is a breakdown of the operations that the project assisted in developing and assisting in the implementation of waste utilization plans:

Type	Number of Farms	Total Animal Units (based on a 1000 pound animal)
Beef	14	217
Dairy	21	1131
Hog	3	935
Poultry	4	300

Residue management practices were planned and installed on 3 farms with 291 acres for wind erosion control. In addition, residue management was installed on 2 farms for 83 acres of water erosion control.

Through the use of Farm*A*Syst evaluations and other educational efforts water from 17 wells was tested and 4 improved fertilizer storage sites were installed. 1 producer changed pesticide storage practices while another producer changed petroleum storage practices. These practices helped reduce the potential of farmstead pollution of groundwater and also educated and informed these producers of potential pollution concerns.

Other major implementation accomplishments are detailed below.

1. Irrigation Scheduling

i. Irrigation scheduling was implemented on 3242 acres for 20 farmers. Scheduling was performed using several different methods, including the checkbook method, feel method, soil moisture blocks and computer modeling. A total of 102 moisture blocks were installed and read regularly.

ii. Anoka Sand Plain Project cooperated with the Sherburne/Wright County Soil Survey staff to update moisture relief curves. These curves are needed for irrigation scheduling throughout the sand plain area.

iii. Project staff developed irrigation evaluation data sheets and crop water use reports to help manage water usage.

2. Water Testing

i. Well water was sampled from 17 wells on 10 different farm sites. The concentration of nitrogen, nitrate and nitrite varied from less than 0.5 ppm to 24.8 ppm. Of the wells tested, 50% exceeded or were within 1 ppm of the national drinking water standard of 10 ppm for nitrates.

ii. A farm site where animal waste management from a dirt feedlot may be contributing nitrates into the groundwater was also a part of the project evaluations. The water in one well was tested as a part of this evaluation.

3. Integrated Pest Management

i. Crop pest scouting was conducted on 4054 acres for 28 farmers. Additional cooperative assistance was provided on 5 farms from private consultants or local cooperatives and agricultural chemical representatives. These practices were implemented on the following crops: alfalfa, field corn, sweet corn, potatoes, soybeans, kidney beans and navy beans.

ii. The ASP project staff developed data sheets for field scouting, weed mapping and inventorying of past and present farming practices.

4. Suction Samplers

i. Suction samplers were installed in 15 fields to monitor nitrogen movement through the soil at both 2.5 and 5 foot depths. 92 suction samplers in all were installed.

ii. Suction samplers were also installed in and outside of the dirt feedlot, previously mentioned, to evaluate nitrate movement associated with animal waste.

5. Yield Checks

i. Yield checks were performed on 28 producers fields. This was done to compare nitrogen rates and various weed control chemicals and control practices.

ii. Harvest yield data sheets for hand yield checks and combine yield checks were developed.

iii. Yield data will be used to assist in the evaluation of BMP's and productivity, environmental impact and cost-effectiveness.

Potential models that may be used are listed below:

NLEAP (Nitrate Leaching and Economic Analysis Package)
GLEAMS (Groundwater Loading Effects of Ag. Management Systems)
EPIC (Erosion Productivity Impact Calculator)
AGNPS (Agricultural Non-Point-Source Pollution Model)

Training is being scheduled and assistance will be needed. This assistance is needed to set-up the model databases and to make individual model runs.

f. Off-Site Objectives

Specific reduction in contaminants to the aquifer system have not been identified as a specific goal of this project.

VI. MEASURED CHANGES IN WATER QUALITY

At this time, measured changes in water quality that are a direct result of the activities of this project can not be documented. Measured changes in water quality may never be made due to physical and financial concerns. It will take many years before changes on the surface of the land equate to positive changes to the aquifer system.

There are a number of research and/or monitoring efforts that will attempt to measure changes to the aquifer directly related to project activities. A few of these are listed below:

1. As a part of the Midwest System Evaluation Area (MSEA) direct measurements in the root zone, vadose zone and the top of the aquifer will be made. These measurements will be made underneath a research site that will implement BMPs'. The project staff are working cooperatively with the MSEA site in a support role.

2. The project is working with the Minnesota Pollution Control Agency (MPCA) to monitor groundwater quality at a number of demonstration sites. This monitoring is being funded by both state funds and Environmental Protection Agency (EPA) Section 319 of the Clean Water Act funds.

VII. IMPACTS ON WATER USE AND IMPAIRMENTS

Impacts on water use and impairments as a result of project activities have not been measured at this time.

VIII. ECONOMICS

1. Representative Farms or Sites

Specific economic analyses are planned for representative farms or sites in the project area.

a. Baseline Conditions

Baseline conditions for the project area are being described in two ways -

i. Crop budgets have been developed for use in planning with the assistance of the PLANETOR computer software. Crop budgets are attached to this report in Appendix II.

ii. A survey was conducted in March of 1991 by project staff. A copy of the survey instrument and the summary report is attached to this report in Appendix III.

b. Implemented Systems and Direct Costs

The improved systems/practices which were implemented and the direct costs associated with them have not been compiled and summarized.

Complete farm financial analysis is planned for 6 to 10 farms this year. These analyses will be conducted in late winter or early spring of 1992.

c. Changes in Practices and Costs

The changes in practices and the costs associated with them have not been compiled and summarized at this time.

As a part of the complete analyses discussed in item b. above practice and cost changes will be detailed.

2. **Federal, State and Local Assistance**

Table VIII - 4 has been completed to detail the major federal, state and local contributors to this project and is attached in Appendix IV.

In the Financial Assistance section, ET&FA Funds have been designated for this project in the amount of $250,000 to ASCS for cost-sharing on SP-53. A portion of these funds have been obligated in FY 1991 but payments will not be made until FY 1992. Other funds under Finacial Assistance of $5,000 are for in-kind services by ASCS to administer SP-53 and the project as a whole. For the Technical Assistance section under ET&FA Funds, $300,000 was spent on the project by SCS at the county, area and state office levels. $6,000 in in-kind services was provided by the SWCD's, ASP SWCD Association and the Tri-County Conservation Project. In the Education/Extension section under ET&FA Funds, MES spent

IX. COMMENTS OR REMARKS

After one full year on the project it is the project staff's opinion that the following items need to be addressed. These items will greatly enhance the already positive accomplishments of the project, increase the potential for future of the project successes and the credibility of this effort.

1. An accurate field by field record keeping system that is either in a hard-copy format and/or computerized is needed. This system of data collection must be fully explainable and user friendly. It should also be able to relate back to a whole farm financial planning package.

2. Soil compaction studies need to be addressed in regards to the impact of water quality degradation from nitrates and pesticides. Additionally a concern arises from the inability to effectively manage irrigation scheduling practices. This is due in part to a lack of adequate methods, staff and technical expertise.

3. Conservation tillage practices need to be incorporated into the overall Integrated Crop Management plan to address erosion concerns and secondary concerns of surface water quality.

4. Irrigation systems efficiency checks need to be conducted to aid in more efficient management of irrigation waters and to lessen the potential for groundwater contamination. Greater monitoring to effectively use computer models or modifying of existing models to meet local needs is essential.

5. Through the Farm*A*Syst program the concern for groundwater degradation from manure packed feedlots has been identified. A producer permitted the project to monitor nitrate movement under and around the feedlot., From one years worth of monitoring it appears that indeed nitrates may be moving through the feedlot. More research is needed on this subject area, along with potential solutions to this potential contamination source.

6. Farm*A*Syst needs to be conducted on all demonstration project participants. This evaluation program has met with widespread support from landusers and will help to address many of the farmstead contamination source issues.

7. A continuation of monitoring and expansion of nitrogen credits in Integrated Crop Management plans for irrigation water, legumes, animal waste, and other sources. Samples (soil, water and tissue) need to be continued in order to help make better management decisions with participants.

8. Integrated Pest Management needs to be continued and expanded for project participants to recognize the need for monitoring in order to reduce the potential impacts to groundwater quality.

9. Interagency cooperation has been an extremely important part of this project. Continued fostering of interagency cooperation in the area of water quality to minimize duplication is essential.

10. A strategy needs to be developed to obtain irrigation evaluation tools (equipment) and experienced staff to conduct the necessary efficiency checks. This should incorporate federal, state, local and private groups.

11. Exploring the transfer of weather data used for irrigation water management to local uses in a timely manner and in a format easily understood by the user is needed.

12. Manure management plans are being developed that utilize University of Minnesota guidelines. A concern has arisen as to whether the producer has the time, energy, equipment and/or knowledge to implement these plans. More will need to be done to educate producers on the implementation of manure management plans.

13. A general comment and concern revolves around the fact that actual water quality improvements may never be able to be documented during the life of the project.

APPENDIX I

SBCTION V TABLES

Table

Table V-C.7

APPLICATION OF FARMSTEAD AND WELLHEAD PROTECTION PRACTICES

Practice Category	Number of Producers Installing Practice
Fertilizer Storage/Handling	4
Pesticide Storage/Handling	1
Petroleum Storage/Handling	1
Well Testing	10 (17 wells)

NITROGEN SPECIFIC MANAGEMENT BY SOIL CONDITION[1]

J.A. Vetsch, G.L. Malzer, P.C. Robert, and W.W. Nelson[2]

Abstract: Recent advances in technology have brought about considerable interest in developing the methodology for making variable N rare applications within a field. The objectives of this study were to evaluate yield variability within production fields, determine yield response to applied fertilizer N and differential N loss as influenced by roil conditions. Results are being evaluated to determine what measurable soil conditions are best suited for making

Symb.	Acres	Text.	Slope %	O. M. %	NO_3-N lbs/A	Subgroup

Pioneer 3369 was planted on April 29 at a population of 31,500 S/A on 38 inch rows. Starter fertilizer was applied as a side banded application of 240 lbs/A of a 12-10-30. Weed Control was accomplished by using a tank mix of Prowl at 2 pts/A and Aatrex at 1.75 lbs/A and cultivation on June 4. Ten treatments consisting of eight constant N rates paired with N-Serve (120, 150, 180 and 210 lbs N/A), one variable rare (soil), and a Check (zero N) were applied sidedress as anhydrous ammonia on June 5 and 6 (sixth leaf Stage). Treatments were applied 1" 25 foot strips (8 rows,

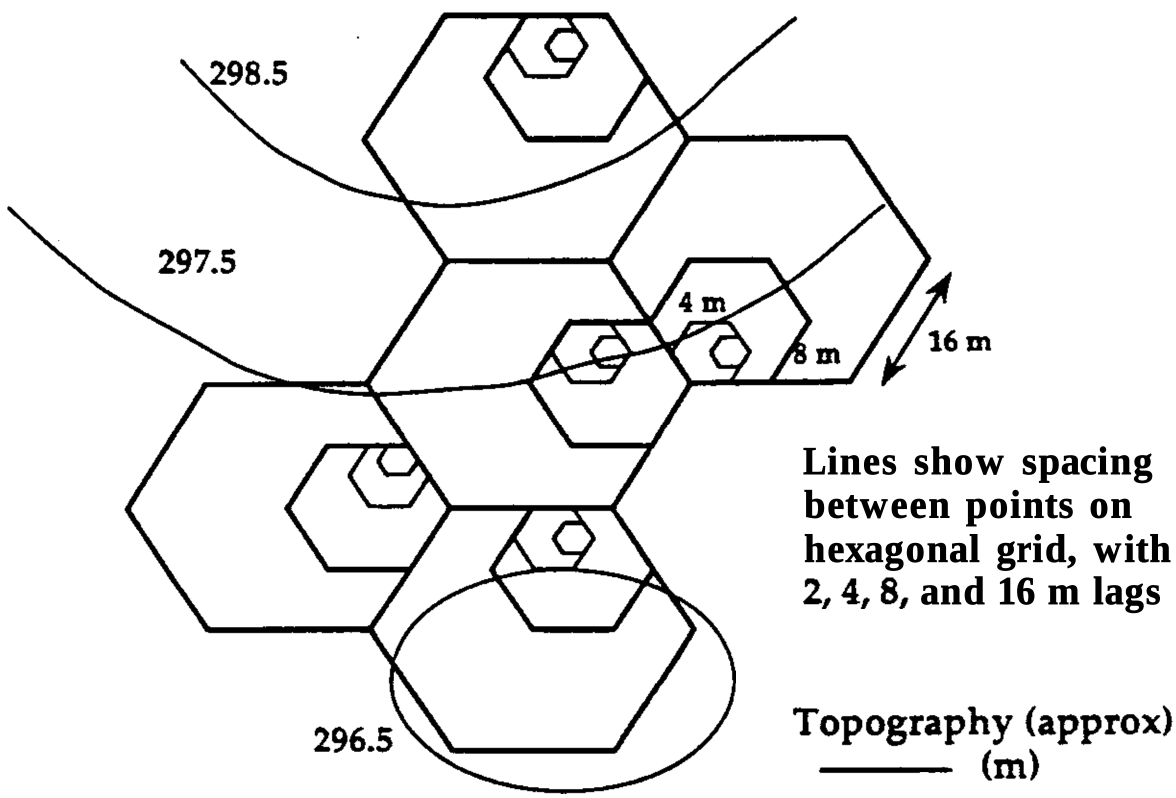
Soil Lameilae:
Genesis, Landscape Distribution, and Water Storage Effects

Mark D. Tomer

Many of the soils found on the Anoka Sand Plain are fine sands, with over 90 percent sand content. The Zimmerman fine sand (Alfic Udipsamment) is a major series on the sand plain. A distinguishing feature of this soil is the presence of lamellae within 1.5 m of the surface. Soil lamellae are thin horizons (usually less than 5 cm thick) with small amounts of illuviated clay and weak iron cementation. The abrupt boundaries and high chroma of lamellae. along with multiple lamcllar and inter-lamellar E horizons. contribute to a striking appearance of the soil profile. Relatively few data on soil lamellae have been published recently: papers by Folks and Riecken (1956). and

Landscape Distribution of Lamellae and Soil Water. A landscape variability study is underway on a soil toposequence at the Management System Evaluation Area site on the Anoka Sand Plain. Objectives of this research are to characterize variability of soil water storage over space and time. and to correlate observed water storage patterns with distribution of lamellae, depositional layering, and surface topography. A hexagonal grid survey of soil corings was made on nested spatial scales. The grid layout is shown in Figure 1. Each horizon observed to a 3 meter depth was noted and sample,: to determine particle size distribution and organic matter. Neutron probe access tubes were installed in each of the coreholes to allow soil water monitoring. Soil water profiles and their changes over time are being measured to determine spatial patterns of water storage and accumulation.

Figure 1. Schematic diagram of nested hexagonal grid soil core survey.



Early results show a depositional discontinuity at a 1.5 to 2.5 m depth; a fine sand (which may be wind deposited) overlies a medium sand (of alluvia1 origin). The discontinuity is relatively horizontal, as it is nearest the soil surface in depressional landscape positions. The greatest development of lamellar horizons is in upland positions, within the fine sand. Lamellae tend to be most numerous and thickest within the fine sand. and within about 50 cm of the textural discontinuity. Up to 30 soil horizons have been noted in a single coring location, with up to 15 lamellar horizons, and 45 cm of accumulated thickness.

Figures 2 and 3 show examples of the particle size distribution and water content profiles being obtained in this study. In the depressional area (Figure 2). a pachic mollic epipedon (about 2 percent organic matter) is responsible for moisture detention in the upper meter of the profile. Below the A horizon. the medium sand allows little water storage. Lamellae are virtually non-existent in the medium sand. In upslope positions (Figure 3). the A horizon is thinner and organic matter contents are lower: the epipedon is usually not mollic. This causes less water detention near the surface. Sub-surface water detention is associated with lamellae and the textural discontinuity at depth. as a significant increase in water storage is observable at

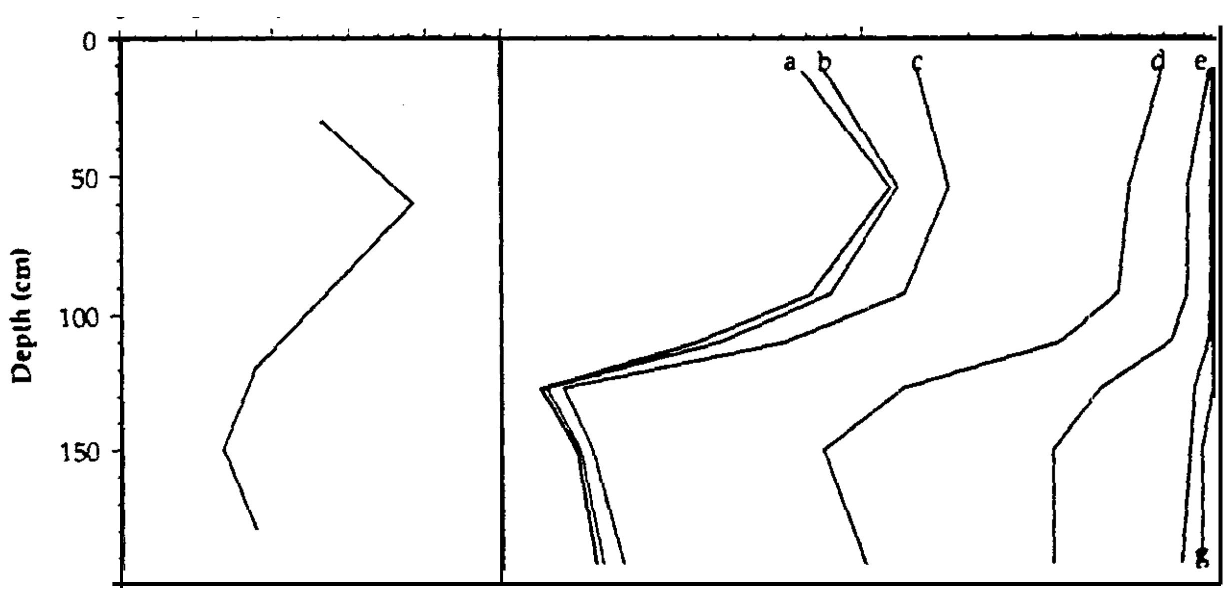
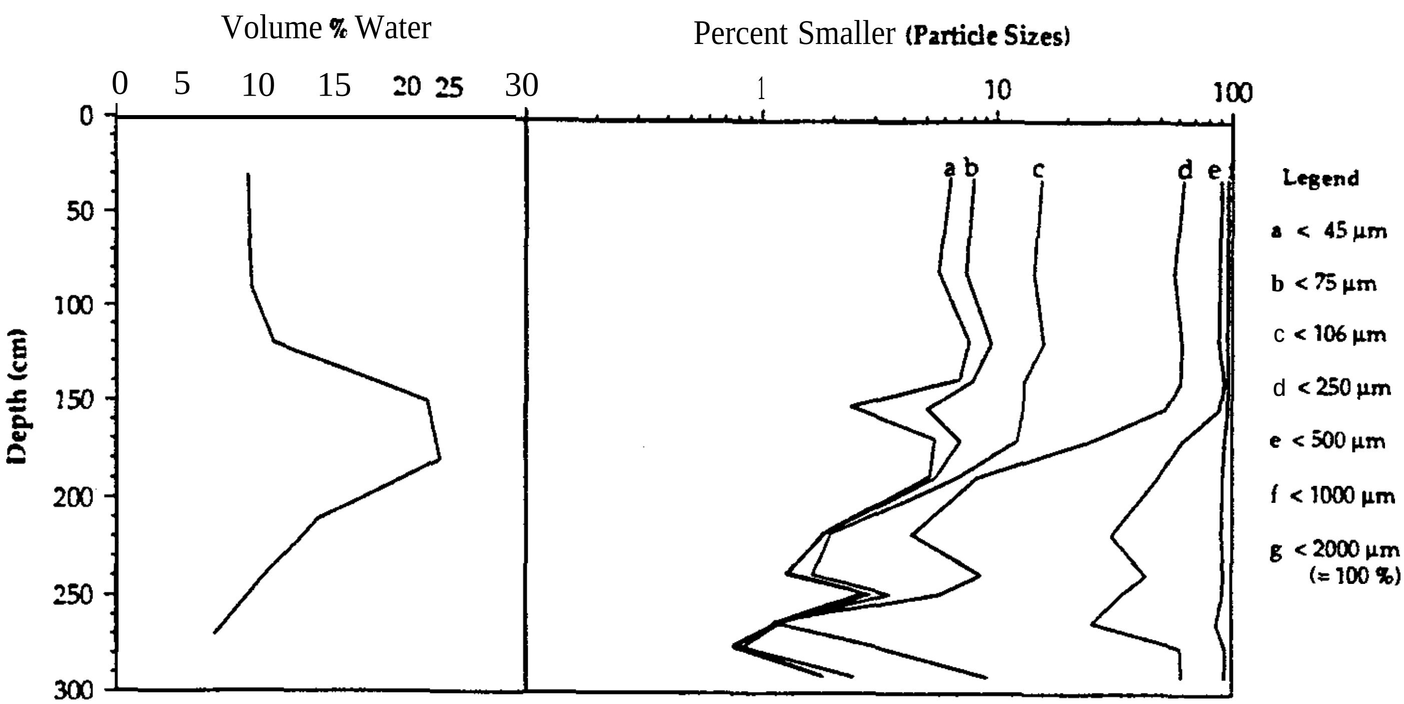


Figure 3. Water content and particle size distribution profiles in a upslope landscape position. The water profile was measured after a period of heavy rain.



Early results show distinct patterns of landscape variability in soil development and soil water storage patxems. Lamellae are dominant features only at depth in upslope positions. Soil water detention is associated with lamellae in these positions, however. in depressional positions. water detention is associated with a thick A horizon. Considering patterns of plant water use, these differences are important determinants of landscape variability of crop productivity, as well as movement of nitrates and pesticides IO the groundwater.

Literature Cited

Bouabid, R. 1992. Soil Solution Chemistry, Mineral Weathering and

Northern Cornbelt sand Plains
Management Systems Evaluation Area(MSEA)

J.A. Lamb', J.L. Anderson, R.H. Dowdy,
G.N. Delin, R. Knighton, and D.E. Clay

Tbe period of February 1991 to April 1992 was tho initial establishment of the Northern Cornbelt Sand Plain MSEA project. Sites were ● stablisho4 at Arena, WI; Princeton, MN; Aurora, SD; and Oakos, ND. Tho *common management system at* all sites is a corn-soybean rotation with ridge tillage. Tho borbicidos atraeino and alachlor for Corn production and metribuzin and alachlor for soybean production were band appliod at planting. Herbicide application rates woro determined from tbo product label and extension service recommendations at each location. Nitrogen is appliod in split applications at rates based on land grant university recommendations. These locations encompass a gradient in climate particularly precipitation, across the Northern Cornbelt. At the Princeton location, two additional rotations are being investigated: potato-swoet corn and continuous corn. At all locations, ground *water* wells were sampled in 1991 to characterize the ground water quality.

Data Management

A database management system has been *designed for* data storage at all four locations. Five separate database areas are being used. Tbey arc as follows: 1. Ground water - includes the nutrient and herbicide analyses from each ground water well sampled. 2. Soil - includes nutrient and herbicide analyses from soil samples taken after herbicide application during the *growing season.* 3. Weather - includes information collected and reported hourly by the automated weather stations at each location. 4. Plant - include nutrient content, crop growth, and yields taken during the growing season for each rotation at each location. 5. Farming and sampling operations - includes a log which notes events an4 information will be particularly useful in interpreting the data collected during this project. Currently we have compiled data *from* the Princeton ME, Oakes ND, and Aurora SD locations. The data from Arena, WI is due June 1, 1992. Information presented in this report will *be from* the Princeton, Oakes, and Aurora locations.

'J.A. Lamb and J.L. Anderson, Soil Science Department, Univ. Of Minnesota, St. Paul, EN.; R.H. Dowdy, USDA-ARS, St. Paul, EN; G.N. Delin, USGS, St. Paul, MN; *R.* Knighton, Boil Science Department, North Dakota State Univ., Fargo, ND; an4 D.E. Clay, Plant Science Department, South Dakota State Univ., Brookings, SD.

Ground Water Characterization

Initial ground water samples were taken during April 1991 at Princeton, June 1991 at Oakes, and November 1991 at Aurora. Soil incorporated herbicides use& in the cropping systems included atrasine, alachlor, metribuzin, and metolachlor.

At Princeton, 16 wells were sampled between April 3 and April 16, 1991. No detections of alachlor, chloralechlor, mstolechlor or metribusin were found, Table 1. Atrazine, de-ethylatrasine, de-isopropylatrasine and 2,6-diethylanaline were detected. The median values were below the reporting limit of 0.08 ug L^{-1}. Nitrate-N plus nitrite-N ranged from less than the reporting limit to 19.9 mg L^{-1} with a median for the initial 17 well samples of 7.0 mg L^{-1}.

Table 1. Contaminants measured in ground water at Princeton, MN sampled April 3 and April 18, 1991.

Contaminant	Number of water samples	Range	Median	Number of detections
		------ ug L^{-1} ------		
Atrasine	17	<0.08 - 0.17	<0.08	2
De-ethylatrasine	17	<0.08 - 2.30	<0.08	9
De-isopropylatrasine	17	<0.08 - 0.98	CO.08	3
Alachlor	17	<0.08	<0.08	0
2,6-diethylanaline	17	<0.08	<0.08	1
Cbloralaeblor	17	<0.08	<0.08	0
Ketolacblor	17	<0.08	<0.08	0
Metribuzin	17	<0.08	<0.08	0
		------ mg L^{-1} ------		
Nitrate-N + Nitrite-N	17	<0.5 - 19.9	7.0	17

Table 2 contains the summary of results from ground water analyses of samples taken at Princeton, MN between August 1 and August 21, 1991. At this sampling 75 ground water wells were sampled and 3 samples were taken from Battle Brook which borders the north side of the research site. No detections of 2,6 - dietbylanaline or metribuein were found. Few detections of de-isopropylatraeine, cbloralacblor, and metolacblor occurred. There were 33 and 55 detections of atrasine and de-ethylatrasine, respectively. The median values were less than 0.08 ug L^{-1} for stranine and 0.09 ug L^{-1} for de-ethylatrazine. When tbe location of the wells with these detections are compared with the location of the cropping systems using atrasine, there is no clear relationship. The nitrate-N plus nitrite-N concentration in the 78 water samples analyzed ranged from below the reporting limit to 26.5 mg L^{-1}. The median value was 12.1 mg L^{-1} which is greater than the median value of the April sampling. This occurred because of the addition of several new wells from the research site which exhibited elevated levels of NO_3^--N.

Table 2. Contaminants measured in ground water at Princeton, MN sampled between August 1 and August 21, 1991.

Contaminant	Number of water samples	Range	Median	Number of detections
		------ ug L⁻¹ ------		
Atrazine	75	<0.08 - 3.67	<0.08	
De-ethylatrazine	75			
De-isopropylatraeine	75			
Alachlor	75			
2,6-diethylanaline	75			
Chloralachlor	75			
Wetolachlor	75			
Metribuzin	75			
Nitrate-N + Nitrite-N	78			

Table 4. Contaminants measured in ground vater at Oakes, ND sampled November 4, 1991.

Contaminant	Number of vater samples	Range	Median	Number of detections
		------ ug L^{-1} ------		
Atraeine	8	<0.08	<0.08	0
De-ethylatrasine	8	<0.08	<0.08	0
De-isopropylatrazine	8	<0.4	<0.4	0
Alachlor	8	<0.08	<0.08	0
2,6-diethylanaline				
Chloralachlor				
Hetolachlor	8	<0.08	<0.08	0
Xetribuzin	8	<0.08	<0.08	0
		------ mg L^{-1} ------		
Nitrate-N + Nitrite-N	8	1.3 - 55.6	15.2	8

The November 21, 1991 ground water atrazine and nitrate plus nitrite-N values are reported in Table 5. Atrasine was reported in 14 of 17 water samples collected with the median value less than the reportable limit of 0.20 ug L^{-1}. All water samples had substantial amounts of nitrate plus nitrite-N. The median value was 29 mg L^{-1}.

Table 5. Contaminants measured in ground vater at Aurora, SD sampled November 21, 1991.

Contaminant	Number of vater samples	Range	Median	Number of detections
		------ ug L^{-1} ------		
Atrasine	17	<0.2	<0.2	14
De-ethylatrazine				
De-isopropylatrasine				
Alachlor				
2,6-diethylanaline				
Chloralachlor				
Metolachlor				
Wetribusin				
		------ mg L^{-1} ------		
Nitrate-N + Nitrite-N	17	23 - 32	29	17

Crop Production

The Princeton location received 635 mm of precipitation between April and October 1991. No irrigation Water was applied. Nitrogen fertilieer was split applied at the times and amounts listed in Table 6. Corn grain, sweet corn green ear, soybean grain and potato tuber yields were measured from 64 - 12.7 m by 15.2 m grids to determine spatial variability in each research block, Table 7. For non-irrigated sandy soil conditions the corn yields were very good. The coefficients of variation (CV) were 11.3 % for tbe continuous corn and 6.4 % for the corn in rotation. The cropping area with the most variability was the potato block which had a CV of 13.9 %.

Table 6. Nitrogen fertilizer applications at Princeton, MN in 1991.

Crop	Starter	Split 1	split 2	Total
	------------- kg ha^{-1} -----------			
Corn				
Continuous	22	56	78	156
Rotation	22	56	78	156
Sweet	22	56	78	156
Potato	112	56	56	224
Soybean	0	0	0	0

Starter = nay 2 for continuous corn, Way 3 for rotation corn, Way 8 for sweet corn, and April 26 for potato.
Split1 = V6, June 11-12 for corn and June 13 for potato.
Split2 = V8, June 26 for corn an& June 26 at hilling for potato.

Table 7. Yield variability in research blocks at Princeton, MN in 1991.

Crop	Range	Mean	SD.	C.V.
	------- Mg ha^{-1} -------			%
Corn				
Continuous	5.7 - 10.2	8.5	1.0	11.3
Rotation	7.8 - 11.1	9.2	0.6	6.4
Sweet	9.1 - 16.6	12.9	1.6	12.2
Potato	13.8 - 29.4	21.1	2.9	13.9
Soybean	1.5 - 2.6	2.2	0.2	10.8

Nitrogen fertilizer applications at Oakes, ND were timed differently than the Princeton site, Table 8. Applications included a small preplant N mount (4 kg ha^{-1}). The 1991 yield summary for corn and soybean, Table 9, indicates excellent grain yields and small variabilities, CVs of 5.3 and 5.4 % for corn and soybean, respectively.

Table 8. Nitrogen fertilizer applications at Oakes, ND in 1991.

Crop	Preplant	Starter	Split 1	Split 2	Total
	------------------	--------	kg ha^{-1}	--------	------------------
Corn	4	13	75	34	126
Soybean	0	0	0	0	0

Preplant = April 11 for corn.
Starter = Ray 17 for corn.
Split1 = V6, June 18 for corn.
Split2 = R1, July 16 for corn.

Table 9. Yield variability in research blocks at Oakes, ND in 1991.

Crop	Range	Mean	SD.	C.V.
	------- Mg ha"	-------		%
Corn	11.7 - 13.1	12.3	0.6	5.3
Soybean	3.9 - 4.4	4.1	0.2	5.4

At Aurora, N was applied at two times, Table 10. The first application occurred on May 21, 1991 of 56 kg N ha^{-1} and the second application was on June 13, 1991 of 45 kg N ha^{-1} for a total Of 101 kg N ha^{-1}. The corn graia yield averaged 10.9 Mg ha" with a CV of 21.2 %, Table 11. The soybean grain yield averaged 2.5 Mg ha^{-1} with a CV of 5.8 %.

Table lo. Nitrogen fertilizer applications at Aurora,SD in 1991.

Crop	Split 1	Split 2	Total
	--------	kg ha^{-1}	--------
Corn	56	45	101
Soybean	0	0	0

Split1 = V1, May 21 for corn.
Split2 = VS, Juae 13 for corn.

Table 11. Yield variability in research blocks at Aurora, SD in 1991.

Crop	Range	Mean	SD.	C.V.
	------- Mg ha^{-1}	-------		%
Corn	8.8 - 13.4	10.9	2.3	21.2
Soybean	2.3 - 2.6	2.5	0.1	5.8

socio-Economic

A survey of 306 producers in the Anoka Sand Plain was completed in 1991. The return response to the survey was 62 %. The survey results indicate average farm size to be 111 ha. Eighty one percent of the producers grow corn. Soil testing, nutrient credits, and reduced tillage are practiced by a majority of the producers. Only 16 % of the producers are using IPM techniques. Nitrogen is applied in split application for corn with the total amount based on a yield goal of 6.8 Ng ha-'. Producers do rely on chemical and mechanical weed control for row crops. A full report of this survey is being prepared for publication in 1992.

Public Relations Activities

Several field tours were held in 1991. Audiences ranged from producers, local decision makers, to personnel from state and federal agencies. A tri-fold brochure was prepared and has been used at several local producer and irrigation association meetings.

Reprinted from Irrigation and Drainage Proceedings 1991
IR Div/ASCE
Honolulu, HI/July 22-26, 1991

Ground Water Impacts From Irrigated Ridge-Tillage

James L. Anderson, Robert H. Dowdy and
Geoffrey N. Delin[1]

Abstract

The Northern Cornbelt Sand Plain Project is a cooperative research effort between the State Agricultural Experiment Stations, USDA/Agricultural Research Service and U.S. Geological Survey in Minnesota, North Dakota, South Dakota and Wisconsin. This project is one of five Management System Evaluation Areas (MSEA).

The primary objective is to evaluate the impact of en agricultural management system on ground rater in sand plain settings in the four ststes. As data are obtained relative to the impact on ground water, the system will be modified to reduce those impacts. Specific objectives are to: (1) investigate the impacts of ridge-tillage practices in a corn and soybean cropping system bn the rate of transport of atrazine, alachlor, and metribuzin in unsaturated and saturated zones. (2) determine the effects of nitrogen management by soil test, (3) characterize water flow and relate these characteristics to transport and storage of agricultural chemicals. and (4) determine the relation between ground water recharge and agricultural-chemical loading of ground water.

Introduction

Agricultural chemicals have been transoorted into surface and ground waters from both point and non-point sources. While the amounts, sources, and risks to human and animal heslth have often not been quantified. concern

---

[1] Associate Professor and Director of Center for Agricultural Impacts on Water Quality, Depsrtment of Soil Science, University of Minnesota, St. Paul. MN 55108: Research Leader USDA/Agricultural Research Service. Department of Soil Science, University of Minnesota. St. Paul, MN 55108: and Hydrologist

by the public is increasing. These concerns are focused on nitrates and pesticides.

Usjor agricultural sources of nitrogen include fertilizers, animal wastes, legumes in crop rotations and mineralization of soil organic matter. Recommended annual applications of nitrogen fertilizer to corn in northern sand plain areas range from 130 to 220 kg/ha. Because of the many sources of nitrogen and variations in climate. soil, topography and geology, careful agricultural management practices are needed to protect water quality while economically producing crops.

Pesticides are used in crop production to control weeds, insects and diseases. The total volume of pesticides applied to farms was estimated at 195 million kilograms of active ingredients in 1987. The Midwes confined-drift aquifers and major bedrock aquifers from which drinking-waler supplies have been developed. The aquifer consists primarily of gray. calcareous outwash (Des Moines lobe). The outwash, generally thick, is well-sorted coarse grained sand. Till lenses are present within the aquifer and clay-rich till and lake deposits of lower permeability underlay most of the aquifer.

Table 1. Characteristics of Anoka Sand Plain Aquifer

UNSATURATED ZONE

Composition-medium to very coarse sand and gravel:

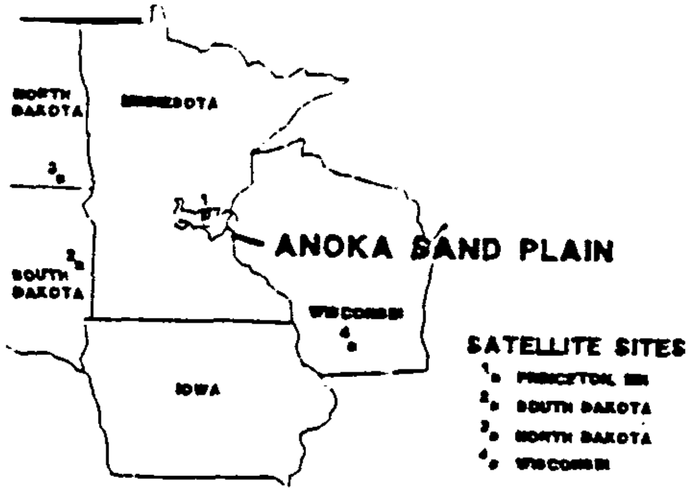
ground-water velocity-between 0.1 and 1.0 m per day; and
Ground-water recharge rate-about 20 cm per year.

Surface and ground waters are predominately calcium-bicarbonate. Regional studies of water quality have shown elevated concentrations of nitrstes, herbicides, and selected inorganic constituents (H.W. Anderson, 1990. U.S. Geological Survey, written commun.), especially in irrigated areas, and are greatest near the water table surface (Table 2).

Table 2.--Median concentrations of selected chemical constituents in the Anoka Sand Plain Management Evaluation Area (Anderson. H.W., 1990, Wall and Magner, 1988).

Nitrate - 5.2 mg per liter (maximum of 18 mg per liter);
Atrazine - 0.1 u per liter (maximum of 1.7 u per liter):
Specific conductance - 570 microsiemens per centimeter:
pH - 7.6 units:
Sulfate - 17 milligrams per liter: and
Chloride - 13 milligrams per liter.

The dominant soil association on the Anoka Sand Plain consists of the Zimmerman (Alfic Udipsamment). Isanti (Typic Haplaquoll), and Lino (Aquic Udipsamment)



[redacted]

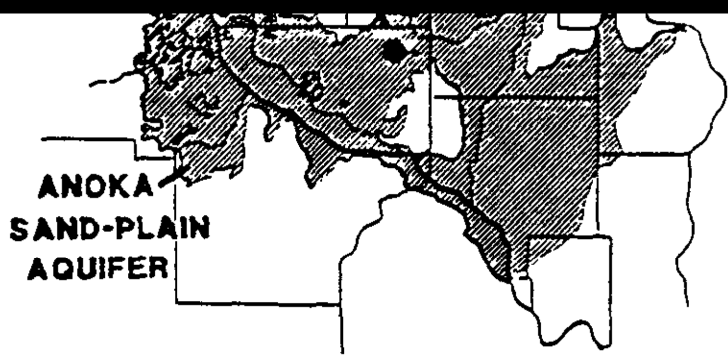


Figure 2. Extent of Anoka Sand Plain Aquifer

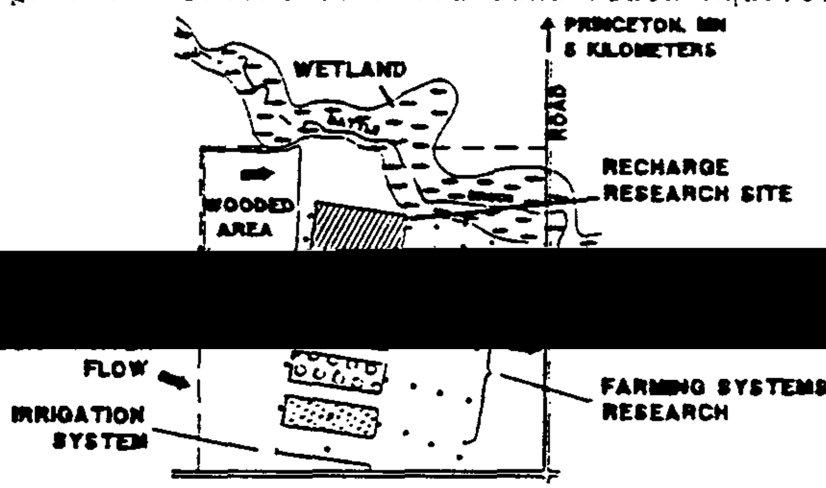


Figure 3. Minnesota Management System Evaluation Area (MSEA) site plan

series. These soils occur on broad undulating outwash plains and were formed in fine textured sandy sediments. Distinctions between soils are related to soil drainage and depth to water table.

At each site, en irrigated ridge-tillage system will be established having the following characteristics:

Crop rotation/tillage: Field corn - soybeans with both crops occurring each year, with ridge tillage.

Fertilization rate: As recommended by soil test.

Pesticide usage: Atratine, alachlor, metribuzin. and insecticides according to current IPM practices.

Irrigation: As predicted by state of the science irrigation scheduling system which optimizes production and uses precipitation risk to minimize leaching.

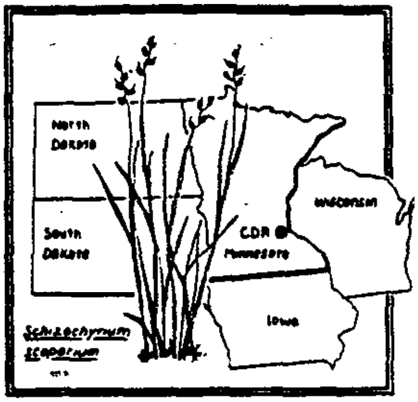
Fertigation: Used to maximize application flexibility and nitrogen use efficiency.

Management decisions minimize fertilizer and pesticide movement. Ridge tillage reduces herbicide usage because it is banded over the row while interrow weed control is cultural and mechanical. A cover crop planted in early fall. and winter killed, will be used after soybeans to control vind erosion and minimize nitrate movement by extending the growing season. Following corn, crop residue will control erosion and taken from multiport observation wells installed immediately up and down gradient of each strip (Figure 3). Samples will be collected at least four times during the year.

Assessment of economic and social characteristics of

References

Anderson. H.W., Jr. 1990. Effect of agricultural and residential land use on rater quality in the Anoko sand-plain aquifer, east-central Minnesota: U.S. Geological Survey Water Resources Report



Cedar Creek ***Natural History Area (CDR)***

RESEARCH SETTING

Cedar Creek Natural History Area (CDR) is a 2,200-ha experimental ecological reserve operated by the University of Minnesota in cooperation with the Minnesota Academy of Science. It is located in Anoka and Isanti Counties about 50 km north of Minneapolis and St. Paul, just east of Bethel, Minnesota. Cedar Creek lies at the biome transition between tallgrass prairie and oak woodland As such, it is likely to be highly susceptible to climatic change.

Site Characteristics

Cedar Creek is 8 mosaic of uplands dominated by oak savanna, prairie, hardwood forest, pine forest, and abandoned agricultural fields and lowlands comprised of ash and cedar swamps, acid bogs, marshes, and sedge meadows. Large tracts of the pre-agricultural ecosystems of the region are preserved within its boundaries as perspectives. Cedar Creek is a mosaic of landscape elements that differ in productivity. herbivory, disturbance history, soil processes, and landscape position. Each of these factors interacts and co-varies with the other factors. To understand the cause of spatial and temporal dynamics, we uncouple these factors through experimentation, find how they are finked in nature through additional experiments and long-term observations, and synthesize these data through the development of ecosystem models and general ecological theory. Our work looks at the direct. indirect, and feedback effects of ecosystem elements on each ocher. Feedback effects, if positive, can cause ecosystem divergence and multiple stable equilibria Even negative feedback effects can cause long-term oscillations that might influence successional dynamics and spatial structure.

Succession is slow at CPR Si years after cessation of agriculture, Gelds have neither returned to pre-agricultural nitrogen levels nor re-attained their woody cover. Only long-term observations can describe adequately the slow secondary succession in these fields. And only long-term experimentation can unravel paths of causation, and distinguish spurious correlation from causation.

on composition and dynamics of grassland vegetation. DAVID SMITH

Our highest priority initially was to establish long-term experimental and observational plots in old fields. We now have over 1,100 permanent experimental plots, as well as 2,300 permanent observational plots distributed among 22 fields in a successional chronosequence. We are building a systematic, long-term data set that has already proven useful, but increasingly unique and

SPATIAL AND TEMPORAL TRENDS IN CARBON STORAGE IN LAKE STATE'S FORESTS

Investigators: J.C. Bell, D.F. Grigal, and P.C. Bates, Department of Soil Science, University of Minnesota, St. Paul.

E.S. Verry, North Central Forest Experiment Station, Grand Rapids, MN

This project is funded as part of the USDA Forest Service Global Change Research Program. The major objective is to estimate carbon storage in 2 contrasting physiographic regions. Both regions are composed of a mosaic of uplands and lowlands. The two study areas include:

1. The Cedar Creek Natural History Area -- Part of the Anoka Sand Plain, located in east central Minnesota. Upland vegetation is primarily oak and oak savannah. Lowland vegetation includes black spruce, tamarack, cedar, an sedge.

2. The Marcell Experimental Forest -- Located in a glacial moraine complex in northcentral Minnesota. Upland vegetation is predominantly aspen and northern hardwoods. Lowland vegetation is similar to that at Cedar Ck.

There are two major goals for this project:

1. Develop statistical functions that allow us to predict carbon storage as a function of vegetative cover, soil map unit, and topography (specifically landscape position and slope steepness and curvature).

2. Investigate the possibility of predicting peatland geometry based on characteristics in the surrounding upland. An important objective given the importance of peatlands as a potential source/sink for carton.

Our analyses will rely heavily on GIS technology. We are currently developing a geographic database for each area. The key data layers include: vegetative cover, soil map unit, ground water elevation, and digital terrain models. We will intensively transect both areas and collect data in order to estimate carbon storage in 3 pools: biomass, forest floor, and soil.

We will use GIS capabilities to extrapolate our results across the landforms represented by the two study sites in order to develop estimates of carbon storage at the landscape level.

Both landforms represent a wide range of land use histories, ranging from landclearing for agriculture (and subsequent abandonment) to commercial timber harvesting, to undisturbed. 'Thus, we hope to use the results of our analyses to predict carbon dynamics in response to environmental change -- whether rapid changes brought about by management activities, or long-term changes induced by global processes.

(f) changes in the composition and structure of the microbial community.

Primary Productivity experiments include (a) addition of nutrients one a1 a time or in combination to determine which limit production; (b) experimental productivity gradients of natural vegetation within deer and gopher exclosures; and (c) similar experimental productivity gradients with all herbivores present

Herbivore Experiments include (a) selective removal of herbivore guilds (foliage-feeding insects, xylem- and phloem-feeding insects; below-ground feeding insects; *Microtus pennsylvanicus*; *Geomys bursarius*; all herbivores); (b) deer exclosures a1 the margins of old fields 10 determine the role of deer herbivory in succession; and (c) comparisons of fenced and unfenced N gradients to determine effects of gophers and deer, (d) studies of grasshopper feeding preferences and competition.

One of 16 burn compartments in an experiment to determine the effects of burning frequency on vegetation at the prairie/forest boundary. DAVID TILMAN

Disturbance Experiments include (a) comparisons of disturbed vs. undisturbed plots that receive different N additions; (b) a 27-year running se1 of prescribed bums in large blocks of native oak savanna designed to test effects of fire frequency. (c) prescribed burns a1 various frequencies in a 25-year-old field; and (d) manipulations of water-table depth 10 mimic the potential impact *of* climate change. Most srudia have been done in the same fields in a coordinated manner, so that results of one study are directly relevant to those of others.

Biodiversity Studies include (a) long term observations on effects of climatic variation on biodiversity in permanent plots; (b) experimental studies of effects of diierent levels of soil heterogeneity and of herbivory on plant diversity and (c) experimental srudia of effects of local recruitment limitation and neighborhood competition on plant diversify in old fields and native prairie.

Penanent *Observational* Plots

Permanent observational plots are located in a chronosequence formed by 22 old fields of different ages. Within each field we established 100 permanent quadrats (150 in two fields) for repeated, non-destructive sampling of vegetation to species, soils (total N. pH, organic matter, sand, silt. day), and disturbance events. Other quadrats have been sampled for total plant biomass (above.. and belowground. the former separated to leaves and stems). soil chemistry (total N; pH; dissolved organic C; total organic C; extractable NH, and NO,), microbial biomass, microfungi, mycorrhizal fungi, small mammals (IO species), and grasshoppers (IO species). This chronosquence has provided a rich description of the changing importance of various processes during succession. By periodic resampling, we will determine the extent to which inferences based on a chronosquence are indicative of the actual pattern of dynamic change during succession.

Our observational studies suggest that N dynamics, light, colonization rates, disturbance history, and possibly herbivory are the major factors influencing successional dynamics and spatial patterning at CDR. Low levels of N in newly abandoned fields, and the 100-plus years required for soil N levels to return to that of undisturbed savanna, may partially explain the pattern and rate of succession, especially the slow revegetation by woody plants. However, this cannot explain the domination of early successional, N-poor fields by annuals and short-lived perennials. Might their dominance be the result of the transient dynamics of competitive displacement or of a tradeoff between the competitive ability of a plant species versus its dispersal ability?

Our experiments have shown that transient dynamio are a general response of ecosystems to perturbation. Are the results that we have observed after ten years of nutrient addition indicative of the eventual relations between ecosystem stmcture and productivity? Or are the species that dominate afier ten years also transients to be displaced by other species? We do not yet know how long experiments such at our productivity gradients must proceed before it is possible to distinguish between transient dynamics and long-term effects Our models predict that transient dynamics may last for 30 to 40 years in grasslands. If this is so, our experiments may need to proceed for another 25 to 35 years.

Slow increases in soil N and plant biomass during secondary succession at CDR suggest that the successional gradient is also a productivity gradient. However, contrary to our initial hypothesis. there are dramatic differences between the correlational patterns observed between ecosystem structure and productivity in successional fields and those observed in native, undisturbed ecosystems. We do not know what causes these differences. Why, for instance, do plants that dominate the poorest soils of secondary succession have root:shoot ratios almost five times lower than plants that dominate the least productive areas of non-successional ecosystems? Why is *Agropyron repens* dominant on N-poor soils during succession, but on the most N-rich soil in our experimental N gradients? Given the length of time that successional fields remain free of a woody overstory, why do woody plants of N-poor, undisturbed soils, such as *Corylus* and ericaceous species, not come to dominate the old fields? In other words, why is species composition along the successional productivity gradient so different from that along a non-successional productivity gradient, though both have similar physiognomic characteristics? We shall address these questions by continuing our existing research and by apanding it to include studies of productivity gradients in additional non-successional habitats.

Our work to date has demonstrated the power of combining experimental, observational and theoretical approaches, and the need for long-term observations and long-term experiments. It has led us to formulate a series of general theoretical predictions that we now wish to test not only at Cedar Creek, but also by performing comparisons across the North American productivity gradient represented by the LTER Network.

FUTURE DIRECTIONS

Our research will continue to seek the underlying mechanisms that cause broad scale patterns in ecosystem composition, diiity, and productivity. We are currently interested in and greatly concerned about the potential impact of global climatic change on biotic diversity, and believe that our long-tenn experimental and observation studies will help address this issue.

Furthermore. we have just begun a new series of experiments designed to determine the roles of various processes (dispersal, competition, soil heterogeneity, disturbance) in allowing the local coexistence of numerous species. ,

* CDR Climate Data 1951 - 1980

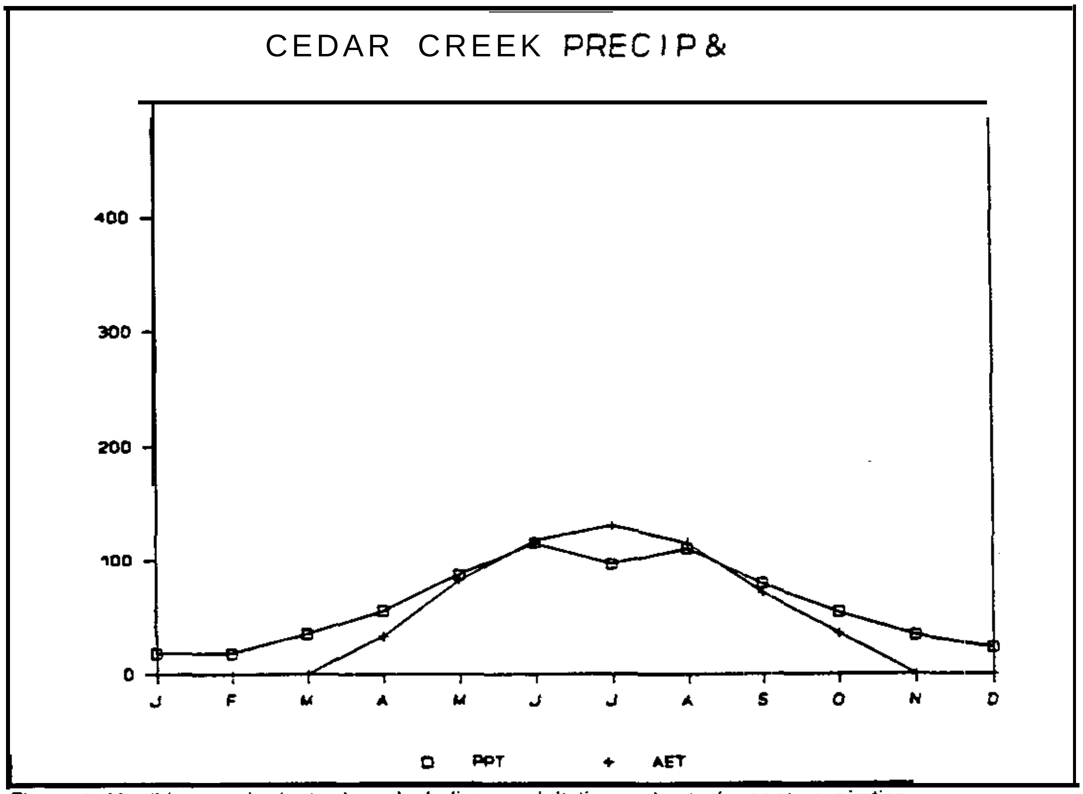


Figure 1. Monthly water budget values, including precipitation and actual evapotranspiration.

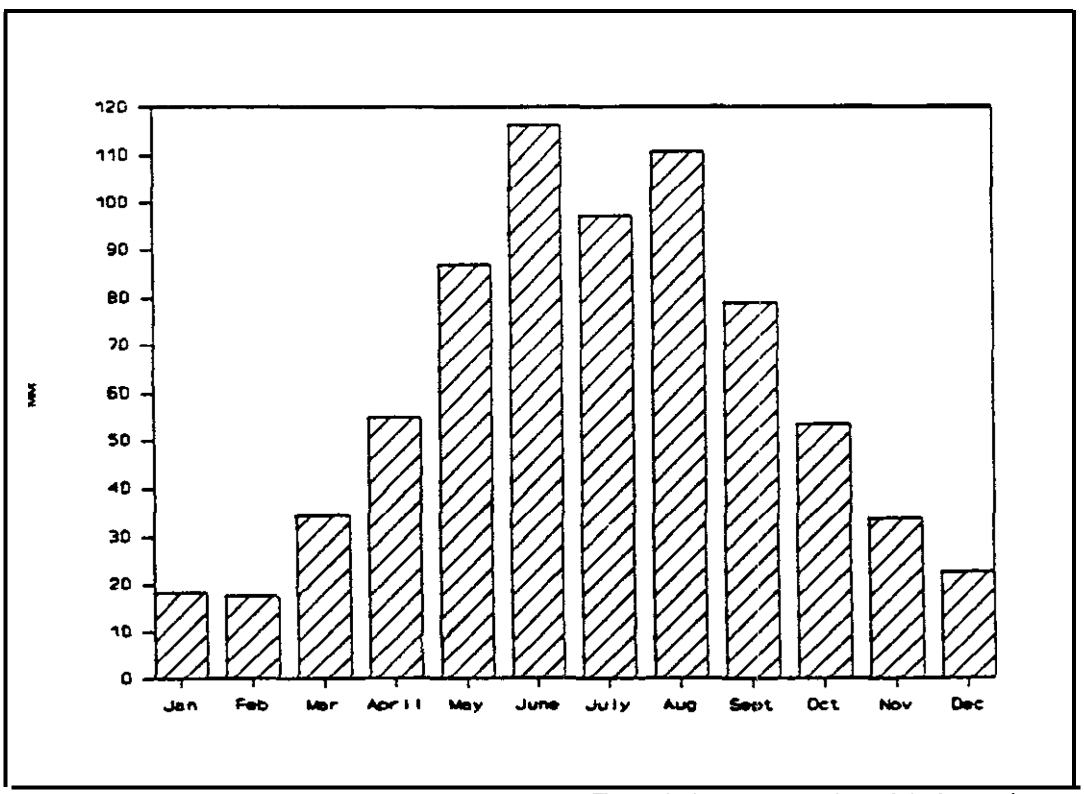
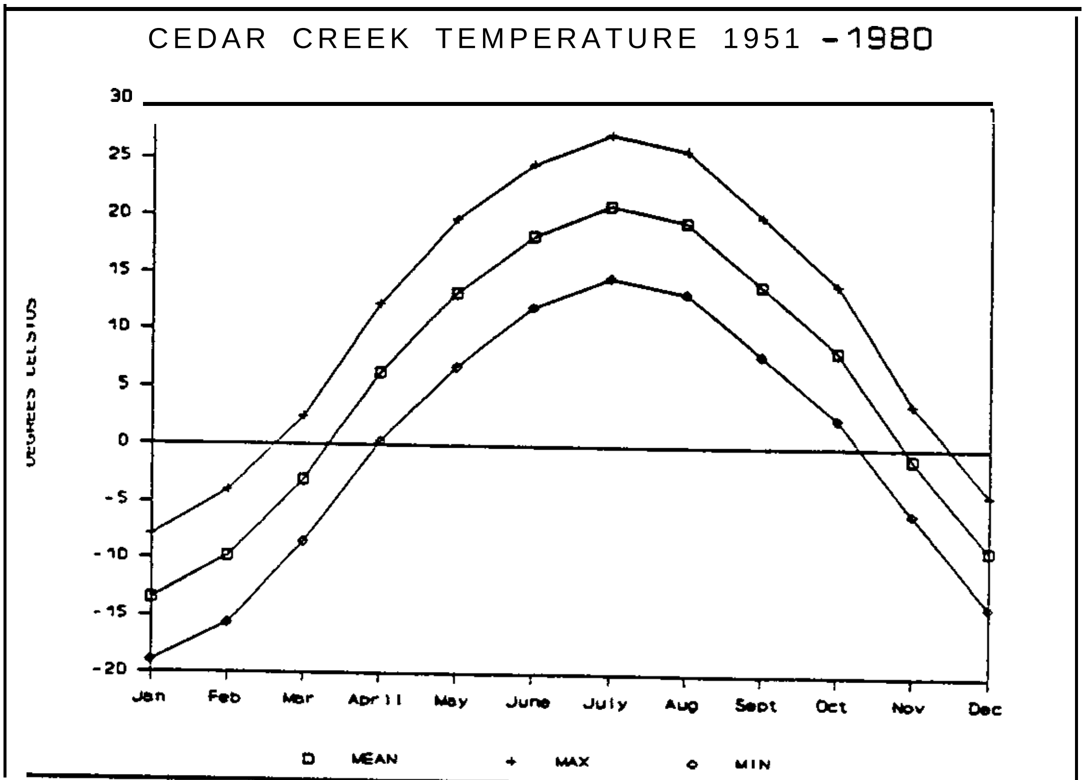
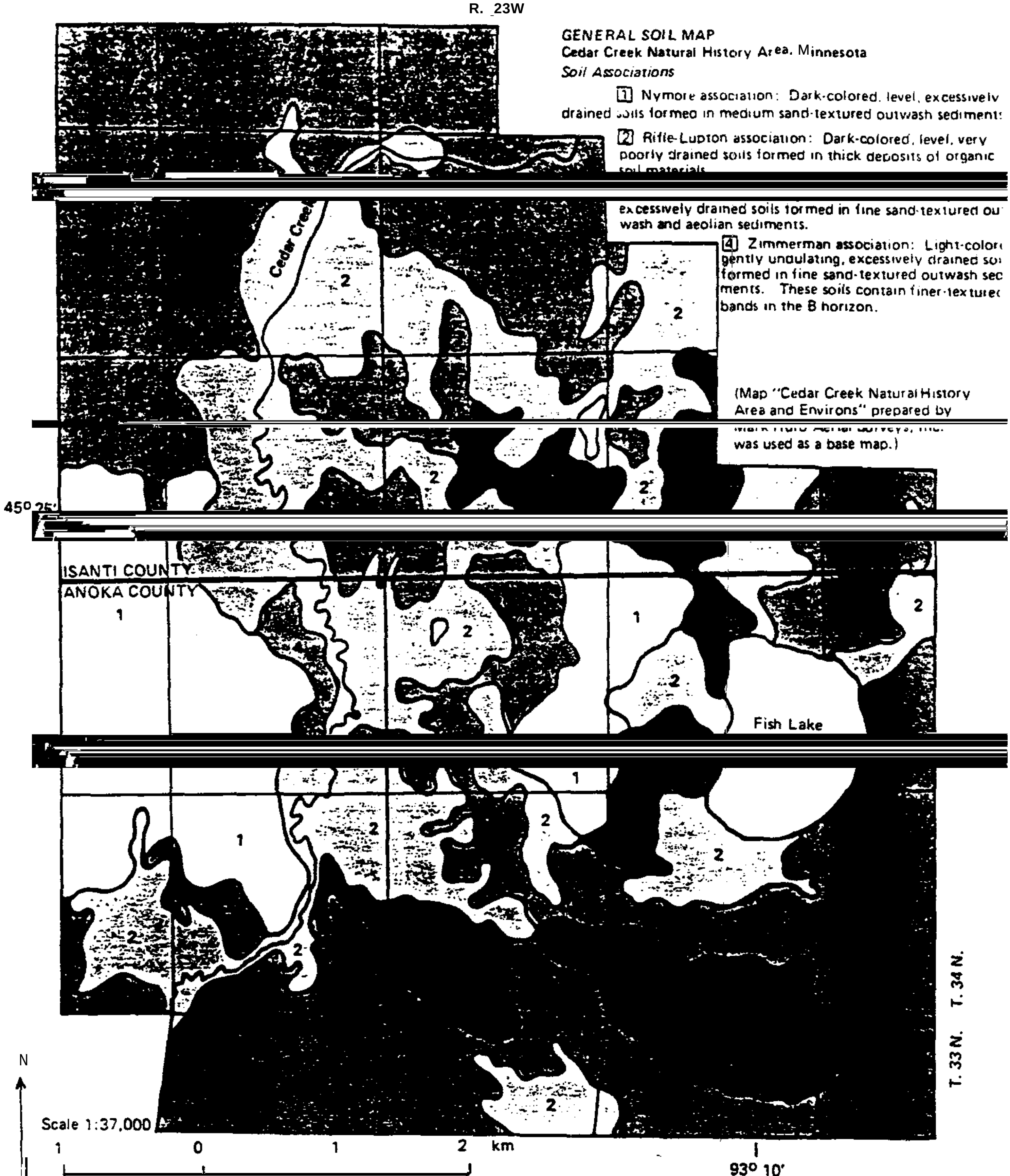


Figure 2. Average annual precipitation totals.



'ure 3. *Average annual temperature values.*

• Data from on-site or nearest weather station.


R. 23W
GENERAL SOIL MAP
Cedar Creek Natural History Area, Minnesota
Soil Associations
1 Nymore association: Dark-colored, level, excessively drained soils formed in medium sand-textured outwash sediments
2 Rifle-Lupton association: Dark-colored, level, very poorly drained soils formed in thick deposits of organic
excessively drained soils formed in fine sand-textured outwash and aeolian sediments.
4 Zimmerman association: Light-colored, gently undulating, excessively drained soils formed in fine sand-textured outwash sediments. These soils contain finer-textured bands in the B horizon.
(Map "Cedar Creek Natural History Area and Environs" prepared by
was used as a base map.)
Cedar Creek
ISANTI COUNTY
ANOKA COUNTY
Fish Lake
T. 34 N.
T. 33 N.
N
Scale 1:37,000
1 0 1 2 km
93° 10'

LONG-TERM ECOLOGICAL RESEARCH IN THE UNITED STATES

The National Science Foundation (NSF), Division of Biotic Systems and Resources (BSR)*, has undertaken the support of research on long-ten ecological phenomena at a national network of sites. An initii objective in establishing these site-specific projects was to provide the environmental biology research community with the opportunity to utilize the sites for research projects. Projects are both short- and long-term and focus on phenomena manifest at the sites.

The LTER Program offers investigators fhe opportunity to interact with other scientists performing related research. ready access to field sites with bng-term availability, and well-documented and accessible records of background and corroborative data.

An initial set of six sites was selected and funded in 1979. Competitions in 1980 and 1987 resulted in funding of 10 additional sites. In 1988, two sites withdrew and two new sites were added, bringing the total to 17. A 1990 competition for an Antarctic site through the diions of Polar Programs and BSR brought the Network to a total of 1 8 sites in 1991. The sites represent a very broad array of ecosystems and research emphases. They do, however, share a common commitment to long-term research and the inclusion of the following five core research topics within their overall programs es stipulated by the National Science Foundation:

1. Pattern and control of primary production;

2. Spatial and temporal distribution of populations selected to represent trophic structure;

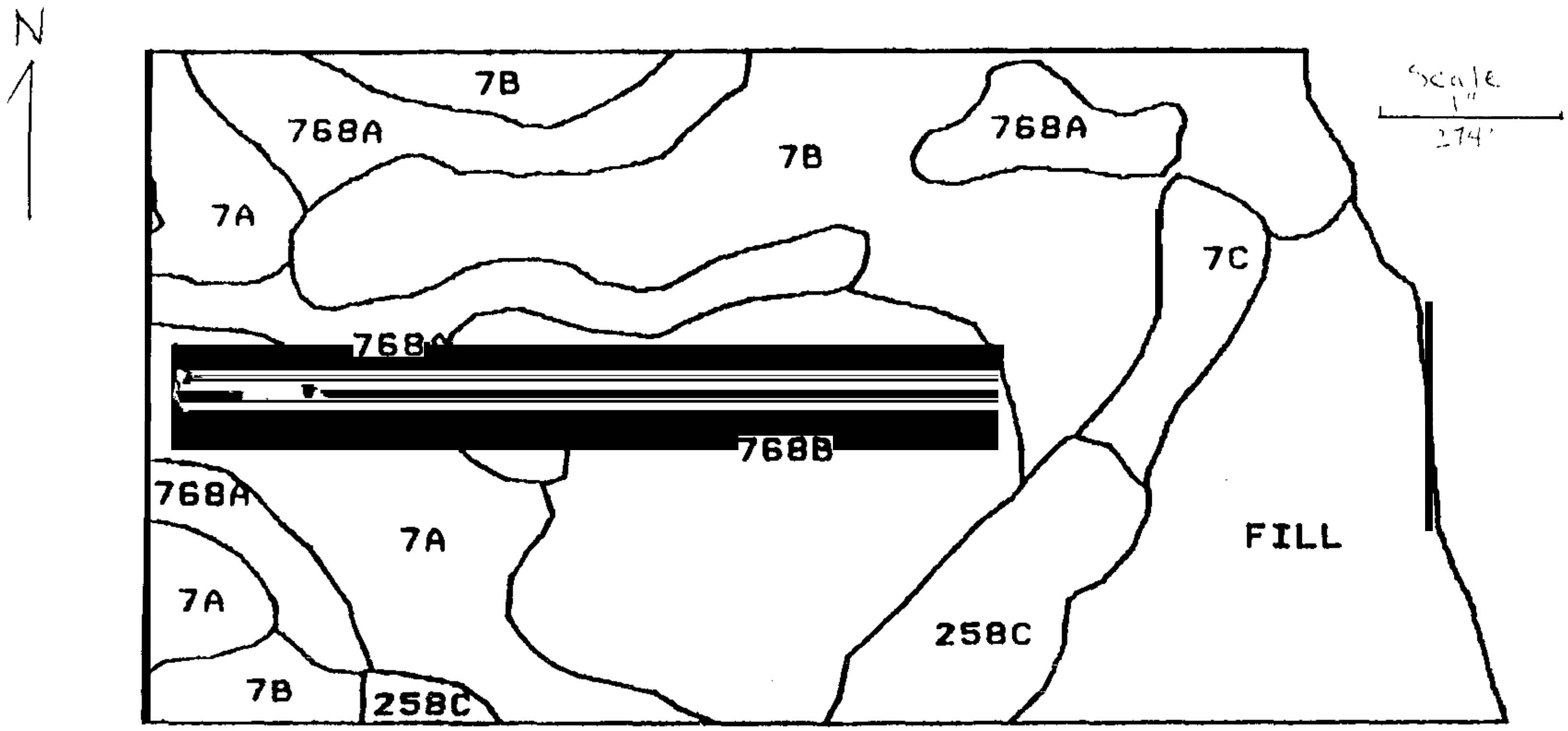
3. Pattern and control of organic matter accumulation in surface layers and sediments;

4. Patterns of inorganic inputs and movements of nutrients through soils, groundwater and surface waters; and

5. Patterns and frequency of site disturbances.

now the Division of Environmental Biology (DEB), Biological Sciences Directorate (BIO)

Soil Map Olson Farm, Sherburne Co. Variable Nitrogen by Soil 1991



Map Unit	Series Name	Soil Texture	Percent Slope	Acres
7A	Hubbard	Loamy Sand	0 to 2	6.4
7B	Hubbard	Loamy Sand	2 to 6	10.8
7C	Hubbard	Loamy Sand	6 to 12	1.2
Fill	Sand/Marsh	Sand/Peat	0 to 2	7.4
768A	Monticello	Sandy Loam	0 to 2	6.8
768B	Monticello	Sandy Loam	2 to 6	8.8
258C	Sandberg	Loamy Course Sand	6 to 12	2.7

LOCATION HUBBARD MN+WI

Established Series
Rev. MFG-TCJ-ROP
4/91

HUBBARD SERIES

The Hubbard series consists of very deep, excessively drained and moderately well drained, rapidly permeable soils that formed in sandy glacial outwash on outwash plains, valley trains and stream terraces. Slopes range from 0 to 35 percent. Mean annual precipitation is about 26 inches. Mean annual temperature is about 43 degrees F.

TAXONOMIC CLASS: Sandy, mixed Udorthentic Iiaploborolls

TYPICAL PEDON: Hubbard loamy coarse sand with slightly convex nearly level slope on a valley train in a cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 8 inches: black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry: weak very fine granular structure: very friable: few very fine roots: about 1 percent gravel; moderately acid: abrupt smooth boundary. (7 to 11 inches thick)

A--8 to 13 inches: black (10YR 2/1) loamy sand, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure: very friable: few very fine roots: about 1 percent gravel; neutral: clear smooth boundary. (0 to 10 inches thick)

AB--13 to 20 inches; very dark brown (10YR 2/2) loamy coarse sand, dark grayish brown (10YR 4/2) dry: weak very fine subangular blocky structure: very friable; about 2 percent gravel; slightly acid: clear wavy boundary. (0 to 8 inches thick)

Bw--20 to 32 inches; dark yellowish brown (10YR 3/4) loamy sand: weak very fine subangular blocky structure: very friable; about 3 percent gravel: slightly acid: gradual wavy boundary. (8 to 21 inches thick)

BC--32 to 46 inches; yellowish brown (10YR 5/4) sand; single grain: loose: about 4 percent gravel: slightly acid; gradual wavy boundary. (0 to 24 inches thick)

C--46 to 60 inches; brown (10YR 5/3) sand: single grain: loose: about 1 percent gravel; slightly acid.

TYPE LOCATION: Sherburne County, Minnesota; about 2 miles north and 1 1/2 miles west of Becker: about 90 feet north and 1150 feet east of the southwest corner of sec. 24, T.34N., R.29W.

RANGE IN CHARACTERISTICS: The depth to free carbonates is 40 to over 60 inches. The mollic epipedon is 10 to 26 inches thick. Typically, the soil profile above a depth of 50 inches does not have rock fragments, but some pedons contain as much as 10 percent rock fragments by volume, either dispersed throughout or in strata. The rock fragments are of mixed lithology and mostly 2 to 5 mm in size.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It typically is coarse sand, sand, loamy coarse sand, or loamy sand, but is coarse sandy loam or sandy loam in the upper 10 inches or less in some pedons. It is strongly acid to neutral.

The AB horizon has value of 2 or 3 and chroma of 2 or 3. It is loamy sand, loamy coarse sand, or loamy sand. It is strongly acid to neutral.

The Bw and BC horizons have hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is coarse sand, sand, loamy coarse sand, or loamy sand. It is strongly acid to neutral.

The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma 2 to 6. A moderately well drained phase has mottles below a depth of 40 inches. It is coarse sand or sand. It is moderately acid to slightly alkaline.

COMPETING SERIES: These are the Kost, Lohnes, Maddock, and Sandberg (T) series. Kost and Maddock soils have 30 percent or less medium sand or coarser in the series control section. Lohnes and Sandberg soils have free carbonates within 40 inches. Lohnes and Maddock soils are also substantially drier in the soil moisture control section for the 120 days following the summer solstice.

GEOGRAPHIC SETTING: The Hubbard soils have slightly concave to convex slopes on outwash plains, valley trains and stream terraces. Slope gradients range from 0 to 35 percent. These soils formed in sandy glacial outwash sediments. The materials are chiefly Late Wisconsin in age. Wean annual temperature ranges from 37 to 45 degrees F. The mean annual precipitation ranges from 24 to 33 inches. The mean precipitation during the growing season ranges from 14 to 20 inches. Frost-free days range form 90 to 145. Elevation above sea level ranges from 670 to 1450 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Duelm and Isan soils which are members of a drainage sequence with Hubbard. The Duelm soils are moderately well drained and somewhat poorly drained and the Isan soils are poorly drained and very poorly drained. These soils typically are on lower lying less sloping terrain.

DRAINAGE AND PERMEABILITY: Excessively drained and moderately well drained. Surface runoff is slow. Permeability is rapid.

USE AND VEGETATION: Most of these soils are cropped to corn, small grain, and hay. Native vegetation is principally tall grass prairie with scattered bur oak and hazel.

DISTRIBUTION AND EXTENT: Primarily in central and north-central Minnesota with a small acreage in western Wisconsin. This soil is extensive.

SERIES ESTABLISHED: Wadena County, Minnesota, in 1926.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to a depth of 20 inches (Ap and AB horizons); udorthentic subgroup due to low chroma of Ap horizon and absence of a cambic horizon.

'ADDITIONAL DATA: Refer to Minnesota Agricultural Experiment Station Central File Code Nos. 4374 and 178

Established Series
Rev. LMC-JFC-ROP
4/91

ISANTI SERIES

The Isanti series consists of very deep, poorly and very poorly drained soils that formed in sandy glacial outwash or eolian sediments on outwash plains and valley trains. These soils have rapid permeability. Slopes range from 0 to 2 percent. Mean annual precipitation is about 26 inches, and mean annual temperature is about 44 degrees F.

TAXONOMIC CLASS: Sandy, mixed, frigid Typic Haplaquolls

TYPICAL PEDON: Isanti fine sandy loam on a slightly concave slope of less than 1 percent in native vegetation. (Colors described are for moist conditions unless otherwise stated.)

Al--O to 4 inches: black (10YR 2/1) fine sandy loam: weak medium platy structure: very friable: common roots; strongly acid; abrupt smooth boundary.

A2--4 to 10 inches: black (N 2/0) fine sandy loam; weak thin platy structure: very friable: common roots: strongly acid: abrupt wavy boundary. (Combined thickness of A horizons is 7 to 18 inches.)

Bgl--10 to 14 inches; gray (N 5/0) fine sand: single grain: loose; few roots: common very dark gray (10YR 3/1) 1 to 3 cm thick discontinuous horizontal streaks and a few small black inclusions: moderately acid; clear wavy boundary.

Bg2--14 to 26 inches: gray (10YR 5/1) fine sand: single grain; loose: few roots; strongly acid: abrupt smooth boundary.

Bg3--26 to 31 inches; dark gray (10YR 4/1) fine sand; single grain: loose; moderately acid: abrupt wavy boundary. (Combined thickness of Bg horizons is 13 to 36 inches.)

Cg--31 to 60 inches: light brownish gray (10YR 6/2) fine sand; single grain; loose: moderately acid; gradual smooth boundary. (6 to 16 inches thick)

TYPE LOCATION: Anoka County, Minnesota; about 7 miles east of Anoka; 1,345 feet east and 960 feet north of the southwest corner of sec. 5, T. 31 N., R. 23 W.

RANGE IN CHARACTERISTICS: The series control section is dominated by fine sand and has 85 percent or more passing the No. 40 sieve. It also has no rock fragments. Some pedons have an O horizon as much as 6 inches thick. The mollic epipedon ranges from 10 to 18 inches in thickness where texture is loamy fine sand or coarser and 7 to 18 inches in thickness for those soils with finer textures.

The A horizon has hue of 10YR or 5Y, or is neutral. Some pedons have an AB or BA horizon as much as 6 inches thick. The A horizon is loamy fine sand, fine sand, sand, loamy sand, fine sandy loam, or sandy loam. Some pedons have an O horizon as much as 6 inches thick. It ranges from slightly acid to strongly acid.

The Bg horizons have hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or less, or is neutral and has value of 4 or 5. In some pedons it has discontinuous nearly horizontal remnants as well as involutions of the A horizon 0.5 to 10 cm thick that presumably resulted from frost action. It is fine sand, sand, loamy fine sand or loamy sand. It ranges from slightly acid to strongly acid. Some pedons have a BC horizon.

The Cg horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 1 or 2. It is sand, fine sand, loamy sand, or loamy fine sand. Reaction is moderately acid to mildly alkaline.

COMPETING SERIES: These are the Hamar, Hangaard, Isan, Medano, and Venlo soils. Hamar, Hangaard, Medano, and Venlo soils have neutral or higher pH in the series control section. Isan soils have less than 85 percent sand passing the No. 40 sieve.

GEOGRAPHIC SETTING: These soils have plane or concave slopes in depressions, drainageways, and low flats on outwash plains and valley trains. Slopes range from 0 to 2 percent. The Isanti soils formed in gravel free, noncalcareous sandy glacial outwash or eolian sediments of Late Wisconsinan Age. Mean annual temperature ranges from about 37 to 45 degrees F. Mean annual precipitation ranges from about 24 to 33 inches. Frost-free days range from 90 to 150. Elevation above sea level ranges from 700 to 1450 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are principally the Anoka, Lino, Sartell, and Zimmerman soils. The Lino soils are on slightly higher elevations and are somewhat poorly drained. The Anoka, Sartell, and Zimmerman soils are better drained.

DRAINAGE AND PERMEABILITY: Poorly and very poorly drained. Surface runoff is slow to ponded. Permeability is rapid. An apparent water table is at plus 1 foot to 2 feet.

USE AND VEGETATION: Mostly idle or in pasture, but some areas are drained and cropped to corn, soybeans, potatoes, or sod. Native vegetation was primarily grasses, sedges, and willow.

DISTRIBUTION

LOCATION SARTELL MN

Established Series
Rev. ELB-ROP
6/91

SARTELL SERIES

The Sartell series consists of very deep, excessively drained soils that formed in sandy eolian or glacial outwash sediments on outwash plains and valley trains. These soils have rapid permeability. Slopes range from 0 to 25 percent. Mean annual precipitation is about 26 inches. Wean annual air temperature is about 44 degrees F.

TAXONOMIC CLASS: Mixed, frigid Typic Udipsamments

TYPICAL PEDON: Sartell fine sand with a convex slope of 2 percent on an outwash plain in an oak forest. (Colors are for moist soil unless otherwise stated.)

A--O to 4 inches: very dark gray

COMPETING SERIES: These are the Champlain (T), Claire, Corliss (T), Feldtman (T), Friendship, Grayling, Mahtomedi, Menahga, Nymore, Omega, Pelkie, Plainbo, Serden, Shawano, and Sunday soils. Claire, Corliss, Grayling, Mahtomedi, Menahga, and Nymore soils have less than 50 percent fine sand in the series control section. Feldtman (T), Omega, Pelkie, and Shawano soils have hue of 7.5YR or redder in the series control section. Friendship soils are mottled in the lower part of the series control section. Plainbo soils have lithic contact beginning at depths of 20 to 40 inches. Serden soils are neutral or slightly alkaline in the series control section. Champlain and Sunday soils have substantially wetter soil moisture control sections.

GEOGRAPHIC SETTING: These soils typically are on undulating to rolling "old" dune-shaped topography on outwash plains and valley trains. Slopes are short and irregular with gradients of 0 to 25 percent. The Sartell soil formed in deeply leached, gravel free, fine sands that are mostly eolian in origin but some probably are glaciofluvial in origin. Mean annual air temperature ranges from 36 to 45 degrees F. Mean annual precipitation ranges from 22 to 33 inches. Frost-free period is 88 to 142 days. Elevation above sea level ranges from 670 to 1600 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the somewhat poorly drained Lino and very poorly drained Ssanti soils, which are members of a hydrosequence with the Sartell soils. The well drained Anoka and excessively drained Zimmerman soils are associated in some areas. Active blowouts are in some areas.

DRAINAGE AND PERMEABILITY: Excessively drained. Surface runoff is slow to medium. Permeability is rapid.

USE AND VEGETATION: About one-half of these soils are cropped to soybeans, corn, small grain, and forage. Most of the remaining areas are in forest. Native vegetation primarily was savanna with forest species such as northern red oak and bur oak and in some places jack pine.

DISTRIBUTION AND EXTENT: Primarily east-central Minnesota: moderately extensive.

'SERIES ESTABLISHED: Benton County, Minnesota; April, 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are: ochric epipedon - the zone from the surface to 4 inches (A horizon); udic moisture regime.

ADDITIONAL DATA: Some chemical and physical characteristics of the typical pedon are reported in SSIR No. 9, profile S60 MINN-71-4, pages 78 and 79.

National Cooperative Soil Survey

Established Series
Rev. LMC-KRV-ROP
12/91

ZIMMERMAN SERIES

The Zimmerman series consists of very deep, excessively drained soils that formed in sandy glacial outwash or eolian sediments on glacial outwash plains, deltas, and valley trains. These soils have rapid permeability. Their slopes range from 0 to 60 percent. Mean annual precipitation is about 28 inches. Mean annual temperature is about 41 degrees F.

TAXONOMIC CLASS: Mixed, frigid Alfic Udipsamments

TYPICAL PEDON: Zimmerman loamy fine sand with a convex slope of 4 percent on a glacial outwash plain in a mixed oak forest. (Colors are for moist conditions unless otherwise stated.)

A--0 to 2 inches: very dark gray (10YR 3/1) loamy fine sand: weak very fine granular structure; very friable; many clean sand grains: strongly acid: abrupt smooth boundary. (0 to 7 inches thick)

E--2 to 10 inches: dark brown (10YR 4/3) loamy fine sand: very weak fine subangular blocky structure: very friable; moderately acid; clear smooth boundary. (0 to 30 inches thick)

Bwl--10 to 18 inches; yellowish brown (10YR 5/4) fine sand: single grain: loose; slightly acid; clear smooth boundary.

Bw2--18 to 28 inches: light yellowish brown (10YR 6/4) fine sand: single grain; loose; slightly acid; gradual smooth boundary. (Combined thickness of Bw horizons is 6 to 36 inches.)

E'--28 to 36 inches; very pale brown (10YR 7/4) fine sand: single grain; loose: slightly acid: abrupt irregular boundary. (0 to 36 inches thick)

E'

value of 3 or 4, and chroma of 2 or 3 is in some pedons.

The E and E' horizons have hue of 10YR or 7.5YR, or is neutral: value of 4 to 7: and chroma of 1 to 4. The A and E horizons are fine sand or loamy fine sand.

The Bw horizon has hue of 10YR or 7.5YR with value of 4 to 7, and chroma of 3 to 8.

The Bt part consists of one or more thin (less than 3 inches thick) of irregular discontinuous or continuous lamellae or bands that begin at depths ranging from 30 to 60 inches and range from 0.4 inches to a

ADDITIONAL DATA: Refer to MAES Central File Code Nos. 1079 for results of some laboratory analysis of the typical pedon and to 1550 for an additional pedon.

REMARKS.: Diagnostic horizons and other features recognized are: Ochric epipedon - the zone from the surface to 10 inches (A and E horizons): alfic feature - lamellae totalling less than 6 inches within 60 inches (E' & Bt horizon).

National Cooperative Soil Survey
U.S.A.

Minnesota Soil Survey Laboratory - University of Minnesota

Analysi6 Report

Report Date : 2/04/91

CFC number : 4374   Lab numbers : 20534 to 20539

Soil : Hubbard   MapUnit :
Location : 90ftN & 1150ftE of SW cor   sec 24 T34N R29W
county : Sherburne   State ID: S90MN141-88(1-6)
Sampled by : T Jackson   On: 11/14/90
Site tentatively identified as a typical pedon of this soil
Field description type(s) : 007
Type(s) of samples : horizon(a)

Samples received: 12/12/90   By : BN   Primary anal yst : BN
First reported on: 2/04/91
Information last updated on - CFC : 12/12/90   Sample data : 1/25/91
Amount billed to date :
Note : Establishing new location for Official series.

Lab #	Seq	Horizon	Depths (in) Up	Low	Ca1c ?	FS	pH	OC	CCE	CSC	0⊢g	Db	MR	CMin	FC	PK	EC	SS	Gyp	Misc
									Test Status											
20534	1	Ap	0-	8	N	C	C	C									H			
20535	2	A	8-	13	N	C	C	C									H			
20536	3	AB	13-	20	N	C	C	C									H			
20537	4	Bw	20-	32	N	C	C	C									H			
20538	5	BC	32-	46	N	C	C	C									H			
20539	6	C	46-	60	N	C	C	C									H			

------ Particle size data (%) -------

Seq	Horiinn	>2mm	Total Sand	Silt Coarse	Silt Fine	Silt Total	Total Clay	USDA Texture
1	Ap	1	86.9	2.1	5.2	7.3	5.8	LS
2	A	0	a5.4	2.z	5.1	7.4	6.2	LS
3	RF	0	83.7	2.5	6.2	a.7	7.4	LS
4	Bw	0	84.1	2.9	4.3	7.2	6.7	LS
5	BC	4	97.5	0.0	.8	.8	1.7	S
5	C	1	97.7	.6	0.0	.6	1.7	S

(CFC : 4374 continued on next page)

Analysis Report

Report Date : 2/04/91
CFC number : 4374 (continued)

Seq	Horizon	VCS 2-1	CS 1-.5	MS .5-.42	MS .42-.25	FS .25-.1	VFS .1-.074	VFS .074-.05	Total Sand
		------ Particle size Sand Fractions (%) ------							
1	Ap	2.1	13.6	8.6	33.0	26.4	2.4	.8	85.9
2	A	2.7	13.7	A.7	32.0	2h.4	2.2	.7	86.4
3	AB	3.0	14.7	R.5	31.1	23.4	2.1	.8	83.7
4	Bw	2.5	14.1	9.4	31.9	2.3.5	2.0	.7	86.1
5	BC	5.3	17.3	B.8	31.5	32.4	1.8	.4	97.5
5	C	2.4	10.6	B.0	28.5	43.5	4.0	.7	97.7

Seq	Horizon	pH H2O	pH CaCl2	O.C. %	CCE %	CSC %
1	Ap	6.0	5.5	1.2		
2	A	6.8	5.0	1.0		
3	AB	6.3	5.8	.8		
4	Bw	6.3	5.8	.5		
5	BC	5.1	5.5	.1		
5	C	6.2	5.5	.1		

Seq	Horizon	Ca	Mg	Na	K	H	C.E.C.	% Base Sat.	Direct C.E.C. (meq/100gm)
		- Cation Exchange Capacity (Summation) - meq/100gm							
1	Ap								
2	A								
3	AB								
4	Bw								
5	BC								
6	C								

Minnesota Soil Survey Laboratory - University of Minnesota

Analysis Report

Report Date : 11/25/91

CFC number : 4486   Lab numbers : 20934 to 20939

Soil   Unnamed series   MapUnit : 768
Location : about 160ftW & 2550ftS of NE cor   sec 19 T33N R27W
County : Sherburne   State ID: S91MN141-116(1-6)
Sampled by : T Jackson   On: 4/29/91
Site tentatively identified as a proposed new series
Field description type(s) : 007
Type(s) of samples : horizon(s)

Samples received: 5/08/91   By: RH   Primary analyst:
First reported on: 8/06/91   Last reported on : 11/25/91
Information last updated on - CFC : 8/06/91   Sample data : 11/22/91
Amount billed to date : 252.00
Note : Support for proposed series.

C ---------- Test Status ---------
C

Lab #	Seq	Horizon	Depths (in) Up	Low	I
20934	1	A1	0-	8	
20935	2	A2	8	12	
20936	3	Bw1	12-	16	
20937	4	Bw2	16-	21	
20938	5	2BC	21-	33	
20939	6	2C	33-	60	

Particle size data (%) -------

	-------- Silt -------- Coarse	Fine	Total	Total Clay	USDA Texture
71	6	11	17	12	
70	5	12	17	13	
77	4	9	13	10	
83	3	6	9	8	
92	2	1	3	5	
96	1	0	1	3	

(CFC : 4486 continued on next page)

Soil Survey Laboratory - University of Minnesota

Analysis Report

Report Date : 11/25/91
CFC number : 4486 (continued)

		------ Particle size Sand Fractions (%) ------							
		VCS	CS	----- MS ---		FS	--- VFS ---		
				.5-	.42-	.25	.1-	.Ø74	Total
Seq	Horizon	2-1	1-.5	.42	.25	-.1	.Ø74	-.Ø5	Sand
1	A1	2	17	1Ø	26	14	1	1	71
2	A2	3	17	9	25	14	1	1	7Ø
3	Bw1	4	19	1Ø	26	16	1	1	77
4	Bw2	4	18	1Ø	31	17	2	1	83
5	2BC	7	22	12	35	15	1	Ø	92
6	2C	4	11	6	22	47	5	1	96

		--- pH ---		O.C.	CCE.	CSC
Seq	Horizon	H2O	CaCl2	%	%	%
1	A1	6.1	6.Ø	2.2		
2	a 2	6,4	5.4	1.8		
3	Bw1	5.9	5.4	.6		
4	Bw2	5.5	5.1	.4		
5	2BC	5.3	5.1	.2		
6	2C	5.5	5.3	Ø.Ø		

		- Cation Exchange Capacity (Summation) -						%	Direct C.E.C.
		-------------- meq/1ØØgm ---------------						Base	(meq/
Seq	Horizon	Ca	Mg	Na	K	H	C.E.C.	Sat.	1ØØgm)
1	A1	13.2	2.6	.Ø4	.2	6.1	22.1	73.	
2	A2	12.6	1.9	.Ø6	Ø.Ø	5.2	19.7	74.	
3	Bw1	6.2	1.4	.Ø4	Ø.Ø	4.7	12.4	62	
4	Bw2	2.8	.7	.Ø3	Ø.Ø	3.Ø	6.5	[illegible]	
5	2BC	1.6	.4	.Ø3	Ø.Ø	1.3	3.3	[illegible]	
6	2C	1.5	.3	.Ø3	Ø.Ø	1.Ø	2.8	[illegible]	

NATIONAL COOPERATIVE SOIL SURVEY

North Central Regional Conference Proceedings

Ames, Iowa
June 4-8, 1990

United States
Department of
Agriculture

Soil
Conservation
Service

St. Paul,
Minnesota

National Cooperative Soil Survey

North, Central Soil Survey Conference Proceedings

June 4-8, 1990
Ames, Iowa

TABLE OF CONTENTS

North Central Soil Survey Conference
Ames, Iowa
June 4-8, 1990

Table of Contents (continued)

AGENDA

1990 NORTH CENTRAL REGION SOIL SURVEY WORK PLANNING CONFERENCE
SCHEMAN CENTER, IOWA STATE UNIVERSITY, AMES, IOWA
JUNE 4-8, 1990

Monday, June 4, 1990	Moderator: T.E. Fenton
10:00-12:00	Registration, Scheman Center, Rooms 175-179
1:00- 1:30	General Session - Welcome and Introduction Dr. Thomas A. Frets, Associate Director, Iowa Agric. and Home Economics Experiment Station Mr. Jim Gulliford, Director, Division of Soil Conservation, Iowa Dept. of Agriculture and Land Stewardship Mr. J. Michael Nethery, State Conservationist, USDA Soil Conservation Service
1:30- 2:oo	Soil Survey Operations Jim Ware, Washington DC Perspective from National Headquarters
2:00- 2:30	Quality Assurance Jim Culver, Lincoln
2:30- 3:00	BREAK
3:00- 5:oo	Committee 1: Soil Survey in the 1990s Sylvester Ekart, Chair Committee 2: Geographical Information Systems Mark Kuzila, Chair

Tuesday, June 5, 1990	Moderator: C.A. Miller
8:00- 8:30	Leopold Center for Sustainable Agriculture Dr. James Swan, Associate Director
8:30- 9:00	National Soil Tilth Laboratory Dr. Jerry Hatfield, Director
9:00- 9:30	Results of Water Quality Studies in Iowa Dr. David Stoltenberg
9:30-10:00	BREAK
10:00-12:00	Committee 3: Soil Correlation and Classification Richard Base, Chair Committee 4: Water Quality Carolyn Olson, Chair
12:00- 1:00	LUNCH

Moderator: Doug Oelmann

1:00- 3:00	Committee 5 -- Soil Interpretations Tom Bicki, Chair Committee 6 -- Data Bases William Frederick, Chair
3:00- 3:30	BREAK
3:30- 4:00	On-Farm Demonstration Project Results Gerald A. Miller
4:00- 5:00	Preparation for field trip

Wednesday, June 6. 1990

8:00- 5:00	Field Trip - Greenfield Quadrangle and Des Moines Lobe
6:15- ?	Barbeque - Brookside Park

Thursday, June 7, 1990 — **Moderator: Dale** Lockridge

8:00- 9:00	National Soil Survey Center and Soil Survey Laboratory Carolyn 01800 - Activities Report, Soil Survey Lab Dennis Lytle - Soil Interpretations and Geography, Automation and Progress Richard Fenwick - Changes in Soil Taxonomy
9:00- 9:30	Global Positioning Systems Tom Seiler
9:30-10:00	BREAK
10:00-12:00	NCR-3 Meeting Soil Conservation Service Meeting
12:00- 1:00	LUNCH

Moderator: M.L. Thompson

1:00- 3:00	Committee Reports
3:00- 3:30	BREAK
3:30- 4:00	Committee Reports
4:00- 5:00	Conference Business Meeting

Friday, June 6, 1990

8:00-10:00	Optional Tours National Soil Tilth Laboratory Agronomy Department Research Center

1990 CONFERENCE SPONSORS

Art’s Manufacturing and Supply, Inc.

Centurion International, Inc.

Giddings Machine Company

Hach Company

Larson Systems, Inc.

The Sidwell Company

Tremble Navigation

Participants
North Central Soil Survey
Work Planning Conference
June 4-7, 1990
Ames, Iowa

Steve R. Base
USDA SCS
Lincoln, NE

Francis Belohlavy
USDA SCS
Lincoln, NE

Loren Berndt
USDA SCS
East Lansing, MI

Lester J. Bushue
USDA SCS
Champaign, IL

John Cain
Dept. of Natural Resources
Madison, WI

James R. Culver
USDA SCS
Lincoln, NE

Robert Darmody
University of Illinois
Urbana, IL

Tom D'Avello
USDA SCS
Champaign, IL

Tony Dohmen
Iowa State University
Ames, IA

Bill Effland
Iowa State University
Ames, IA

Thomas E. Fenton
Iowa State University
Ames, IA

Richard Fenwick
USDA SCS
Lincoln, NE

Don Franzmeier
Purdue University
Lafayette, IN

William E. Frederick
USDA SCS
East Lansing, MI

Thomas A. Fretz
Iowa State University
Ames, IA

Tim Gerber
Dept. of Natural Resources
Columbus, OH

Jon C. Gerken
USDA SCS
Columbus, OH

Allan G. Giencke
USDA SCS
St. Paul, MN

C.L. Girdner
USDA SCS
Lincoln, NE

Carl L. Glocker
USDA SCS
Lincoln, NE

Jim Gulliford
IA Dept. of Ag & Land Stwdsp
Des Moines, IA

R. David Hammer
University of Missouri
Columbia, MO

Jerry Hatfield
National Soil Tilth Lab
Ames, IA

Cornelius J. Heidt
USDA SCS
Bismarck, ND

Norman P. Helzer
USDA SCS
Lincoln, NE

Mack S. Hodges
USDA SCS
Champaign, IL

William D. Hosteter
USDA SCS
Indianapolis, IN

X.X. Huffman
USDA SCS
Columbus, OH

Faruque Khan
Iowa State University
Ames, IA

Mark S. Kuzila
University of Nebraska
Lincoln, NE

Dave Lewis
University of Nebraska
Lincoln, NE

L. Dale Lockridge
USDA SCS
Des Moines, IA

Kenneth W. Lubich
USDA SCS
Madison, WI

Dennis Lytle
USDA SCS
Lincoln, NE

Robert F. McLeese
USDA SCS
Champaign, IL

Xeven McSweeney
University of Wisconsin
Madison, WI

Patrick C. Merchant
USDA Forest Service
Bedford, IN

Randall J. Miles
University of Missouri
Columbia, MO

Gerald A. Miller
Iowa State University
Ames, IA

Paul E. Minor
USDA SCS
Columbia, MO

Gary Muckel
USDA SCS
Portland, OR

J. Michael Nethery
USDA SCS
Des Moines, IA

Dennis Nettleson
USDA SCS
Lincoln, NE

Douglas B. Oelmann
USDA SCS
Des Moines, IA

Carolyn Olson
USDA SCS
Lincoln, NE

Ken Olson
University of Illinois
Urbana, IL

Sam Orr
DRN-Div of Enviro. Quality
Jefferson City, MO

Robert J. Parkinson
USDA SCS
Columbus, OH

Donald D. Patterson
North Dakota State University
Fargo, ND

William R. Pauls
USDA SCS
Columbus, MO

Richard D. Paulson
USDA SCS
St.

David Stoltenberg
Iowa State University

COMMITTEE ASSIGNMENTS
NORTH CENTRAL SOIL SURVEY CONFERENCE
JUNE 4-8, 1990
AMES, IOWA

COMMITTEE 1 -- Soil Survey in the 1990's.
Chairman - Sylvester Ekart, North Dakota
Vice-Chairman - Neil Smeck, Ohio

John Cain, Wisconsin
James Culver, Nebraska
Don Franzmeier, Indiana
Charles Girdner, Nebraska
Carl Glocker, Nebraska
K.K. Huffman, Ohio
Leonard Kempf, Wisconsin
Dave Lewis, Nebraska
Robert McLeese, Illinois
Ken Olson, Illinois
Sam Orr, Missouri
William Pauls, Missouri
Steve Payne, Wisconsin
Larry Ragon, Nebraska
Alexander Ritchie, Ohio
H. Raymond Sinclair, Jr., Nebraska
Bobby Yard, Indiana
Ronald Yeck, Nebraska
Larry Zavesky, South Dakota

COMMITTEE CHARGES

1. What guidelines and procedures are used in the region to determine the need for updating? Are the guidelines adequate? Should the National Soil handbook contain the minimum requirements for updating? Should updates be multi-county or by MLRA? If the answer to the previous question is yes, should a common legend be used?

2. Does "updating" actually describe what is taking place, i.e., do we have complete resurveys in many counties?
   a. Remapping
   b. Recorrelation
   c. Interpretations
   d. Base map update
   e. Time required for update

3. Vi-at format should the survey of the future have (text, electronic, or combination)?

4. Is there additional information that should be included la the updates or future roil survey report?

5. How much soil scientist time is planned in the region for training, basic soil services, etc. vs. time for updating roil surveys (field mapping, manuscript, transects, etc.)

COMMITTEE ASSIGNMENTS
NORTH CENTRAL SOIL SURVEY CONFERENCE
JUNE 4-8, 1990
AMES, IOWA

COMMITTEE 2 -- Geographical Information Systems.
Chairman - Mark Kuzila, Nebraska
Vice-Chairman - Bruce Thompson, Missouri

James Crum, Michigan
Jim Fortner, Kansas
GIS Specialist, Illinois
R. David Hammer, Missouri
Norman Helzer, Nebraska
Dale Lockridge, Iowa
Warren Lynn, Nebraska
Patrick Merchant, Indiana
Fred Minzenmayer, South Dakota
Robert Nielson, South Dakota
Robert Parkinson, Ohio
Michael Ulmer, North Dakota

COMMITTEE CHARGES

1. What kinds of systems are In use or are planned In the region (list by state)?

2. What Is the status of soil digitizing In the region (list by state)?

3. What are the advantages of GRASS vs ARC INFO vs other GIS systems? Discuss the compatibility of different GIS systems used In the region. What georeferencing systems are used for the base maps?

4. What kinds of information will be Included in each state's GIS system and what agencies are Involved?

5. Who has the responsibility for documentation, maintenance, and updating of the data bases, I.e., soils, land use, geology, etc.

6. What plans are there (In each state) to share data bases?

COMMITTEE ASSIGNMENTS
NORTH CENTRAL SOIL SURVEY CONFERENCE
JUNE 4-8, 1990
AMES, IOWA

COMMITTEE 3 -- Soil Correlation and Classification.
chairman - Richard Base, Nebraska
vice-chairman - Robert Darmody, Illinois

James Bowles, Wisconsin
Lester Bushue, Illinois
W. Richard Folsche, Texas
Tim Gerber, Ohio
Howard Gundlach, Wisconsin
Milo Harpstead, Wisconsin
Corneilius Heidt, North Dakota
William Hosteter, Indiana
Wiley Ne rtle ton, Nebraska
Donald Patterson, North Dakota
Richard Paulson, Minnesota
Dennis Potter , Missouri
M.D. Ransom, Kansas
Robert Turner, Nebraska
Kenneth Vogt, Missouri
Cleveland Watts, Kansas

COMMITTEE CHARGES

1. Are the criteria for defining and differentiating soil series, taxadjuncts, and soil phases adequate? If not, develop new criteria.

2. How has the decision to discontinue the use of variants affected correla tions?

3. Review and comment on updates of ICOMFAM and ICOMAQ.

4. Explore the effects of extending series criteria to 60 inches.

5. Review the use and present concept of the soil moisture control section. Field test soil moisture states.

6. Have we made it too easy to make conceptual changes in Soil Taxonomy? Conversely, is it too difficult to classify soils into families where there are existing criteria but no series has been recognized to date?

COMMITTEE ASSIGNMENTS
NORTH CENTRAL SOIL SURVEY CONFERENCE
JUNE 4-8, 1990
AMES, IOWA

COMMITTEE 4 -- Water Quality.
Chairman - Carolyn Olson, Nebraska
Vice-Chairman - Gerald Miller, Iowa

James Anderson, Minnesota
Thomas Bicki, Illinois
Allan Giencke, Minnesota
Jerry Larson, Indiana
Gary Lemme, South Dakota
Randall Miles, Missouri
Delbert Mokma, Michigan
Larry Ratliff, Nebraska
Walter Russell, Wisconsin
J.W. Scott, Illinois
Michael Thompson, Iowa
Nyle Wollenhaupt, Missouri

COMMITTEE CHARGES

1. Can the information in soil survey reports be extended to cover geomorphic and stratigraphic relationships to soil series and soil map units? If not, develop procedures that would allow that additional information to be incorporated in to reports. Include estimates of time, equipment needs, and outline educational programs that would allow the field soil scientists to develop expertise in these areas.

2. Identify other potential sources of information that would aid in geomorphic and stratigraphic studies of a survey area.

3. Should there be a section in the soil survey report that relates soil and landscape properties to water movement and environmental quality? If the answer is yes, develop a prototype.

COMMITTEE ASSIGNMENTS
NORTH CENTRAL SOIL SURVEY CONFERENCE
JUNE 4-8, 1990
AMES, IOWA

COMMITTEE 6 -- Date Bases.
Chairman - William Frederick, Michigan
Vice-Chairman - Steve Shetron, Michigan

Picky Bigler, Nebraska
William Braker, Nebraska
John Doll, Illinois
Jon Gerken, Ohio
Martin Jurgensen, Michigan
J. Cameron Loerch, Nebraska
Kenneth Lubich, Wisconsin
Joseph McCloskey, Minnesota
Doug Oelmann, Iowa
James Thiele, North Dakota
Richard Tummons, Missouri

COMMITTEE CHARGES

1. What is the status in the region, by state, of the State Survey Data Base?
   a. What data bases are used for soil survey information and what information is contained in the data base?
   b. What is the compatibility of these data bases and what is the potential for exchange of information about data bases?

2. Discuss modifications made in state soil survey data bases for use in CAMPS.

3. There are several groups compiling data dictionaries in the region. One dictionary of interest is being developed by the National Soil Survey Soil Characterization Data Base Committee chaired by Dr. Ellis Knox. Another is the data dictionary for 3SD. Review, compare, and suggest additions and/or changes to these dictionaries.

Minutes of the North Central Soil Survey Conference
Ames, Iowa
June 4-8, 1990

The 1990 meeting of the North Central Soil Survey Work Planning Conference was called to order by Chairman Ton E. Fenton at 1:00 p.m. on June 4, 1990. Conference attendees were welcomed by Dr. Thomas A. Fretz, Associate Director, Iowa Agricultural and Home Economics Experiment Station; Mr. Jim Gilliford, Director, Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship: and J. Michael Nethery, State Conservationist, USDA-Soil Conservation Service.

A summary of committee recommendations and conclusions is included in the proceedings.

The minutes of the NCR-3 meeting follow the minutes of the general session and business meeting.

The meeting was opened by Dr. Tom Fenton at 3:00 p.m. on Thursday afternoon. A motion was made to approve the minutes of the 1988 North Central Soil Survey Work Planning Conference held at Ames, Iowa. The motion was seconded and the minutes were approved as written.

The following committee recommendations and charges were presented by each committee.

Committee 1. Soil survey in the 1990'8.

Because many of the charges considered by the committee were oriented toward information gathering rather than action and decision, the committee adopted the following recommendation:

Recommendation: Committee 1 be continued but with the assignment of more specific policy and procedure charges by the steering committee.

Motion to accept the committee report was made by Neil Smeck and seconded

Committee 2. Geographic Information Systems.

CONCLUSIONS

Charges to this years committee dealt with the collection of information about GIS activities throughout the region. This report should provide background information about individual state GIS activities. The committee recommends that the GIS committee continue and that in the future it should address specific charges about GIS within soil survey. Below are six charges that we propose for the 1992 GIS Committee.

Char-se 1. Should members of the National Cooperative Soil Survey provide for quality assurance of soil survey data bases used in GIS by non-cooperators?

Charae 2 What should be the standard format for GIS data exchange (DIG, etc.)?

Charae 3. What types of controlled base maps should be used to input data to a GIS system?

Charge 4. What strategies would improve the quality and utility of soil survey information through integrated use of GIS and allied techniques (i.e. the use of DEM)?

Charge 5. What priority should updating existing data bases have (vs. first time mapping of low priority areas) and how should updating data bases be funded?

Charae 6. Has a data dictionary for GIS been developed? If so, who should be responsible and what terms need to be added. If not, should one be developed?

Motion to accept the committee report was made by Mark Kuzila and seconded.

committee 3. Soil Correlation and **Classification.**

Sixteen people served as committee members this year. Committee 3 was assigned six charges by the Steering Committee.

Charae I. Are the criteria for defining and differentiating soil series, taxadjuncts, and soil phases adequate?

Recommendation: Review W.D. Nettleton's 1990 response to the Soil correlation and Classification Committee to eliminate the use of soil taxadjuncts in soil survey.

Charae 2. Now that variants are no longer recognized, what has been the affect on soil surveys?

Recommendation: This charge should be dropped.

Charae 3. Review and comment on updates of ICOMFAM and ICOMAQ.

Recommendation: This charge was ranked high in priority for discussion at the June meeting. It appears that we should continue to follow and participate in the developments of ICOMAQ and ICOMFAM as a committee and as individuals. Those of us that are particularly interested in one or both of these international committees should contact the committee chairman and ask to be put on the mailing list.

Charae 4. Definition of series control section.

Recommendation: We recommend to the National Soil Classification staff that they send their proposal on series control section out for general review.

Charae 5. Review the use and present concept of the soil moisture control section and field test of soil moisture states.

Recommendation: This charge should be dropped.

Charae 6. Have we made it too easy to make conceptual changes in Soil Taxonomy? Conversely, is it too difficult to classify soils into families where there are existing criteria but no series has been recognized to date?

Recommendation: No discussion.

Motion to accept the committee report was made by Steve R. Base and seconded.

Committee 4. Water Quality.

Committee Resolutions:

1. NCSS leadership consider prototyping block diagrams for physiographic regions.

2. Administrative structure in NCSS look at identifying several survey areas and develop guidance for developing prototypes for expanding geologic and physiographic information in general soil association section and soil forming factors section. Specifically in the soil association section insert discussion concerning stratigraphy, geomorphology, and native vegetation.

3. NCSS leadership continue to review pesticide/nitrogen runoff potentials for general situations as well as site specific cases. Therefore, encourage NCSS administrative structure to develop new hydrologic models to be used at general and site-specific scales.

4. Recommend that committee be continued. This meeting was the initial activity of the committee and the committee discussion was general in nature. We recommend that future committee charges look at specific charges such as how we as soil scientists can collect relevant data concerning water quality as related to soils.

5. Move the report be accepted.

Motion to accept the committee report was made by Gerald Miller and seconded.

Committee 5. Soil Interpretations.

Recommendations:

1. The committee recommends that the steering committee develop specific charges on criteria or interpretations that need to be revised.

2. The committee recommends that consideration be given to separating soil interpretation records by different land uses in order to more accurately describe soil properties.

3. The committee recommended that data collected by other groups dealing with the 2 to 10 meter zone, be examined to determine suitability for use in water quality interpretations.

Motion to accept the committee report was made by Richard Schlepp and seconded.

Committee 6. Development and Coordination of Soil Survey Data Bases.

Recommended charges for the next conference.

Charoe 1. What are the future software database needs (programs and/or modules) that would benefit either the 3SD or soil survey programs available to field soil scientists? (DOS or UNIX)

Are you able to use existing software programs with present data base management systems such as R:Base or D:Base?

Charqe 2. Outside of cooperating agencies, who are the users of the soil survey information in your state, and what information is being requested?

Charae 3. What are the future anticipated needs for storage data base information. What systems (hardware) would be best to use? (Examples: optical disk, bernuoulli box, tape back-up, etc.)

Charae 4. Are the users of soil survey software programs receiving the needed training to use database programs? What training programs have worked and what hasn't?

Motion to accept the committee report was made by William Frederick and seconded.

The next work planning conference was scheduled to be held in Minnesota in 1992. A discussion was held on the possibility of a joint meeting with the western region. The consensus was to pursue this joint meeting.

A motion for adjournment of the Work Planning Conference was made by C.L. Girdner and seconded. The motion was approved.

Respectively submitted,
Dennis M. Heil, Secretary

NCR-3 ANNUAL MEETING
JUNE 7, 1990

AMES, IOWA

ATTENDANCE

Jim Culver	SCS, Lincoln, NE	(402)-437-5353
Bill Effland	Iowa State University	
Tom Fenton*	Iowa State University	(515)-294-2414
Don Franzmeier*	Purdue University	(317)-494-8065
Mark Kuzila	University of Nebraska	(402)-472-1533
Dave Lewis*	University of Nebraska	
Gerald Miller	Iowa State University	
Randy Miles*	University of Missouri	
Ken Olson*	University of Illinois	
Sam Orr	Ho. Dept. of Nat. Res.	
Don Patterson*	North Dakota State Univ.	
M. D. Ransom*	Kansas State University	
Pierre Robert*	University of Minnesota	
Stephen Shetron	Michigan Tech Univ.	
Neal Smeck*	Ohio State University	
Mike Thompson	Iowa State University	
Earl Voss	University of Illinpis	

MINUTES

Committee Reports

Soil Taxonomy Committee

North and South Dakota have requested some well-documented changes on wetness criteria of Udolls and Ustolls. A proposal has been made to add a new diagnostic horizon for soils with glossic characteristics. Proposals have also been submitted concerning Spodosols, permafrost, and Ultisols with frigid temperature regimes.

Tom Fenton, a new member of the committee did not receive any information about the proposals. It seems that the SCS reaional office was not informed of his membership on the committee. Jim Culver will notify the appropriate people.

Don Franzmeier moved and Tom Fenton seconded that Neal Smeck be elected to the Taxonomy Committee to replace Don Franzmeier. The ‘motion passed.

1989 National Soil Survey Conference Steering Committee

Dave Lewis stated that although the primary function'of NCSS is to make good soil maps but that most of the discussion at the conference was on data bases and data processing. He also suggested that a way be developed to see that recommendations made by committees at such meetings are addressed.

Tom Fenton said that six task forces discussed papers at the conference. He also was concerned about how committee recommendations are tracked.

Sam Orr suggested that the NCR-3 committee show support for the tracking and the institution of regional and national committee recommendations. Futher discussion followed. An executive summary of conference proceedings would be helpful because most people do not take the time to read the entire proceedings. Tom Fenton and Jim Culver will provide a summary for these meetings. It was suggested that North Central region Committee Chairman provide a summary for their committees.

Jim Culver suggested that Chairman Smack write a letter to Dr. Arnold about the need to implement and follow-up on committee recommendations. Chairman Smeck will write a letter to Dr. Arnold.

Stephen Shetron suggested that NCR-3 implement a policy of follow-up on committee recommendations and not wait for SCS.

Nomination of NCR-3 Member to Steering Committee for 1991 National Soil Survey Conference

Normally the Chair or Co-chair, whoever is an NCR-3 member, of the regional conferences before and after the national conference are nominated to the steering committee for the national conference and are also delegates to the conference. It was recommended by Gerry Miller that someone with an extension appointment also be a delegate to the conference. Don Franzmeier moved and Randy Miles seconded that Tom Fenton and Pierre Robert be on the steering committee and that they, plus Jim Anderson be delegates to the conference. If Jim Anderson is unable to attend Pierre Robert was asked to find someone from the region with an extension appointment to attend. The steering committee will likely meet in August or September 1990.

National Soil Survey Laboratory Data Base

Tom Fenton reported that this data base will include lab data as well as a description. Ellis Knox, Head of the NSSL has hired a programmer who will enter data to the data base using the EPIC model. Neal Smeck asked who will manipulate the data from state data bases to get it into the correct form before it can go into the national data base. It was suggested that Area Resource Soil Scientists can manipulate the data during the winter months. Funding needed to. get the data in the system will probably come from state sources.

Randy Miles asked if anyone has used a qualifying statement about the reliability of the data. It was suggested that qualifying statements, by the method of analysis used, could be developed.

Old Business

Regional Soil Map

Tom Fenton Reported that not much progress has been made and that North and South Dakota have some join problems. Gary Lemme has stated that he is willing to help with the South Dakota portion of the map. The concern is to finish the map and get the legend set-up. Jim Culver suggested that the regional map correlate well with the SCS STATSGO map. Tom will get copies of the map to each state for review before the lines are digitized. A Minnesota state agency may digitize the map. It was suggested that since the map will be digitized, it may be appropriate to list the estimated acreages Of each map unit to aid the user.

Soil Scientist Inventory

Sam Orr reported on the inventory of soil scientists he developed after the last regional meeting. Federal response was high and University response was low. There seemed to be some misunderstanding of who the questionaire was for. It was suggested that the inventory focus on pedologists and those involved in soil survey and not all soil scientists (soil physicists, chemist6 etc.) in general. Sam distributed additional questionaires and asked that NCR-3 reps ask their colleagues whose work relates to pedology or soil survey to answer the first page. The NCR-3 reps will fill out the second page and attach a list of appropriate courses.

NCR-3 Representative on the National Soil Survey Center Advisory Committee. (See appendix A)

Dave Lewis volunteered to be the NCR-3 rep to the NSSC advisory Cornm. Ken Olson moved and Mike Thompson seconded that Dave Lewis serve a 2-year term as NSSC Advisory Comm. rep. The motion passed. NCR-3 member6 are asked to send comment6 about the National Soil Survey Center to Dave 60 he can bring them to the board.

Nomination of Secretary for Next Meeting

Tom Fenton moved and Randy Miles seconded that Kevin McSweeney be secretary for the 1991 meeting. The nominations were closed. The motion passed.

The meeting will be held in the Omaha area the week of June 10th 1991. Mark Kuzila will make arrangements for the meeting.

Issues

Tom Fenton and Gerry Miller voiced concern about change6 being made on soil survey maps during FSA appeals. Changing soil maps leads to poor quality control. If changes are made all cooperating agencies should be notified. It was suggested that a representative of this committee present a charge to the next national soil survey Conference pertaining to the decision making process for changing soil maps.

Mark Kuzila commented on the problem Nebraska is having with the use of leaf-on photography in soil survey. He stated that leaf-on photography is unacceptable for soil survey mapping and for use as a base map for soi 1 survey reports.

Mickey Ransom suggested that the length of the NCR-3 meeting at the next regional conference be expanded to 4 hours to allow for more discussion.

Time was not available for individual state reports, please see appendices B through I for state reports.

Tom Fenton Moved and Randy Miles seconded that the meeting adjourn. Motion carried. Meeting adjourned at 12:05 pm.

Submitted by

Mark Kuzila

APPENDIX A

National Soil Survey Center
Federal Building, Room 345
100 Centennial Mall North
Lincoln, NE 68508-3866

MGT- National Soil Survey Center (NSSC) Technical Advisory Committee

May 29, 1990

Karl H. Langlois, Jr., Head, Soil Interpretations Staff, NENTC, SCS, Chester, PA 330-3
Joe D. Nichols, Head, Soil Interpretations Staff, SNTC, SCS, Fort Worth, TX
Gary B. Muckel, Head, Soil Interpretations Staff, WNTC, SCS, Portland, OR
C. L Girdncr, Acting Head, Soils Section, ESSP, MNTC, SCS, Lincoln, NE

This is to follow up on National Soil Survey Conference Steering Committee action and last week's conversation.

At the Steering Committee meeting last year, near the end of the Conference, we discussed and approved asking each regional conference to appoint one Agricultural Experiment Station (AES) cooperator to serve on a 4-person technical advisory committee lo the NSSC. There was a little conversation about making sure that interaction does not compete with the role of the national conference, and that will be avoided.

me purpose of the committee will be at least two-fold: (1) to review NSSC activities from a technical standpoint and (2) lo strengthen NSSC-AES interactions. AES people are specifically requested, because they tend to be skilled in a number of new, highly technical subject areas which we are beginning to address and the traditional soil survey technical topics. Most are professionals in the teaching arena, and will be good advisors about the growing training effort. They are familiar wilh institutional technical reviews, and they are a group with whom a great deal can be gained by strengthening collaborative research and development. Being independent state institutions, they are also the most difficult for the NSSC to keep in close touch with, and the group most likely to have potential contributions to the National Cooperative Soil Survey (NCSS) that are overlooked.

Please ask the AES representatives at your regional soil survey conference to consider this request, and if they are willing to participate in this way, to assign one person per region. Also advise them that this requesl is made with the intention that the advisory group should be a serious force for quality and for better collaboration. This is not done for appearances sake, and the group will be taken very seriously at this end.

There is another need that might be helped by such a committee, although not a charge to it. Thal is the problem of combining forces within the agricultural community to make ourselves competitive with non-agricultural institutions having flashier credentials. We will probably take advantage of meetings with this committee lo talk about how to strengthen the NCSS program by strengthening its parts through stronger, perhaps more integraled grant proposals and the like.

We will undoubtedly have to pay transportation lo get the 4 people to Lincoln once a year (more if the 4 get on the trail of something requiring further deliberation). Initially, this assignment will have 2-year duration, with new appointments by the AES delegation at each regional conference. We would not insist on retention of this interval if the participants determine that a stagger in appointments or other changes would be preferable.

The assignment will require a minimum of one week per year. During that week, the group will be apprised of technical activities at the NSSC, including training, will have the opportunity to critique any technical activities. and will have the opportunity to bring up technical or coordinating concerns they or their region choose to cover. The technical focus, of course, is on the NSSC and the quality of things for which it is responsible.. As part of this, there will be time to discuss ways to strengthen collaborator-r wrth AES cooperators.

C. STEVEN HOLZHEY
Assistant Director
Soil Survey Division, SCS

cc:
R. W. Arnold, Director, Soil Survey Division, SCS, Washington, DC
D. L. Anderson, National Leader. NSSDB, NSSC, SCS, Lincoln, NE
J. R. Culver, National Leader, NSSQA, NSSC, SCS, Lincoln, NE
E. G. Knox, National Leader, NSSIV, NSSC, SCS, Lincoln, NE
M. J. Mausbach, National Leader, NSSIT, NSSC, SCS, Lincoln, NE
J. E. Witty, National Leader, NSC, NSSC, Soil Survey Division, SCS, Washington, DC
R. W. Fcnwick, Soil Scientist, NSC, NSSC, SCS, Lincoln, NE

APPENDIX B

NORTHCENTRAL SOIL SURVEY CONFERENCE
Ames. Iowa, 1990
Illinois Report

As many of you are aware, our pest NCR-3 representative, Dr. Ivan Jensen, died on Sept. 24. 1989. I have been been ● eeigned his Soil Survey reponeibilitiee including serving as the NCR-3 representative *for the* Illinois Agricultural Experiment Station.

The Soil Conservation Service provides most of the field work and supervision for the soil survey program. The University of Illinois assists in field reviews, correlation, laboratory support end research support. The University now has a three men professorial staff in pedology.

To date, 34,000,000 acres have been mapped with approximately 2,000,000 acres remaining. Fifty-nine counties have published reports, 31 are waiting to be published, end the remaining.17 surveys are being surveyed. We anticipate re-mapping a few counties which were completed in the 1940's end 1950's end published on a topographic bees. A number of soil ecientiets will be assigned co area offices with additional soil scientists vorking on GIS es the let phase of the coil eurvay mapping is completed.

Dr. Tom Bicki, our extension pedologist, has developed extension education programs to assist farmers in the selection of soil management and tillage practices that reduce environmental impact end enhance production. His research includes the development of soil suitability ratings for alternative sewage dlspossl systems end monitoring the leaching of pesicides in sandy soils under various tillage and irrigation practices.

Ken Olson continues to teach soil conservation and management as well as the soils section of a land appraisal course. His research includes erosion-productivity, soil productivity, soil porosity, conservation tillage, and erosion-sedimentation studies. A number of papers are listed at the end of this report which summarizes the various findings.

Journal Articles (July, 1988 to Hay, 1990)

Agbu, P. A., A. G. Ojanuga, and K. R. 01son.1989. Soil-landscape relationships in the Sokota-Rima Basin, Nigeria. Soil Sci. 148:132-139.

Cremeens, D. L., L. D. Norton, R. G. Darmody, and I. J. Jansen. 1988. Etch pit measurements on scanning electron micrographs of weathered grain surfaces. Soil Sci. Soc. of Am. J. 52:883-885.

Darmody, R. G. end T. J. Bicki. 1989. Use of civil engineering fabrics in pedological field research. Soil Sci. Soc. Am. J. 53:1912.

Kreznor, W. R., K. R. Olson, W. L. Banwart and D. L. Johnson. 1989. Soil, landscape. and erosion relationships in a northvest Illinois watershed. Soil Sci. Soc. of Am. J. 53:1763-1771.

Nizeyimana, E. and K. R. Olson. 1988. Chemical, mineralogical, and physical differences between moderately and severely eroded Illinois soils. Soil Sci. Soc. of Am. J. 52:1740-1748.

Olson, K. R. 1988. Effects of erosion on roll pore size dlstrlbutlons and root ramification in fine-textured Illinois soils. Soil Sci. 145:365-373.

Olson, K. R., R. F. Darmody; J. S. Steiner and A. H. Beavers. 1988. X-ray technique to evaluate pedon and erosion variability of an Ava map unit. Soil Scl. Soc. Am. J. 52:1748-1753.

Olson, K. R. and C. J. Johannsen. 1988. Dr. Gerald W. Olson - A memorial tribute. Soil Scl. Soc. of Am. J. Soil Survey Horizons 29:44-45.

Olson, K. R. end E. Nizeyimana. 1988. Maize yield rasponse differences between moderately and severely eroded Illinois soils. Soil Survey Horizons 29:57-62.

Olson, K. R. and T. M. Zobeck. 1989. 1989. Improved mercury displacement method to measure the density of soil ● ggregstes. Soil Sci. 147:71-75.

Tan&rich, J. P., T. J. Bicki, D. P. McKenna, and R. G. Darmody. 1990. The pedo-weathering profile and its implications for ground water protection. Ground Water Management 1:893-900.

Ten&rich, J. P., R. J. Schatrel, and R. G. Darmody. 1988. Conversations with Francis D. Hole. Soil Survey Horizons 29:9-21.

Thorn, c. E., J. C. Dixon, R. G. Darmody, and J. M. Rissing. 1989. Weathering trends in fine debris beneath a snow patch, Niwot Ridge, Front Range, Colorado. Physical Geography 10:307-321.

APPENDIX C

INDIANA REPORT. NCR-3.
D. P. Franzmeier, June, 1990

All mapping for modern surveys is complete, and reports for 82 of the 92 counties are published. Updating (i. e. remapping) is • ctive in 5 counties that now have reports published around 1962 to 1974. Field mapping is being done at a scale of 1:12,000. Surveys will be published on orthophotography, but it is not available now. SCS has 10 soil scientists in five administrative areas, but one in each area has mainly area-wide responsibility and thus spends little time on the survey. Thus, surveys are progressing slowly.

Soil survey users become confused when the same soil in adjoining counties has a different name. When this happens, it is usually because the counties were mapped at different times and thus used different series definitions. From a technical standpoint, it would be best to concentrate all mapping in one land resource area, complete that area, and then move to another. From a political and practical (moving soil scientists) point of view. however, this seems to be impossible. There is some consideration being given the idea that a soil survey need not be correlated end published immediately after the mapping is completed. It might be held in limbo until an adjoining county is mapped, so at least those two will be compatible.

Work is progressing on developing a data base, by horizon, for each kind of soil in the state. The first step was to put all the characterization data from Purdue, and that available on diskette from the National Lab. into a data base management system and to clean it up (an understatement). Then soil scientists familiar with the soil, supplied the current series name and Soil Interpretation Record number, and it was summarized by SIR phase. After that, similar horizons from each pedon were averaged to get average data values for each horizon.

We are participating in developing an Ecological Classification System for the Hoosier National Forest in southern Indiana. It will be used to define map units on the basis of soils, vegetation, and landform. Research is now progressing in areas that have not been logged for around 80 years, so vegetation has had time to adjust to its environment.

We are also studying silica by uptake by native forest and prairie species. Si uptake depends on plant species end soil factors. Apparently monocots '(grasses) take up much more Si than dicots (hardwood trees), but the data for trees is typically from forest areas and for grass, from the middle of the prairie, so some of this difference could be due to soil factors. To isolate the plant variable, we are looking et Si uptake by trees and grasses growing on the same soil. The uptake patterns would greatly influence silica equilibrium end precipitation of silica end silicate minerals as the plants use soil water. Another student is working on some soils with plinthire from Brazil.

APPENDIX D

NCR-3 REPORT - JUNE 7, 1990
IOWA AGRICULTURE EXPERIMENT STATION

T.E. Fenton

Table 1 shows the current status of the soil survey program in Iowa. The 5 counties that are presently being surveyed are technically called updates but many are resurveys. Jefferson and Lucas counties are being mapped at a scale of 1:15840 but all counties starting subsequent to these are to be mapped at a scale of 1:12000. There are presently 9 resource soil scientists for the 6 SCS areas in Iowa. Fourteen soil scientists are assigned to the counties being mapped for a total of 23 soil scientists in the field.

We have shifted our resources from primarily field mapping to a combination of field mapping and digitizing of completed soil surveys. A cooperative agreement was signed by the Soil Conservation Service, Division of Soil Conservation, Extension Service, and Experiment Station in March of 1987. The agreement provides for the funding of the digitizing program and contains a priority listing of all counties in the state. Presently we have completed 80 counties in terms of soil lines and symbols and are now concentrating on drainageways and spot symbols. Pour counties are completed and about ready for release. Our goal is to have all counties where modern field work has been completed ready for release by December of 1991. The digitized soil maps, associated data bases, and the software will be distributed through the Extension Software Distribution Center.

An additional project that we continue to expand is ISPAID (Iowa Soil Properties and Interpretations Database). It contains soil properties and interpretations for approximately 2100 map units we have correlated to date. For each map unit we currently have 80 fields of data. The fields in ISPAID are listed in Table 2. The fields of data that are common to-the SOI-5 and 3SD are cross checked and, if there are differences, the problems resolved by a committee before the data becomes an official part of our data. We eventually plan to have a county-specific data file for many of the fields of data.

We also are evaluating older soil surveys as to the need for updating. Randomly selected 160-acre tracts stratified by townships are mapped at a scale of 1:12000. The maps are then compared to the published soil maps. The maps, legends, text, *and* tables in the published report are evaluated using a standard format for all counties. Local officials and users are also encouraged to complete the evaluation form. Meetings are held at the county level, the evaluation forms summarized, and a recommendation made concerning the extent of the update.

Table 1. status report of soil surveys in Iowa, June 1990

State	Total	Published	In Press	In Prog.	Waiting[1]	Field Soil Survey Scientists: Federal SCS	Federal NonSCS &	State local	Est. Compl. Date
IA	99	79	15	5	1	23	0	0	1989 (1992)[2]

[1]Humboldt County scheduled for update beginning July of 4990.

[2]Includes five counties designated as updates.

Table 2. Fields available in ISPAID

Acreage Available Water Capacity Bulk Density, Subsoil Bulk Density, Surface *Cation Exchange Capacity Clay Content (Surface) Corn Suitability Rating Depth of Free Carbonates Depth of High Water Table *Depth to Strongly Contrasting Particle-Size Class *Depth to Textural or Compositional Discontinuity Drainage Class Drainage Class Code Erosion Class Erosion Factor: K Erosion Factor: T Flooding Frequency Flooding Frequency Code *Highly Erodible Land • Hydric Soil Code Hydrologic Croup	Kind of Component Kind of Map Unit *Land Capability Class/ Subclass Landscape Position	*Subsoil K *Subsoil P *Surface Layer Color Value *Surface Layer Color Chroma Taxonomic Classification

APPENDIX E

REPORT TC NCR-3
Kansas Agricultural **Experiment** Station
M.D. Ransom
June 7, 1990

I. Kansas Soil Survey Program

A.	Total number of counties	105
B.	Published	98 surveys, 100 counties
C.	In press	5
D.	In progress	3 (updates)
E.	Waiting	0

F. All of Kansas or 52,657,500 acres, has been mapped in a "once over" soil survey.

G. The oldest modern survey, Saline County, was published in 1959. Remapping has just been completed. Updates of three other counties published in the early 1960's are also in progress.

H. Plans have been developed to evaluate all soil surveys in Kansas by FY 95. Updates will be done on a multi-county (MLRA) basis where possible.. All updating and transfer of existing soils information will be completed on a 1:24,000 ortho-quad base. Most surveys is Kansas have been published at a scale of 1:20,000 and are not geo-referenced. At least 18 surveys will need *extensive* updating.

I. We are developing a proposal in cooperation with the Geography Department to digitize all soil surveys in Kansas for a state-wide geographic information system. We envision a project lasting about six years at a cost over $1 million. Existing soil map sheets will be recompiled onto mylar overlays of USGS 7.5 min quadrangles, which will *then* be scan digitized.

J. Soil characterization data are available for only about 150 pedons in *Kansas.*

II. Kansas Soil Survey Personnel

A.	SCS field stiff	12 (6 doing field mapping and 6 area soil soil scientists)
B.	SCS state office staff	3
C.	Other Federal, State, and local staff	0

III. KAES Research Activities Related to Soil Survey

A. - Clay translocation and carbonate accumulation in the 16- 26 inch rainfall zone of western Kansas.;

B. Use of Landsat TM and SPOT satellite imagery for soil mapping of rangelands and for detection of residue cover.

C. Distribution and properties of clay minerals in *Kansas* soils with emphasis on applications to soil fertility.

D. Joint project with soil microbiologists and Michigan State University on stratification-of N in soil profiles.

- 50 million acres in the state
- have 4 counties in which to complete the mapping of private lands
  - Cherry County
  - Sioux county
  - Garden County
  - Sheridan County

- have updating activities in 2 counties
  - Dundy County
  - Saunders County

- all 6 counties are accelerated by annual state and local cooperative financial agreements totaling about $385,000 of which
  - $150,000 is from the state legislature
  - $108,000 is from natural resource districts

- maintenance activities for published soil surveys include
  - recorrelate by major land resource area to
    - update soil interpretations
    - document areas needing remapping
    - remapping and republishing as in Dundy end Saunders Counties

- technical services At the Area level
  - have one resource soil scientist in each of 4 offices

- digitizing soil survey maps
  - presently digitizing completed soil surveys by 2 acre cells (Nebraska Resources Commission, SCS field office and SCS Resources staff)
  - in 1990 plan to start digitizing while

Other FY 89 Progress includes:

Developed semi-tab format for nap unit write-ups.

State Soil Survey Database developement is 100% downloaded.

Updat ing soil surveys - Dundy County and Saunders County . Mapping scales include 1:24,000 and 1:12,000.

Saunders County updating meetings continue. Sixty-five persons have attended one or more of the last seven meetings. Six committees are working on proposals to improve soil survey technique6 and products.

Soil Survey Reports were issued for Platte and Wheeler Counties.

Larry Ragon traveled to Cochise County, Arizona, to study aridic soils 60 a6 to verify that Nebraska has none.

Memoranda of Understanding have been drafted for the Saunders County project and the MLRA-72 project. Nebraska will be requesting permission from the National Office to update the Washington County soil survey.

- During FY 1989, six soil scientists, mostly survey party leaders, detailed to Louisiana, North Dakota, Montana and Minnesota for FSA soil mapping.

Taken from Nebraska Soil Survey 1990 Plan of Operations by Norman Helzer, SCS State Soil Scientist.

APPENDIX G

NCR-3 Report 1990
North Dakota Agricultural Experiment Station
D.D. Patterson

Soil Survey Program - North Dakota

1. Projected Completion date: 1992 (Except for the remapping of 3 counties originally mapped in the 1930's. Completion of these counties and the state scheduled for 1994.)
2. Percent Mapped: 87 percent
3. Surveys in Progress: 14
4. Reports Awaiting publication: 9
5. Updates Scheduled: 8

NCR-3

Ohio Progress Report

June 7.1990

Ames, Iowa

Currently 99% **of Ohio has been covered by a modern soil survey. Our** projection in Ohio is to have a modern detailed soil survey completed for each of the 88 counties by July, 1991. To date, mapping by the Ohio Division of Soil and Water **Conservation** - Soil Inventory Section and the Soil Conservation Service has been completed in 83 counties with soil survey reports published in 68 counties. Project soil surveys are currently underway in all of the remaining 5 counties with cost-sharing involved in all *of those* counties. In addition, field work is underway in 5 counties in order to produce a modernized soil survey. Cost-sharing contracts have been signed in 5 additional counties for soil survey modernization programs.

The Ohio Soil Characterization Laboratory is currently analyzing 20 to 30 pedons each year in support of the Ohio soil survey program and current research. These analyses include all routine physical and chemical **properties with mineralogy** being determined for selected pedons. All pedon description, and accompanying data are currently being stored on floppy diiks but the compilation **and electronic storage of descriptions and data generated in** prior years is now on hold due to a lack of personnel and funds.

Research projects currently underway which are related to soil survey activities include: I) the **origin of smectites in soils of western Ohio, 2) the relationship between water chemistry and** soil mineralogy. 3) the origin and characteristics of dense. brittle zones which are apparently permeable to water. and 4) the genesis of soils as related to hillslope processes in eastern Ohio.

Recent Publications

Smeck. N. E., M. L. Thompson, L. D. Norton, and M. *J.* Shipitalo. 1989. WeatheringM. Smeck
[illegible]

APPENDI'X I

SOUTH DAKOTA NCR-3 REPORT JUNE 1990

D. D. MALO

SDSU-CONTINUING ACTIVITIES

1. Soil Ratings

A. Soil Ratings for MLRA 102B and 55C.

MLRA 102B and 55C soil ratings based on current SCS-5 data for soil mapping units used in South Dakota were developed. The project is in cooperation with the SCS and the S.D. Dept. of Revenue. Three soil ratings were developed for each soil mapping unit. They include:

a) a crop rating;
b) a range/grass rating; and
c) a soil productivity rating.

The procedure developed is a revision of earlier methods. A forage value rating (usefulness based on species composition) has been calculated for each soil and is used to adjust the total pounds of forage produced listed on the scs-5. Ten counties have been completed and published (Bon Homme, Clay, Hutchinson, Lake, Lincoln, Minnehaha, McCook, Turner, Union and Yankton). The entire state is scheduled to be completed by July 1991.

2. Pothole Wetlands (Hydric Soil Characteristics/Water Quality).

Water quality and hydric soil characteristics are being tested on native wetlands in eastern South Dakota. The Wildlife Department (SDSU), the USFWS and the SCS are cooperating. One thesis and two USFWS Biological Reports have been published.

3. Subsoil Fertility Levels, Soil Genesis and Soil Taxonomy.

Soil variability, soil genesis and subsoil fertility levels are being examined in MLRA 102B. Bray-P, Bicarb-P, X and SO_4-S are being tested at type locations in at least 5 counties for each soil studied. Six different parent materials are being studied and the 25 soils selected represent benchmark or important agricultural soils in the area.

SDSU-COMPLETED ACTIVITIES

1. Woodland Grazing Potential-Black Hill (Lemma).

A study dealing with woodland grazing potential on limestone soils in the Black Hills was completed. A thesis by Wary Rasmussen was published. Cooperative project with USFS and SCS.

2. Aquifer Vulnerability Mapping (Lemme).

Completed work on aquifer vulnerability mapping project. Two papers published in the 1990 March-April issue of JSWC 45(2). Cooperative project with the SCS and the USEPA.

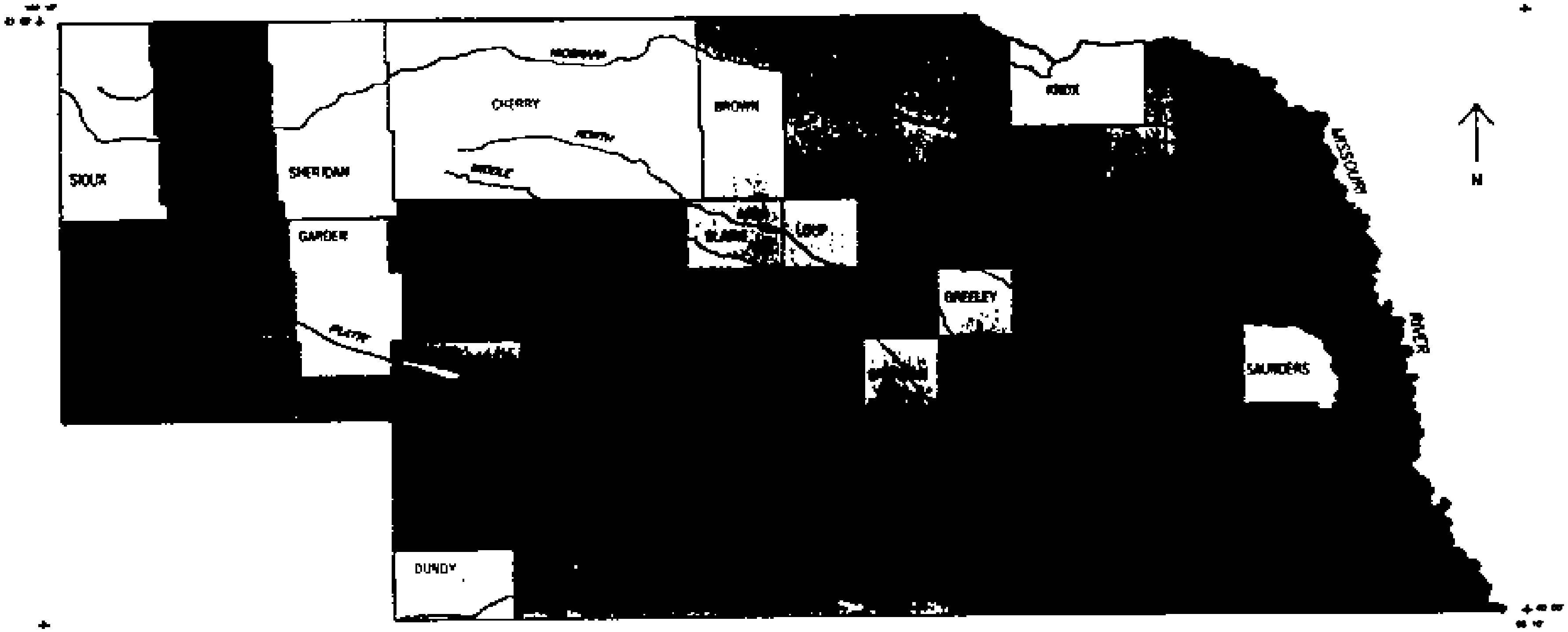
3. STATSCO Map of SD (Lemma).

Completed work on STATSCO Map of SD. Cooperative project with the SCS.

SDSU-MISCELLANEOUS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

MODERN PUBLISHED SOIL SURVEY

MAPPING COMPLETE - AWAITING PUBLICATION

SOIL SURVEY IN PROGRESS

STATUS OF SOIL SURVEYS
NEBRASKA
OCTOBER 1989

0 25 50 75 100 MI

SOURCE:
DATA PROVIDED BY SCS FIELD PERSONNEL. MAP COMPILED USING AUTOMATED MAP CONSTRUCTION WITH THE FOCAS EQUIPMENT. NATIONAL CARTOGRAPHIC CENTER, FORT WORTH, TEXAS 1989

REVISED AUGUST 1989 1000120

NATIONAL COOPERATIVE SOIL SURVEY AND ITS NEW CHALLENGES

NORTH CENTRAL SOIL SURVEY WORK PLANNING CONFERENCE

JUNE 9, 1990

JAMES H. WARE

The theme of the National Cooperative Soil Survey Conference held in Lincoln, Nebraska last July was "The Soil Survey of the Future". The task forces were challenged to present ideas of where the NCSS efforts should be going. Those recommendations are what I consider the New Challenges for NCSS, and I am pleased to report that many of the issues discussed at the conference are already being addressed.

First and foremost, and it addresses many of the issues from the conference, is that the entire soil survey program has made a significant change in its philosophy of operation. The soil survey program is no longer a program designed solely to produce a soil survey report. It is now a program designed to support the collection, management, and maintenance of soil survey information and to provide that information in the format appropriate to address the needs of our clients.

The Soil Survey database and software development initiative being directed by Dave Anderson and his staff is addressing the needs of users of soil survey information. Also, it is looking at ways to manage soils information and provide data that reflects the accuracy and reliability of the soils information in the system.

When addressing the needs of users of soils information, one theme comes back again and again, and that is "the needs for soils information are in constant change and evolution." Recent examples of this are reflected in the information being added to the Soil Interpretations Records. This includes items such as CEC, sodium adsorption ratio, calcium carbonate equivalent, wind erodibility index, and others. New uses include determining the effects of soils on the infiltration of pesticides into the ground water, and the impact of soils on Low Input Sustainable Agriculture. Again, Dave Anderson's group is addressing ways to make the new Soils Information System (NASIS) adaptable to changes in information inventoried as well as the ways that information may be interpreted. Gary Muckel is providing guidance for a symposium on soil quality standards that will begin to address some of the issues of Low Input Sustainable Agriculture. The National Soil Survey Interpretations Staff headed by Maury Mausbach is also looking at the development of soil quality standards in base saturation, erosion rates (improving on the concepts of T), and building on the Forest Service work with bulk density.

The soil survey staffs in the states of Colorado, *Kansas*, Oklahoma, and New Mexico are cooperating in an effort is to update soil survey information on a regional basis. In this case the effort is to update the soil surveys in MLRA 77. MLRA 105 in Wisconsin, Illinois, Minnesota, and Iowa is also being evaluated for a coordinated update here in the North Central States.

This MLRA approach will lead to the development of uniform legends and will provide better descriptions of soils, as they will be looked at across their entire range of occurrence instead of only some part that occurs within political (state or county) boundaries. This concept also includes an effort to design map units based on natural landscape segments.

All of these efforts are being conducted in an atmosphere of awareness of increasing needs by an increasing number of clients, both public and private, for more information that is more accurate and more reliable.

We in NHQ couldn't be more excited about the future of the National Cooperative Soil Survey. We can see the Soil Survey entity being much more responsive to the issues developed by the Task Forces and Committees of both regional and national conferences. These issues are also reflected in four major objectives being used to guide the direction of the Soil Conservation Soil Survey Division: 1. Improve methods and products to meet expanding user needs;
2. Provide new knowledge, procedures, concepts, data sets, and relationships to support the use of soil information;
3. Provide technical soil services (support in the application of soil survey information) and train users of soils information and: 4. Implement, support, and maintain soil survey activities.

Finally, two other issues:

STATSGO: Most States are completing their maps and attribute datasets. They are to keep STATSGO as a high priority for getting it operational. Dennis Lytle has updated and will soon distribute a new status map showing the states progress. Our goal is to have all states joined and the attribute database operational as soon as possible.

GPS: Global positioning technology is being tested by Jim Doolittle of the National Soil Investigations staff. One unit is being tested in Massachusetts and New Hampshire in cooperation with the Massachusetts Department of Transportation. It is being tested as a tool to help soil surveyors locate themselves in areas with dense canopy cover, to locate significant landscape breaks, and to locate pedon sites. It has the capability of providing locations by latitude and longitude, and it is using LORAN c technology which presently helps in the landing of aircraft.

In my remaining time, I would like to share with you the trends for mapping progress, funding, publications, and the Soil Scientist workforce over the last several years. Needless to say, the 1985 Food Security Act has had a tremendous impact on our operations.

STATUS REPORT

1. Total acres in the United States 2,281,717,000
   Total acres mapped at the end of FY-90 1,625,545,000

Approximately 70% of the U.S. is covered by soil maps. Mapping is progressing at a rate of about 40,000,000 acres per year.

2. Total acres of private lands in the U.S. 1,570,935,000
   Total acres mapped at the end of FY-90 1,362,383,000
   Acres remaining to be mapped 208,552,000

Approximately 87% of the private lands in the U.S. is covered by soil maps. Mapping is progressing at a rate of about 31,000,000 acres per year.

3. Total acres of federal lands in the U.S. 644,774,000
   Total acres mapped at the end of FY-90 376,492,000
   Acres remaining to be mapped 268,282,000

Approximately 58% of the federal land in the U.S. is covered by soil maps. Mapping is progressing at a rate of about 6,367,000 acres per year.

4. Total acres of cropland in the U.S.

5.

1986	27%
1987	48%
1988	54%
1989	52%
1990	4%

The decrease in numbers of acres mapped during the 1987-1989 period reflects the inefficiencies in mapping cropland only. Inefficiencies primarily were: 1. not block mapping; and 2. detailing soil scientists into areas where they had no previous mapping experience. Many states in this region of the country had better efficiencies than these national figures show because of the large areas of open cropland that was mapped in blocks.

6. SCS soil survey funding:

1984	53.4 million	- a 1.6% increase over a
1985	54.0 million	three year period with
1986	54.3 million	inflation at about 3%
		per year = loss of 7.4%
1987	58.1 million	- a 25% increase over a
1988	67.7 million	4 year period with
1989	68.0 million	inflation at about 3%
1990	68.0 million	per year = gain of 13%

The 9 million dollar increase in 1988 was provided for meeting the cropland mapping needs of the 1985 Food Security Act. This funding was used to hire additional soil scientists, contract for mapping, and pay for detailing of soil scientists into states with high cropland mapping workloads.

7. The numbers of SCS soil scientists reflect the status of the soil survey budget. During years 1984-1987 the numbers of soil scientists in SCS declined from 1,341 to 1,155. With the increases in funding for the 1985 Food Security Act the numbers have increased to 1,359.

8. The drop in numbers of soil scientists from 1984 to 1987 was reflected in the drop in the number of acres mapped per year. This trend was accelerated by the emphasis placed on mapping of croplands. The trends for the number of acres mapped per individual soil scientist, however, actually began to increase prior to the Food Security Act cropland mapping initiative. This increase in efficiency by individual soil scientists reflected the implementation of productivity improvement initiatives such as better management of soil survey projects, providing word processing equipment for manuscripts, better availability of field equipment, and a better understanding of the soil mapping process by the individual soil scientists. Now that cropland mapping is essentially complete, this trend is expected to continue since the emphasis is again being placed on project mapping.

9. The number of soil survey reports published each year increased from 61 in 1984 to 78 in 1986 and 1987. In 1988 the amount of funding for publication was reduced and diverted to cropland mapping. This was reflected in a decline in the number of publications to 70. In 1989 the funding was restored and publications rose to 79. During the period of 1987, 1988, and 1989 manuscript development processes have been improved and desktop publishing equipment has reduced the time and the cost associated with manuscript editing and formatting. At the same time more flexibility in manuscript formatting, color covers, color plates inside the publications, and improvements in paper quality have been achieved. The cost savings are reflected in the number of publications that can be published. Presently we are anticipating about 110 publications this year.

Thank you for the opportunity to meet with you this week. At this time, I will answer any questions that you may have.

Presentation by James H. Ware, Soil Scientist, Soil Survey Division, Washington, D.C. Adapted from a paper prepared by Thomas E. Calhoun, Assistant Director, Soil Survey Division, Washington, D.C.

MIDWEST REGIONAL
COOPERATIVE SOIL SURVEY 1/

Welcome. share

ssignments.
faculties

University

Staffing and Personnel

m.

t e intense energy

Agricultural Experiment station Cooperator to serve on a four-person technical advisory committee to the National Soil Survey Center. Two objectives of the committee would be (1) provide technical resources and evaluation of NSSC activities, and (2) maintain interaction between • ctiv* participants in the NCSS. We are looking forward to a selection being made at this conference to represent the Midwest on this Steering Committee.

The soil scientists on the Soil Survey Quality Assurance Staff are • ssigned • re* of responsibility largely on the basis of Major Land Resource Region. These three areas are the West, Central, and East. Roger Haberman was recently selected to be the supervisory soil scientist for the West and Berman Hudson, who previously had responsibilities for the West is now coordinating our field activities for the East • re*. Larry Ratliff is the supervisory soil scientist for the Central area.

As many of you are aware, there has been a gradual reduction in soil scientist6 on our staff through retirements during the past 2 years. The retirement of Rod Harner, Dick Johnson, Gerald Post, Marvin Dixon, Louie Buller, and Bob Turner represent a vast amount experiences. However, I might add the newer soil scientists who have joined the Soil Survey Quality Assurance Staff have demonstrated excellent potential to quickly fill this gap. Two of these soil scientists, Earl Lockridge and Craig Ditzler are currently working on a PhD programs at the University of Nebraska.

ACTIVITIES OF SOIL SCIENTIST ON THE QUALITY ASSURANCE STAFF

Major quality assurance responsibilities include (1) Field reviews and soil correlation, (2) Soil series descriptions and interpretations (3) Soil classification, (4) Soil survey manuscript6, and (5)

Field Reviews

MW Regional Cooperative Soil

Series Description

The processing of all roil series into OSED (Official Series Description) continues to be a high priority with the Soil Survey Quality Assurance Staff. During recent months we have begun to use a scanner to move the series descriptions in our file to OSED for a number of states. This has enabled the series description6 to be in a useable database and will facilitate the states in making needed revision6 or update6 on these series descriptions.

A total of 2,241 soil series were processed into OSED in 1989. To date, there are approximately 18,000 soil series in U.S . The minimum number of soil series processed by month ranged from 53 in July to a maximum of 429 in December. Since January of this year, we have processed about 1,300 soil series into OSED. A high percent of the roil series being processed into OSED are from the Western part of the United States.

Quality Assurance Soil Survey Interpretations Records

A January 1990 summary chows that on a national basic we are using over 30,000 Soils-5's in our cooperative soil survey program. A summary of the number of Soil-S's being used in each NTC area is as follows.

NTC	Number of Soils-5's
NENTC	1.845
SNTC	3.705
MWNTC	5,090
WNTC	20,797

The Soils-S's as presently used are an integrate part of the data gathering and delivery system. The information on the Soils-5's is being used by 6 wide variety of customers.

There is a continued need at all levels, i.e., Field, Area, State, NTC, and NSSC, to be cognizant of the values on each Soils-S. Recent personal experience with changes on the Soils-5's related to Hydric soil criteria, soil drainage classes, and coordination with the soil series description clearly demonstrates that a continued effort by each of us is needed to maintain quality Soils-5 data. Recent review of selected Soils-5's and 6oil series descriptions by the Fish and Wildlife Service has indicated some inconsistencies in our databases.

One proposal discussed between our office, the NTC's, and some states is coordination and quality review of the Soils-5's by Major Land Resource Areas (MLRA). This would allow us to review all of the Soils-5's in a geographic ares at one point in time. We think that this approach offer6 an excellent opportunity to utilize our databases in searching for inconsistencies in our data sets.

Soil Classification and correlation

Most of you by now have received the new version of keys to Soil Taxonomy. The Andisols order will require reclassification of several soil series in selected western states. A working session has been planned at Portland, Oregon this November to address this issue. I am not aware of any soil series in the Midwest which will be reclassified to be in keeping with the Andisol order.

Mk [redacted] [redacted]

Technical Revi

50 to 100 map units, the percent of series reviewed is 15 percent; and a 10 percent review of series is made in survey areas with sore than 100 map units. For each series reviewed. all map units. general soil map descriptions, and tables associated with the selected series are given technical review.

We have slightly modified our procedure for technical review of roil survey manuscripts. All technical reviews are presmtly coordinated by Bill Braker, soil scientist-manuscript. We feel this procedure will assist in providing a consistent timely technical review of the manuscripts you submit to our office.

Training

Training is one of the major activities in the NSSQA Staff each year. In addition to training provided on soil survey manuscripts. workshops. state meetings, etc., several formal courses are conducted. These formal courses are:

1. Basic Soil Survey

2. Soil Correlation

3. Soil laboratory Deta Procedure

4. Soil Laboratory Dsta Use

5. Pilot Course - Soil Survey Field and Laboratory. A 2-week session combining two previous courses.

   1st Session - May 14-25, 1990
   2nd Session - June 4-15, 1990

Major topics in this pilot course are: geomorphology, map unit design, soil descriptions, transects, collecting field notes, soil taxonomy, diagnostic horizons, soil sampling and site selection, soil water relationships, understanding date sheets, soil interpretations and cartographic. Field exercises were conducted in geomorphology. transecting. use of field kits, describing and sampling soils and soil classification.

There presently is interest in developing courses in (1) Advance roil correlation, (2) Soil Interpretations, and (3) Party Leader Management.

Soil Survey Publication

A summary of the national schedule of soil surveys by state and survey area shows 236 soil survey manuscripts in the system. This number includes manuscripts in some stage of review, edit, and publication. Soil ups for 181 of the 236 soil surveys have been submitted to the National Cartographic Center.

Current projections indicate that we will edit about 60 to 65 roil survey manuscripts in FY 90. This total is possible because we are presently using resources in contract proofreading and contract editing. We anticipate thst this use of contractors will allow us to edit an additional 10 soil survey manuscripts during the fiscal year.

We currently have about 45 soil survey manuscripts on the shelf ready for editing. Soil maps for 20 of these soil survey areas have been submitted to the National Cartographic Canter. The soil survey manuscript6 with roil maps submitted to the National Cartographic Center will be high priority for editing.

Current projections suggest that there is potential for about 100 soil surveys to be published this year. This is contingent in part on three contracts, covering about 17 soil surveys each, that GPO has with private industry for publication.

Desktop publishing is effectively being used by NSSQA Staff to reduce the cost of producing and reduce staff time in preparing material for roil survey publication. The system was set up in July, 1988. The software, MAGNATYPE, is used on an AT&T 6386 computer. Typically soil survey publication cost was $16.000 to $17,000 in 1988. In 1989. with the desktop publishing system, the cost was only $13,000. This is a saving of $3,000 to $4,000 per survey. In addition, the ayatem caves about three months editorial staff time per survey. A brief handout on Desktop Publishing System by Paige E. Mitchell, editor on our staff, gives an excellent overview of this system.

There are two areas we are presently developing to enhance our editing capability. (1) Tables in soil survey manuscripts are presently made using the Soils-6 file and the Soils-5 databases at Ames, Iowa. State adjustments in tables i.e., crop yield tables are made in pencil and submitted to our office for editing. This requires our office to manually make all recommended corrections on each table. We plan to have operational by the end of this fall a system where each state will have an opportunity to make these needed adjustments in their state soil survey database (3SD). Each state will submit to NSSQA a disk of the tables essentially ready for publication. (2) The pedon description program is currently being reviewed to be consistent with the new National Soil Survey Manual. We also need to have the pedon program to be in agreement with the editing style used in published soil surveys. Once operational, this would allow for the Party Leader to use the pedon program to describe pedons used in manuscripts that would require a very minimum amount of editing and would significantly receive potential errors.

Through the years, we have continually review the format in which we publish coil surveys. The section on coil maps has been fairly stable. However, the text including the description of soils and their interpretation have been presented in different formats.

We currently have a group of four state soil scientist (Sy Ekart, North Dakota; Arville Touchet, Louisiana; Jim Carley, Washington; and Steve Hundley, Massachusetts) Bill Brodercon and Berman Hudson, NSSC to review the present format. One of the major considerations is to have the soil survey manuscript to be presented as two separate documents. (1) Maps and (2) Interpretations. The soil interpretations in the published soil survey that is the first section to be outdated by technology.

This advisory group is scheduled to meet in June, 1990 at Lincoln, Nebraska to discuss and make recommendations. We plan to have these proposals reviewed by the National Cooperative Soil Survey participants this calender year. This will allow us to proceed forward with any major format changes the first part of 1991.

Modernization and Maintenance of Soil Surveys by Major Land Resource Areas (MLRA).

There has been an increase interest to modernize and maintain soil surveys on a major land resource concept. Our staff has coordinated two separate sessions during the past three months to discuss modernization on the MLRA concept. Larry Ratliff, supervisory soil scientist, SSQA Staff has provided excellent coordination of these two very productive sessions. A brief summary of these sessions is as follows:

MLRA 77 - Southern High Plains

Meeting held at Stillwater, Oklahoma during the week of March 5-8, 1990. This area, about the size of the state of New York, includes parts of Texas. Oklahoma,

National Soils Handbook (NSH)

There is a strong desire at the NSSC to update the National Soils Handbook (NSH). The present format is prior National Soil Survey Center. Berman Hudson, supervisory soil scientists on SSQA Staff is chairing a committee to develop an outline for the updating the NSE. Several ● ections i.e., 601, 602, 603 have initial first drafts and are in various ● tages of review. Specific details which are subject to periodical change are planned not to be included in the NSA. Tentative plans are to have a draft of the NSH in new format completed for review and testing in the spring of 1991.

Soil Survey Technology Development

One of the taskforces at the 1989 National Cooperative Soil Survey Conference was model coil surveys. Presently there is interest in the national office to encourage individual project6 which would test or develop a new procedure on methodology which would result in technology applicable to the next generation of soil survey. These projects would be designed to collect specific information. You may wish to contact Lawson Spivey, soil scientist in the national office if you have or desire to develop these type of projects in your state.

We in the Quality Assurance Staff will be looking forward to working with each state as we begin to develop our schedule of coil survey activities for this next fiscal year. We will welcome your comments or expressions which will contribute to a more efficient way of doing the same item, new initiatives or ways to improve the quality of our product. Please feel free to contact our office to formally or informally discuss issues of mutual soil survey quality assurance concern.

LEOPOLD CENTER FOR SUSTAINABLE AGRICULTURE
presented at the 1990 North Central Region Soil Survey Work Planning Conference, June 5, 1990
Dr. James Swan, Associate Director

WHO ARE WE, AND WHAT DO WE DO?

The Leopold Center for Sustainable Agriculture was established in the Iowa Agricultural and Home Economics Experiment Station at Iowa State University by the Iowa Legislature in 1987 as part of the Groundwater Protection Act (HF-631). The enacting legislation defines sustainable agriculture as ". ..the appropriate use of crop and livestock systems and agricultural inputs supporting those activities which maintain economic and social viability while preserving the high productivity and quality of Iowa's land."

The mission on the Center reflects the "land ethic" philosophy of Aldo Leopold, conservationist, ecologist, and educator.

To accomplish a sustainable agriculture in Iowa, the statue established three objectives for the Leopold Center:

1. Conduct and sponsor *research to* identify and reduce negative environmental and socioeconomic impacts of agricultural practices.

2. Research and assist in developing emerging alternative practices that are consistent with a sustainable agriculture.

3. Develop, in association with the Iowa Cooperative Extension Service, an educational framework to inform the agricultural community and the general public of its findings

Functions of the Center are supported by direct appropriation from the Iowa Legislature and by funds from the Agriculture Management Account, provided by special fees on nitrogen fertilizer and pesticides. The Center accomplishes its mission through three major programs: The competitive grants program, an interdisciplinary research program, and a program for adult education and outreach.

COMPETITIVE GRANTS PROGRAM

The competitive grants program was initiated in fiscal year (FY) 1989 with oil overcharge funds. In the following fiscal year, competitive grants were funded from general purpose revenues provided by the Iowa Legislature. Grants for FY 1990 grouped below by category, ranged from $4,700 to

$62,700; the median was $20,000. For 1990-1991 the Center will fund 40 projects for a total of $989,781.

COMPETITIVE GRANTS, 1989-1990

Category	Number of Grants	Amount
Cropping Systems	4	$78,900
Soil Fertility	2	28,150
Energy	6	84,700
Insect Control	6	130,700
Weed Control	4	108,800
Disease Control	1	17,500
Water Quality	3	32,000
Socioeconomic	2	34,000
Soil Conservation	1	21,000
Forest Management	2	33,400
TOTAL	26	569,177

INTERDISCIPLINARY RESEARCH TEAMS

The Leopold Center is sponsoring seven interdisciplinary "Issue Teams". The teams are composed of researchers from Iowa State and from other universities and colleges in Iowa, along with farmers and conservationists who assist in refining the team's research agenda. Each team has at least one leader with a part-time appointment in the Center. Each team works closely with the Center's director to establish an innovative research project.

Issue Team	Team Leaders
Agroecology	Richard Schultz & Bruce Menzel
Alfalfa Pest Management	John Obrycki
Animal Management	James Russell
Animal Waste Management	Stu Melvin
Cropping Systems	Rick Cruse & Doug Karlen
Human Systems	Gordon Bultlena
Weed Management	Brent Pearce

CENTER STAFF AND LOCATION

The director of the Leopold Center is Dr. Dennis Keeney, a native Iowan and Iowa State University graduate. Dr. Keeney was head of the Land Resources Program in the Institute for Environmental Studies at the University of Wisconsin, Madison prior to being named director of the Leopold Center. He has published extensively on soil nitrogen and was President of the Soil Science Society of America and Chair of the Soil Science Department at the University of Wisconsin, Madison. Staff include associate and assistant directors, an information specialist, account clerk, and secretary. Recruitment of an education specialist is underway.

The Leopold Center is housed on the first floor of the National Soil Tilth Laboratory located at the intersection of Pammel Drive and Wallace Road on the Iowa State University campus.

ADVISORY BOARD

The statute also specifies the function and membership of an advisory board which advises the director in the development of a budget, on the policies and procedures of the center, in the funding of research grant proposals, and regarding program planning and review. The Advisory Board consists of the following members:

A. Three from Iowa State University,
B. Two from the State University of Iowa
C. Two from the University of Northern Iowa
D. Two from Iowa private colleges
E. One from the Department of Agriculture and Land Stewardship
F. One from the Department of Natural Resources and
G. Two members actively engaged in farming appointed by the State Soil Conservation Committee.

SOILS INFORMATION IS ESSENTIAL FOR SUSTAINABLE AGRICULTURE

The definition of sustainable agriculture, which refers to "the appropriate use of crop and livestock systems and agricultural inputs" and to "preserving the high productivity and quality of Iowa's land" and its presence in legislation on water quality, together imply that site specific management recommendations are required in order to accomplish the objectives of the act. The diversity of soil and associated climatic conditions, crop and animal production systems, and their interactions make site specific recommendations necessary.

Sustainable agriculture requires consideration of the effects of production practices on the environment. These effects are also a function of the soil and crop, and of weather conditions and variability. Thus site specific information and recommendations are required if practices are to be adjusted to protect the environment. An example of the use of site specific information is the USLE and its replacement; both are based on individual soil and local climatic information.

The variability of weather introduces a significant element of risk into agricultural production. The risk of economic loss due to reduced yields or lost opportunities must be below some specific level in order for farmers to adopt any practice including alternative practices. Methods of assessing the effect of soil differences and of weather variability on specific production and environmental protection practices are required.

Neither money nor time is available to evaluate the range of alternative practices at more than a few locations. To extend the information gathered at a limited number of sites (on a limited range in soil types with a limited range of weather conditions) to other specific sites in Iowa requires the use and validation of crop simulation models. These models use various inputs of soil, plant, and meteorological information to simulate plant growth and yield. Representative soil and climatic information is essential for accurate simulation of the process or processes involved.

Sustainable agriculture alternative practices such as cover crops, tillage and residue management, and rotations involving deep rooted legume forage crops can alter the water budget with significant effects on water and solute movement in and through the soil profile and on crop production.

In order to make progress in protecting the environment and maintaining or increasing agricultural production we will require more precise recommendations and assessments of the environmental effect of production practices. Experiment station field research results must be more closely related to individual farm, field, and in some cases to individual soil type. Single or multiple site research and demonstrations, however sophisticated the experimental design or well conducted, will accomplish this objective only when combined with a means of transferring the information obtained and modifying the process simulated to account for the specific soil and climatic conditions and management capabilities encountered on an individual field.

In conclusion there is a great need for soil and climatic information in sustainable agriculture. Achievement of the goals of environmental protection and a sustainable agriculture depends to a large extent on correctly interpreting and applying research results to individual soil, crop, and climatic situations. Soil and climatic information is essential in order for field research results to be correctly interpreted and is just as necessary for them to be correctly applied.

SOIL TILTH AND THE PRESERVATION OF THE SOIL RESOURCE

J. L. Hatfield
Laboratory Director
National Soil Tilth Laboratory
Ames, Iowa

Soil tilth has been described as the "wellness of the soil". Every gardener can accurately describe tilth. However, as a scientific term, tilth lacks a quantitative definition or a quantitative description as to the processes which create or maintain tilth. Throughout recent history tilth has been associated with the physical characteristics of the soil and more specifically the structure of the soil aggregates. A more effective definition of tilth includes the premise that tilth is a result of complex physical-chemical-biological interactions. In this brief report we will explore the current research being conducted on soil tilth at the National Soil Tilth Laboratory.

Soil is a result of the interactions of the climate and the parent material. In explaining this simple concept there are many caveats and subtle characteristics which must be considered. The simple fractions of sand, silt, and clay are not sufficient to describe the tilth characteristics of a soil. On the other hand. an assessment of the organic matter content provides some additional information but does not provide a basis for quantifying tilth. We do know, however, that organic matter is an important factor in the creation and maintenance of tilth. One of the important questions is what factors begin to change within a soil as organic matter is added and how are these processes interrelated. Presently, research is being conducted on the variation in the microbial, fungal, and mesofauna activities and populations in different soils with different organic matter and different surface treatments. As we begin to understand the variation in the biological processes then we can focus on the role that the biological system plays in the development of soil aggregates. One of the important questions which needs to be addressed is how these processes interact with different parent materials and species of clay throughout the United States.

This simple illustration provides a glimpse es to how we are approaching the development of a scientific infrastructure within the Tilth Laboratory. To answer the question presented above requires a multidisciplinary approach with each individual sharing their expertise in answering the question. To fully answer the question will require a physical chemist, soil biologist, organic chemist, and a clay mineralogist. However, the questions which these individuals raise will require the incorporation of other expertise to fully develop the complete answer. The scientists are also charged with defining the question and therefore must choose the most profitable lines of attack to reach a solution. This concept is different from that often used in the past but we feel that it will provide a research structure from which there will be valuable and exciting information. The staff of 20 scientists which will eventually be within the Tilth Laboratory will form a large base of scientific expertise from which we can draw in order to address the problems which are facing American Agriculture. In the remaining sections the current areas on which we are working will be described.

One of the current concerns is the impact of farming systems on the water quality both in the surface runoff and ground water. There are many pieces of this puzzle which must be addressed and will require a team approach if definitive solutions are to be forthcoming. For example, the interaction of agrichemicals and nitrates with organic matter and the microbial system must be understood if the fate and transport is to be quantified. The role of preferential flow on the movement of materials within the soil profile and through the vadose zone must be understood. All of these processes change as the farming practice is changed from a conventional tillage to a no-till practice or if the chemical is placed onto the soil in a banded or

b e u n

STATE-WIDE WATER QUALITY SURVEYS IN IOWA - A SUMMARY

David E. Stoltenberg
Agronomy Extension - Water Quality
Iowa State University[1]

Abstract. Two of the more prominent water quality surveys that

Atrazine was the only herbicide detected in 33 of the 62 public wells that had herbicide detections. Atrazine concentration in these wells was usually less than 1 ppb. Of the remaining wells that had herbicide detections other than atrazine, 16 had potential point sources, most commonly pesticide mixing and loading sites, within a few hundred feet and as close as 50 feet from the well.

Of the 735 public wells sampled, 1.1% (eight wells) exceeded Environmental Protection Agency (EPA) lifetime health advisory levels for one or more herbicides (Table 1). Atrazine alone exceeded the EPA lifetime health advisory level of 3 ppb in only one public well or 0.1% of the wells sampled. In this well the atrazine concentration was 3.5 ppb. Lasso alone exceeded the current EPA lifetime health advisory of 0.4 ppb[2] in six wells or 0.8% of the 735 public wells. The average Lasso concentration in these six wells was 1.3 ppb. One well had multiple herbicide detections that each exceeded EPA liftetime health advisory levels. In this particular well, atrazine, Bladex, and Lasso were detected at 14.0, 11.0, and 20.0 ppb, respectively. Potential point-sources of herbicides, usually sites where herbicides had been mixed and loaded for several years, were within the vicinity of six of the eight wells in which lifetime health advisories were exceeded.

Synthetic Organia Compound Detection in Public Wells. Fifty-nine percent of the well systems had detectable levels of synthetic organic compounds (Table 1). Most of the synthetic organic compound detections were due to trihalomethanes, such as chloroform, bromofonn, and bromodichloromethane. These compounds can be formed as a result of disinfection of drinking water. During the chlorination process, chlorine can react with naturally occuring organic matter in the water to form trihalomethanes. The trihalomethane chloroform has been found to cause cancer in laboratory animals, representing a significant health concern. The maximum contaminant level (MCL) for trihalomethanes is 100 ppb.

Synthetic organic compounds exceeded maximum contaminant levels in 4 public wells (0.5%) of the 735 sampled wells. In these four wells, an MCL was exceeded for one or more of the following compounds: benzene, methyl-butylether, tetrachloroethylene, total trihalomethanes, and vinyl chloride.

---

[2]A lifetime health advisory level (non-cancer effects) for alachlor (Lasso) in drinking water has not been established. Alachlor is considered by EPA to be a probable human carcinogen. As a result, the 0.4 ppb alachlor concentration is established on the basis of cancer risk. EPA estimates that if an individual consumes water containing alachlor at 0.4 ppb over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million chance of developing cancer as a direct result of drinking water containing this pesticide. Recently EPA has proposed a MCL of 2 ppb for alachlor in drinking water.

Table 1. Pesticide and synthetic organic compound analysis of 735 public well6 in Iowa during 1986 and 1987.[a]

Compound	Public Wells With Detection6	Well6 Exceeding Drinking Water Standards or Advisories
	---------- (% of	total) ----------
Herbicides:		
Atrazine	5.9	0.3
2,4-D	1.6	0
La660	1.4	1.0
Bladex	1.1	0.1
Dual	0.8	0
Lexone/Sencor	0.4	0
Ramrod	0.1	0
Pramitol	0.1	0
All other6	0	0
Insecticide:		
Furadan	0.1	0
All others	0	0
Synthetic Oraanics:	59.0	0.5

[a] Iowa Department of Natural Resources, 1988.

Table 2. Pesticide and synthetic organic compound analysis of 44 public surface water systems in Iowa durina 1986 and 1987.'

	Public Surface Water Systems With Detections	Surface Water Systems Exceeding Drinking Water Standard6 or Advisories
	----------- (% of	total) -----------
Herbicides:		
Atrazine	59	7
Bladex	37	0
Dual	17	0
La660	12	7
All others	0	0
Insecticides:		
Dyfonate	2	0
All others	0	0
Synthetic Organics:	95	36

[a] Iowa Department of Natural Resources, 1988.

Pesticide Detection In Public Surface Water Supplies. Herbicides were detected in 59% of the 44 public surface water systems that were sampled (Table 2). An insecticide (Dyfonate) was detected in only one surface water system. Atrazine was the most commonly detected herbicide, being detected in 59% of the surface systems. Bladex, Dual, and basso were the only other herbicides detected and they were found in 37, 17, and 12% of the surface systems, respectively.

Six surface water supplies (14%) had herbicide concentrations that exceeded lifetime health advisory levels. The 3 ppb atrazine lifetime health advisory level was exceeded in three surface water systems: the average atrazine concentration in these three systems was 3.7 ppb with a maximum of 4.3 ppb. Three other surface water supplies exceeded the Lasso lifetime health advisory of 0.4 ppb, averaging 1.1 ppb basso with a maximum of 1.5 ppb.

Synthetic Organic Compound Detection In Public Surface Water Supplies. Synthetic organic compounds, primarily trihalomethanes (chlorination by-products) were detected in 95% of the surface water systems. Total trihalomethanes (TTHM) exceeded the maximum contaminant level of 100 ppb in 16 (36%) surface supplies. Average TTHM concentration in these 16 surface water supplies was 195 ppb, with a maximum of 275 ppb.

Conclusions from the Pesticide and Synthetic Organic Compound Survey of Iowa Public Water Supplies. This survey showed that surface water supplies have a greater potential for contamination from herbicides and total trihalomethanes than water supply systems utilizing groundwater.

The survey found that shallower groundwater sources have a greater potential for contamination from herbicides and synthetic organic compounds than deeper groundwater sources. The majority of herbicide detections in wells utilizing bedrock aquifers occured in Northeast and East Central Iowa. Many factors may influence this regional distribution of detections, including 1) the relatively shallow depth of the aquifers in this area, 2) shallow fractured limestone bedrock and approximately 12,700 sinkholes, 3) the relatively high percent of corn acres treated with atrazine, and 4) the relatively high application rates of atrazine as compared to other areas of Iowa.

The survey also showed that the sand and gravel aquifers of Western Iowa were vulnerable to herbicide contamination. Many of the pesticide detections in the sand and gravel aquifers were due to atrazine, most of which were less than 1 ppb.

During the 12 month sampling period of this survey, a seasonal trend in pesticide occurences was not observed.

Iowa State-wide Rural Well-Water Survey

The Iowa Statewide Rural Well-Water Survey was designed and conducted by the Iowa Department of Natural Resources Geological Survey Bureau and The University of Iowa Center for Health Effects of Environmental Contamination. Systematic sampling of 686 rural wells was conducted during 1988 and 1989. Sample design was based on rural population density and total geographic coverage of all 99 counties in Iowa. Water samples were analyzed for coliform bacteria, nitrate, 27 pesticides, and several pesticide metabolites.

The survey included a questionaire and site evaluation that determined well characteristics, potential point sources of chemicals, agrichemical use and practices, and existing health symptoms or conditions. Preliminary results were released in February of 1990; complete analysis of the results is expected within one to two years.

Total Coliform Bacteria Detection In **Private Wells.** A greater percent of private wells were unsafe due to total coliform bacteria than any other contaminant; 44.6% of the private wells tested were considered unsafe (Table 3). Coliform bacteria are not themselves a health concern, but are an indication that other pathogenic microbes may be able to enter the water system. Ongoing analysis of survey data suggests that 6 to 7% of the samples show contamination with fecal coliform bacteria.

The highest percent of wells considered unsafe due to total coliform bacteria were in Western and Southern Iowa. Wore specifically, when results are expressed on the basis of Iowa State University Extension Areas, the highest percent of unsafe wells was found in Southwest Iowa (72.5%), followed by Southeast (62.3%), Northwest (60.1%), and Central Iowa (58.4%). In contrast, the lowest percent of wells that had unsafe bacteria levels was in Northeast Iowa where 20.2% were tested unsafe.

Well depth was a significant factor with respect to contamination from total coliform bacteria. For wells less than 50 feet deep, 71.5% were found to have unsafe levels of total coliform bacteria, whereas wells deeper than 50 feet were less vulnerable to bacterial contamination with 36.3% of these wells being unsafe.

Nitrate-Nitrogen Detection In Private Wells. Nitrate-nitrogen concentrations exceeded the 10 parts per million (ppm) drinking water standard in 18.3% of the private wells tested (Table 3). In a similar distribution as wells with unsafe bacteria levels, the highest percent of wells exceeding the nitrate-nitrogen drinking water standard were in Northwest (32.3%), Southwest (32.2%), and Southeast Iowa (26.5%). Both Southwest (11.3 ppm) and Nothwest Iowa (10.9 ppm) had mean nitrate-nitrogen concentrations that exceeded the drinking water standard.

Table 3. The Iowa State-wide Rural Well-Water Survey: private wells exceeding drinking water standards or guidelines for bacteria, nitrates, and herbicides.[a]

	Percent of Private Wells Sampled
Total Coliform Bacteria: unsafe wells	45
Nitrate-Nitrogen: wells exceeding 10 ppm	18
Herbicides: wells exceeding lifetime health advisory level	1

[a] Iowa Department of Natural Resources and University of Iowa, 1990.

Table 4. Summary of pesticide detections for the 1990 State-wide Rural Well-water Survey.[a]

pesticide	Private Wells with detections (% of total)	Average Concentration (ppb)	Private Wells Exceeding EPA Lifetime Health Advisory Level (% of total)
atrazine	4.4	0.90	0.7
deethyl-atrazine[b]	3.5	0.54	
deisoproply-atrazine[b]	3.4	0.68	
Sencor	1.9	0.16	0
Prowl	1.7	0.19	0
Dual	1.5	0.92	0
Bladex	1.2	0.30	0
Lasso	1.2	0.67	0.3
hydroxy-alachlor[b]	0.4	0.91	
Tordon	0.6	0.39	0
2,4-D	0.6	0.20	0
DCPA	0.4	0.02	0
Ramrod	0.4	0.11	0
Treflan	0.4	5.65	0.1
Furadan	0		
hydroxy-carbofuran[b]	0.4	0.38	
keto-carbofuran[b]	0.4	0.03	
All others	0		

[a] Iowa Department of Natural Resources and University of Iowa, 1990.
[b] Pesticide metabolites.

The lowest percent of wells exceeding the standard was found in North Central Iowa (3.8%) followed by East Central Iowa (7.0%). The lowest mean nitrate-nitrogen concentration was in North Central Iowa (2.5 ppm).

As with bacteria, well depth was an important factor influencing wells exceeding the nitrate-nitrogen drinking water standard. For wells less than 50 feet deep, 35.1% exceeded the 10 ppm nitrate-nitrogen standard. In contrast, 12.8% of the wells greater than 50 feet deep exceeded the nitrate drinking water standard.

Pesticide Detection in Private Wells. Pesticides were detected in 13.6% of the 686 rural, private wells tested in this survey. Nearly all of these detections were herbicides (Table 4). Herbicides concentrations in this survey were generally less than 1 ppb. No active ingredient of any insecticide was detected. However, two metabolites of the insecticide Furadan were each detected in 0.4% of the 686 private wells sampled.

Atrazine was the most commonly detected herbicide in this survey and was found in 4.4% of the private wells sampled (Table 4). Atrazine and/or atrazine metabolites were detected in a total of 8% of the private wells tested. Northwest Iowa had the highest percent of wells (14.6%) with atrazine detections; Southeast Iowa had the lowest (6.2%). Atrazine detections in other areas ranged from 7.1 to 8.8% of the wells sampled.

Several other herbicides were detected in the survey: none were detected in more than 2% of the wells (Table 4). The lowest percent of wells with pesticide detections was in Southeast Iowa (9.3%) followed by Northeast Iowa (10.9%). The highest percent of wells with pesticide detections was in Northwest Iowa (22.0%). In contrast to both bacteria and nitrate results, well depth was not a significant factor with respect to pesticide detections.

Eight wells or 1.2% of the 686 wells tested exceeded EPA lifetime health advisory levels for herbicides (Table 4). Atrazine exceeded the 3 ppb EPA lifetime health advisory level in 0.7% (5 wells) of the 686 sampled. Three wells exceeded lifetime health advisory levels for herbicides other than atrazine. basso exceeded the EPA lifetime health advisory of 0.4 ppb in 0.3% (2 wells) of those tested. The maximum Lasso concentration detected was 4.76 ppb. A spill of the formulated product of Lasso *near* one of these two wells attributed to the elevated concentration Of basso. Treflan exceeded the EPA lifetime health advisory level of 2 ppb in 0.1% (1 well) of the total wells sampled. Treflan detection in this well was attributed to a past backsiphoning event.

Preliminary conclusions from tbe Iowa State-wide Rural Well-Water Survey. The results of this survey should be interpreted within the context of drought conditions, as the survey was conducted during two of the driest years on record. Results may have been considerably different during years with average or above average precipitation. Secondly, the results discussed above are preliminary. The Iowa Department of Natural Resources Geological Survey Bureau and the University of Iowa Center for Health Effects of Environmental Contamination are currently conducting additional analysis of all data collected.

The results of this survey show that private wells in Western and Southern Iowa are the most vulnerable to contamination, primarily due to the dependence on shallow groundwater. The high percent of private wells found to have unsafe bacteria levels suggests a substantial state-wide problem of well construction and/or placement. This factor may also contribute to nitrate and pesticide detection in rural wells, however, the relationship among bacteria, nitrate, and pesticide detections in this survey has not been determined. Analysis of site-specific data is needed to determine the specific factors contributing to well-water contamination.

On a regional basis, the results show a poor correlation between the percent of rural wells with atrazine detection and the level of atrazine use. For example, the region with the highest percent of farm wells with atrazine detection (Northwest Iowa) is a region with traditionally the lowest average per acre application rate of atrazine and the lowest percent of corn acres treated with atrazine. Conversely, the region with the lowest percent of farm wells with atrazine detection (Northeast Iowa) traditionally has had one of the highest average atrazine application rates per acre and one of the highest percent of corn acres treated with atrazine. These results suggest that other factors besides or in addition to atrazine application rate are contributing to atrazine detection in well-water. However, site-specific investigation of past and current atrazine use practices, atrazine application rates, well construction, and well placement, in addition to other factors, is needed.

REFERENCES

1. Fawcett, R.S. 1989. Pesticide and Synthetic organic Compound Survey of Iowa Public Water Supplies. Weed Sci. Soc. Am. Abstracts. 29:42-43.

2. Fawcett, R.S. 1989. Iowa Public Water Supply Pesticide Survey. Report of Towns with Well Systems Containing Pesticides Other Than Atrazine. Iowa State Univ. Agron. Extension.

3. Iowa Department of Natural Resources. 1988. Pesticide and Synthetic Organic Compound Survey - Report for House File 2303. IDNR, Wallace State Office Building. Des Moines, IA.

4. Hallberg, G.R. and B.C. Kross. 1990. Iowa State-wide Rural Well-water Survey - Summary of Results. Iowa Department of Natural Resources Geological Survey Bureau and University of Iowa Center for Health Effects of Environmental Contamination. Iowa City, IA.

ON-FARM DEMONSTRATION PROGRAMS:

IOWA COOPERATIVE EXTENSION SERVICE[1]

On-farm demonstration projects sponsored by the Cooperative Extension service, Iowa state University, represent a major activity for state, area, and county extension service staff. These projects are supported by contracts with the Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship (DSC, IDALS), Iowa Department of Natural Resources (IDNR) and USDA Extension Service (USDA-ES) in cooperation with the Iowa Soil Conservation Service (SCS) end the Iowa Agricultural Stabilization and Conservation Service (ASCS).

The current on-farm demonstration projects are designed to demonstrate environmental protection by: 1) reducing of soil erosion of sediment and chemical runoff to surface water; 2) reducing solute leaching below the plant root zone; end 3) implementing refined farming practices for nutrient and pest management through the adaption of reduced tillage, conservation practices and crop rotations. The projects demonstrate reduced energy consumption and enhanced profitability for crop production and protection.

Integrated Farm Management Demonstration Program(IFMDP)

The IFMDP is funded by DSC, IDALS, with advisement by the Agricultural Energy Management Advisory Council (AEMAC). This program was established in 1986 by Senate File 2305 which was passed by the 71st General Assembly, State of Iowa. The following year the legislature included AEMAC responsibilities as part of the 1987 Iowa Groundwater Protection Action.

Cooperative Extension Service has two contracts and two cooperative agreements to conduct on-farm demonstrations under the provisions of the IFMDP. These are:

- Education and Best Available Technology Assistance. This project, which began in 1987, includes field demonstrations through crop year 1991. The on-farm demonstrations use best available technology to implement refined management practices, The contract's primary emphasis is integrated crop production and protection management practices, including reduced tillage and crop enterprise records. It also includes assessment, inventory, and evaluation of cooperating and non-cooperating farmers as

---

[1]Gerald A. Miller, Professor and Extension Agronomist, Department of Agronomy, Iowa State University, Ames. Prepared for the 1990 North Central Region Soil Survey Work Planning Conference held at Iowa State University, Ames, Iowa, June 4-8, 1990. Oral presentation, June 5, 1990.

well as communications support and training of retail chemical and fertilizer dealers. The project's program elements include: 1) nutrient management: 2) weed management; 3) **tillage** management; 4) nitrogen management for high value vegetable crops; 5) Butler County Integrated Crop Management **(ICM);** 6) Upper Bluegrass Watershed (Audubon County) crop production and protection practices and water monitoring;
7) program evaluation -- assessment and inventory; and 8) media and educational materials for the public. New program activities started in 1990 include: 1) on-farm management services - northeast Iowa; 2) animal manure management **-Benton** and Buchanan counties; and 3) the Field Extension Education Laboratory, located on campus, as well as at a field location in Boone County.

The Education and Best Available Technology Project has demonstrated cost effective and profitable refined management practices for cooperating farmers. For example, during the past two crop years, 45 participating farmers in the Butler County **ICM** project saved an average of $15 to $20 per acre per year on a total of 23,000 acres.

Farm 2000 **Project**. Initiated in 1988, this three-year project is designed to demonstrate a regional model for creating a producer network to address efficient, sustainable agriculture practices. In this project, located in the four-county Grinnell, Iowa, trade area, farm families are introduced to services and management tools that provide a" understanding of how to reduce crop inputs while maintaining farm profitability. In addition, the project gives farmers a" opportunity to develop improved leadership skills. Finally, participating farmers will take leadership roles in educating other farm families about sustainable agriculture practices.

- practical Fanners of Iowa. The cooperative agreement provides for a full-time extension associate, housed at the same location as the Agronomy Extension faculty **and** staff. The extension associate directs educational programs for the Practical Farmers of Iowa (PFI), a non-profit organization. PFI cooperating farmers conduct on-farm paired demonstrations for crop production and protection practices. The purpose is to implement on-farm demonstrations that will accelerate the adoption of best available farm management practices and make farming more sustainable and environmentally **sound.**

This project represents the first phase of a long-term program. The objectives are to:

1) Establish reliable, "fair trial" data on the effectiveness of specific energy efficient agricultural methods on working farms.

2) Communicate information on these "fair trial" data and other alternative agricultural practices as widely and effectively as possible.

■ Cultivate a methodology that will incorporate both the talent of the farmer and the training of the scientist.

- Agri-Education, Inc. This project provides for the development of audiovisual materials and computer software packages developed by Agri-Education, Inc.. Stratford, Iowa. In this cooperative agreement Cooperative Extension Service (CES) provides video footage and technical review of materials produced by Agri-Education, Inc. These videotapes and accompanying software packages will show producers how to reduce energy inputs, minimize environmental degradation and enhance profitability. Products will illustrate crop residue management, soil compaction, soil fertility and liming, and water quality protection. Upon development of the audiovisual and software packages, CES will field test materials through the ISU Extension Service Farm and Family Management program.

Big Spring Basin Demonstration Program (BSBDP)

The BSBDP is funded by the Iowa Department of Natural Resources. This project was established by provisions of the 1987 Iowa Groundwater Protection Act (IGWPA).

Activities in this contract cover a seven-county area in northeast Iowa; specifically, Allamakee, Buchanan, Delaware, Dubuque, Clayton, Fayette, and Winneshiek counties. Project staff are located at the Clayton County Extension Service office, Elkeder. Selected project activities were initiated in 1982 and 1983 by county and area CES staff Targeted funds for CES were included in the IFMDP, which provided funds for implementing on-farm field demonstrations in crop year 1987. The establishment of BSBDP as part of the 1987 IGWPA transferred project activities to the BSBDP.

Iowa CES has a single contract consisting of three program elements. A major thrust of this project is conducting on-farm demonstrations that use best available technology to implement refined crop management practices.

Project activities include developing a network among producers within a 1,050-acre watershed. These farmers demonstrate on-farm environmentally effective farming practices, including long-term agreements for implementing soil conservation structures and practices

The BSBDP also sponsors nutrient, weed, and tillage demonstrations as well as on-farm alfalfa establishment and production activities. Also, integrated crop management practices and crop enterprise records are demonstrated to participating producers.

As part of this project, an ongoing training program and network environment is provided for local retail chemical and fertilizer dealers. In addition, a part-time communications specialist targets public information to the seven counties.

Finally, the BSBDP documents, through on-farm demonstration plot data collection and other appropriate sources, the energy efficiencies of project activities. An extension associate is employed by ISU Extension Service Farm Management section. The extension associate's responsibilities include documentation of energy efficiencies for activities sponsored by BSBDP and IFMDP.

Targeted Education Program Assistance (TEPA) Project

The TEPA project is funded by Division of Soil Conservation, Iowa Department of Agriculture end Land Stewardship. This project was established by the 1987 IGWPA to implement a targeted education program for best management practices and best available technologies that prevent groundwater contamination from agricultural drainage wells, abandoned wells, and sinkholes.

Activities in this project are directed at the Agricultural Drainage Well (ADW) area of Humboldt, Pocahontes and adjacent counties in north central Iowa and the karst areas of northeast Iowa. Selected project activities began in 1988.

Model Farms Demonstration Project (MFDP)

The HFDP is funded by the Iowa Department of Natural Resources. This project was created in 1989 by House File 789, which established a project management team consisting of IDNR and DSC. IDALS representatives and the Iowa CES director.

The HFDP establishes project sites at five regional locations in Iowa: north central, northwest, southwest, south central and southeast. At each regional location on-farm demonstration and education activities are implemented. The goal is to accelerate the voluntary adoption of refined management practices that reduce the environments1 impacts of modern agriculture, reduce energy consumption, and enhance the efficiency and profitability of farm management. The HFDP activities are based on the successful experience gained from the Big Spring Basin and Integrated Farm Management Demonstration projects.

Integrated Crop Management projects, based on the model developed and implemented in Butler County, are established at three locations: Kossuth county, north central; Sioux County, northwest; and Carroll and Audubon counties, southwest. At these locations ICM services will be provided to participants at no charge during crop year 1990. In crop years 1991 and 1992, cooperating farmers will pay one-third and two-thirds the cost of ICM services, respectively, and in crop year 1993 farmers will finance the entire cost of the project.

The south central project is located in Lucas snd adjacent counties. Project staff are located at the Lucas County Extension Service office and will work with staff at the McNay Memorial Research Center located near Chariton. This regional location provides for on-farm demonstrations that emphasize integrated pasture and forage management. Efforts will focus on forage stand establishment and management demonstrations. new forage crop systems, pasture management demonstrations, and rotational benefits from hay and forage crops such as alfalfa. The objective is to establish an information and communications network among cooperating farm producers.

The southeast project is located in Des Moines County and adjacent counties. Project staff are located at the Des Moines County Extension office. Coordination and joint efforts are developed with the Southeast

Area Community College Farm Management Program and the ISU Outlying Research Center (ORC) at Crawfordsville, Washington County.

This regional location establishes a" information and communications network among seven farmers located near Danville, Iowa, to demonstrate refined conservation tillage systems. In addition, a part-time communications specialist develops communications materiel for the 2,000 member Southeast Iowa ORC Association and other interested organizations. individuals and media located in southeast Iowa.

Nonpoint Source Hydrologic Units (NPS HU) Project

The NPS HU projects are funded through the USDA Soil Conservation Service (USDA-SCS), USDA Extension Service (USDA-ES), and USDA Agricultural Stabilization and Conservation Service (USDA-ASCS) as part of the President's Water Quality Initiative of 1990. Initial funding for NPS HU became available during fiscal year 1990 (FY90).

In 1989 Iowa SCS and CES successfully proposed funding for two watersheds with surface water impoundments to implement comprehensive soil conservation and crop production and protection management practices. These two watersheds, Union Grove Lake, a 118-acre lake with a 6,895-acre watershed in Tama and Marshall counties, and Black Hawk Lake, a 925-acre natural lake with a 13,300-acre watershed in Sac and Carroll Counties, are funded for a planned five-year project, starting in crop year 1990.

In both watersheds, the NPS HU project will include a" assessment and inventory of farmers and their practices in the first year. In subsequent years, on-farm demonstrations will be conducted to illustrate refined management practices. The objective of these demonstration programs is to encourage farmers to voluntarily change their farm management practices resulting in improved water quality in the two state-owned lakes.

Project Results

The results of on-farm demonstration efforts are published in numerous reports, including annual reports as well as fac0ojectcuIdtsIK..cuId Kathy L.

National Soil Survey Laboratory
Activities Report
June 1990

Since our last conference, Dr. **Ellis Knox** became the Head of The National Soil Survey Laboratory and in that capacity is the SCS National Leader for Soil Survey Investigations. Dr. Carolyn Olson is the head of the new Field Investigations staff that was added a year and a half ago. New liaison assignments to states and other personnel changes those are reflected on our current staff listing. Those are available to those of you who want them.

We have received the OPM vacancy announcement for a CS-11 research soil scientist to work primarily with our datasystems. This will draw from all sources and hence will not be on the familiar SCS "green sheets". We will soon announce another research soil scientist vacancy, likely for emphasis in soil chemistry. So, if you know of qualified candidates, please have them contact Dr. Knox or one of the Laboratory Staff members.

Analytical Activities

The number of samples that we receive has increased each year for the last several years. Last year we received about 260 projects with about 8,600 samples on which nearly 190;OOO analyses were completed.

A new Soil Survey Laboratory methods is being written and is complete except for final in-house editing. We can provide it as a draft document to NCSS cooperators on request before the end of this calendar year. We plan for it to replace Soil Survey Investigations Report No. 1 after being subjected to a more formal editorial review.

To provide more software uniformity between our analytical instruments and our data storage units we are in the process of purchasing, a Laboratory Information Management System (LIMS). We expect this system to automatically provide some analytical laboratory management tools that we currently lack or have to maintain manually. We anticipate that this will further improve analytical efficiency.

Data Bases and Records

As in the past, as soon as analyses are complete and stored in the mainframe computer, they are electronically available [redacted] using the INTERACT program to access the National Soil Survey Laboratory Database.

Use of the NSSL database is limited by the lack of classification of many of the pedons. We are modifying the instructions for the Soil-S forms to separate the family classification of the pedon itself from the correlation procedure. The classification of the pedon based on the field description and laboratory data can be made as soon as the data are available. We know that the classification of the pedon is likely to differ from the classification of the series identified at final correlation, so there is no need to wait for completion of the survey or for final correlation to force a match with the family of the correlated series. We would like to have the classification of the pedon determined by the states, but if classification is separated from correlation issues, then *any* competent, informed soil scientist can classify.

The National Soil Characterization Data Base development is moving closer to reality with the location of Ellis Benham at the Soil Survey Laboratory. Ellis is an Auburn University Ph.D. candidate employed by Texas A&H University. This database will incorporate data fro6 all NCCS contributing laboratories. The associated committee has experiment station representatives fro6 each region in addition to the SCS members. Analytical data and descriptions with software for manipulation of the data will be distributed periodically on CD ROM to make it available to the SCS and other participants in the National Cooperative Soil Survey.

Training

A great deal of our staff time is spent training other soil scientists. Warren Lynn continues to serve as technical coordinator for lab data courses with three or four sessions taught in Lincoln and usually in one or two other locations each year. Most of the staff helps with these courses. Warren represented NSSL in the joint effort with the NSSQA staff to pilot two sessions of a new soil survey course this year. NSSL staff members also teach at the Soil Science Institute, the soil salinity course, and soil correlation courses.

For the third year, our staff had a well-received presentation at the National Science Teacher's Conference.

Research and Development

Since the list of research activities in which our staff is involved is quite long, permit me to highlight some representative ones.

Looking Ahead

He believe that the use of the data we have now and what we collect in the foreseeable future will be much more heavily concerned with soil survey interpretations. Those will include concerns on which we are already working such as water quality and some just coming onto the horizon such as global warming.

Priorities and protocols for getting additional data may change somewhat from our current ways of operating. Perhaps we will need to consider sampling representative soils in an MLRA instead of a county or group of counties. A proposed sampling protocol for HLRA updates is being written and reviewed by our staff. Some have suggested that the benchmark soils concept may *again* be a viable way to approach sampling. We may also find that our staff liaison assignments may need to be made in a different way. If you have some thoughts about these topics, please tell me your ideas.

Study	Leadership
N.C. Mountain Soils Study and Tour	Lynn
Int'l Soil Correlation Meetings	Kimble
Humic Substances Characterization	Sobecki, Kaisaki
Saline Seeps	Reinsch
Drainmod parameters from S-5 data	Baumer
Particle size by transducer	Reinsch, Baumer
Soil Data Interrelationships	Brasher
Soil Geomorphology SSIRs	Gamble
Soil Climate	Paetzold
Statistical Techniques for Soil Variability	Paetzold
MLRA Projects	Brasher, Olson, Nettleton
Wisconsin Soil Moisture Study	Yeck, Baumer, Olson, Paetzold, Gamble
Soil surface and ephemeral properties	Grossman
Water dispersible clay	Burt
Reconstructed bulk density for Ap horizons	Grossman
Illinois - Till plain study	Olson, Nettleton
Missouri Ozarks	Gamble
New England Bedrock study	Doolittle
Great Plains projects	Field Investigations Staff, Brasher, Nettleton
Oklahoma Panhandle	Olson, Brasher

Mailing Address:

Federal Building., Room [redacted]
100 Centennial Mall North
Lincoln, NE 68508-3866

SOIL SURVEY INVESTIGATIONS STAFF
NATIONAL SOIL SURVEY LABORATORY
USDA-Soil Conservation Service
National Soil Survey Center, MNTC
Lincoln, Nebraska

Ellis G. Knox, Head
Ronald D. Yeck, Asst. Head
Sherrill A Hostetler, Secretary
Charlotte E. Winter, Clerk-Typist
Valda Jaunzemis, Clerk-Typist

SOIL CHARACTERIZATION STAFF

Laurence E. Brown, Staff Leader
Richard L. Pullman, Soil Scientist
Carole A Van Amerongen, Computer Assistant
Kelly D. Henry, Clerk-Typist (SIS)
Lori A. Belschner, Computer Clerk (WAE)

PHYSICAL ANALYSIS
Thomas G. Reinsch, Soil Scientist
Rebecca Burt, Soil Scientist

RESEARCH AND DEVELOPMENT STAFF

Kirsten L. Stuart, Secretary
Nancy A. Martinez, Clerk-Typist (SIS)

DATA SYSTEMS

LIAISON ASSIGNMENTS 6/90

Area and States	Scientist
Pacific Northwest (WA, OR, ID)	Rebecca Burt/Fred M. Xaisak
Montana	Richard L. Pullman
Lake States, Alaska (MN, WI, MI, AK)	Ronald D. Yeck
New England (ME, NH, VT, MA, CT, RI)	Laurence E. Brown
Lower Northeast (NY, NJ, PA, MD, DE, DC, WV, VA) and Northern Plains (NE, ND, SD)	Robert B. Grossman
Hawaii	Leo C. Klameth
southwest (CA, NV, AZ, NM)	Otto W. Baumer
Intermountain (UT, CO)	Thomas G. Reinsch
Central Corn Belt and Central Plains (IA, IL, IN, OH, MO, KS, WY)	W. Dennis Nettleton
South Central (OK, TX, LA, AR)	Benny R. Brasher
Southeast and Puerto Rico (KY, TN, NC, SC, GA, MS, AL, FL, PR)	Warren C. Lynn

REGIONAL LIAISON

Midwest National Technical Center	W. Dennis Nettleton
Northeast National Technical Center	Robert B. Grossman
South National Technical Center	Warren C. Lynn
West National Technical Center	Otto W. Baumer

*** N S S L D A T A B A S E ***
P E D O N C O U N T S
01/May/90

STATE	TOTAL	PRE1978	1978-UP	U/TAX	NO TAX	DESCRIPTION	CORRELATED
			<---- 1978 & UP				---->
HOT IDENTIFIED	35	2	33	0	33	0	0
ALASKA	344	80	264	29	235	207	28
ALABAMA	104	19	85	72	13	35	71
AMERICAN SAHOA	25	10	15	15	0	15	15
ARKANSAS	70	27	43	14	29	26	14
ARIZONA	581	295	286	38	248	198	38
CALIFORNIA	1193	529	664	116	548	341	74
COLORADO	482	212	270	8	262	143	8
CONNECTICUT	23	8	15	15	0.	11	15
DISTRICT OF COLUMBIA	3	3	0	0	0	0	0
DELAUARE	24	15	9	0	9	3	0
FLORIDA	155	94	61	4	57	13	4
FOREIGN NATION	894	3	891	566	325	652	560
GEORGIA	244	54	190	69	121	101	64
GUAM	20	0	20	19	1	16	19
HAWAII	42	7	35	17	18	21	17
I OVA	780	146	634	443	191	543	409
IDAHO	554	129	425	189	236	199	59
ILLINOIS	479	142	337	90	247	197	101
INDIANA	319	9	310	94	216	70	84
KANSAS	346	111	235	126	109	126	126
KENTUCKY	244	85	159	70	89	100	71
LOUISIANA	230	124	106	71	35	32	37
MASSACHUSETTS	89	69	20	4	16	5	4
UARYLAND	150	17	133	0	133	96	0
MAINE	121	63	58	14	44	18	7
MICHIGAN	173	90	83	31	52	34	31
MINNESOTA	151	108	43	26	17	38	27
MISSOURI	327	82	245	100	145	93	99
MISSISSIPPI	163	123	40	30	10	29	29
MONTANA	538	296	242	72	170	95	53
NORTH CAROLINA	260	59	209	51	158	86	51
NORTH DAKOTA	424	171	253	173	80	53	172
NEBRASKA	752	292	460	159	301	224	105
NEW HAHPSHIRE	107	70	37	2	35	30	2
NEW JERSEY	86	54	32	29	3	26	29
NATIONAL LABORATORY	79	0	79	0	79	0	0
NEU MEXICO	368	137	231	94	137	104	72
NEVADA	600	261	339	14	325	181	14
NEW YORK	279	75	204	46	158	84	19
OHIO	32	6	26	18	8	22	18
OKLAHOMA	163	68	95	IO	85	69	8
OREGON	478	285	193	1	192	68	18
PENNSYLVANIA	57	40	17	2	15	0	2
PUERTO RICO	188	100	88	1	87	58	0
SOUTH CAROLINA	85	30	55	14	41	21	11
SOUTH DAKOTA	412	198	214	·33	181	111	33
TENNESSEE	228	168	60	15	45	52	15
TRUST PACIFIC ISLAND	37	0	37	35.	2	27	36
TEXAS	706	273	433	240	193	255	229
UTAH	458	265	193	4	189	122	1
VIRGINIA	76	13	63	0	63	19	0

*** * * N S S L   D A T A B A S E   * * ***

P E D O N   C O U N T S

01/May/90

STATE	TOTAL	PRE1978	<---- 1978 & UP ---- 1978-UP	V/TAX	ND TAX	DESCRIPTION	CORRELATED ---->
VIRGIN ISLANDS	12	8	4	0	4	4	0
VERMONT	175	73	102	39	63	67	39
WASHINGTON	504	162	342	25	317	151	25
WISCONSIN	515	178	337	139	198	134	59
WEST VIRGINIA	159	59	100	51	49	71	51
WYOMING	412	191	221	9	212	93	10
GRAND TOTALS ------>	16563	6188	10375	3546	6829	5589	3083

**** SOUTHERN STATES ****

STATE	TOTAL	PRE1978	<---- 1978 & UP ---- 1978-UP	V/TAX	NO TAX	DESCRIPTION	CORRELATED ---->
ALABAMA	104	19	85	72	1.3	35	71
ARKANSAS	70	27	43	14	29	26	14
FLORIDA	155	94	61	4	57	13	4
GEORGIA	244	54	190	69	121	101	64
KENTUCKY	244	85	159	70	89	100	71
LOUISIANA	230	124	106	71	35	32	37
MISSISSIPPI	163	123	40	30	10	29	29
NORTH CAROLINA	268	59	209	51	158	86	51
OKLAHOHA	163	68	95	10	85	69	8
PUERTO RICO	188	100	88	1	87	58	0
SOUTH CAROLINA	85	30	55	14	41	21	11
TENNESSEE	228	168	60	15	45	52	15
TEXAS	706	273	433	240	193	255	229
VIRGIN ISLANDS	12	8	4	0	4	4	0
GRAND TOTALS ------>	2860	1232	1628	661	967	881	604

TOTAL . . . . All of the pedons in the NSSL Database.
PRE1978. . . . . . . Pcdons sampled prior to 1978 by the NSSL and it's predecessor laboratories.
1978-UP . . . . . . Pcdons sampled by NSSL beginning in 1978.
W/TAX . . . . Pcdons classified by states or TSC's on NSSL Soil-8 forms returned to NSSL.
NO TAX . . . . Pedons not classified by states or TSC's.
DESCRIPTION . . Profile descriptions currently stored in the NSSL Database.
CORRELATED . . . Pcdons with a correlated series name shown on NSSL Soil-8 form returned to HSSL.

SOIL INTERPRETATIONS and GEOGRAPHY
AUTOMATION and PROGRESS

Dennis J. Lytle

Presented at the North Central Soil Survey Work Planning Conference June 4-8, 1990. Ames la.

I would like to talk about the future. I am not pipe dreaming now about what I would like to see. but what is very close to reality. Automation has had a giant impact on the National Cooperative Soil Survey, and indeed on our lives as a whole. In relation to providing information to our clients we are in a position now to make major **improvements** in the quality and availability of soil data. But like the effort to complete a once over soil survey it must be a cooperative effort to improve our data. To borrow some words from Steve Holzey -

"If we believe that a well maintained and updated nation soil survey can be a strong positive force in the struggle for the well being of our nation and our planet, then we have to make others aware of what is at stake it the maintenance and update phases of our surveys. It is easy to impart the impression that a soil survey ends with the completion of mapping. The following similes are sometimes helpful:

- Soil Surveys require maintenance, just as the family car. Each new one increases the overall maintenance cost by one survey. Hence, we are spread thinner each year. even if nothing changes except the number of surveys mapped and published.

- Like the family car, soil surveys or some of their parts wear out and have to be repaired. We have fallen behind in that repair.

- Like our conservation efforts, soil surveys are becoming more complex because technology and needs of the populace are changing. Each new development hastens the obsolescence of older surveys unless there is a maintenance program to counter that obsolescence.

- In the 1990s and beyond, political boundaries are not the most effective limits when planning for update and maintenance. Physiography. demographics and other factors have to be considered when striving for the regional uniformity needed for a host of high-impact applications.

- The faster we build regional uniformity and deliver needed new information. the better for our users. Accelerating just one revision of an important application can make an immense difference to our colleagues, our customers and the images and blood pressures of all concerned."

Automation will not be a panacea. The process itself is painful and we have not yet put up the dollars needed. But we have the tools to more easily revise and repackage our soil surveys. We are revisiting our soil interpretative criteria and I expect we will make numerous other changes and improvements. Indeed the process of automation has forced us to rethink the way in which we make soil interpretations.

Some items we are currently working on are:

- Updates of criteria tables
- New/Revised data elements for form 5
  - Sand. Silt and Clay
  - Separate entry for ponding
  - Kf - K for fine earth fraction for RUSLE
  - Water table depths by month
- RUSLE - revised USLE 1991
- Revisions to hydric soils criteria
- Standard Computer method for “T” for use with RUSLE (will not effect HEL lists)
- Fertility Classification System
- Regional Forestry Interpretations

We can not. will not, do it alone.

With the soils layer in a Geographic Information System (GIS) we will have a tool to be able revise our soil map on a continuous basis. As we find errors or reasons for refinement through use and on site investigation we will be able to revise the soil map so that we have a continually improving product. We will also have a tool to repackage and display the results of our new or revised interpretations to our clients. Interpretative maps that are relatively easy to make. are aesthetically pleasing and easily convey a theme. We will have a tool to look at our data spatially during the process of the soil survey to aid in quality control. correlation and classification. Show me where all the Aquolls are mapped in this survey, state or Major Land Resource Area. The possibilities to do what if’s with our spatial and attribute data now seem limitless.

But as I said before we can not do it alone. We need everyone's ideas. In short we need ways to strengthen our National Cooperative Soil Survey effort.

Presentation by Richard Fenwick at the
1990 North Central Soil Survey
Work Planning Conference

SOIL TAXONOMY

Soil Taxonomy has undergone significant changes in the last few years, and it is the purpose of this presentation to examine how these changes were decided on, what they are, and how they are recorded. This involves discussing the work of the International Soil Classification Committees and of the Soil Taxonomy committees in the United States, since most of the proposals for change have originated from them. The new format of the keys to subgroups will be explained, as well as the status of the Keys to Soil Taxonomy, and future plans.

International Committees on Soil Classification

To discuss and solve major problems regarding specific aspects of Soil Taxonomy, nine International Committees on Soil Classification (Table 1) have been formed under the sponsorship of Soil Management Support Services (SMSS) and the Soil Conservation Service (SCS). Membership in these committees is open to all interested soil scientists worldwide, and the response from the international community has been excellent, with soil scientist from many countries participating and contributing their expertise. Most of the committee work is carried out through correspondence with the committee chairperson, who sends out a circular letter detailing the problems and suggested changes to all those who are interested in participating, and asking them to respond. After receiving and summarizing their comments and suggestions, he distributes another circular letter. To support the work of these committees, a series of nine International Soil Classification Workshops and six International Soil Correlation Meetings have been held. Most of these workshops and meetings took place outside the United States, but four of the last six were held in the USA.

The first committee to be established was the International Committee on Low Activity Clays (ICOMLAC). The recommendations of this committee were approved in 1986. The resulting classification changes were published as an amendment in National Soil Taxonomy Handbook (NSTH) Issue No. 8 and were incorporated in the revised 1987 edition of Keys to Soil Taxonomy. The main contribution of the committee was the introduction of the concept of the kandic horizon and the establishment of the kandi and kanhapl great groups to Ultisols and Alfisols (kandic horizons also occur in some Oxisols).

The International Committee on the Classification of Oxisols (ICOMOX) was the next committee to be established. Participants in this committee, as in the first, were predominantly soil scientists from outside the United States, although the second committee had slightly more US participation. ICOMOX recommended changes in all categories above the series. The definition of the oxic horizon was changed, and a separate key for mineralogy was added. Like the recommendations of ICOMLAC, the proposals made by ICOMOX were published as an amendment (NSTH Issue No. 11) and incorporated in the 1907 edition of Keys to Soil Taxonomy.

The International Committee on Soil Moisture Regimes Areas (ICOMMORT) was active in the late and early 19806, and in 1982, the chairman, A. van Wambeke, proposed the committee's recommendations. He proposed a set of subclasses to the current soil moisture classes. This proposal, however, has never been adopted, mainly because of our inability to develop a model for predicting soil moisture regimes that would be suitable for use in detailed soil surveys. J. Nichols (SCS, Fort Worth, Texas) and R. Paetzold (SCS, National Soil Survey Center, Lincoln, Nebraska) are currently working on this problem but their work is progressing very slowly. After an inactive period of several years, the committee is now being reactivated under the chairmanship of R. Paetzold, with its mandate expanded to include soil temperature. The committee's new name is International Committee on Soil Moisture and Temperature Regimes (ICOMMOTR).

The International Committee on Andisols (ICOMAND) was the third and latest committee to complete its mandate. Its final recommendations were submitted in 1988, and an amendment to Soil Taxonomy adding an 11th order to the classification system has been approved and is currently being printed as NSTH Issue No. 13. The 1989 edition of Keys to Soil Taxonomy includes this new order.

The International Committee on Aridisols (ICOMID) was established next. A great deal of work has been devoted to the problems of Aridisols. There were soil classification workshops in Syria, Sudan, and the southwestern USA, and an International Soil Correlation Meeting was held in August 1989 to study the cold arid soils of the USA. The committee chair, A. Osman, is summarizing the recommendations of this meeting and developing a final proposal regarding Aridisols. The proposal that has been tested was a major revision of the whole order. The overall results of all these efforts, however, have not been very satisfying It might be best to follow the UN Food and Agriculture Organization's lead and make the order inactive. The Ardisols could then be divided up between the Alfisols (Torralfs) and Inceptisols (Torrepts). There are already Torroxes, Torrands, Torriorthents etc., so this could be very conveniently done.

For the time being, however, it appears that the Aridisol order will be retained.

The International Committee on Vertisols (ICOMERT) has recently made good progress, and it is hoped that its recommendations will be submitted by the end of 1989. Part of the International Soil Correlation Meeting conducted in August 1989 was devoted to a study of cold Vertisols, and a proposed Vertisol key was tested. It seems that the main unresolved problem is how to identify the moisture regime and especially the degree of wetness.

The International Committee on Aquic Moisture Regime (ICOMAQ) has been very active since 1985, but major problems still exist. Circular Letter No. 9, containing new proposals, was distributed in June 1989. Some of the points under discussion was whether to use the term "aquic conditions" rather than "aquic moisture regime" and "redoximorphic features" rather than "mottling," and whether to define saturation in terms of zero or positive pressure rather than the presence of water in an unlined borehole. Other features of wet soils such as gleyic, stagnic, and antraquic features have tentatively been defined.

Another International Soil Correlation Meeting on wet soils is scheduled to be conducted in Louisiana and Texas in October 1990, and it is hoped that most of the remaining problems will be solved by then. One of our goals is to be able to set criteria which will allow a clear distinction between stagnic and gleyic soils, but the criteria tested so far have resulted in too much overlap.

For the International Committee on Spodosols (ICOMOD) a continuing problem has been the difficulty of formulating a better definition of the spodic horizon. Several sets of criteria are currently being tested, and it is hoped that one of them will proved satisfactory. One critically important goal of the committee is to draw a clearer distinction between Spodosols and Andisols.

The most recently established committee has been the International Committee on the Soil Family Category (ICOMFAM). This committee is just beginning its work. Major problems to be studied are how to define the family category, how to select and define family criteria, and whether to develop a new format. The family criteria should not be the same for all orders, so it would probably simplify application of the criteria if they were tailored to each individual order and listed in the same chapter as that order.

In concluding this review of the International Committees on Soil Classification, it must be noted that nearly all major changes that have so far been made in Soil Taxonomy have resulted from recommendations by these committees. Most of the International Committees are still active, and any contributions to their work that have been made, or will be made, by soil scientists from all over the world are very much appreciated. These committees are providing information that is vital for the development of Soil Taxonomy into a truly international system of soil classification.

Soil Taxonomy Committees

Within the United States, a Soil Taxonomy committee has been established by the Soil Science Society of America, and the National Cooperative Soil Survey of the SCS and its cooperators has established four Regional Soil Taxonomy Committees. Although most of the changes in Soil Taxonomy have resulted from proposals by the International Committees, the Soil Taxonomy committees established by the Soil Science Society of America and by the National Cooperative Soil Survey have been very helpful in reviewing proposals that originated in the United States. Most of these proposals have resulted in refinements of, or additions to, subgroup definitions.

Keys to Subgroups

As indicated earlier, the amendment to add the new order of Andisols to Soil Taxonomy has been approved. Also included in this amendment is a reformatted version of the keys to subgroups, which have now been put in the same format as the keys to orders, suborders, and great groups. Users of the 1987 edition of Keys to Soil Taxonomy have noticed that the keys to subgroups of Oxisols appeared in a different format than the keys to subgroups of other orders. The 1989 edition of Keys to Soil Taxonomy lists all the keys to subgroups in his new format.

In developing the new format, 146 subgroups were added to the list. These were implied subgroups which had not previously been named but were considered valid. About 40 implied subgroups were deleted and their properties combined either with those of a typic subgroup or, if that seemed more appropriate, with those of another subgroup. Most of these 40 implied subgroups seemed to be fragments of other subgroups rather than valid classes in themselves. In the new format, most of the criteria are stated in a positive form in contrast to the negative statements that predominated in the old keys to subgroups.

The new Keys to Subgroups have met with some criticism, but the review responses received so far have been at least twenty to one in favor of the new format. Most critics seem to feel that this format closes the system, but that is not the case. If it is shown and documented that a new subgroup ought to be added or an existing one renamed, this can be done. The new format of the subgroup keys does not close the system any more than use of that same format has closed it at the higher categories, where a new order has just been added.

Keys to Soil Taxonomy

Since 1983 the Keys to Soil Taxonomy have been updated regularly and a new edition printed every two years. The revised 1989 edition, which was published by the Virginia Polytechnic Institute and State University at Blacksburg, Virginia, was distributed early this year. It is about one third thicker than previous editions, mainly because the new order of Andisols has been added and because the subgroup keys have been reformatted, which should make them easier to use. Minor editorial corrections have been made to clarify some ambiguous statements.

Future Plans

Soil Taxonomy was never properly edited, which resulted in an unacceptably high incidence of imprecise wordings in its definitions. In the 1989 revised edition of Keys to Soil Taxonomy, some of these ambiguous statements have been clarified. A revision of Keys to Soil Taxonomy by an editor is planned before the 1991 edition is printed, but all of Soil Taxonomy will probably not be edited thoroughly until a new edition is prepared for publication, which will probably take until 1995.

There are no plans to republish Soil Taxonomy until most of the current International Committees have submitted their recommendations and amendments have been prepared. In the meantime, a revision of each of the diagnostic surface and subsurface horizons is planned, and any suggestions for improving their definitions will be appreciated. Among the changes under consideration is a possible redefinition of cambic horizons to allow for a sandy particle-size class and for an inclusion of horizons that are normally considered transitional to argillic or spodic horizons. Also being considered is an expansion of the concept of the argillic horizon to include the criteria for the kandic horizon, which would make a separate kandic horizon unnecessary.

Table 1. International Committee5 on Soil Classification

NAME	YEAR ESTABLISHED	CHAIR
International Committee on Low Activity Clays (ICOMLAC)	1976	F. R. Moormann (Netherlands)
International Committee on Oxisols (ICOMOX)	1978	H. Eswaran (Belgium)
	(since 1980)	S. W. Buol (USA)
International Committee on Soil Moisture Regimes of Tropical Areas (ICOMMORT)	1978	A. van Wambeke (USA)
Renamed: International Committee on Soil Moisture and Temperature Regimes (ICOMMOTR)	(since 1989)	R. Paetzold (USA)
International Committee on Andisols (ICOMAND)	1980	M. Leamy (New Zealand)
International Committee on Aridisols (ICOMID)	1980	A. Osman (Syria)
International Committee on Vertisols (ICOMERT)	1981	J. Comer-ma (Venezuela)
International Committee on Aquic Soil Moisture Regime (ICOMAQ)	1982	F. Hoonnann (Netherlands)
	(since 1985)	J. Bouma (Netherlands)
International Committee on Spodosols (ICOMOD)	1982	T. Miller (USA)
	1986	R. Rourke (USA)
International committee on the Soil Family Category (ICOMFAM)	1987	B. Hajek (USA)

GLOBAL POSITIONING SYSTEMS [1]

G.P.S. What is it?

G.P.S. is a 10 billion dollar U.S. Government operated system of satellites orbiting the earth at an altitude of 12,600 miles. When completed the system will include 24 satellites with 21 active along with 3 spares. The purpose of the system is to provide positioning or navigation information to users with a G.P.S. receiver. The G.P.S. receiver is capable of computing and displaying a Geodetic coordinate, which is latitude, longitude and height above the ellipsoid.

The current status of the system is there are 13 healthy satellites orbiting the earth in polar orbits approximately twice each day. Six of these 13 satellites are Block I satellites and two of these are over 10 years old. Seven of the thirteen satellites are the newer Block II satellites and on March 25, 1990, the Department of Defense degraded the signals of these satellites by initiating selective availability (SA). This limits the real time positioning accuracy of a single autonomous, non U.S. military C.P.S. receiver to 100 meters or worse. For civilian users who require greater accuracies than 100 meters, this can be easily achieved by using two or more receivers and placing one over a geodetic point such as a N.G.S. first order control station and the other over unknown points. This process is called differential correction and requires that the data from both receivers be post processed in a pc to come up with the vector information from our known point to the unknown point. The accuracies attained here can range from 1 to 5 meters, 1 to 10 centimeters, or even sub-centimeters depending on the type of C.P.S. equipment used and the length of time spent measuring the line.

The current limitations of the system include having approximately only 12 hours per day of 3 dimensional availability, which means 4 or more satellites in view above 10° above the horizon. There are approximately 18 hours per day of 2 dimensional satellite coverage which means 3 satellites or more in view above 10°. New satellites are being launched by Delta II rockets at the rate of one every two months and this will continue to lengthen the periods of time available for G.P.S. positioning, navigating, or surveying.

What are some of the Applications?

A. Positioning = Real time position fixes of latitude, longitude, and altitude or height above WGS 84 Ellipsoid. Positioning is used in Geographic Information Systems (GIS) Land Information Systems (LIS). Trimbles pathfinder system allows the geographic information to be converted to over 25 GIS software applications, including: ARC/INFO, Auto Cad, EPPL7, Erdas, GRASS, INTEKCRAPH, MOSS, pMAP, and TerraSoft.

B. Navigation, with Real time display of speed and heading applicable on land, at sea or in the air in planes or helicopters.

C. Surveying: Between 2 points, accuracies of 1 centimeter plus 1 to 2 parts per million and azimuths to 1 or 2 arc seconds.

[1]Paper presented by Tom Seiler, Marketing Manager. Seiler Instruments & Mfg. Co. Inc. St. Louis, Missouri

G.P.S. How does it work?

The G.P.S. system works with the satellites, each broadcasting radio signals including a dual frequency course acquisition code and two ranging codes including the civilian CIA code and the military P code. They also broadcast a satellite message which includes the satellite's ephemeris data which is the prediction of where the satellite is at a point in time in space. If a G.P.S. receiver is tracking 4 or more satellites, the receiver will compute 3 dimensional fixes of latitude, longitude, and altitude each second. These positions are determined by the receiver performing a large resection using the distances or ranges to each satellite being tracked in the sky. Some of the factors affecting the accuracy of the CPS system are the effects of Ionispheric interference, Atmospheric interference, Selective Availability, or multipath.

What are the Costs and Benefits?

The costs have been decreasing dramatically and today a commercial autonomous receiver, such as the Trimble Transpack, costs less than $4,000.00. The Pathfinder system including receiver, antenae, polycorder, batteries and software is less than $15,000.00 each and the surveyor models 4000 sts are down to $27,000.00 each. These various G.P.S. units are also available on lease or rent. To operate the many G.P.S. software programs, an IBM or compatable computer is required. It also requires 2 or more G.P.S. receivers to do differential or relative post processing and thereby achieve accuracies in the sub meter, or centimeter level.

The benefits of G.P.S. include the rapid acquisition of the 3 dimensional location of Geographic Information. The data is derived from a common reference system (WGS 84 reference ellipsoid). The data can be easily transformed into other coordinate or software systems. Site infervisibility is not required, only a mostly clear view of the sky required. Distances and directions can be easily computed and displayed. New geographic features can be digitized with G.P.S. and the base maps updated. G.P.S. is used to set up control networks to manage large resource areas or projects. G.P.S. can be used to periodically take core samples from the same location given only the known xy coordinates desired. G.P.S., in 1993, will become a 24 hour per day, all-weather utility for transportation, surveying, resource management and many other uses.

NORTHCENTRAL SOIL SURVEYCONFRRENCE

AMES, IOWA

JUNE4-7, 1990

FIELDTRIP

A field trip with stops in the Greenfield Quadrangle and on the border area of the Des Moines Lobe was held on Wednesday, June 6. A field guide was prepared by Tom Fenton. Soil-landscape relationships were discussed and demonstrated. Three soil pits were examined and discussed in detail. The pits were dug in the following soils:

Sharpsburg silty clay loam-Fine, montmorillonitic, mesic Typic Argiudoll
Nira silty clay loam-Fine-silty, mixed, mesic Typic Hapludoll
Clarinda silty clay loam-Fine, montmorillonitic, mesic, sloping Typic Argiaquoll

Presentations were made by the following soil scientists:

Louis Boeckman
Tony Dohmen
W. R. Effland
T. E Fenton
Jim Gertsma
Faruque Khan
Dale Lockridge
G. A. Miller
Doug Oelmann
M. L Thompson & K. Woida

We were joined for lunch at Lake Greenfield by the Adair County Extension Director, Russell Bredahl and the SCS District Conservationist, Marvin Lundstedt. After lunch, these two gentlemen told us about life and agriculture in Adair County.

In the afternoon, just north of Springbrook Park in Guthrie County, we examine road cuts and landscapes in the boundary area between the Wisconsin loess-mantled landscape and the Cary Till of the Des Moines Lobe. The environmental framework for soil and landscape development was discussed.

North-Central Region Soil Survey Work Planning Conference, June 4-7, 1990

MICROMORPHOLOGY OF A BURIED YARMOUTH-SANGAMON PALEOSOL NEAR EARLHAM, IOWA

Kathleen Woida
Department of Geology. University of Iowa. Iowa City, Iowa 52242
Michael L. Thompson
Agronomy Department. Iowa State University. Ames. Iowa 50011

Introduction

Yarmouth-Sangamon paleosols are the most extensive of the pre-Wisconsinan paleosols in Iowa (Ruhe. 1969). Where not removed by erosion. they occur throughout the state immediately below Wisconsinan loess or till. In southern Iowa. Yarmouth-Sangamon paleosols are best preserved on broad upland divides below 2 to 5 m of Wisconsinan loess. They overlie and typically grade into a Pre-Illinoian till. Some Yarmouth-Sangamon paleosols appear to be developed in the latest Pre-Illinoian till in Iowa. the Hickory Hills Till Member of the Wolf Creek Formation, but tills underlying most Yarmouth-Sangamon paleosols in southern Iowa have not yet been correlated.

Yarmouth-Sangamon paleosols are classically interpreted to have developed during the Yarmouthian interglacial, the Illinoian glacial, and the Sangamonian interglacial stages of the Pleistocene in Iowa. It is estimated that the Hickory Hills Till Member was deposited about 500,000 years ago, and the earliest Wisconsinan loess in Iowa is dated at about 30,000 years before present (Hallberg, 1980). Therefore, the Yarmouth-Sangamon paleosols in southern Iowa that developed in till may have been at the land surface throughout the Yarmouthian interglacial, the Illinoian glacial. the Sangamonian interglacial. and much of the Wisconsinan glacial stages of the Pleistocene.

Yarmouth-Sangamon paleosols have unique morphological properties. Where not exhumed on sideslopes, they typically consist of 1 to 6 m of unconsolidated material, are either gray or strongly mottled with red or reddish-purple colors. and contain 45 to 60 percent clay (<2 µm). The clay fraction is dominated by smectite, although clay mica and kaolinite may occur in lesser quantites. Textures gradually become coarser with depth. as the solum grades into till or glaciofulvial deposits. Soil structure in Yarmouth-Sangamon B horizons is usually strong. fine. subangular blocky or angular blocky. Coatings of clay occur on the faces of soil aggregates, but it is often not clear whether they are produced (1) by clay deposition, (2) by swelling pressures, (3) by the pressure of overriding ice (i.e., where the paleosol has been covered by till). or (4) by a combination of these processes (Thompson, 1986).

Soil micromorphology is the study of undisturbed soil materials. usually by describing thin sections (30 µm thick) with a petrographic microscope. Because undisturbed materials are investigated. the morphological characteristics of pedological features too small to be studied in hand specimen, as well as their spatial relationships, can be documented and compared. Such pedological features include porosity patterns, organic residues. faunal excrement and passage features. clay fabric, clay coatings, and secondary minerals.

Relatively few paleosols have been studied in detail by micromorphological methods, yet the approach promises to provide significant information concerning the nature and sequence of pedogenic and diagenic events in paleosols (Thompson and Smeck, 1983). The morphology of pedological features is closely related to their genesis. and their genesis depends on the soil environment during pedogenesis. Therefore, interpretations of paleoenvironment (e.g.. humid vs. arid climate, well-drained vs. poorly drained landscape position, vegetation and soil faunal activity) and diagenesis must be based on careful and detailed micromorphological descriptions of the paleosols and on rigorous comparison with macromorphological and field-scale studies.

Setting

In an abandoned limestone quarry near Earlham, Iowa, a laterally extensive exposure of the Yarmouth-Sangamon surface has been investigated (Fig. 1). The site is just south of the southern limit of Wisconsinan glaciation in Iowa, and is located in Madison County. Here the Yarmouth-Sangamon paleosol is underlain by Pre-Illinoian glacial drift and mantled by Peoria Loess. Several representative profiles have been sampled, either in the cut or in cores. We have completed macromorphological descriptions, as well as determinations of particle-size distribution, organic C content, and $CaCO_3$ content. Micromorphological investigations are currently in progress, as are studies of clay mineralogy. Thin sections have been prepared from air-dried. undisturbed samples, and they have been described according to Bullock et al. (1985). In this extended abstract and the field discussion we emphasize our preliminary results concerning pedon 5 at the south end of the quarry.

Results

Figure 2 shows the horizon nomenclature that was assigned in the field description of the Yarmouth-Sangamon paleosol. In color and particle size distribution, this soil was similar to many Yarmouth-Sangamon paleosols in southern. Iowa. Clay content was near or greater than 50 percent in much of the 3Btb horizon. Soil structure was fine and very tine blocky throughout the paleosol. Clay coatings were noted on ped surfaces throughout the Yarmouth-Sangamon paleosol, although their mode of formation could not be determined in the field.

Micromorphological observations suggested alternative interpretations of some of the horizons. We found evidence of an A horizon both at the top of the Yarmouth-Sangamon paleosol and in a lower horizon, just below the 3Btb horizon. The evidence consisted of granular peds, channels, and abundant packing porosity observed in thin sections from these zones. In the B horizon of the Yarmouth-Sangamon paleosol we found dominantly planar porosity and both clay coatings and slickensides. The micromorphological observations have suggested an alternative horizon nomenclature, as indicated in Fig. 3. Thus what appears to be a thick, uniform pedon may really be a compound soil representing at least two periods of soil formation.

References

Bullock, P., N. Fedoroff. A. Jongerius, G. Stoops, and T. Tursina. 1985. Handbook for soil thin section description. Waine Research Publ., Albrighton, U.K.

Hallberg, G.R. 1986. Pre-Wisconsinan glacial stratigraphy of the central plains region in Iowa, Nebraska, Kansas, and Missouri. Quat. Sci. Rev. 5:11-15.

Ruhe. R.V. 1969. Quatemary landscapes in Iowa. Iowa State University Press, Ames.

Thompson, M.L. 1986. Morphology and mineralogy of a pre-Wisconsinan paleosol in Iowa. Soil Sci. Soc. Am. J. 50:981-987.

Thompson, M.L. and N.E. Smeck. 1983. Micromorphology of polygenetic soils in the Teays River Valley. Ohio. Soil Sci. Soc. Am. J. 47:734-742.

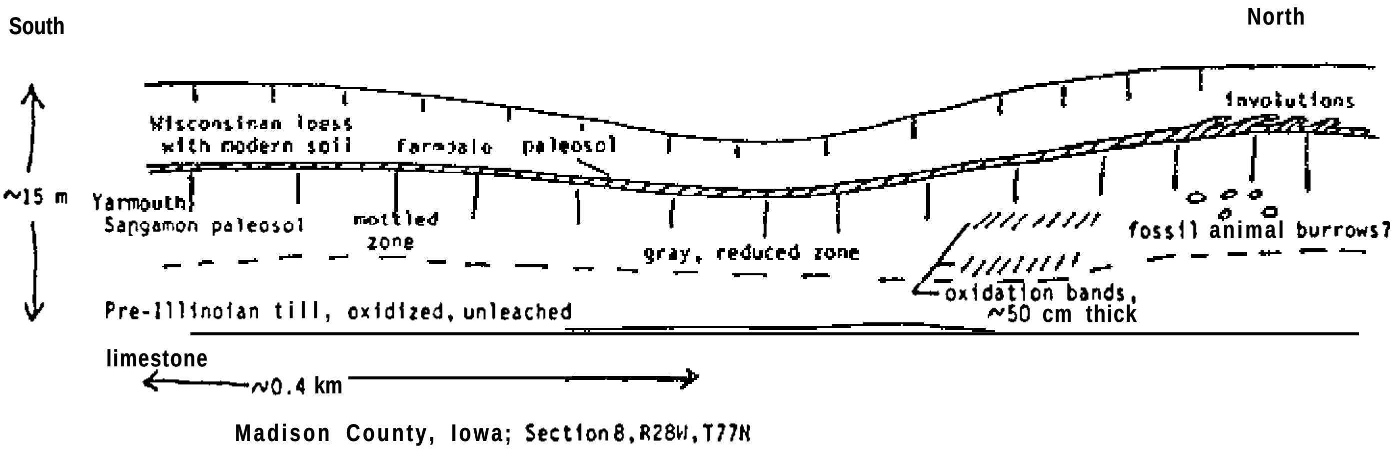


Fig. 1. Schematic diagram of the exposure of Yarmouth-S...

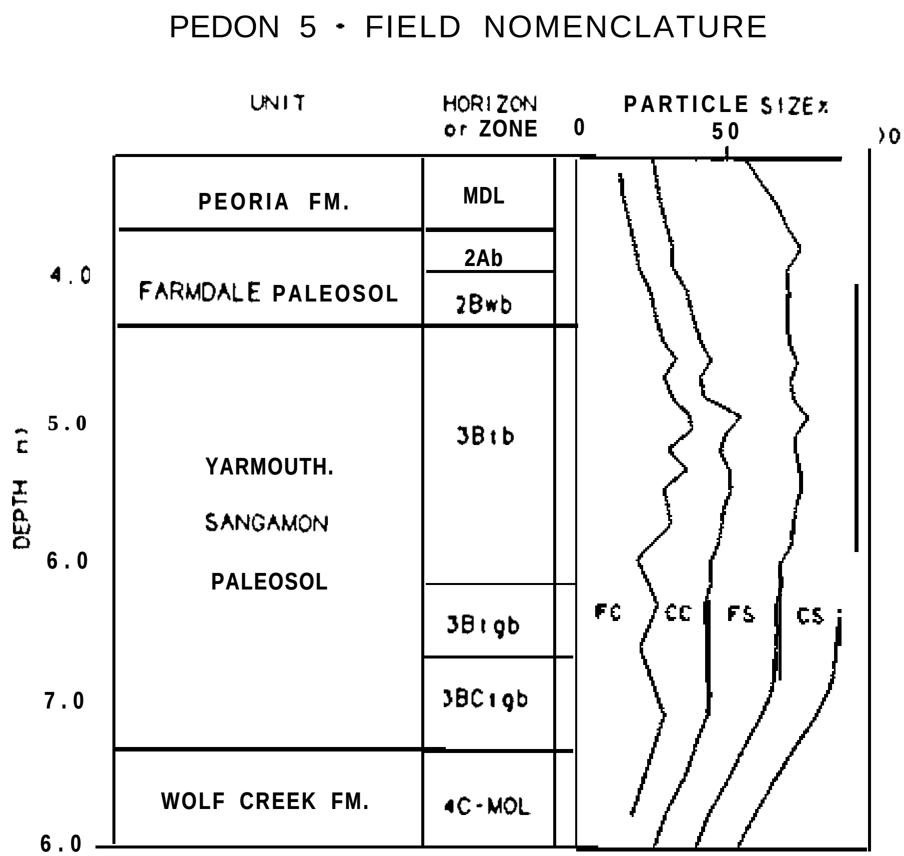


FIG. 2

PEDON 5 - MODIFIED NOMENCLATURE

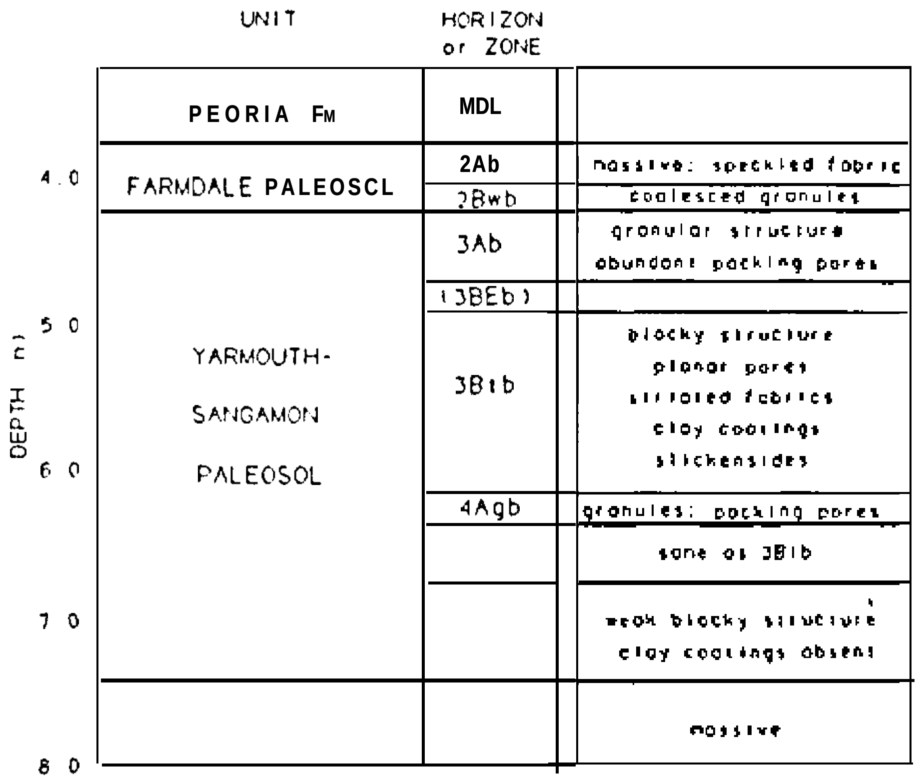


FIG. 3

NORTH CENTRAL SOIL SURVEY CONFERENCE

June 4 - 8, 1990

Ames, Iowa

Committee 1 Report
Soil Survey in the 1990's

Chairman - Sylvester Ekart, ND

Vice Chairman - Neil Smeck, OH

Charge I. What guidelines and procedures are used in the region to determine the need for updating? Are the guidelines adequate? Should the National Soil Handbook contain the minimum requirements for updating? Should updates be multi-county or by MLRA? If the answer to the previous question is yes, should a common legend be used?

SUMMARY OF COMMENTS ON CHARGE I.

Question 1 - What guidelines and procedures are used in the region to determine the need for updating? The responses were divided into three categories:

a. no guidelines - 2

b. national guidelines - 3

c. state guidelines - 5

It is apparent that most states are currently using their own evaluation tools to determine the need for updating older soil surveys.

Question 2 - Are the guidelines adequate?

a. no - 3

b. yes - 4

c. don't know - 2

The responses indicate that most states are satisfied that guidelines currently in use are adequate but there was concern expressed that decisions, to date, regarding updating soil surveys have been easy as most decisions involved pre-1965 published soil surveys. In the future, decisions will become more difficult as more modern surveys are considered. Thus, there may be a need for more consistent guidelines and a more definitive national policy in the future.

Question 3 - Should the National Soil Handbook contain the standard requirements for updating?

a. yes - 6

b. no - 4

There was no clear consensus on this question. The discussion was split between members:

1) satisfied with present requirements in the National Soil Handbook because the guidelines are general enough to allow flexibility in the development of priorities, policies, and tools for evaluating old surveys and plans for conducting updates.

2) favoring more detail in the national guidelines, but not necessarily at the expense of flexibility. It was suggested that the National Soil Handbook contain minimum guidelines for such items as: a) work plan, b) staffing plan, c) base map plan. and d) a plan for conducting the survey.

Question 4 - Should updates be multi-county or by MLRA?

a. yes - 11

b. no - 1

The Committee was overwhelming in favor of adopting plans for updating surveys on the basis of a plan for broader geographic regions than standard survey areas. There was a decisive opinion expressed that updates should be approached in the context of plans for areas based on natural rather than political boundaries. To emphasis this need, the Committee proposed and passed the following recommendation:

RECOMMENDATION: Updates be undertaken in the context of a plan for MLRA's or other broad geographic areas.

Several points that evolved during the discussion of this recommendation need to be stated for purposes of clarification:

1) The recommendation does not imply that the survey area is the MLRA or other broad geographic area. Only that updates of survey areas be undertaken within the context of a plan for the MLRA or other broad geographic area. Current survey areas would be maintained.

2) The recommendation does not imply that all survey areas within the MLRA be updated immediately. But as updates are conducted based on local needs and support, the update be conducted following a plan or scheme developed for the MLRA or broad geographic area.

3) The recommendation does imply that survey plans. legends, and priorities for updating survey areas within an MLRA or broad geographic area be developed as soon as practical. In many cases, multiple states will be involved in such planning efforts.

4) The recommendation does **not** imply that no changes in plans for an MLRA or broad geographic area can be accommodated in the future as new information becomes available. But it is anticipated that changes with this approach will be minimized.

Question 5 - Should a common legend be used?

a. yes - 7

b. no - 1

c. in-part - 4

During the discussion, the Committee proposed and adopted the following recommendation:

RECOMMENDATION: A common legend with an appropriate scale be developed for MLRA's or other broad geographic areas.

Charge 2. Does "updating" actually describe what is taking place, i.e. do we have complete resurveys in many counties?

a. Remapping
b. Recorrelation
c. Interpretations
d. Base map update
e. Time required for update

The responses suggest that "updating" does describe what is going on. if one uses "updating" as an umbrella term. One respondent suggested the word "modernization" is preferred to "updating"; another respondent suggested "updating" should be an umbrella term.

Do we have complete resurveys in many counties?

a. all - 0

b. some - 8

In describing what was taking place or what is needed, the responses were:

a. remapping - 8

b. recorrelation - 10

c. interpretations - 11

d. new base map
1. possibly - 2
2. always - 4

e. time required for update
1. 1 to 2 years - 0
2. 2 to 3 years - 1
3. 3 to 4 years - 1
4. more than 5 years - 0

The responses indicated that there are a lot of activities going on under the umbrella of “updating”, a few surveys are being remapped. but in general each survey area seems to be unique in its needs.

Charge 3. What format should the survey of the future have (text, electronic, or combination)?

SUMMARY

S

In regard to the latter, the Committee proposed and adopted the following recommendation:

RECOMMENDATION: Resources be allocated to expedite the development of a basic soil data base.

Charge . How much soil scientist time is planned in the region for training, basic soil services, etc. vs. time for updating soil surveys (field mapping, manuscript. transects, etc.)?

Although there is considerable variation among states because of differences in priorities and needs, the responses indicate that from 20 to 60% soil scientist time is devoted to training and basic soil services and from 20 to 80% is devoted to updating soil surveys.

Committee Future

Because many of the charges considered by the Committee were oriented toward information gathering rather than action and decision, the Committee adopted the following recommendation:

RECOMMENDATION: Committee 1 be continued but with the assignment of more specific policy and procedure charges by the steering committee.

Respectively Submitted:

Neil E. Smeck
Vice-Chairman

REPORT
COMMITTEE 2 - GEOGRAPHIC INFORMATION SYSTEMS
NORTH CENTRAL REGION SOIL SURVEY WORK PLANNING CONFERENCE

ATTENDANCE

D.D. Patterson	Tim Gerber
Bobby Ward	Jon Gerken
Al Giencke	Lee Sikes
Jim Thiele	Bob Parkinson*
Douglas Oelman	Tom D'Avello*
Jerome Schaar	Sam Indorante
Stephen Shetron	David Hammer*
Bill Frederick	Norman Helzer*
Dennis Robinson	Dale Lockridge*
Bill Hosteter	Dennis Lytle
Bob Darmody	Roger Greenough
Kevin McSweeney	Patrick Merchant*
Mickey Ransom	Bruce Thompson*
Tony Dohmen	Mark Kuzila*

*Committee Member

The use of digitized soil survey information in GIS is increasing. In many instances, those who manipulate soils data do not know much about soils or how soil maps are made. Before we release data to non-soil scientist users, we should train them in the proper use of the data and inform them about how the data was collected and how soil maps are made.

CHARGE 1. What kinds of systems are in use or are planned in the region (list by state)?

Throughout the region many systems are in use by local, state and federal agencies. Below is information on systems used in each state.

ILLINOIS

SCS is using GRASS on an AT&T 6300 with ALTEK digitizer, Hewlett Packard Draftmaster plotter, and Tektronix 4696 ink jet printer. Version 3.0 is in hand but not installed on AT&T 6386.

Installation of GRASS planned for two field offices during 1990.

State agency GIS include: Natural History Survey, Geological Survey, Water Survey, State Museum and Division of Energy and Environmental Affairs. ARC INFO on PRIME minicomputers support approximately 300 users.

CERL (Army Corp of Engineers), developers of GRASS are in Champaign, Illinois and support design and development.

Lake County, Illinois using Intergraph for county wide GIS operations.

University of Illinois: GIS laboratory in the Geography Department using GRASS on SUN work stations for instructions and research.

INDIANA

UNIVERSITIES: The university GIS Alliance includes appointed representatives of the 5 state funded universities in cluding Ball State University, Indiana State University, Indiana University, Indiana-Purdue University at Indianapolis and Purdue University.

Systems include ARC/INFO,ERDAS,IMAGIS(SYNERCOM), GRASS, SPANS, EPPL7, McDonnel Douglas GDS, ELAS, Intergraph, HLIPS, LARSYS, and SLAMM.

STATE AGENCIES: The Indiana Department of Natural Resources is using ARC/INFO. The State Highway Department, State Police, Department of Environmental Management and the Board of Health arein theprocess of acquiring systems.

FEDERAL AGENCIES:

SCS: The SCS has contracted with the Corp of Engeineers to enhance their GRASS program for use within SCS. SCS in Indiana is approximately three (3) years away from implementation of GRASS in field offices. GRASS will be used on the AT&T 6386 or the Tandy 4000 microcomputer. GRASS files can be converted to run on ARC/INFO.

Forest Service: The Forest Service has a large RFP for complete GIS software and hardware, including the possible replacement of existing office automation equipment. They have an agrement with SCS to digitize soil maps and with the USGS to digitize existing 7.5 minute (1:24,000) maps within the National Forest Boundaries. The Forest Service is commited to using GIS.

US Geologic Survey, Water Resources Division: This agency is not involved at this time. They are waiting for a contract approval for procurement of hardware that will, among other things, run ARC/INFO software. There are presently seven (7) pilot project underway for water quality. Groundwater information will be entered into a GIS system. They hope to use GIS as a tool to present information. they are presently working with the highway Department regarding bridges over waterways, etc.

Farmers Home Administration: Are not presently using GIS. They would benefit from It. The communities and engineers could use GIS systems for rural development activities (i.e. information on water table, soils, etc.) Also, could be used for inventory of property.

ASCS: Not using GIS at the present time. They rely on SCS for technical information. They would use photography for keeping track of ownership. ASCS uses IBM hardware and software written by their own programmers.

US Fish and Wildlife Service: Presently they are working with the Division of Fish and Wildlife, Indiana DNR on mapping wetlands. Ten (10) counties are digitized and entered into the GIS. They are using Mississippi as a source of information on GIS.

National Park Service: They are in the process of digitizing all national parks in Indiana.

IOWA

SCS state office is using GRASS on AT&T 6386E computer with an ALTEK digitizer, HP Draftmaster II Plotter and Textronix 4696 color ihk jet printer.

Iowa SCS is a test site for LTPlus digitizing software. We are in the process of doing some quarter Quads at 1:12,00 scale. It is working very well. We hope to develop and interface with the camera scanner at ISU. Also a system using LTPlus software to join the section data done at ISU is under development with assistance of NCC at Fort Worth.

The land use analysis lab at ISU has 25 Zenith PC's being used to digitize county soil surveys completed since 1960. Also a Datacopy Scanning Camera is used to capture the section data and the Minnesota sofware does the processing and attributing of the maps.

DNR is using a pc ARC/INFO system for digitizing state parks and other similar data capture.

DOT is using intergraph for digitizing all roads and 950 towns in Iowa

US Geological Survey Bureau is using pc ARC/INFO and EPPL7 in GIS development work for DNR and SCS.

Polk County (city of Des Moines) is in the process of acquiring a GIS System.

OHIO

Additional GRASS workstations will be set up as hardware and databases are acquired, and as CAMPS software is implemented in Ohio field offices.

Hardware is primarily AT&T 6386.

Ohio SCS has cooperative ventures with Ohio Department of Natural Resources - Division of Soil and Water Conservation for development of digital soils databases meeting SSURGO criteria. The ODNR-DSWC has pc ARC INFO and probably will be upgrading to ARC INFO in 1990.

ODNR-DSWC existing databases (in raster format) will be tested for interim field office use in the future, it is anticipated.

SOUTH DAKOTA

Hardware: 6386E WGS computer with 4 MB RAM and 135 MB hard drive and 5.25", 3.5", and streaming tape drives.
80387-20 math coprocessor
NEC 14" color monitor
Tektronix 4696 Ink Jet Plotter
HP - 7475A pen plotter
Altek Digitizing Board

Software: GRASS 3.0

WISCONSIN

ARC/INFO - currently being used in state office for digitizing of soils. Also was used in Dane County in connection with a county developed information program. Has also been installed in a RC&D office for use by SCS and the Council for developing a cooperative resource information system.

GRASS - installed on the state office 3B2 system; on a 3B2 system located in the above RC&D office; and on a county developed information system. Wisconsin (SCS) has not yet developed a long range GIS plan, for further distribution of the software.

Funding has limited the expansion of the use and development of the states GIS system.

CHARGE 2. What is the status of soil digitizing in the region (list by state)?

Most states in the region have an ongoing soil digitization program. Below is information on the status of soil digitization throughout the region. Discussion of this charge during the meeting focused on the fact that anyone can digitize soil surveys but that soil survey cooperators must be involved in quality control and that the maps must be on a controlled base. Soils will generally be a part of a GIS that involves natural resources or the environment but many GIS do not have soils as a data layer.

ILLINOIS

One county has digitized soil maps from orthophotographic base.

About 12 other counties are in process of digitizing, using distorted imagery as a base. At least as many are exploring digitizing.

Private vendors are doing most of the digitizing.

Digital data is seen as an efficient way to manage soil-tract information for State mandated tax assessment based on soil productivity. Maintenance of standards is up to each county, and many have no interest in multiple use of digital layers. A challenge of the SCS is to sell the standards and specifications for digitizing as the desired level of quality for digital soil maps.

INDIANA

The soil surveys will be digitized by the counties but will need to establish accuracy since surveys were mapped on uncontrolled aerial photography. Members of the Indiana Cooperative Soil Survey are evaluating the redrafting of county soil surveys on topographic maps on on controlled photography. stata and local entities will need to help financially support surveys that require more detailed information beyond what SCS can provide. SCS can provide a priority list of counties that will be digitized.

There is no soil digitizing occurring at this time. SCS is working with Marion County on a pilot project which includes digitizing soils information.

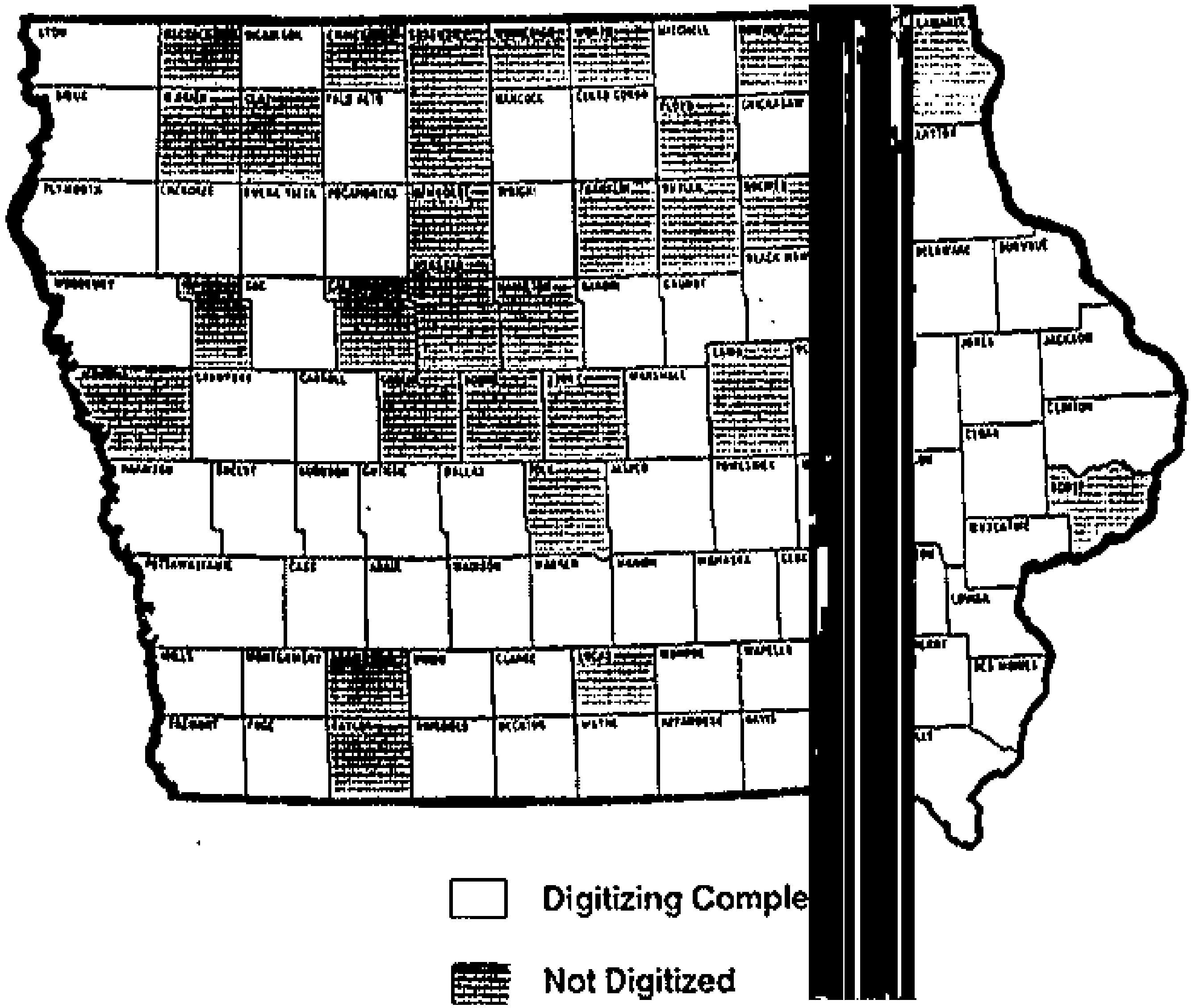
IOWA

A statewide soil digitization program is underway. See Figure 1.

KANSAS

-- the STATSGO maps are nearly done, due by 3-l-90.
-- We currently have 3 counties that we would consider complete, with all or parts of 5 others in progress. We have plans to start 4 or 5 more this FY. These are all being done in the line segment mode, georeferenced to the

Status of Digitization in Iowa



F GURE 1

7.5 min. quads, which will be readable with GRASS and ARC/INFO.
-- Six other counties were done using the MIADS grid-cell method several years ago; readable with GRASS.
-- Several other counties were done by the counties themselves using various other systems; these were not georeferenced prior to digitizing.

MINNESOTA

See Figure 2.

Digitized detailed soil surveys are in the SSIS format. Since soil surveys do not have an orthophotobase, SSIS digitized maps are not georeferenced.

Software is being developed to georeference to state coordinates SSIS data.

MISSOURI

St. Louis County, St. Charles County, Clinton County and Buchanan County soil surveys have been digitized using contracts through the NHQ. As part of the accleration of the Missouri soil survey program, the Department of Natural Resources (DNR) has purchased an Intergraph digitizing package. They have digitized 7 counties but the data is not in a usable format for GRASS. It does appear to be usable for ARC-INFO. SCS is currently working with DNR to make the information available in DLG-optional 3 format so it can be used with the GRASS GIS.

NEBRASKA

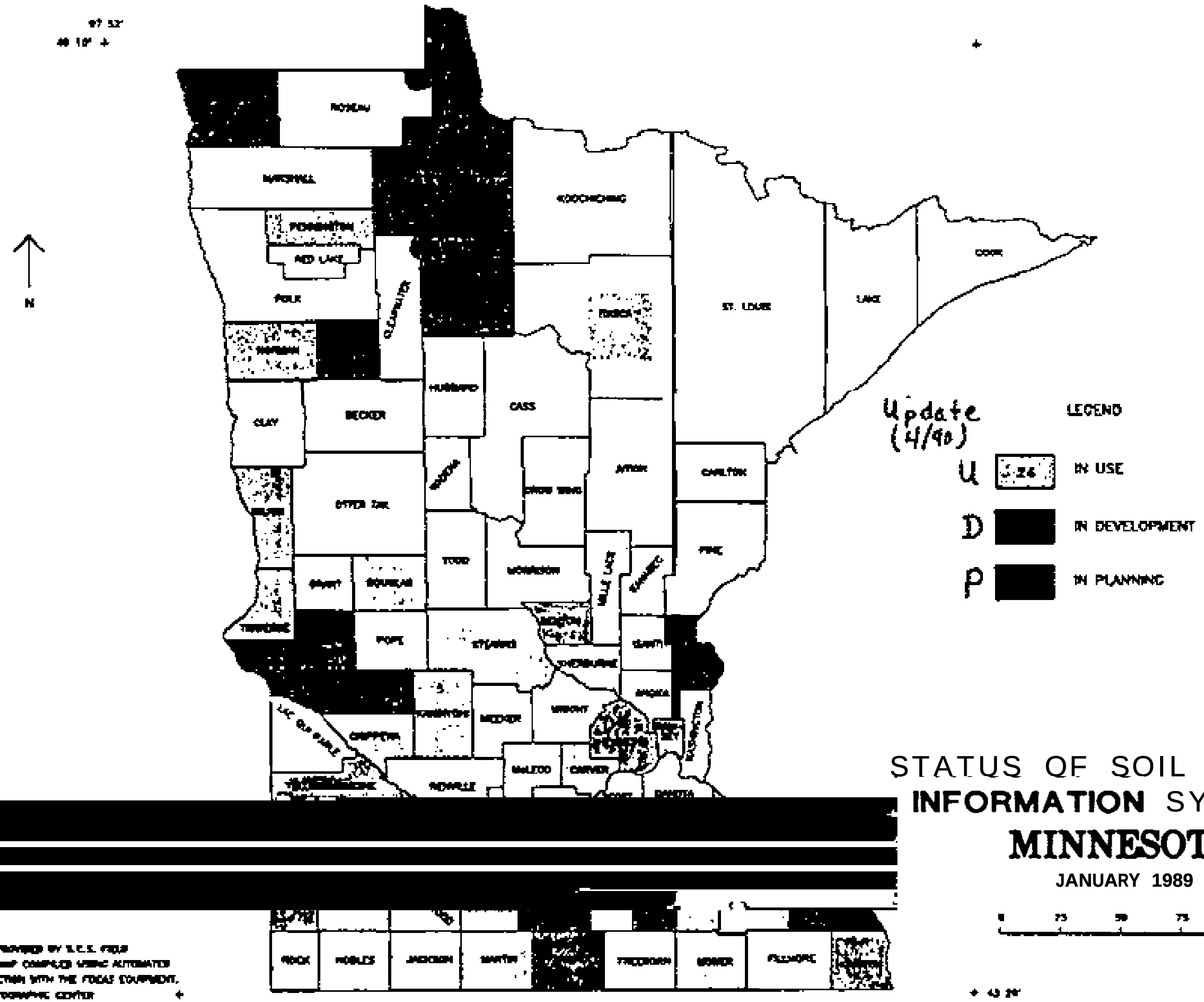
Nebraska Natural Resources Commission is digitizing published soil surveys they started using cell data but are now starting to scan (Figure 3). Dundy County, Nebraska (updated survey) is being scanned in the soil survey office as maps are completed.

NORTH DAKOTA

North Dakota has one county digitized that meets map standards. Plans are in place to establish cooperative digitizing centers with the State Soil Conservation Committee and North Dakota State University. These centers should be operational by early 1991. They will concentrate on digitizing soil surveys.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



STATUS OF SOIL SURVEY INFORMATION SYSTEMS

MINNESOTA

JANUARY 1989

SOURCE:
INFORMATION PROVIDED BY S.C.S. FIELD PERSONNEL. MAP COMPILED USING AUTOMATED MAP CONSTRUCTION WITH THE FOCAS EQUIPMENT, NATIONAL CARTOGRAPHIC CENTER FORT WORTH, TEXAS 1989.

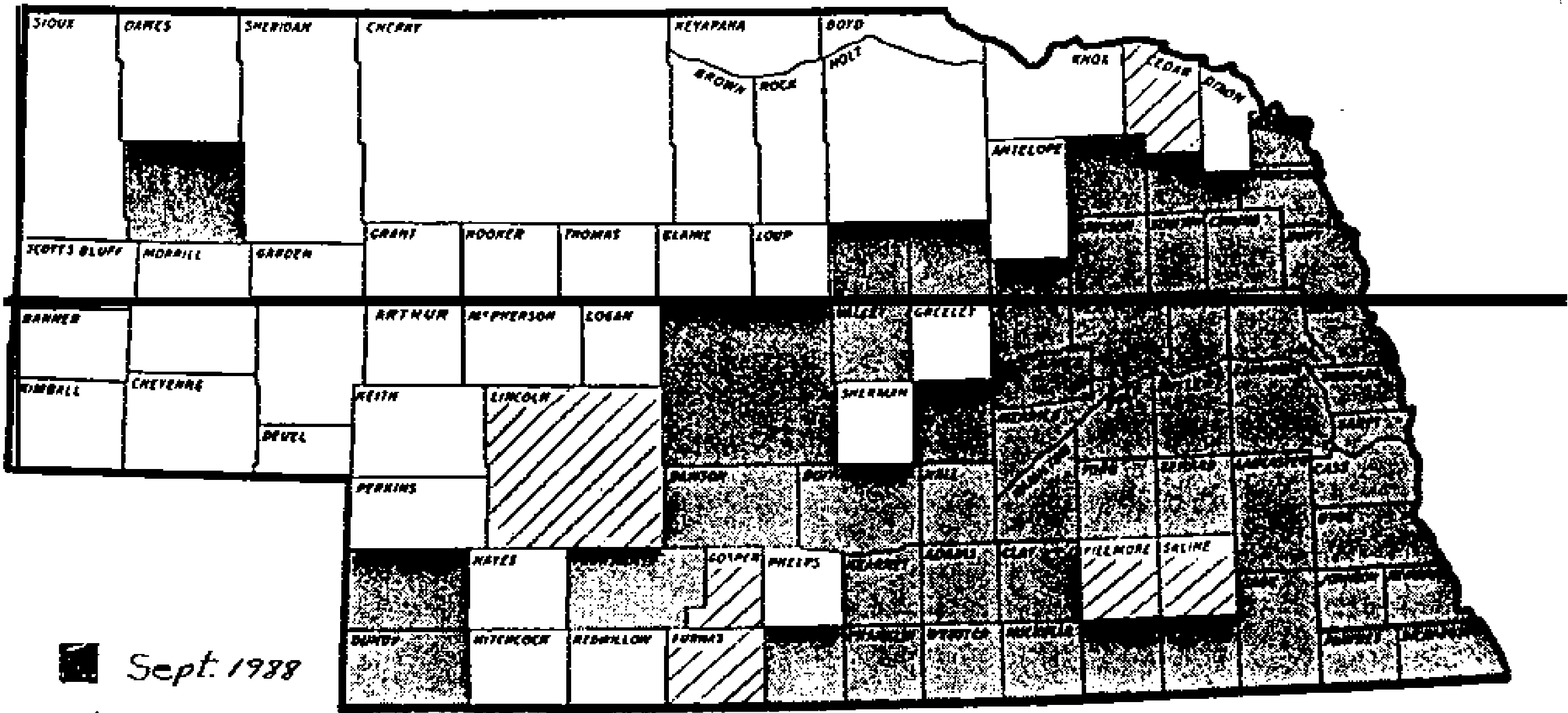
REVISED FEBRUARY 1989

108

110

Soil Surveys Processed

RASKA NATURAL RESOURCES COMMISSION
DATA BANK



Sept. 1988

Sept 1989 Update

Soil Surveys Processed

Adams	Custer	Hamilton	Nuckolls	Stanton
Boone	Dakota	Harlan	Otoe	Thayer
Box Butte	Dawson	Howard	Pawnee	Thurston
Buffalo	Dodge	Jefferson	Phelps	Valley
Butler	Douglas	Johnson	Pierce	Washington
Burt	Dundy	Kearney	Platte	Wayne
Cass	Franklin	Lancaster	Polk	Webster
Chase	Frontier	Madison	Richardson	Wheeler
Clay	Gage	Merrick	Sarpy	York
Colfax	Garfield	Nance	Saunders	
Cuming	Hall	Nemaha	Seward	

53

In Progress

Furnas
Saline
Fillmore
Lincoln
Gosper
Cedar

FIGURE 3

OHIO

One county completely digitized using line-segment digitizing (Hardin County, Ohio)

Two counties being digitized to SCS standards (Gallia County, Hamilton County, Ohio)

Two counties soil survey maps being recompiled onto planimeteric base for digitizing (Huron County, Hamilton County, concurrent with digitizing)

Two additional counties set for recompilation onto planimeteric base maps (Licking County, Summit County, Ohio)

About 50 digital soil databases already exist in raster format for much of northern and central Ohio. Some data exist for southern Ohio. These databases do not meet the qualifications for SSURGO.

SOUTH DAKOTA

Two county soil surveys are currently contracted for digitizing through the National Cartographic Center and are nearing completion. One of these will be published using the digital maps.

Three published county soil surveys are being recompiled on USGS 7.5 minute quads for digitizing.

One recently completed soil survey is being prepared for digitizing and will be digitized for publication through the National Cartographic Center.

WISCONSIN

Statewide digitizing of STATSGO completed.

Dane County detail survey digitized using a county developed program under the ARC/INFO program.

Three other counties partially digitized by the state office soils staff using ARC/INFO program.

CHARGE 3. What are the advantages of GRASS vs. ARC/INFO vs. other systems?

Below are comments by state on the advantages of GIS systems. Discussion on this charge during the meeting focused on the ability to convert data back and forth from raster to vector form. In order to convert data between raster and vector forms the digitizing procedure and format must be known, thus they should be documented. If data is to be entered in raster form and a conversion to vector is anticipated, the data should be entered in small cells so it can be converted to the best vector product possible. The cost of entering data in small cells is high and much storage space is needed. In general, programs can be written to convert data between raster and vector forms.

ILLINOIS

Raster vs. Vector has been documented. Ease of multi-layer analysis, simple file structure and image analysis capability compared with cartographic Integrity and database management capability.

GRASS is easy to learn and use compared to ARC INFO. Link between GRASS and ARC INFO will facilitate transfer of data between users of each system.

No standard coordinate system is used for referencing, UTM, State Plane etc.

INDIANA

No Comment. Cannot add any additional information to the other states discussion.

KANSAS

GRASS advantages:

1. It will run on the AT&T UNIX computers that SCS has, as well as several other UNIX platforms, and will interface with the CAMPS program in the future.
2. It will read the DLG data format which is also read by ARC/INFO; Intergraph will not.
3. It is public domain software, therefore it is very low cost.

ARC/INFO advantages:

1. It is not as hardware specific as GRASS; it runs in the MS-DOS environment.
2. It has a built-in relational database.
3. It will handle various geographic coordinate systems and projections. GRASS will only read UTM.
4. You should be able to get better support from the developers then is available with GRASS.

Kansas has chosen the USGS 7.5 minute quadrangle format for georeferencing.

MINNESOTA

No experience yet with GRASS. The SCS state office is just getting started.

ARC/INFO is fine when used by state offices or main offices, where permanent technical help is available on a long term basis.

ARC/INFO is too complex and requires too much training for most field offices.

There is a need for much simpler, user-friendly systems such as EPPL7 and SSIS (Soil Survey Information System) for field uses.

MISSOURI

Cost is one of the main considerations. Since SCS is using AT&T hardware and GRASS has been programmed to work on the hardware, we have no choice but to use GRASS. Since ARC-INFO and Integraph are not public domain geographic information systems, they are costly to purchase up front. The Intergraph used by DNR cost in excess of $300,000 for the hardware and software.

GRASS is considered to be user friendly. I can't compare it to the other systems since I haven't used them.

There is a problem of transferring data from the Jntergraph to GRASS. It seems to be a formatting problem and it is presently being worked on in order to clarify the problem. It has been reported in GRASS Clippings that software is available to provide the needed format to allow the data transfer.

GRASS uses UTM's. It appears that Intergraph allows the use of State Plane Coordinate or UTM's.

NEBRASKA

MIPS has scanning capabilities/is compatible with GRASS/MAPDEV.

NORTH DAKOTA

I have not worked with ARC-INFO.

Compatibility of software systems.

Although there will be some compatibility problems, I feel that most can be solved if certain digitizing standards (i.e., base map, accuracy levels) are maintained.

Georeferencing systems.

GRASS uses UTM, but conversion routines with other systems are available.

OHIO

a. Lat-long for old ODNR-DSWC (OCAP) data
b. State Plane - Hal-din County
c. UTM - eventual system, it's anticipated

SOUTH DAKOTA

I am only familiar with the GRASS capabilities and can not discuss the advantages and disadvantages of other GIS systems and software.

South Dakota is using USGS 7.5 minute stable base quads to georeference and recompile published soil surveys. Soil mapping in survey areas that have started within the last 10 years are using ortho-photo quads as the georeferenced map base for publication and digitizing.

WISCONSIN

N/A

CHARGE 4. What kinds of information will be included in each state's GIS system and what agencies are involved.

Below are comments, by state, about the kinds of information included in GIS and the agencies involved. It was suggested that Digital Elevation Models (DEM) be integrated into GIS and used to enhance the soils layer and to aid in soil survey updates.

ILLINOIS

Each agency has their own set of data layers and manages them independently. Layers included based on agency, i.e., Geologic Survey-bedrock, tectonic, glacial, mineral etc. SCS has about eight layers developed for one watershed (soils, land use, slope, roads, watershed, fields, tracts). These layers will probably be of most importance to SCS in the future.

INDIANA

Refer to question 1.

IOWA

See Table 1.

KANSAS

Kansas has a GIS Policy Board and Technical Advisory Committee. The Policy Board consists of 21 heads of agencies- county, state, and federal- that were appointed by the governor. Each Board member then appointed a representative to the Technical Advisory Committee. The member agencies are as follows:

KS. Geological Survey	KS. Dept of Administration
KS. Dept. of Health & Envir.	Ks. Secretary of State
KS. Corporation Commission	Legislative Research Office
County Appraisers	Soil Conservation Service
State Conservation Commission	Ks. Water Office
Groundwater Mgmt. Districts	Governor's Office Rep.
Wildlife & Parks	US Geological Survey
KSU Dept. of Geography	Ks. Biological Survey
Ks. Div. of Water Resources	KS. Dept. of Commerce
Ks. Dept. of Revenue	Kansas Inc.
Ks. Dept. of Transportation	

The purpose of the Policy Board is to provide direction for the creation of a statewide GIS with the sharing of data between member agencies. The Technical Committee provides advice to the Advisory Board by providing input into the databases to develop or acquire and technical specifications to follow. We have identified 12 to 15 databases to target initially. They include public land survey with county and township boundaries, drainage patterns, land use/land cover soils, geology, census data (TIGER files), public water supply sites, contamination sites, transportation routes, water rights, elevation data, watershed district boundaries, injection well sites, wastewater disposal permits, and property ownership. Funding is currently to be from state water plan funds. Therefore, the databases must be water related.

MINNESOTA

The only detailed soil data base, at this moment, is SSIS. All soil survey data descriptions, characteristics, interpretations are included and very easily accessible. New interpretations for forest management and environmental protection are developed. The Department of Soil Science, University of Minnesota is the principal developer. USDA-SCS is collaborating. The LMIC has a 40 acre cell base GIS of the Minnesota Soil Atlas (1:250,000).

TABLE 1. Iowa GIS Hardware, Software and Data Information.

AGENCY	CONTACT	HARDWARE	SOFTWARE	DATA
Iowa Dept of Natural Resources Geological Survey Bureau 123 N. Capitol Street Iowa City, IA 52242	Bernie Hoyer 319-335-1575	4 Compaq 386's [illegible], 4 IBM PS/2 [illegible], Concurrent 3250 [illegible] computer, Comtal image processor, [illegible] digitizers, Calcomp 1043GT plotter, Tektronix 4696 color plotter, HP LaserJet printer	3 complete set PC Arc/Info and 2 Starter Kits, 3 [illegible], [illegible] (old version), PC [illegible], [illegible], dBase	Geology, groundwater, coal and economic minerals
Iowa State University Dept of Civil Engineering Town Engineering Bldg Ames, IA 50011	[illegible] 515-294-[illegible]	Apollo workstations	[illegible]	Iowa State University campus, section corners of Story County, IA.
Iowa Dept of Natural Resources Coordination and Information Wallace State Office Building Des Moines, IA 50319	[illegible] 515-281-[illegible]	Compaq 386/25 model 300, Compaq 386/20e model [illegible], Calcomp digitizing tablet, Calcomp plotter, HP7550 plotter, HP PaintJet color printer, HP LaserJet II	3 complete set of PC Arc/Info, 2 PC Arc/Info Starter Kit, [illegible]	DNR's GIS Data Library
Iowa Dept of Natural Resources Wildlife Research Station RR 1 Boone, IA 50036	Jim [illegible] 515-432-[illegible]	IBM PS/2 model 60, HP LaserJet II, Summagraphics bit pad 2	[illegible]	Pheasant and quail habitats
US Geological Survey Water Resources Division 400 S Clinton Iowa City, IA 52244	Jim [illegible] 319-337-[illegible]	Prime 9955, Sun 3 workstation	ARC/INFO	Hydrologic units, Iowa outline, [illegible] & 1:2M & 1:500K, precip monitoring network, GW quality stations, SW quality stations, streams & lakes 1:2M, gaging stations
Iowa Utilities Board Department of Commerce Lucas State Office Building Des Moines, IA 50319	[illegible] 515-281-[illegible]	None yet - still investigating	None yet	Hope to develop service territory boundaries for electric, natural gas and telephone utilities.
Iowa Dept of Natural Resources Chariton Research Station RR 1 Box 209 Chariton, IA 50049	[illegible] 515-774-[illegible]	IBM AT, Summagraphics bit pad II, Toshiba P351 Printer	[illegible]	Quail research study site habitat classification
[illegible] & Kima Inc. 300 West Bank [illegible] 22nd Street West Des Moines, IA 50265	Ted [illegible] 515-225-[illegible]	Compaq 386/20, HP plotter (Intergraph or SUN workstation being considered)	ARC/INFO (under consideration)	Polk County, Iowa (Central Iowa Automated Map group)
Iowa State University Dept of Landscape Architecture [illegible] College of Design Ames, IA 50011	Paul Anderson 515-294-[illegible]	Zenith 386/16, Summagraphics [illegible] dig tablet, HP PaintJet, Zenith 248/12, Hitachi [illegible] dig tab, HP7475A plotter	[illegible], [illegible], [illegible], [illegible], home grown utilities	Land cover/land use, soils, elevation, land ownership, zoning, utilities, public lands - for 10 to 20 study areas in Iowa - used for research and teaching purposes.
University of Iowa Geography Department 316 Jessup Hall Iowa City, IA 52242	[illegible] 319-335-[illegible]	Dell 386/16, IBM AT, IBM PS/2 and 80, Macintosh, [illegible] digitizer ([illegible]), HP 7475 plotter, HP LaserJet, ImageWriter, 486 pc on order	[illegible], Atlas Graphics, Atlas Draw, MapInfo, [illegible], [illegible], Academic Map Analysis Package, Locally written software, [illegible] (Macintosh)	[illegible], misc study areas
USDA - Soil Conservation Service 693 Federal Building 210 Walnut Street Des Moines, IA 50309	[illegible] 515-284-[illegible]	AT&T 6386E, [illegible] digitizer, Tektronix 4696 ink jet color printer, HP 7595A Draftmaster Plotter	GRASS	Polk County soils (in progress), in process of converting soils from other counties.
Iowa Department of Education Grimes Data Center Grimes Building Des Moines, IA 50319	[illegible] 515-281-[illegible]	None currently - have many 386 computers when we establish GIS, both networked and stand alone. Would be interested in pursuing potential of mainframe use as well.	Atlas Graphics. Considering ARC/INFO and [illegible] and [illegible] for some applications.	School district boundaries. Waiting for TIGER data for variety of applications.
Iowa Dept of Transportation Office of Transportation [illegible] 800 Lincoln Way Ames, IA 50010	[illegible] 515-239-[illegible]	Intergraph [illegible], IBM mainframe	Intergraph [illegible], [illegible], [illegible], IBM Interleaf	State coverage - county files, city files, [illegible] - roads, railroads, water, pipelines, Township-range-section
Iowa State University Agronomy Dept 2407 Agronomy Ames, IA 50011	[illegible] 515-294-[illegible]	[illegible] Zenith 248's, [illegible], [illegible] 373's, IBM PC/2, Macintosh Plus, HP Paint Jet Printer, Laser Printer, dot matrix printer	Software developed in-house to access soil survey database ([illegible]) and link to digitized soil maps.	Soil maps of 70 Iowa counties. We will have counties completed within the next 3 years. Also have a soil survey database for 2100 map units used in Iowa with approximately 70 fields of data.
City of Des Moines Engineering Dept 400 E 1st St Des Moines, IA 50322	[illegible] 515-283-[illegible]	Currently evaluating	Currently evaluating	
Polk County Planning 5895 NE 14th St. Des Moines, IA 50313	[illegible] 515-286-[illegible]	Currently evaluating	Currently evaluating	211 sq. miles of digital maps ([illegible] scale) showing planimetric features for the Des Moines urban area
Iowa Dept of Natural Resources State Forest Nursery 2404 S. Duff Ave Ames, IA 50010	[illegible] 515-233-[illegible]	IBM AT, HP PaintJet, HP LaserJet II, Hitachi 1212 digitizing table	[illegible]	Forestry, state forests, nursery stock outplantings
SIMPCO MPO Division (Transportation) P.O. Box 447 Sioux City, IA 51102	[illegible] 712-279-[illegible]	None currently, possibilities being explored	None currently	None currently
Iowa State University Botany Department [illegible] Bessey Hall Ames, IA 50011	Arnold van der Valk 515-294-[illegible]	IBM PS/2 mod 70, HP PaintJet color printer, [illegible] digitizing table, HP plotter	[illegible] for the PC, [illegible]	variety of educational data bases
Iowa Coop. Fish & Wildlife [illegible] [illegible] Science Hall II Iowa State University Ames, IA 50011	Paul [illegible] 515-294-[illegible]	Portable 386 computer, video imaging system, color digitizer, [illegible] optical drive, HP PaintJet, [illegible] digitizing pad	[illegible], [illegible]	On large areas, [illegible] aerial transparencies of several research areas, wildlife habitat on several research areas, city of Ames
Iowa Dept of Natural Resources Environmental Protection Div. Wallace State Office Building Des Moines, IA 50319	[illegible] 515-281-[illegible]	Compaq 386/25 model 300, IBM PS/2 model 50, Calcomp 9500 digitizing tablet, Calcomp 1025 plotter	2 complete sets of PC ARC/INFO, [illegible]	Landfills, abandoned/uncontrolled sites, registered private and abandoned wells, municipal wells, designated rivers, 1987 TRI data

MISSOURI

Presently SCS is working on the digitizing of soils, hydrologic units and wetlands. The Department of Natural Resources is doing the soils digitizing using 1:24,000 orthophotoquads. SCS will do their own digitizing of the hydrologic units. The wetlands will be done by SCS with input from the Missouri Department of Conservation and possibly the Corps of Engineers. The source of additional data bases are presently being discussed by a group of potential users and agencies within the state.

NEBRASKA

SCS to encode - soils, land use/cover, C factor, P factor, and Water source/management identification.
Acquired - STATSGO/MLRA, digital elevation, DLG, SPOT data (Saunders Co. & vicinity), other satellite data, as needed, Landsat MSS for state (1979 - July thru Sept.), and other digital data as needed.
Agencies involved - SCS, Conservation & Survey Division, UN-L, Nebraska Natural Resources Commission, Corps of Engineers (Omaha). and U.S. Fish 6 Wildlife Service (Grand Island).

NORTH DAKOTA,

North Dakota has not completely coordinated GIS efforts. The SCS plans to have soils, drainage, cultural features, land division, land use, and land operator in its GIS. Other agencies will develop and maintain their own databases, i.e., Water Commission-aquifer data, etc.

OHIO

It is anticipated the SSURGO database will be a primary map layer for an Ohio SCS work station -- at the field office, project office, area or state office level. Ohio SCS will be instrumental in this database development.

Other map layers like land use/cover, property boundaries, roads, etc. will be incorporated/developed into a GIS database as they are needed. It is anticipated that Ohio SCS will try to use existing databases of cooperators to reduce cost and eliminate duplication of effort.

Useful map layers include:
1. digital soils
2. land use/cover
3. transportation
4. hydrography
5. watershed boundaries

6. field boundaries
7. land owner/operator/SWCD co-operator states
8. wetland inventory data
9. soil potential studies
10. point data -- PSU site; soil sample sites; etc.
11. topography -- DEW
12. others.

SOUTH DAKOTA

GIS information layers:

Soils - Soil Conservation Service
Land owner 6 landuse - Agricultural Stabilization and Conservation Service (hard copy) & scs recompiles and digitizes
Geology - SCS and state geologic survey cooperating when geology layer is required.
Cultural layer - TIGER data as developed by the National Cartographic Center.

WISCONSIN

The state's (SCS) GIS committee is in the process of developing a long range GIS plan. The makeup of the final GIS system has not been decided as yet.

The State of Wisconsin recently passed a statute establishing a state land records board which will have the responsibility for developing a statewide system for land and property records. The Board has introduced a bill in the current Wisconsin legislative session which included a user fee on all property record transactions. The funds generated through this fee, approximately six million dollars statewide per year would be used for improvements in local land records and information systems. These funds will impact on information systems at all state government levels, including the counties. At some early point in the development of these systems, we anticipate that SCS will be involved and will be a participant in the sharing of layers of information for the data base.

The State DNR has recently become very active in the GJS field and is attempting to coordinate with other state and federal agencies in the development of a GIS system. The initial effort is in the area of establishing a standard base map to be used by all agencies, (OQ) and to solicit cost shared funding for a 1992 NAPP aerial photography flight.

It is anticipated the agencies to be involved in a GIS effort will include:

(federal) SCS, ASCS, USGS, FS
(state) Dept. of Trans., DNR, DATCP. St. Forestry, Ext. State Land Records Board
(county) County government agencies.

The following data bases would be included in a GIS system:

Soils	Land cover	Topography
Roads 6 streams	Field boundaries	Land records/ownership
HELands	Watersheds	Railroads
Lakes/ponds	River basins	Wetlands

CHARGE 5. Who has the responsibility for documentation, maintenance and updating of the data bases, i.e., soils land use, geology, etc.?

The concensus is that the agency responsible for data should be responsible for the documentation, maintenance and updating. For example, soils data is the responsibility of the NCSS, geologic data is the responsibility of USGS or state geological survey etc.. See below for comments by each state.

ILLINOIS

Each agency takes care of its own: Geological Survey takes care of geologic data, Natural History takes care of biological data, etc.

INDIANA

At the present time each agency has responsibility for their data bases.

KANSAS

We have decided that whichever agency furnished the original data will be responsible for its maintenance and updating.

MINNESOTA

The Department of Soil Science, University of Minnesota is maintaining and updating the SSIS data base. SCS is the principal agency updating the state soil database (3SD). Updates of the state soil database are automatically transferred to the SSIS geographic database.

MISSOURI

The soil data base will remain the responsibility of SCS. I assume the other agencies that provide the sources of the data base will retain responsibility for maintenance, etc. At the present time, DNR digitizes the soils data base but we check and sign off on the accuracy of the material.

NEBRASKA

As far as I'm concerned, whoever develops a database has responsibility for documentation. Responsibility for maintenance and updating could vary (e.g., database developer or site where database ultimately resides).

NORTH DAKOTA

The SCS will maintain and archive all soils data. We hope to have the Soil Conservation District maintain the landuse and operator files. Other agencies would hopefully maintain their databases.

OHIO

a. It is anticipated the proprietor will be responsible for documenting and maintaining (including updating) the database where databases are required through other agencies, etc.

b. Ohio SCS will be the proprietor of the SSURGO digital soil database which is based on the Ohio Soil Survey program.

SOUTH DAKOTA

The state Geographic Information Specialist has responsibility for maintaining the system integrity, data bases, and interpretive output products.

WISCONSIN

The responsibility for each layer of the data base has not been decided. However, the state or federal agency having statutory responsibility for or greatest use for a data base layer will likely have the responsibility for maintaining and updating the various data bases. scs would be responsible for the soils data base.

CHARGE 6. What plans are there (in each state) to share data bases?

The problem with sharing data bases is that the agencies involved do not have the same software and hardware. SCS seems to be lagging behind state and local agencies in GIS involvement and it is important that we in the NCSS become involved in GIS before we are left behind. Below are comments, by state, on plans to share data bases.

ILLINOIS

Getting data on disk or tape is no problem. Goal in Illinois is to get all users linked by computer so access to various data is in real time. A memo of understanding would be needed so no agency misinterprets or misuses a data layer from another agency.

INDIANA

The Indiana Geographic Information System (GIS) Forum was first organized in 1988 by the Indiana Department of Natural resources. The purpose of the GIS Forum was to establish a network of individuals nd resources for promoting coordination of GIS activities. Through the GIS Forum state agency representatives can exchange information on GIS activities of the various agencies with some visibility of current applications and future development in and around Indiana. the Forum consists of representatives from federal, state, local counties, cities and towns and other interested individuals gathering for presentations by professionals using GIS technology.

The University GIS alliance, composed of major universities jointly participates with the forum to further the goals of studying, planning, developing and implementing a state of Indiana GIS for the 1990'6.

The Forum has completed a draft version of the "Proposed Initial Standrds and policies for Indiana Geographic Information Systems".

The Forum also publishes a monthly newsletter entitled Indiana GIS Newsletter. This publication began in August 1989 using facilities provided by the Indiana department of Environmental Management.

The state of Indiana moved one giant step closer to the reality of a coodinated, statewide application of GIS technology with the establishment of the State office of GIS in March ,1990 within the Indiana Department of Administration(DOA). Although presently informally organized, the State Office of GIS continues to effectively function as a central entity for the dissemination of information and technical expertise related to GIS technology. The office of GIS is recommending a policy committee and several task forces be developed, including: the GIS Mapping Policy Coordinating Committee (GISMPCC), the Geodetic Technical Advisory Task Force, the Aerial Photography technical

Advisory Task Force, and the County GIS/LIS Policies and Standards Technical Advisory task Force.

KANSAS

In Kansas, member of the statewide system will share data with each other. At least this is in the plan.

MINNESOTA

The Minnesota Natural Resource Geographic Information Systems Consortium (NRIGS) recently renamed Minnesota GIS/LIS was created in1988 to develop and coordinate the use of GIS in Minnesota. The Land Management Information Center (LMIC) of the MN State Planning Agency has the state responsibility to maintain and update the "State Geographic DataBase". State agencies and state funded projects are required to transfer new data to the LMIC state database.

Extension specialists of several departments are developing an educational short course on GIS for the Department of Natural Resources (DNR). If founded by the state, a similar program will be developed for counties.

MISSOURI

Presently there is a round of meetings being conducted where representatives of different user groups are discussing this issue. All parties agree that a data base library needs to be established in the state. The where, how, funding has yet to be discussed but will be in the near future.

NEBRASKA

a. Nebraska (ad hoc) GIS Steering Committee (1988 to present)
b. Nebraska Intergovernmental Data Communications Advisory Council (NIDCAC) - created by LB312 in the 1987 legislative session. NIDCAC is in the process of establishing a GIS subcommittee.
c. Natural Resources Commission Data Bank.

NORTH DAKOTA

North Dakota has established a GIS Technical Work Group (of which the SCS is a part). Part of their responsibility is to maintain a current inventory of GIS products, digital data availability and specifications, and an agency representative to contact for more information.

OHIO

Ohio SCS is cooperating with DDNR-DSWC (see Ohio under charge 1) in database development. A state coordinating committee, called the Ohio Geographically Referenced Information Program (OGRIP), has been formed to survey the use of GIS technology in Ohio and develop recommendations on co-ordinating efforts in-state.

SOUTH DAKOTA

Soil Conservation Service, South Dakota will share all digital spatial data bases and subsets with cooperating federal, state, and local governmental agencies and contributing private parties. SCS South Dakota is developing GIS data development cooperative agreements with county governments, USDA Forest Service, National Park Service, and several state agencies.

WISCONSIN

The intent of a cooperative GIS would be to share the system with as many other state and federal agencies as possible. This would tend to make more data available to each of the participating agencies.

CONCLUSIONS

Charges to this years committee dealt with the collection of information about GIS activities throughout the region. This report should provide background information about individual state GIS activities. The committee recommends that the GIS committee continue and that in the future it should address specific charges about GIS within soil survey. Below are six charges that we propose for the 1992 GIS Committee.

Charge 1. Should members of the National Cooperative Soil Survey provide for quality assurance of soil-survey data bases used in GIS by non-cooperators?

Charge 2. What should be the standard format for GIS data exchange (DLG, etc.)?

Charge 3. What types of controlled base maps should be used to input data to a GIS system?

Charge 4. What strategies would improve the quality and utility of soil survey information through integrated use of GIS and allied techniques (i.e. the use of DEM)?

Charge 5. What priority should updating existing data bases have (vs. first time mapping of low priority areas) and how should updating data bases be funded?

Charge 6. Has a data dictionary for GIS been developed? If so, who should be responsible and what terms need to be added. If not, should one be developed?

Submitted by

Mark Kuzila
Chairman, 1990 GIS Committee

NORTH CENTRAL SOIL SURVEY CONFERENCE
Ames, Iowa
June 4-8, 1990

Committee 3 Report

Soil Correlation and Classification

Sixteen people served as committee members this year. Committee 3 was assigned six charges by the Steering Committee.

Charge 1
Are the criteria for defining and differentiating soil series, taxadjuncts, and soil phases adequate?

Most of those responding to this charge feel that the present criteria is adequate.

W. D. Nettleton suggested to eliminate taxadjuncts by allowing the series to range across the limits between families , or between classes of any higher category. This proposal would, however, require family classification of the modal series concept and those similar soils currently classified as taxadjuncts. We recommend these changes because (1) natural soil bodies would no longer be subdivided by artificial boundaries, (2) Taxonomy would be retained to facilitate technology transfer, (3) the National Soils Handbook prohibition against publishing data for taxadjuncts in soil survey reports would be nullified, and (4) the exchange of information about the actual distribution of properties of series and their use and management as mappable bodies would be facilitated.

Recommendation:
Review W. D. Nettleton's 1990 response to the Soil Correlation and Classification Committee to eliminate the use of soil taxadjuncts in soil survey.

Charge 2
Now that variants are no longer recognized, what has been the affect on soil surveys?

All that responded to this charge were in favor of dropping variants in soil correlation and allowing series to be established that are less than 2,000 acres in extent.

Recommendation:
This charge should be dropped

Charge 3
Review and comment on updates of ICOMFAM and ICOMAQ.

Comments received concerning ICOMAQ Circular Letter No. 9 were favorable.

M. D. Ransom submitted the following:

As a member of the North Central Region Soil Taxonomy Committee, I have had the opportunity to review and comment on previous ICOMAQ circular letters. Much effort and thought has gone into developing the ideas expressed in this last circular letter. I believe that ICOMAQ will not put out another letter until after the meeting on wet soils to be held in Louisiana and Texas next October. In general, I agree with redefining the aquic moisture regime as aquic conditions and moving away from chroma 2 mottling as conclusive evidence for reduced soil conditions. I also agree that in order for aquic conditions to be present, both saturation and reduction must occur. The occurrence of saturated conditions without the development of chroma 2 colors is well documented in the literature. I also concur that reduction can be characterized by direct Eh measurements. However, my experience with Eh measurements (Ransom and Smeck, 1986) is that they are difficult and highly variable. Results will depend on the method used. In previous research in Ohio (Ransom and Smeck, 1986), we used one of the staining techniques mentioned in Circular Letter No. 9 and found that the procedure yielded results which agreed well with Eh measurements and Fe^{2+} contents measured in soil water samples. I have strong reservations about the use of the term "stagnic" to describe redoximorphic features associated with a perched, seasonal water table. Webster defines stagnant as motionless and not flowing. Many soils with "stagnic" features will have lateral movement of water above a layer with a restriction in permeability.

The 1988 committee recommended that further study be made of the soil family category. Very few committee members were in favor of the Soil Family Task Force Proposal. However, most members expressed considerable interest. Many of the responses supported the current soil family criteria.

The following response was submitted by W. D. Nettleton:

Some excellent suggestions for improvement in the family category are given in the papers published in SSSA Special Publication No. 16.

What properties best meet the needs or intent for the family category?

1. Particle size of the whole soil

2. Mineralogy (or a substitute term that expresses soil chemical, or rheological, or other behavior)

3. Calcareous and reaction classes

4. Soil temperature classes

5. Soil depth classes

6. Soil slope classes

7. Soil consistence classes

8. Classes of coatings (on sand)

9. Classes of cracks

The above nine properties are important ones. We need to find better ways to describe some of them. Mineralogy is an example. The field scientist struggles to interpret his observations of soil behavior into mineralogy classes. The laboratory scientist can identify the minerals present, but he is less certain about amounts of each.

A good place to begin is SSSA Special Publication No. 16, Mineral Classification of Soils. Among its most useful suggestions for improvement of the family classes are the following:

1. Whenever contrasting particle-class sizes occur, whether of pedogenic or geologic origin, they should be recognized in defining the family (Lietzke, page 11). I agree with Lietzke; we should recognize contrasting particle-size, or mineralogy whether these occur within the control section or between the A and B, or between the B and C horizons.

2. Playing the contrasting A-B horizons further Hendricks et al.. pages 48-51, point out the failure of our family classes to recognize "the part of the soil most used by plants, most critical to water infiltration and storage, most subject to erosion, most commonly free of carbonates and salts, and in many places most uniform. It is. in fact. the most important part of the soil for most uses."

These authors suggest two mineral control sections for soils with rooting zones >50 cm. One would be the upper 25 cm , and the other would be the current zone. If most of the mineral control section were above 25 cm, only the single depth limit would be used. Clay mineralogy should be a part of the family mineralogical criteria irrespective of the clay content. Soils with over 15 percent carbonate clay in the <2 mm fraction should be identified at the family level regardless of other characteristics. Gypsum also dominates properties of the soils when present in amounts >15 percent and should be recognized in the family name if possible.

They further suggest that to overcome the problem of arriving at the particle size for gypsic soils that (page 50) "... the family particle size be based on 1500-k Pa water retention (as adjusted for gypsum structural water) to estimate clayeyness and field tactile examination be used to establish whether sandy. loamy, or silty."

Hallmark (page 58) suggests that changes in the mineralogy subclasses are needed. "The application of calcareous subclass should be broadened by removing all restrictions except for application where redundancy would occur, i. e.. taxa which require free carbonates throughout the soil." He would include all soils that are calcareous in all horizons from the surface to the bottom of the control section after mixing the upper 18 cm of soil.

As a minimum he further states that "... a value of 2 percent gypsum in all soil horizons after mixing of the upper 18 cm of soil is suggested for the gypsiferous subclass."

Richardson and Levin (pages 61-73) also agree that more subdivisions are needed in calcareous and carbonatic classes. They suggest a multicategorical breakdown for calcareous groups such as "(i) 0 to 15 percent $CaCO_3$ equivalent plus gypsum equals calcareous (or gypsic if over 1/3 gypsum). (ii) 15 to 25 percent $CaCO_3$ equivalent, (iii) 25 to 40 percent $CaCO_3$

equivalent, and (iv)>40 percent CaC03 equivalent. Appropriate gypsic classes could parallel these groupings."

Franzmeier and McKeague (pages 75-86) discuss these "... problems: the depth of the control section varies greatly among soils. different particle-size fractions are used to classify similar soils, there are no standard methods of analyses, class definitions are very complex and are difficult to apply, the mixed mineralogy class includes too many soils, and many spodic horizons qualify in the oxidic mineralogy class ...." They also have the interesting view that "... classes based on surface area might be more relevant than current classes to specific uses of the soil, especially for medium- and fine-textured soils."

Hajeck and Zelazny (pages 87-93) attack the mixed mineralogy class. They state that "Central Concepts and Class limits are needed for mixed mineralogy classes. This class as currently defined has no genetic, agronomic, or engineering interpretive significance."

Three papers (Uehara and Ikawa, Nettleton and Engel, and Engel and Nettleton) discuss the problems with classification of tephra influenced soils and made suggestions for improvement in Soil Taxonomy. These have been considered in the development of the Andisol proposals.

Alexander, Wildman and Lynn (pages 135-146) proposed that "... the serpentinitic class should be expanded to include more soils on ultramafic rocks by adding olivine, orthopyrorenes, brucite,magnesite hydromagnesite. and lithogenic chlorite to serpentine and talc in the list of diagnostic minerals." They also proposed lowering and required percentage of diagnostic minerals from 40 to 15 percent and adding a" exchangeable Ca/Mg ratio as a criterion.

Harris and Zelzany (pages 147-160) recommended simplification of the micaceous mineralogy class by basing its recognition directly on grain counts of dominant particle size fractions exclusive of particles >2 mm. Because so few soils occur in chloritic or vermiculitic soil families and because these minerals influence management practices eve" when present in amounts less than the present class limit of 40 percent. Douglas (pages 161-167) Suggested "... that the texture requirements for the family be reconsidered ...."

What additional proposals given in SSSA Special Publication No. 16 should Soil Survey adopt? Some already have been adopted. In summary, I think we should plan to do the following additional ones.

1. Have two mineral control. sections for soils with rooting zones >50 cm. One would be the upper 25 cm. and the other would be the current zone. 11 most of the mineral control section were above 25 cm only the single depth limit would be used. If both control sections have the same mineralogy only one would need to be listed. If the control sections are contrasting both should be listed.

2. Carbonate clay should again be recognized in the family name if present in amounts >10-15 percent.

3. Gypsic soils should be placed in textural families based on 15-bar water retention (as adjusted for structural water of gypsum) to estimate clayeyness and field tactile examination used to establish whether sandy, loamy or silty.

4. The calcareous subclass should be broadened to include all soils except for application when redundancy would occur. It should include all soils that are calcareous in all horizons from the bottom of the control section after mixing the upper 18 cm of soil. A similar subclass should be defined for soils with 2 percent or more of gypsum.

5. Mineralogy substitutes such as names for combinations of surface area, particle size. and CEC should be tested.

- What should the family control section reflect? The family was designed for interpretations. The family control section should be the principal zone used for these interpretations.

- Do we need to change the control section? If so, what should it be? I recommended that we have two control sections--one for the surface, the other for the subsurface (the present family control section). There is some support for a third one also for the horizons below the present control section. I would favor having three for soils that have contrasting zones (A vs. B vs.C) for either particle size or mineralogy. The surface one is especially important for agriculture, the C horizon for engineering.

- Should we simplify the family? I would not favor eliminating information from the family name. Perhaps the way it is presented can be simplified. For example, mineralogy name substitutes based on a **combination** of mineralogy, surface area, and CEC could be both simpler and more connotative than those we presently use.

- Should the specifications for identification of families be presented in a separate chapter of Soil Taxonomy as is done now or should they be distributed within the text in the chapters for each of the orders? Both! This is the computer age. It would be useful to have the specifications in a separate chapter as they are now. Where these definitions are needed again to complete the text they should be added.

Recommendation:
This charge was ranked high in priority for discussion at the June meeting. It appears that we should continue to follow and participate in the developments of ICOMAQ and ICOMFAM as a committee and as individuals. Those of us that are particularly interested in one or both of these international committees should contact the committee chairman end ask to be put on the mailing list.

Charge 4
Definition of series control section.

The following is a proposal by the National Soil Classification Staff defining series control section.

The control section for soil series is from the soil surface to:

1. 200 cm, if both the top of the any root limiting layer and the bottom of the deepest diagnostic horizon are greater than 200 cm.

2. The top of any root limiting layer or the bottom of the deepest diagnostic horizon, whichever is shallower, if the top of any root limiting layer or the bottom of the deepest diagnostic horizon is between 150 and 200 cm.

3. 150 cm if the bottom of the deepest diagnostic horizon is less than 150 cm and the depth to any root limiting layer is greater than 150 cm.

4. A lithic contact or to 25 cm below the top of any other root limiting layer if the depth to a root limiting layer is less than 150 cm.

The response received seemed to favor the National Soil Classifications Staff's proposal but there were some reservations.

1. Mapping rate could be affected.

2. Include paralithic in item 4.

3. Need to discuss the effect of the change in the classification of some of the series.

4. The concept of some of the series could be split after initiating the change.

Recommendation:
We recommend to the National Soil Classification Staff that they send their proposal on series control section out for general review.

Charge 5
Review the use and present concept of the soil moisture control section and field test of soil moisture states.

The principal responses to this charge are as follows:

M. Harpstead.--I really doubt that the control section for soil moisture regimes is used very often. Getting the soil moisture data for, say, 7 years out of 10 is not easily done. I dare say that extrapolations from weather bureau data are more common and probably just as good if the known relationships are factored in.

D. D. Patterson.--The present concept of the soil moisture control section is inadequate. We read and talk about it but we do not use it because measurements to quantify/verify its limits are not available for most regions. The soil moisture control section does not "facilitate estimation of soil moisture regimes from climatic data" as it is supposed to.

Maybe we don't need a defined soil moisture control section as such. Could we not delineate climatic regions as we presently do and use long-term weather data to estimate some cumulative aspect of evapotranspiration during the growing season? This information could become the basis for defining moisture regimes. Some people may not appreciate the use of climatic data since it is not a soil property but it may be more realistic than trying to quantify an illusive soil characteristic.

The aquic moisture regime is an exception to be defined by monitoring soil water during the growing season and relating the data to morphology, etc., as mentioned in the summary of the ICOMAQ Circular Letter. Criteria for the aquic regime probably varies by regions and textural families.

I presume the field tests of the soil moisture states are those discussed in chapter IV of the Soil Survey Manual. If so, I see these criteria as just another observation to be made by the field man at the time he takes a pedon description. If one had a lot of observations over the growing season for the major horizons of a given soil series, he would have some useful information. Information collected at the same sites over a period of years would be valuable. But who is likely to do this?

W. D. Nettleton.--The intent in defining the SMCS was to facilitate estimation of soil moisture regimes from climatic data. The intent has been realized in my opinion. Climatic data have been used around the world to determine the moisture regimes of soils. Attempts to directly measure moisture in the field have been somewhat frustrated by the definition, however.

It appears that the water infiltration rate used in the definition will accommodate even the very slow to slow permeability class without runoff from the defined rain storm (1 inch in 24 hours or 0.04 inches/hour and 3 inches in 48 hours or 0.06 inches/hour).

I have used the definition many times for soils in ustic, xeric, and aridic moisture regimes and find that depths to carbonate, gypsum and salts may be predicted closely enough for many purposes. Range production also may be predicted by means of these definitions and climatic data.

Converting the definitions to profile depths requires more effort. These depths would be needed for research projects and field monitoring of soil moisture regimes. It was important that such studies be done to test the definitions and the classification of climatic-soils data. Such studies have been done and have (I thought) resulted in general acceptance of the definitions and their application.

I have not used the soil moisture states as they are not published. It seems to me that they would be useful for describing soils, but not needed for identifying soil moisture regimes. Climatic data are mostly what is needed for- those.

M. D. Ransom.--In the committee meeting. I favor limiting the discussion only to the use and concept of the soil moisture control section. A discussion of field tests is beyond the scope of our committee on correlation and classification. This entire issue on soil moisture control section was extensively discussed by the Committee on Soil Water Relationships (pages 106-107 in the 1988 Central Soil Survey Conference Proceedings).

Committee 3 Report

Recommendation:
This charge should be dropped.

Charge 6
Have we made it too easy to make conceptual changes in Soil Taxonomy? Conversely, is it too difficult to classify soils into families where there are existing criteria but no series has been recognized to date?

A summary of the responses seem to be as follows:

1. Conceptual changes in Soil Taxonomy should be made easily.

2. Changes should continue to be made only after proposals are made and tested worldwide.

3. Soil Taxonomy should not be changed until soils for each new class are known to exist.

Recommendation:
No discussion.

Respectfully submitted,

STEVE R. BASE
Chairman, Committee 3

1990 North Central Soil Survey Work Planning Conference
Ames, Iowa June 4-8, 1990

Report of Committee No. 4: Water Quality

Committee Members:

Carolyn Olson, SCS, Lincoln, NE, Chm.
Gerald Miller, ISU, Ames, IA, Vice-Chm.
James Anderson, UM, St. Paul, MN
Thomas Bicki, UI, Urbana, IL
Allan Giencke, SCS, St. Paul, MN
Jerry Larson, SCS, Indianapolis, IN
Gary Lemme, SDSU, Brookings, SD
Randall Miles, UM, Columbia, MO
Delbert Mokma, MSU, East Lansing, MI
Larry Ratliff, SCS, Lincoln, NE
Walter Russell, FS, Milwaukee, WI
J.W. Scott, SCS, Champaign, Il
Michael Thompson, ISU, Ames, IA
Nyle Wollenhaupt, UM, Columbia, MO

Committee Charges

1. Can the information in soil survey reports be extended to cover geomorphic and stratigraphic relationships to soil series and soil map units? If not, develop procedures that would allow that additional information to be incorporated into reports. Include estimates of time, equipment needs, and outline educational programs that would allow the field soil scientists to develop expertise in these areas.

Response summary:

Soil survey reports can include more information on geomorphic and stratigraphic relations. Most soil scientists know a great deal about these relations but have not been encouraged to include them in the past. Better descriptions of the relations between soil map units and landscapes and unsaturated zone characteristics must be documented in reports. At the very least, the local nature of underlying materials should be reported, if not by map unit then by some larger delineation such as a hydrologic unit or subdivison of an MLRA.

Input should be encouraged in soil survey from other disciplines. A team of knowledgeable people from different disciplines might work together on a soil survey. State soil survey programs should cooperate and develop working relations with active state and local earth science agencies and with geology departments in universities, perhaps through MOU's or other formal and informal agreements.

2. Identify other potential sources of information that would aid in geomorphic and stratigraphic studies of a survey area.

Response summary:

Information is provided by a number of agencies in published format. These publications include geologic atlases produced on a county cost-shared basis, surficial deposits maps, three-dimensional maps and stack-unit maps as well as oil and water well logs.

3. Should there be a section in the soil survey report **that relates soil and landscape properties to water movement and environmental quality? If the answer is yes, develop a prototype.**

Response summary:

A section should be inserted in soil survey reports to address water quality and environmental issues.

More emphasis most be placed on the initial design and identification of map units. Reliability estimates of map unit composition and limitations on the use of information provided in soil survey reports must be provided.

Additional properties such as slope length and slope shape, natural vegetation and stratigraphy and spatial relations of adjacent map units should be incorporated into map unit design with more precise and standardized formats.. Tables could be added showing soil series or map units and associated stratigraphic units or hydrologic flow units. Reliability estimates for water-related parameters such as water availability could also be included.

Block diagrams representative of soils, surficial stratigraphy and water movement for a specific map unit or watershed unit should be included similar to the idea of a type section as used in geology or to a modification of the benchmark soil idea.

Soil leaching and water movement as related to water quality should be included using rating systems for soil leaching and runoff potential. Pesticide and nutrient management guidelines could be included. More soil survey interpretations for water movement and environmental quality should be developed.

Thr underlying issues that emerged during committee discussion include:

-- Need to record and/or collect additional soil attribute data. But we need to collect relevant soil attribute data. And we must be aware of the trap of collecting data for the sake of data collection, Therefore, effort must be expended to prioritize items for systematic data collection.

-- Need to continue to evaluate and fine tune guidelines for interpretations.

-- We have a demand for site specific interpretations. Issue -- how we take existing soil attribute data and general guidelines to meet the needs of site-specific users.

-- There are opportunities to include scientists from other disciplines to be involved in the actual writing of sections in the soil survey. For example, in our older modern reports foresters, climatologists, and engineers contributed to the soil survey manuscript and were appropriately identified by name. The issue today, however. is everyone is busy having their time more than adequately allocated. Geologist from state GS are hesitant to sign MOU's. The question is what do they receive in return for time and effort invested.

Committee Resolutions: 4

1. NCSS leadership consider prototyping block diagrams for physiographic regions.
2. Administrative structure in NCSS look at identifying several survey areas and develop guidance for developing prototypes for expanding geologic and physiographic information in general soil association section and soil forming factors section. Specifically in thr soil

association section insert discussion concerning stratigraphy, geomorphology, and native vegetation.

3. NCSS leadership continue to review pesticide/nitrogen runoff potentials for general situations as well as site specific cases. Therefore, encourage NCSS administrative structure to develop new hydrologic models to be used at general and site-specific scales.

4. Recommend that committee be continued. This meeting was the initial activity of the committee end the committee discussion was general in nature. We recommend that future committee charges look at specific charges such as how we as soil scientists can collect relevant data concerning water quality as related to soils.

5. Move the report be accepted.

REPORT OF THE SOIL INTERPRETATIONS COMMITTEE

COMMITTEE 5 - SOIL INTERPRETATIONS

PREPARED FOR THE NORTH CENTRAL WORK PLANNING CONFERENCE

JUNE 4-9, 1990 - AMES, IOWA

COMMITTEE MEMBERS

Thomas J. Bicki, Chairperson, Urbana, Illinois
Richard L. Schlepp, Vice-Chair, Salina, Kansas
Robert Aherns, Lincoln, Nebraska
Francis Belohavy, Lincoln, Nebraska
Loren Berndt, East Lansing, Michigan
William Broderson, Lincoln, Nebraska
Mack Hodges, Champaign, Illinois
Harry James, Springfield, Missouri
James Jordan, Ironwood, Michigan
Donald Last, Stevens Point, Wisconsin
Douglas Malo, Brookings, South Dakota
Paul Minor, Columbia, Missouri
Dennis Robinson, Marquette, Michigan
Jerome Scharr, Huron, South Dakota
Larry Tornes, East Lansing, Michigan
E. Jerry Tyler, Madison, Wisconsin
Robert Grossman, Lincoln, Nebraska

with contributions from:

Maurice Mausbach, Lincoln, Nebraska

Charges developed for Committee 5 - Soil Interpretations, by the Steering Committee of the Work Planning included the following issues.

1. "Hard data" are needed to support soil interpretations. Develop a priority list as to the kind and amount of data that should be collected to support our interpretations. Identify key soil properties used in models by resource people.

2. How can soil interpretations be better related to map units.?

3. What new soil interpretations are needed?

4. Should additional interpretations be given by soil map unit rather than soil series? If so, what are the interpretations?

5. As more "hard data becomes available, what statistical parameters should be included with the data?

6. Develop guidelines for interpretations of map units named for higher categories in Soil Taxonomy.

7. Should we put more emphasis on soil potential in the region? If so, in what area?

8. What soil potentials have been developed in the region (list by state)?

These charges were evaluated by circulating a questionnaire to each of the committee members. Their response to the charges were compiled and summarized by the committee chair. In most instances there was majority agreement on the charges. However, in some instances there was no clear consensus. A summary of responses to the charges is as follows:

Charge 1: Hard data are needed to support soil interpretations. Develop a priority list as to the kind and amount of data that should be collected to support our interpretations. Identify key soil properties used in models by resource people.

The committee concluded that data are needed to support two modeling components of soil interpretations. The first component deals with the other soil properties. For instance, basic soil characterization data are needed to model permeability, hydraulic conductivity, bulk density, cation exchange capacity, aggregate stability, and corrosivity. The second component addresses soil properties needed by data intensive models. A list of model parameters were compiled by the committee and ranked according to their priority. The parameters listed below are needed by such models as WEPP, GLEAMS, DRAINMOD, RUSTIC, PRZM, LEACHM, AND LUST. The consensus of the committee was that if data elements are needed for soil interpretations then those data elements should be collected. The committee also felt that a statement of reliability or limitations of the model should be included.

Data is critically needed for depths ranging from the surface to a depth of 2m or more. Concerns were raised by the committee about the need for collection of data from 2 to 10 meters or more and where to report such information. Committee members suggested it be included in special section on geology or possibly as a data table.

Prioritv	Parameter/Data Element
High	Permeability, saturated hydraulic conductivity and infiltration rate
High	Soil moisture regimes - (water table - depth, kind, and duration)
High	Clay mineralogy (total surface area measurements)
High	Moisture characteristic curves
High	Landscape and landform
High	Soil organic matter
High	Particle size analysis
Medium	Bulk density, both spatial and temporal variability
Medium	Cation exchange capacity
Medium	P and K supplying capacity of subsoil
Medium	Aggregate stability
Medium	Liquid limit/plasticity index
Medium	Gypsum
Medium	Corrosivity
Medium	SAR
Medium	pH
Medium	Surface & near surface features (i.e. crusting)
LOW	Shrink-swell
LOW	CaC03

Charse 2: How can soil interpretations be better related to map units?

The consensus of the committee was that the composition of the named soil or soils and contrasting soils should be given in the map unit description so that interpretation for the map units can be provided by individual components. No consensus was reached about whether percentages of similar soils are needed. Maurice Mausbach indicated that the NSSC is developing guidelines.

Interpreting map units requires statistically reliable data on map unit composition. Several members indicated a need for more transect data to better document the composition of the nap unit. Several members of the committee expressed concern about the availability of data collected on taxadjuncts. A consensus of the committee was that taxajuncts should be eliminated from the system. If the taxajunct is truly similar and interpretations are not affected, then it is not significant. If the taxadjunct has interpretations that are different then it should be, a new series or at minimum a separate SIR.

The committee discussed the possibility of a narrative on crop, pasture management, woodland, etc., that could be used to cover the management measures needed. Since cover crops, conservation tillage, etc., are applicable on almost all soils. This should be discussed in the use and management section.

Charae 3: What new interpretations are needed?

The committee concluded that a number of new soil interpretations were needed. A list of interpretations were compiled and ranked by priority.

Priority	Parameter/Data element
High	GLEAMS-Soil Pesticide ratings
High	Nitrogen leaching and runoff ratings
High	Tillage system suitability ratings
High	Runoff curve numbers or infiltration
High	Productivity index
High	Effects of conservation practices on protecting soil resource.
High	Water Quality Interpretations for Vadose Zone or for depths greater than 2 meters
Medium	Drainage suitability

Charge 4: should additional interpretations be given by soil map unit rather than soil series? If so, what are the interpretations?

There was a consensus among committee members that interpretations are now provided for soil components by nap units and any new interpretations should also be provided by the sane procedure. No new interpretations were submitted.

Charge 5: AS more **"hard data" becomes available, what statistical parameters should be included with the data?**

There was no consensus by committee members as to what statistical parameters should be included in future soil databases. Basic statistical parameters such as mean, median, node and standard deviation, and coefficient of variation were discussed for possible use. Resources for collecting data will dictate what is collected.

Geostatistical approaches are data intensive. A need was expressed for the development of statistically reliable techniques for collection of data by field soil scientists. It was noted that work is underway by NSSC to provide a structure to make location of measurements part of the soil nap.

Charse 6: Develop guidelines for interpretations of map units named for higher categories in Soil Taxonomy.

The NSSC is currently developing guidelines. The dilemma is that most interpretations depend on particle size. The principal problem with higher categories is that the ranges in properties are sufficiently great to make the range of interpretations less meaningful. There was agreement that when we map at the higher categories, interpretations are one of the things we sacrifice.

Several committee members suggested that miscellaneous areas, such as borrow pits, landfills, etc. should not be classified but should simply be "named for what they are". It was also pointed out that aÿÿ datab

CHARGES AND RECOMMENDATIONS

1. The **committee recommends** that the steering committee develop specific charges on criteria or interpretations that need to be revised.

Summary of Responses and Recommendations to Charges for Committee - 6
Development & Coordination of Soil Survey Data Bases

North Central Soil Survey Conference
Ames, Iowa
June 4-7, 1990

<u>Charge 1</u> What is the status in the region, by state, of the State Survey Data Base?

a. What data bases are used for soil survey information and what information is contained in the data base?

b. What is the compatibility of these data bases and what is the potential for exchange of information about data bases?

Within the confines of the State Soil Survey Database (3SD) it would appear that all states that responded to this charge are full utilizing most all parts of the 3SD. A summary of these parts of the data base is as follows:

MUIR Data - Used by all states.

Soil 5 Data - Used by all states.

Soil 6 Data - Used by all states.

CSD - Used by all states.

Scheduler - Used by all states.

STATSGO - Mentioned by two states as being completed or near completion.

Other data bases, that are not a part of the 3SD that were mentioned in response to this charge and their compatibility were as follows:

a. Lab data from the NSSL - no apparent compatibility problems.

b. Lab data form a university - The format of the data is in the same format as that of the National Lab data base, and accessing the data is no problem.

c. Nontechnical soil descriptions as written in Professional Write Word Processor were converted to Rbase DBMS but was time consuming.

d. In Iowa the ISPAID data base in use prior to 3SD has county specific data that is being uploaded to 3SD.

c. It was brought to the committees attention that there is an effort to collect data for a National Soil Survey Laboratory Database from cooperating agencies such as universities, but no one was aware in what stage this project was in. It appears that so far there has not been an effort to get this data collected.

Recommendations:

1. There should be an effort on the part of the National Soil Survey Data Base staff to get updates of the State Soil Survey Data Base program out on time and reasonably tested.

2. Operating systems for the future should be standardized, (UNIX/DOS) or translator software programs should be provided. (Example: Providing a DBase version of the DSSIS program for states that do not have access to RBase or the funds to buy RBase.)

Charge 2 - Discuss modifications made in state soil survey data bases for use in CAMPS.

From the responses received most of the states are modifying or editing the soil data used in CAMPS. All but one state mentioned that they have already begun this process. In most all cases the soil data elements that are being checked most carefully are the following:

K factors

T factors

Capabilities

Hydrologic Group

Crop yields - adjusted to the county, especially for older surveys.

Charge 3 - *There are several groups compiling* data dictionaries in the region. One dictionary of interest is being developed by the National Soil Survey Characterization Data Base Committee chaired by Dr. Ellis Knox. Another is the data dictionary for the State Soil Survey Data Base (3SD). Review, compare, and suggest additions and/or changes to these dictionaries.

NOTE: Since the time these charges were given to this committee we have been notified that the two databases mentioned in this charge will be combined, and placed into the SSD data dictionary when it is next updated. The review process is ongoing at this time.

All states that responded to this charge felt that the data dictionary in the SSD and additional data definitions written by the National Soil Survey Laboratory were well written.

No comments or additional terms were supplied to add to the definitions.

Recommendation:

There should be a method that states can request additions to the dictionary as the need arises. This would probably be best done through the National Soil Survey Investigations Staff.

Respectfully submitted,

William E. Frederick
Committee Chairman

use in CAMPS. The process was very time consuming.

N. DAKOTA: We are using all phases of 3SD that are operational at this time. Areas used consistently are MUIR, OSEDS, SO16, and Scheduling. We have provided computer access to OSEDS to all soil survey parties. We are downloading MUIR data and brief map unit descriptions (where available) for CAMPS. All field offices in the state have the CAMPS program in AT&T 6386's. Through soil reports and queries, we expect to generate most of the data necessary for the update of Section II of the Field Office Technical Guide.

I would expect that most of the databases (UNIX) are compatible, however, there needs to be some sort of control clearinghouse for exchange of information. Currently, exchange of information is nearly nonexistent.

WISCONSIN: a. We use the UNIX prelude Database in the state office. All of our soil survey offices and our area soil scientists use MS-DOS RBase System V. We have only one county using UNIX CAMPS at this time, all other field offices use DOS CAMPS. We have put a higher priority on converting our field offices to UNIX than our soil survey offices so I feel it will take a few years to get UNIX in the soils offices.

We are using the Field Soil Survey Information System (FSSIS) in all our soil survey offices and area offices. I have added some state options to this program. These include:

1. Field Office Technical Guide Application (FOTG2). This application is used to print reports for Section 2 of the Field Office Technical Guide (FOTG) from the CAMPS Soil Database. Data for each report is drawn from one or more tables and printed with headers and'footers identifying the report as part of the FOTG. The county name and state is taken from the Soil Database so the application can be used in any state.

2. LESA Application
This application is used to run the LESA program from our CAMPS Database. It uses the data presently in the Soils Database and creates one additional table in the database. This application can be used with an Soil Database.

3. Acres Measurement
I put this application together to record acreage measurements and print corresponding reports. The database is in its own directory, but the application copies map unit information from wither the Soils Database or the SOIL-6 Database. The application *can* be used in any state and if neither a Soils Database or a SOIL-6 Database is available the map unit information could be keyed in.

b. All three of these applications can be used in *any* state in conjunction with *a* Rbase Soil Database. Several state have obtained copies of the FOTG2 Application.

I gave a presentation on these applications at the area soil scientist meeting we hosted earlier this month and several area soil scientists asked for copies and were given them.

IOWA: We have *a* soil database that was created at *Ames* before 3SD was developed. The database is called **ISPAID** *and* contains about 60 fields of information. We are currently uploading county specific information from **ISPAID** to **3SD.** Examples are yield estimates, organic aatter, and K factors that are county **specific.**

MISSOURI: Status of the state survey database.
MUIR tables **have been** loaded into the state soil survey database for all Missouri soil surveys currently in the map unit use file. This data covers about **70** counties. An additional 18 counties have SOIL-6 data entered into 3SD. These will be added to **the MUUF** and MUIR tables loaded into 3SD **as** correlations are completed and **SOIL-**6's finalized. The remaining 26 counties have no data in the state soil survey database.

All **of the** official series descriptions and their associated soil interpretations records used in Missouri are now in the state database.

Two counties, St. Louis and St. Charles, have been digitized and information can be generated through GRASS. The Missouri Department of Natural **Resources** is in the *process* of digitizing the remainder of Missouri's soil surveys. Currently their system is not compatible with the SCS database. The goal of the project is to have digitized soil survey information that is compatible to the state soil survey database. The

STATSGO maps are being digitized by a scanner in the Missouri SCS state office. This project should be completed in the next few weeks.

MICHIGAN : a: State Soil Survey Database Status:

60 counties are in the MUIR database which ix divided into Mesic and Frigid sub-directries, 10 counties have on-going soil surveys in which the MUIR data will be finalized at the final correlation and 13 counties have yet to be completed.

SOIL-5 records are updated via tape from Ames twice a year so records are fairly recent.

SOIL-6 records are maintained for all 10 for the most part through the Michigan Dept. of Agriculture and County Commissioners offices who cooperate in the soil survey program. Tha software provided is DBase, while the FSSIS runs in RBase. Since neither the state or SCS has money to buy the RBase program at time there is a need to make or convert this program to DBase. This is one concern that people on the National Soil Survey Database Staff might want to look into, as other states may have a similar problem.

3. Soil Survey Digitizing - has been completed for 6 previously published counties in the state through the use of the CMAP program developed by the Mich. Department of Natural Resources, Center for Remote Sensing. Nine of ten on-going soil surveys and all new soil surveys will be digitized in the field as they are completed and published from the digitized data on a photographic background. We are in the final stages of completing this process through the National Cartographic Center for our first survey - Saginaw County.

Charge 2 - Discuss modifications made in state soil survey data bases for use in CAMPS.

S. DAKOTA: We plan to tailor the MUIR tables to the county level.

OHIO: Modifications in 3SD for use in CAMPS has varied depending on the age of the existing correlation and availability of documentation of field investigations. If a county has a recent correlation and/or documentation is at current standards, 3SD is modified to reflect the same information that would be incorporated into manuscript tables for a published soil survey. On older correlations where documentation is not up to current standards, only those changes that can be documentated by the correlation, the manuscript, or field notes is incorporated into 3SD.

N. DAKOTA: We have not made any modifications yet in 3SD for use in CAMPS. One of our area soil scientists created a program for brief map unit descriptions. His program uses MUIR tables (COMP-LAYER-MAPUNIT-RSPROD) to develop most of the database needed. The progran automatically writes paragraphs for soil (SOI), agronomy (AGR), range (RNG), pasture (PAS), windbreak suitability (WBS), and wildlife habitat (WLH). I am attaching a sample of the data created and entered into 3SD. We plan to share this program with the National Soil Survey Database staff as soon as a users' manual is completed.

WISCONSIN: We have reviewed and localized portions of our Soil Database these including:

- K factors
- T factors
- Capabilities
- Hydrologic Group
- Crop Yields (still in process)

The changes we made were generally fairly minor, such as adjustrng the K factor to represent the map unit texture when more than one texture was on the surface line of the SIR or reducing a T factor for a severely eroded map unit. We also changed a few capabilities for out of state soils with different slope breaks than those we use.

The FOTG2 Application adds a table to the Soil Database used to convert wind erodibility groups to wind erodibility values.

The LESA Application also adds one permanent table to the Soils Database.

IOWA : We have completed editing of each county database and dounloaded to UNIX CAMPS in all 100 field offices. We are modifying yields, organic matter and K factors for each county. Additional fields of data are also being added from ISPAID that are not in the 3SD database.

MICHIGAN : The raw data contained in the MUIR database is at first partially edited and checked for the following data elements before it is downloaded for use in CAMPS:

- K Factors
- T Factors
- Capabilities
- Yield data

This was done originally at the state office, but now has been delegated to the area soil scientists with quality control provided by the state office. After the data has beenedited the nontechnical soil descriptions are added and downloaded with the CAMPS data.

A fully edited version of the data,(all data elements in the tables) is made later as time permits.

Other than these changes and edits, no other modifications or additions have been made to the MUIR data.

Charge 3 - There are several groups compiling data dictionaries in the region. One dictionary of interest is being developed by the National Soil Survey Characterization Data Base Committee chaired by Dr. Ellis Knox. Another is the data dictionary for the State Soil Survey Data Base (3SD). Review, compare, and suggest additions and/or changes to these dictionaries.

S. DAKOTA: The biggest need for dat dictionaries is to have them interrelational and compatible.

OHIO: No comments or additions at this time. The dictionaries will be further reviewed prior to the meetings and suggestions or additions will be made at that time.

N. DAKOTA: No comments on the dat dictionaries, except that they should be reviewed by all disciplines at the Technical Centers.

WISCONSIN: I have no problems with the definitions of the data elements, but I would also like to see a standard abbreviation that could be. used as a column heading.

IOWA: I feel the data dictionaries should be coordinated as much as possible. We don't want different definitions for the same data element in each database. Recently we have sent a list of data elements to Dave Anderson to be added to the Pedon program. These dat elements were in ISPAID.

MISSOURI: The data dictionary for the state soil survey database is well written and comprehensive. States may want to add more specific landforms and geologic terms to fit their area.

MICHIGAN: We feel the database dictionaries are well written and have been well coordinated to date. We also feel as Missouri, that there may be a need to add certain landform and geologic terms to the database. The definitions of these terms should be approved and passed through the National Soil Survey Investigationr Staff.

ADDITIONAL NOTE: Since the time these charges were given to this committee we have been notified that the two databases mentioned in this charge will be combined, and placed into the 3SD data dictionary when it is next updated. The review process is ongoing at this time.

OTHER ITEMS MENTIONED BY COMMITTEE MEMBERS:

1. A menu opiton in soil reports for map unit yields just like the one currently available for component yields. This lis needed for Section II of tech. guides and also soil survey manuscripts.

2. We need additional items on the SOI6 to become part of the database. Entries needed for North Dakota are:

a. Productivity index (PI) of the map unit.
b. Windbreak suitability groups for map unit components.
c. Pasture groups for map unit components.
d. Additional farmland of statewide importance.
e. Additional farmland of local importance.

Record of North Central Soil Survey Conference

Year	Location of Meeting	Chairman
1955	Missouri	Ableiter, Aandahl
1956	Michigan	Westin
1957	Illinois	Bartelli
1958	Wisconsin	Bidwell
1959	Kansas	Rogers
1960	Indiana	Elder
1961	North Dakota	Engberg
1962	Ohio	Riecken
1964	Nebraska	Nelson
1966	Iowa	Ulrich
1968	Minnesota	Mitchell
1970	Illinois	Fehrenbacher
1972	South Dakota	Bannister
1974	Missouri	Scrivner
1976	Michigan	Harner
1970	Wisconsin	Hole
1980	Indiana	Sinclair
1982	North Dakota	Patterson
1984	Kansas	Roth
1986	Ohio	Smeck
1988	Nebraska	Culver
1990	Iowa	Fenton

Membership of North Central Soil Survey Conference
January 1990

Frank L. Anderson
Soil Conservation Service
6515 Watts Rd., Suite 200
Madison. WI 53719-2726

Loren Berndt
Soil Conservation Service
1405 S. Harrison Rd., Rm. 101
East Lansing, MI 48823-5202

James L. Anderson
Department of Soils
University of Minnesota
St. Paul. MN 55108

Dr. Thomas Bicki
Turner Hall, Dept of Agronomy
1102 S. Goodwin Avenue IL 61801
Urbana, IL 61801

Steve R. Base
SCS, USDA. MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Jerry Bigham
Department of Agronomy
Ohio State University
Columbus, OH 43210

Otto W. Baumer
SCS, USDA, MNTC, Room 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Ricky Bigler
USDA-SCS, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Albert Beaver
616 Van Hise
Uni. of Wisconsin
Madison, WI, 53706

James G. Bockheim
Dept. of Soil Science
University of Wisconsin
Madison, WI 53706

Francis Belohlavy
Research Soil Scientist, UNL
Federal Bldg., Rm 345
100 Centennial Mall North
Lincoln, NE 68508-3866

James A. Bowles
University of Wisconsin-
Stevens Point
Stevens Ppint, WI 54481

Louie L. Buller
SCS-USDA, MNTC, Rm. 345
100 Centennial Mall, N
Lincoln, NE 68508-3866

James R. Culver
USDA-SCS, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Lester J. Bushue
Soil Conservation Service
301 North Randolph Street
Champaign, IL 61820

Robert Darmody
Dept. of Agronomy
University of Illinois
Urbana, IL 61801

John Cain
Wisconsin Dept. of Nat. Resources
Box 7921
Madison WI 53707

John C. Doll
Soil Conservation Service
301 North Randolph St.
Champaign, IL 61820

David T. Cleland
Huron-Manistee Nat. Forest
421 S. Mitchell St.
Cadillac, MI 49601

Sylvester C. Ekart
Soil Conservation Service
P.O. Box 1458
Bismarck, ND 58502

Terence H. Cooper
Dept. of Soils
University of Minnesota
St. Paul, MN 55455

Gary R. Evans
Coop. State Research. USDA
West Auditors Bldg.. Rm. 121
Washington. DC 20251

James Crum
Dept. of Crop & Soil Sciences
Michigan State University
East Lansing, MI 48824

T.E. Fenton
Dept. of Agronomy
Iowa State University
2407 Agronomy Hall
Ames, IA 50011

W. Richard Folsche
USDA-SCS
P.O. Box 6567
Fort Worth, TX 76115

Forest Soil Scientist
Superior National Forest
P.O. Box 338
Federal Bldg.
Duluth, MN 55801

Jim Fortner
Soil Conservation Service
760 South Broadway
Salina, KS 67401

Don Franzmeier
Dept. of Agronomy
Purdue University
Lafayette, IN 47907

William E. Frederick
Soil Conservation Service
1405 S. Harrison Rd. #101
East Lansing, MI 48823-5202

Erling E. Gamble
SCS, USDA, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Danella George
USDA, Forest Service
Box 25127
11177 W. 8th Avenue
Lakewood, CO 80225

Tim Gerber
Ohio Dept. of Nat. Resc.
Fountain Square Drive
Columbus. OH 43224

Jon C. Gerken
Soil Conservation Service
200 N. High St. Rm. 522
Columbus. OH 43215

A.R. Gilmore
Dept. of Forestry
University of Illinois
Urban, IL 61801

Allan G. Giencke
Soil Conservation Service
316 N. Robert St.
St. Paul, MN 55101

Jerry D. Gott
Mark Twain National Forest
401 Fairgrounds Rd.
Rolla, MO 65401

David F. Grigal
Dept. of Soil science
University of Minnesota
St. Paul. MN 55455

Milo Harpstead
Dept of Soil Science
Uni. of Wis-Stevens Point
Stevens Points, WI 54481

Robert B. Grossman
SCS-USDA, NSSL, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Rodney Harner
SCS-USDA, MNTC,Rm. 345
100 Centennial Mall, North
Lincoln, NE 68508-3866

Howard F. Gundlach
Soil Conservation Service
6515 Watts Road, Suite 200
Madison, WI 53719-2726

Corneilius J. Heidt
Soil Conservation Service
P.O. Box 1458
Bismarck, ND 58502

Roger Haberman
SCS-USDA, MNTC, Rm. 345
100 Centennial Mall, North
Lincoln, NE 68508-3866

Dennis Heil
SCS, Room 200
316 North Robert St.
St. Paul, MN 55101

George F. Hall
Dept. of Agronomy
Ohio State University
Columbus, OH 43210

Gary Heitman
Bureau of Indian Affairs
1154th Ave. SE
Aberdeen, SD 57401

R. David Rammer
Dept. of Agronomy
23 Mumford Hall, Uni of Mo.
Columbia, MO 65211

Norman P. Helzer
USDA-SCS, Fed. Bldg Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

John S. Hickman
Department of Agronomy
Kansas State University
Manhattan, KS 66506

Berman D. Hudson
USDA-SCS, MNTC, Rm. 345
100 Centennial Mall North
Lincoln. NE 68508-3866

Mack S. Hodge
Soil Conservation Service
301 No. Randolph St.
Champaign, IL 61820

K. K. Huffman
Soil Conservation Service
200 North High St. Rm. 522
Columbus. OH 43215

Hubert Holdorf
U.S. Forest Service
P.O. Box 7669
Missouls, MT 59807

Harry R. James
SW Missouri State Univ.
Agriculture Department
Springfield, MO 65802

C. Steven Holzhey
USDA-SCS, NSSC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Ivan Jansen
Agronomy Dept.
University of Illinois
Urbana, IL 61801

David Hoppe
Nicolet National Forest
68 South Stevens Street
Rhinelander, WI 54501

Paul Johnson
U.S. Forest Service
370 Reed Road
Broomall, PA 19008

William D. Hosteter
Soil Conservation Service
6013 Lakeside Blvd.
Indianapolis, IN 46278

Paul R. Johnson
SCS-USDA, MNTC, Rm. 345
100 Centennial Mall
Lincoln. NE 68508-3866

James K. Jordan
Ottawa National Forest
East U.S. Hwy. 2
Ironwood, MI 49938

Leonard S. Kempf
Chequamegon National Forest
1170 4th Avenue South
Park Falls, WI 54552

Charles R. Kruegor
Ohio Agricultural Research
and Development Center
Wooster, OH 44691

Ronald J. Kuehl
Soil Conservation Service
210 Walnut St.
693 Federal Bldg.
Des Moines, IA 50309

Mark S. Kuzila
Conservation & Survey Div
Univ of Nebr., 113 Nebr. Hall
Lincoln, NE 68588

Jerry Larson
Soil Conservation Service
6013 Lakeside Blvd.
Indianapolis, IN 46278

Donald Last
Univ. of Wisconsin
Stevens Point
Stevens Points, WI 54401

Gerhard B. Lee
Dept. of Soil Science
University of Wisconsin
Madison, WI 53706

Christine Lietznu
Michigan Dept. of Ag.
P.O. Box 30017
Lansing, MI 48909

Gary D. Lemme
Dept. of Plant Science
South Dakota State Uni
Brookings, SD 57007

Dave Lewis
Department of Agronomy
Univerity of Nebraska
Lincoln, NE 68583

Dave Lockridge
Soil Conservation Service
693 Federal Bldg.
210 Walnut Street
Des Moines, IA 50309

Earl D. Lockridge
SCS, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Joseph McCloskey
Soil Conservation Service
316 N. Robert Street
St. Paul, MN 55101

J. Cameron Loerch
USDA-SCS, Federal Building
100 Centennial Mall N., Rm 345
Lincoln, NE 68508-3866

Robert L. McLeese
Soil Conservation Service

Kenneth W. Lubich
Soil Conservation Service
6515 Watts Rd., Suite 200
Madison, WI 53719--2726

Warren Lynn
SCS, MNTC, NSSL, Rm. 345
100 Centennial Mall North
Lincoln, NE 68608-3866

Fred W. Madison
Geological & Nat. Hist. Surv.
3817 Mineral Point Rd.
Madison, WI 53705

Doug Malo
Dept. of Plant Science
South Dakota State Uni.
Brookings, SD 57007

Randall J. Miles
Dept. of Agronomy, Univ. of MO
138 Mumford Hall
Columbia, MO 65201

Robert D. Nielson
Soil Conservation Service
200 Fourth St., SW
Huron, SD 57350

Gerald A. Miller
2104 Agronomy Hall
Iowa State University
Ames, IA 57350

John Nixon
Soil Conservation Service
210 Walnut St.
693 Federal Bldg.
Des Moines, IA 50309

Paul E. Minor
Soil Conservation Service
555 Vandiver Dr.
Columbia, MO 50011

Douglas Oelmann
Soil Conservation Service
210 Walnut Street
693 Federal Bldg.
Des Moines, IA 50309

Fred E. Minzenmayer
Soil Conservation Service
760 South Broadway
Salina, KS 67401

Ken Olson
Department of Agronomy
University of Illinois
Urbana, IL 61801

Delbert L. Mokma
Dept. of crop & Soil science
Michigan State University
East Lansing, MI 48824

Sam Orr
DRN-Div of Envir. Quality
2010 Missouri Blvd
Jefferson City, MO 65101

Wiley D. Nettleton
NSSL, SCS, Fed. Bldg.. Rm 444
100 Centennial Mall North
Lincoln, NE 68508-3866

Ronald Paetzold
SCS, MNTC, NSSL, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Robert J. Parkinson
Soil Conservation Service
200 No. High Street, Rm. 522
Columbus. OH 43215

Gerald J. Post
SCS, USDA, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Donald D. Patterson
Soil Science Department
North Dakota State Uni.
Fargo, ND 58102

Dennis K. Potter
Soil Conservation
555 Vandiver Drive
Columbia, MO 65202

William R. Pauls
Soil Conservation Service
555 Vandiver Drive
Columbia, MO 65202

Larry Ragon
USDA-SCS, Fed. Bldg. Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Richard D. Paulson
Soil Conservation Service
316 North Robert Street
St. Paul, MN 55101

M.D. Ransom
Department of Agronomy
Kansas State Uni.
Manhattan, KS 66506

Steve Payne
Soil Conservation Service
6515 Watts Rd., Suite 200
Madison, WI 53711

Alexander Ritchie
Ohio Dept. of Nat. Resources
Fountain Sq. Drive
Columbus, OH 43224

Felix Pnder, Jr.
USDA Forest Service
NC Forest Experiment Station
l-26 Agr. Bldg.,
University of Missouri
Columbia, MO 65211

Denniss Robinson
Michigan Dept. of Agriculture
310 W. Washington, Suite 202
Maravette, MI 49055

Walter Russell
USDA, Forest Service
310 W. Wisconsin Ave.
Milwaukee, WI 53203

Stephen G. Shetron
School of Forestry
Michigan Tech University
Houghton, MI 49931

Richard H. Rust
Department of Soils
University of Minnesota
St. Paul, MN 55455

H. Raymond Sinclair, Jr.
USDA-SCS, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Jerome M. Schaar
Soil Conservation Service
200 Fourth Street, SW
Huron, SD 57350

Neil E. Smeck
Department of Agronomy
Ohio State University
Columbus. OH 43210

Richard Schlepp
Soil Conservation Service
760 South Broadway
Salina, KS 67401

David Smith
Forest Service, Box 25127
11177 W. 8th Avenue
Lakewood, CO 80225

J. W. Scott
Soil Conservation Service
301 North Randolph
Champaign, IL 61820

Gary L. Steinhardt
Dept. of Agronomy
Purdue University
West Lafayette, IN 47907

David A. Shadis
Chippewa National Forest
Cass Lake, MN 56633

Don Stelling
USDA, SCS, P.O. Box 6567
National Cartographic Ctr.
Ft. Worth, TX 76115

Neil W. Stroesenreuther
Soil Conservation Service
1405 S. Harrison Rd., #101
E. Lansing, MI 48823-5202

L.A. Tornes
Soil Conservation Service
200 N. High St., Rm. 522
Columbus, OH 43215

Roger A. Swanson
Plant and Earth Sciences
University of Wisconsin
River Falls, WI 54022

Dale Trenda
Shawnee National Forest
901 S. Commercial St.
Harrisburg, IL 62946

James H. Thiele
Soil Conservation Service
Box 1458
Bismarck, ND 58502

Martin Jurgenson
School of Forestry
Michigan Tech. University
Houghton, MI 49931

Bruce Thompson
Soil Conservation Service
555 Vandiver Dr.
Columbia, MO 65202

Richard Tummons
Soil Conservation Service
555 Vandiver Drive
Columbia, MO 65202

Michael Thompson
Department of Agronomy
2503 Agronomy Hall
Iowa State University
Ames, IA 50011

Robert I. Turner
SCS-USDA, MNTC, Rm. 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Pamela J. Thompson
Soil Conservation Service
301 No. Randolph St.
Champaign, IL 61820

E. Jerry Tyler
Dept. of Soil Science
Soils Bldg., Uni. of Wis.
Madison. WI 53706

Michael G. Ulmer
Soil Conservation Service
Box 1458
Bismarck, ND 58502

Nyle Wolenhaupt
214 Waters Hall
University of Missouri
Columbia, MO 65211

Kenneth D. Vogt
Soil Conservation Service
555 Vandiver Drive
Columbia. MO 65201

Joseph E. Yahner
Dept. of Agronomy
Purdue University
West Lafayette, IN 47907

Carl E. Wacker
Soil Conservation Service
FCS Building, Suite 600
375 Jackson Street
St. Paul, MN 55101

Ronald D. Yeck
SCS, MNTC. NSSL, Fed. Bldg. #444
100 Centennial Mall North
Lincoln, NE 68508-3866

Bobby J. Ward
Soil Conservation Service
6013 Lakeside Blvd.
Indianapolis, IN 46278

Larry D. Zavesky
Soil Conservation Service
200 Fourth St. S.W.
Huron, SD 57350

Cleveland Watts
Soil Conservation Service
760 South Broadway
Salina, KS 67401

Gerald Wigger
Hiawatha National Forest
2727 No. Lincoln Rd.
Escanaba, MI 49829