NATIONAL COOPERATIVE SOIL SURVEY

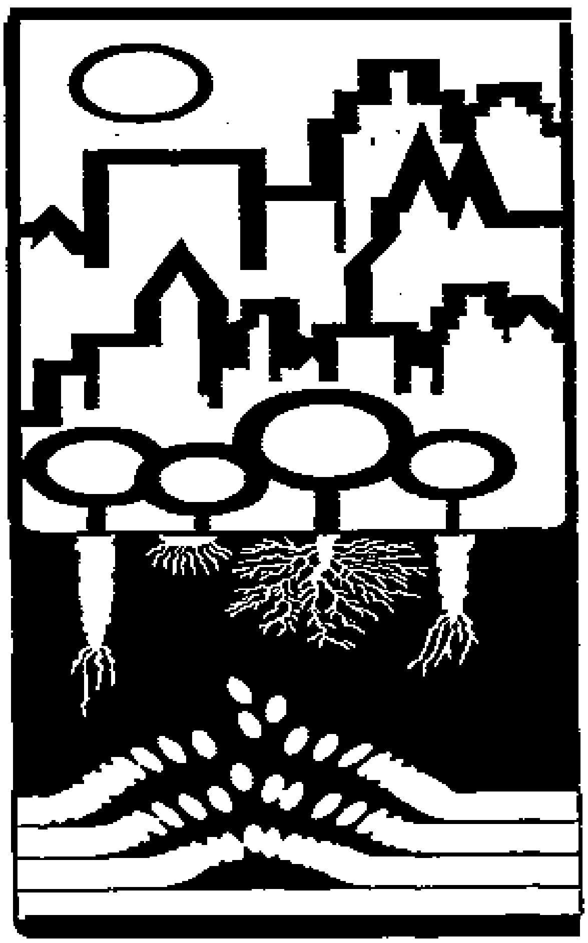
1997 National Conference Proceedings

Baton Rouge, Louisiana
June 16-20, 1997

TABLE OF CONTENTS

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Baton Rouge, Louisiana
June **16-20, 1997**



United States Department of Agriculture
Natural Resources **Conservation** Service

June 15 - Sunda

Registration 4:00 - 7:00 PM

June 16 - Monday

Facilitator: Jerry Daigle

8:00 - 10:00 AM	*Registration*
8:00 - 8:15 AM	*Welcome by Chancelor, Agricultural and Mechanical College, Louisiana State University* William B. Richardson
8:15 - 9:00 AM	*Remarks from the Chief of the Natural Resources Conservation Service and Introduction of the Secretary of Agriculture* Paul Johnson
9:00 - 9:30 AM	*INVITED - Remarks from the Secretary of Agriculture* Secretary of Agriculture, Dan Glickman
9:30 - 10:00 AM	BREAK
10:00 - 10:30 AM	*NRCS in Louisiana* Don Gohmert
10:30 - 11:00 AM	NCSS in *NRCS* Horace Smith
11:00 - 11:30 AM	*Ag. Exp. Station Perspective on NCSS* Wayne Hudnall
11:30 - 11:40 AM	*Highlights of USFS Soil Survey Activities* Gretta Boley
11:40 - 11:50 AM	*Highlights of Soil Survey Activities in the NE Region* John Sencendiver
11:50 - 12:00 PM	*Highlights of BLM Soil Survey Activities* Bill Volk

12:00 - 1:00 PM — LUNCH

Facilitator: Gretta Boley

1:00 - 2:00 PM — *Panel on Accelerated Soil Survey Digitizing Process*
Tommie Parham

2:00 - 2:30 PM — *Canadian Soil Survey Activities*
Ted Huffman

2:30 - 3:00 PM — *South African Soil Survey Activities*
Theo Dohse

3:00 - 3:30 PM — *BREAK*

3:30 - 4.M PM — *1890 Universities report, Southern University*
Bobby R. Philis

4:00 - 5:00 PM — *Soil Taxonomy Standing Committee*
Bob Ahrens

5:00 - 5:30 PM — *Soil Survey Centennial Activities*
Gary Muckel

6:00 - 8:00 PM — Social/Mixer - cash bar

June 17 - Tuesday

Facilitator: Mike Golden

8:00 - 8:10 AM — *Highlights of Soil Survey Activities in the West Region*
Curtis Monger

8:10 - 8:20 AM — *Highlights of the National Park Service Soil Survey Activities*
Larry Pointer

8:20 - 8:30 AM — *Highlights of Soil Survey Activities in the South Region*
Wayne Hudnall

8:30 - 9:00 AM — *Anthropogenic Soils Report*
John Galbraith

9:00 -lo:OO AM — *Panel on Processes for Updating Soil Surveys*
Warren Henderson

10:00 - 10:30 AM — *BREAK*

10:30 - 11:30 AM — *Panel on Field Indicators of Hydric Soils*
Russ Pringle

11:30 - 12:00 PM — *Field Trip Orientation*
Wayne Hudnall

12:00 - 1:00 PM — LUNCH

1:00 - 5:00 PM

Committee Breakout Sessions - 6 sessions running concurrently. Sessions run for one hour. At the end of each hour participants can rotate to another session of interest. This provides participants an opportunity to sit in on 4 sessions of their choice:

1. NCSS *Structure* Bob Rourke
2. *Site Specific Soil Data and Interpretations* Mark McClain
3. National NCSS *Research Agenda* John Kimble/Larry Wilding
4. *Natural Resources Survey* Ken Scheffe
5. *Future of Soil Survey* Cameron Loerch
6. *Marketing* Soil *Survey* Steve Hodges/Gary Muckel

June 18 - Wednesday

8:00 AM - 5:00 PM — FIELD TRIP

June 19 - Thursday

Facilitator: Bobbie Ward

8:00 - 8:30 AM — *Soil Quality/resilience Committee Report*
Cathy Seybold

8:30 - 9:00 AM — *Eroded Soil Committee Report*
Tom Fenton

9:00 - 9:30 AM	*National NRCS Technology Consortium* Lee Herndon
9:30 - 10:00 AM	*BREAK*
10:00 - 10:30 AM	*National Society of Consulting Soil Scientist Activities* Mark McClain
10:30 - 10:40 AM	*Highlights of Soil Survey of the North Central Region* David Hammer
10:40 - 11:00 AM	*International Activities* Hari Eswaran/Paul Reich
11:00 - 11:30 AM	*Global Climate Change Activities* John Kimble
11:30 - 12:00 PM	*Ecological Framework Interagency Committee update* Jim Keys
12:00 - 1:00 PM	LUNCH

FACILITATOR: Wayne Hudnall

1:00 - 1:30 PM	*Soil Hydrology Team Report* Phil Schoenberger
1:30 - 2:15 PM	*Site Specific Management* Fran Pierce
2:15 - 2:45 PM	*NCSS Standards Committee* John Kimble
2:45 - 3:15 PM	*BREAK*
3:15-4:15 PM	*Pad Evaluation of MLRA (NRCS) organization* Dave Smith
4:15 - 4:45 PM	*What do we know about the Pedosphere of the U.S. SSSA S-S committee proposal* Dennis Nettleton

Facilitator: Mark McClain

8:00 AM- 8:30 AM	Committee 1. *NCSS Structure*
8:30 AM - 9:00 AM	Committee 2. *Site Specific Soil Data and Interpretations*
9:00 AM - 9:30 AM	Committee 3. *National NCSS Research Agenda*
9:30 AM - 10:00 AM	*BREAK*
10:00 AM - 10:30 AM	Committee 4. *Natural Resources Survey*
10:30 AM - 11:00 AM	Committee 5. *Future of Soil Survey*
11:00 AM - 11:30 AM	Committee 6. *Marketing Soil Survey*
11:30 AM - 12:00 PM	*Closing* Horace Smith

Steering Committee will meet from 1:00 - 4:00 PM
Horace Smith Chairing

Committee members:

Gretta Boley	Mark McClain
Thomas E Calhoun	Paul McDaniel
Jim Culver	Dennis Potter
Jerry Daigle	Ken Scheffe
Wayne Hudnall	John Sencendiver
Norm Kalloch	Bill Volk
Doug Malo	

BATON ROUGE HILTON HOTEL
5500 Hilton Ave.
Baton Rouge, LA 70808

The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact the USDA Office of Communications at (202) 720-2791.

To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C., 20250, or call 1-800-245-6340 (voice) or (202) 720-1127 (TDD). USDA is an equal opportunity employer.

USDA United States Department of Agriculture | Natural Resources Conservation Service | Soil Survey Division
PO Box 2890
Washington DC 20013
202-720-7848

SUBJECT: **National Cooperative Soil Survey** Conference Steering Committee Minutes

September 17, 1997

TO: Steering Team Members
(See attached list)

File Code:430-14

Please see the attached "Ballot" and return it as indicated.

The Steering Committee for the National cooperative Soil Survey conference met at the conclusion of the Conference on 06/20/97, in accordance with the By-laws. The meeting was called to order by Horace Smith at 1:00 PM, and a quorum was present. Steering Committee members present were the Committee Chair Horace Smith, Thomas Calhoun, Jii Culver, Jerry Daigle, Sid Davis, Scott Davis, Wayne Hudnall, Norm Kalloch; Ken Olson, Dennis Potter, Ken Scheffe, and John Sensindiver.

The agenda included the committee reports from the conference and their associated recommendations, and the location of the next conference in 1999.

The first order of business was to take action on committee reports and recommendations.

COMMITTEE REPORTS

Committee #1 National Cooperative Soil Suwev Structure

A. Committee recommendations for corrections to the By-laws included:

1. Article VI-Section 1 representation from the 1890 schools and from the tribal Universities should be added to the Steering Committee.
2. Article VI-Section 4 the introductory statement should be modified to read: The Steering Committee shall: (dropping "The Steering Committee shah plan, organize, and manage the Conference" as being redundant).

The Steering Committee Recommended:

1. *Establishing aposition on the Steering Committee for a representative of the 1890 and Tribal Schools. The individual to participate will be recommended by the Conference Chair and will be from the vicinity of the next conference.*
2. *The Steering Committee accepted the 2nd recommendation.*

All changes to the by-laws require a majority vote. A ballot will be circulated to the membership.

The Natural Resources Conservation Service is an Agency of the United States Department of Agriculture

AN EQUAL OPPORTUNITY EMPLOYER

B. Committee recommendations on the future role of AES, 1890 and Tribal Universities, and other non NRCS Cooperators in the future of the NCSS included:

1. Explore the use of split appointments between the cooperating agencies and the NRCS whereby both of the organizations gain expertise at a reduced cost as compared to each hiring full time personnel to fill parallel positions that are not adequately funded.
2. Establish potential funding sources for projects that meet the needs of the NCSS.
3. Involve cooperating agencies representatives in at least one MLRA meeting each year to discuss soil survey needs in the management area and to cultivate ideas and build relationships.

The *Steering* Committee accepted *the* recommendations *for inclusion in the Conference Proceedings, and NRCS will notify the MLRA leaders on involving cooperators in MLRA management discussions.*

C. *Committee* recommendations on membership and participation included:

1. Throughout the By-laws references to "Director of Soils, NRCS" should be changed to "Director Soil Survey Division".
2. Article III-A: Change "Chairman" to "Chair".
3. Article III-B: Add "4. Soil scientists from each of the six NRCS regional offices are included as members".

The Steering *Committee directed the secretary to make the title changes suggested in 1 and 2, and the recommendation 3 will be included on the ballot for consideration by the membership.*

D. Committee recommendations on technical transfer of research and other information important to all cooperators in the NCSS included:

1. Develop a method of conveying research results to field soil scientists through either electronic transmissions or published reviews that are presented in a less structured format. A designated reviewer should be established to contact authors, and with their cooperation, develop a popular summary of the search results for dissemination and use by field soil scientists.

The Steering Committee directed the secretary to forward this recommendation to the Chair of the National Standards Standing Committee and to the NCSS Research Standing Committee for their consideration. Discussion focused on the need for Regional Research Committees to work on developing communication strategies.

Committee #2 Site Specific Soil Data and Interpretations

A. The Committee Chair didn't provide a set of recommendations to the Steering Committee for consideration, but did ask that the committee be continued so it could continue working on the issues it had identified.

The Steering Committee agreed to continue the committee with the current chair and composition. It should be prepared to report at the next National Conference the progress made.

Committee #3 NCSS Research Agenda Standing Committee

A. Committee recommendations:

1. Broaden the current composition of the committee membership to ensure representation from all NCSS regions, the private sector professionals, and cooperator constituencies which will serve as partners in the research agenda,

2. Develop liaison representation to NCSS for the agency/departmental research partners who currently are not considered NCSS cooperators;

3. Re-examine charges 2-5 to determine which are of most relevance and germane to the Standing Committee on the NCSS Research Agenda,

4. Develop a mechanism to update the research agenda and its prioritization revolving in a 2 to 4 year cycle;

5. Develop a mechanism whereby the Standing Committee may serve as a clearinghouse for inquiries on NCSS research,

6. Identify areas where NCSS research, expertise, and outreach are germane to emerging global issues such as food security, biodiversity, desertitication, and gas emissions;

7. Establish a Mapping Techniques Committee to evaluate new technologies for soil survey operations and research agenda, and

8. Develop a protocol to measure performance of research agenda milestones and progress.

The *Steering Committee accepted the committee report for inclusion into the Proceedings*

The Steering Committee expressed its concerns that the NCSS Research Agenda Standing Committee develop clear linkages with the Regional Research Committees. It recommends that in broadening the Standing Committee composition (see recommendation I) a memberfrom each of the 4 Regional Research Committees be included.

The Steering Committee also established the Mapping Techniques Committee as a NCSS Standing Committee (recommendation 7). A joint chairingfor this committee by Bob McLeese, NRCS State Soil Scientist in Illinois and Dr. Fran Pierce, Professor of Soil Management, Crop and Soil Sciences Department, Michigan State University was recommended. Suggested committee members include: Terry Aho, NRCS/ITC, Ft. Collins, CO; Craig Ditzler, State Soil Scientist, Raleigh, NC; Dr. Pierre Robert, Professor of Soil Classification, Soil Science Department, University of Minnesota; Dr. Gary Petersen, Penn State University AI Ahmen, Soil Scientist, BLM, Denver CO; and Chuck Gordon, NRCS State Soil Scientist, Bozeman, MT. The Secretary will contact the suggested Co-Chairs to solicit their acceptance. They will then be in charge of establishing the committee membership.

Since this is a standing committee, the joint Chairpersons (Drs. Wilding and Kimble) should pursue the remaining recommendations andprovide a report of theirprogress at the next National Conference in 1999.

B. The Standing Committee Developed the following resolution:

Be it resolved that the National Cooperative Soil Survey (NCSS) Soil Research Agenda Standing Committee commends the USDA-NRCS Soil Survey Division, and its leadership, for its successful development of a Request for Proposal (RFP #126-FW-NRCS-97) to support critical NCSS research issues. This foresighted approach will help facilitate, nurture, and address critical research priorities of the NCSS through a new funding mechanism. It will enhance partnering and synergism among Cooperators, capitalize on shared expertise, leverage funding sources, and provide for a relevant research agenda. The Committee enlists the support of NCSS Cooperators to help augment the funding commitments for the RFP in future years through the political process.

The Steering Committee accepted the resolution for inclusion in the Proceedings,

Committee #4 Natural Resources Survey

A. Committee Recommendations:

It is recommended that efforts of the NCSS partners to develop and test the natural resource survey concept be continued. Standards, guidelines, and procedures should be outlined and reviewed. An analysis of past and on-going state, agency, or institution natural resource survey efforts should be conducted.

The Steering Committee accepted the report for inclusion in the Proceedings. The Committee recommended that NRCS provide copies of the report to all of its State Offices.

Committee #5 Soil Suwev of the Future

A. Committee Recommendations on methods evaluation:

1. Short Term

Commit to providing all field scientists and researchers access to PEDON for data recording.

- Reprioritize NASIS development to focus on field level functions
- Move PEDON into the NASIS data structure
- Develop a DOS version of PEDON

Commit funding to the MLRA Project Office operations to help streamline the publication process, and in general facilitate the production of soil survey information.

*The Steering Committee endorses these **recommendations** and willprovide the recommendation on data loggers to the newly created Standing Committee on Mapping Techniques.*

B. Committee recommendations on content, format, and delivery of soil survey products:

1. Short Term

Set up and maintain au ongoing customer survey to determine appropriate content, format, and delivery needs.

- Contact NRCS Social Sciences Institute for assistance.
- Include all NCSS cooperators in survey.
- Be sure to include the National Society of Professional Consulting Soil Scientists as they depend on soils information for earning a living.

Provide easy INTERNET access to the traditional published product with exception of modem interpretative tables **from** current data base sources.

- Build INTERNET **(WWW)** interface much the same way that CD-ROM encyclopedias are used presently. The interface should be graphical and allow the user to easily "click" through views of the data as follows:
  - geo-political view -- nation to state to county to township or quad
  - natural division view -- ecoregion to MLRA to **STATSGO** to SSURGO to PEDON
- Convert existing collections of soil surveys by scanning maps and adding hypertext or **"pdf"** narrative, and update with current interpretative tables.
- Index hypertext or "pdf' soil survey products to WWW Home Page or CD-ROM or both by state and add color photographs of landscapes and soil profiles.

This option offers no analysis, only access to the information, and maps serve only as a point of reference.

Dates: l-2 year time frame.

Estimated Costs: **$10-20,000** to build interface, no estimated cost provided to get data into digital format.

Develop a system for creating publication quality tables using a sofhvare that is compatible with electronic publishing.

- Develop application in Pagemaker to create table suitable for publication and also linked to rest of manuscript.

  Dates: October 1997

  Cost: $25,000

2. Mid-Term

Soil Information should have INTERNET accessible basic GIS capability for digital SSURGO maps with NASIS interpretive function and also with legacy digital soil survey maps. Minimum levels would be ftp access for national collection of SSURGO spatial and attribute data bundled in a variety of formats via WWW and **ftp** sites that are logical and provide some preprocessed data, with acknowledgment of known limitations should be considered a bare minimum. CD-ROM and hard copy are still offered to clients.

3. Long Term

Soil information should have easy, user friendly interface on-line through the INTERNET or **WWW** (if these are still the terms in use) in the tax-payers living room via the 'TV-Browser". Such access is widely available at this time and the function the soil survey site is advanced problem solving (GIS) analysis available for the entire country with SSURGO quality **data.** User enters site graphically and conducts query by asking a question. Either user site or a provided remote site is conducting the necessary calculation and consulting appropriate user provided data, probably housed in a state or local data store and managed by an NCSS partner and considering NCSS algorithms appropriate to the task. SSURGO data are revised and maintained by quadrangle and attribute data are correlated for a variety of area types in NASIS. SSURGO data are always up to date via national data librarian and an historical log is available. Up-to-date, local, state, and national legislation affecting tax payer is fully acknowledged and presented in the analysis scenario. CD-ROM and hard copy still **offered** to client.

The Steering Committee endorsed these recommendations. They will be provided to NRCS future directions work groups* and *strategic planning sessions for consideration.

Committee #6 Marketing the Soil Survey

No specific recommendations for action were given to the Steering Committee.

The ***Steering Committee accepted the report for inclusion in the proceedings. The committee endorses the allocation of funds to publicize the Soil Survey Centennial and encourages each state to have a marketing campaign and to include the Soil Survey Centennial in that campaign.***

Committee #7 Eroded Soils

A. Committee recommendations:

- Proposed criteria for identification of accelerated erosion and classification of the affected soils be tested in at least the following states for a **period** not to exceed two years: Illinois, Iowa, Kansas, Michigan, South Dakota, Ohio, Wisconsin
- Recognize accelerated erosion as a diagnostic soil characteristic and define it in Soil Taxonomy under the section entitled "Other diagnostic soil characteristics". A listing of proposed diagnostic characteristics is included in tbe committee report.
- 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, could be added and used to waive the requirements for a specific category. The same procedure could be followed for other categories.
- 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.
- Modify Soil Taxonomy for the various categories that are affected by accelerated erosion. For example, for Mollisols, the requirementa 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 parlithic contact.

The ***Steering Committee accepted the reportfor inclusion in the Proceedings. It also continued the committee under the current Chair and membership at the discretion of the Chair. The committee is to follow through with its recommendations andprovide a report to the next National Conference on the results of the "Test", andprovide recommendations for final disposition of this issue. It is the Steering Committee's understanding that agreement to test these criteria with the states listed has already been obtained.***

Committee #8 Sod Quality

The Steering Committee accepted the report on Soil Resilience for inclusion in the Proceedings. With the submission of the report this committee has completed it charge.

Committee #9 *NCSS* Standards Standing Committee

A. Committee recommendations:

1. A subcommittee be established to develop standards for order one mapping.
   - There is a committee working on some aspects related to this but not really developing standards.
   - We recommend **this** committee be chaired by Henry Mount and submit a report to the full committee by January **1, 1998.**
2. A committee is needed to look at new mapping procedures (GPR, EM, etc.) Standards as to the use of these procedures need to be developed. Where do they work, how accurate are they, etc.

The Steering Committee endorsed these recommendations and asks that the committee Chair exercise his prerogative to establish a subcommittee to develop order one mapping standards. The committee to look at new mappingprocedures was established in response to Committee report # 3 NCSS Research Agenda.

LOCATION OF THE 1999 CONFERENCE

The Steering Committee received an invitation from Dennis Potter to hold the next Conference in Missouri at a location yet to be determined in St. Louis. Ken Olson also discussed the possibility of hosting the meeting in Indianapolis, **IN.** The Committee decided in favor of St. Louis since the 1999 meeting is the Centennial year for the soil survey and Missouri was Dr. **Marbut's** home state.

The Steering Committee also suggested that the location of conference be determined at the Steering Committee meeting at which the Conference Agenda is set instead of the Steering Committee meeting held immediately following the Conference. This will be placed on the ballot since that function is set in the current By-laws.

The meeting was adjourned.

THOMAS E. CALHOUN
Program Manager

Enclosure

cc:
Carole **Jett,** Deputy Chief, SSRA, NRCS, Washington, D.C.

NATIONAL COOPERATIVE SOIL SURVEY
CONFBRBNCE STEERING COMMITTEE
1997

Dave Smith
Soil Scientist
USDA - Forest Service
Watershed and Air Management
201 14th St. SW
3rd floor south
P.O.Box 9609
Washington, D.C. 200906090
(202)205-1270

Thomas Calhoun
Program Manager,
Soil Survey Division
USDA - NRCS
P.O. Box 2890
Washington, D.C. 20013
(202)720-1824
FAX (202)720-4593

Jim Culver
National Soil Survey Center
USDA - NRCS
Federal Building, Rm 345
100 Centennial Mall North
Lincoln NE 68508-3866
(402)437-5353
FAX (402)437-5336

Jerry Daigle

Dr. John **Sencendiver**
Professor of Soils
Division of Plant Science
Agricultural Science **Building**
West **Virginia** University
Morgantown WV 26506
(304)293-4817
FAX **(304)293-3740**

Horace Smith
Director, Soil **Survey** Division
USDA **-** NRCS
P.O. Box 2890
Washington, D.C. 20013
(202)720-7848
FAX **(202)720-4593**

William Volk
Soil **Scientist**
U.S. Department of Interior. **BLM**
Montana state Office
P.O. Box 36800
Billings, Montana 20090-6090
(406) 255-2926

OFFICIAL NCSS BALLOT

This ballot reflects committee actions from the National Cooperative Soil Survey Conference held in Baton Rouge, LA this past June that require amendments to the Conference by-laws.

In accordance with **Article IX. Amendments** :

The bylaws may be amended by ballot with a majority vote of the permanent members. An amendment shall, unless otherwise provided therein, be effective immediately upon adoption and shall remain in effect until changed.

Copies of the current by-laws can be found in the NRCS National Soil Survey Handbook, and on the Internet at ***http:www.statlab.iastate.edu/soils/soildiv/***

A vote of yes indicates that you are in favor of the suggested change. A vote of no indicates that you do not approve of the suggested amendment.

Please return this ballot bv October 30.1997 to:

Thomas E. Calhoun
Soil Survey Division
USDA/NRCS
P.O. Box 2890
Rm. 4242-s
Washington, D.C. 20013

---

1. Article VI section 1.0

This section should be amended as follows: **yes__x_** no _
Add **section 1.1.7** "A representative from the 1890 and Tribal Schools as recommended by the Conference Chair, and from the vicinity of the next conference".

2. **Article VI section 4.0**

This section should be amended to read: "The Steering Committee shall:" yes__x_ no _
(this change drops the wording "The Steering Committee shall plan, organize, and manage the Conference" since it is redundant in the context of the article). This article will then be re-numbered to reflect the removal of section 4.1.

3. **Article III-B section 2**

This section should be amended as follows: yes_ x no _
Add **section 2.1.4** "Soil scientists from each of the six NRCS regional offices". Currently them are no permanent members of the Conference representing the 6 NRCS regional offices.

Signed:______________________________

ALL PROPOSED AMENDMENTS PASSES

Bylaws of the National Cooperative Soil Survey Conference

Article I. Name

Section 1.0 -- The name of the Conference shall be the National Cooperative Soil Survey (NCSS) Conference.

Article II. Objectives

Section I.0 -- The objective of the Conference is to contribute to the general human welfare by promoting the use of soil resource information and by developing recommendations for courses of action, including national policies and procedures, related to soil surveys and soil resource information.

Article III. Membership and Participants

Section

Section 1.1.5 -- Make arrangements for lodging, food, meeting rooms, and, local **transportation** for official functions.

Section *1.1.6* -- Provide a recorder.

Section 1.1.7 -- Assemble and distribute the proceedings.

Section 1.1.8 -- Provide publicity.

Section 1.1.9* -- Maintain *the Conference mailing list.

Section 1.1. IO -- Maintain a record of all Conference **proceedings;** proceedings of Regional Conference meetings; and a copy of each Regional Conference's purpose, policies, and **procedures.**

Article VI. Steering Committee

Section I. 0 -- The Conference shall have a Steering **Committee.**

Section 1. I -- The* steering *committee shall consist of:

Section ***1.1.1* -- *The* Director** of Soil Survey, NRCS, is permanent chair and **is** responsible for all work of the Steering Committee.

Section 1.1.2 -- **The** U.S. Forest **Service** Soil Survey **Leader.**

Section 1.1.3 -- The Bureau of Land Management Senior Soil Scientist.

Section 1.1.4 -- Four Agriculture **Experiment** Station Soil Survey Leaders, one from each respective Regional Conference. This normally is the State representative that was chair or vice chair of the previous Regional Conference.

Section 1.1.5* -- *Sii NRCS soil survey **staff leaders,** to include representatives of the National Headquarters, **National** Soil Survey Center, and Regional soil staffs as determined by the Director of Soil Survey, NRCS.

Section 1.1.6 -- The President-elect of the National Society of Consulting Soil Scientists, Inc., representing the private sector.

Section 2.0 -- The Steering Committee shall select a vice chair for a **2-year** term. The vice chair acts for the chair in the chair's absence or disability or as assigned.

Section 3.0 -- The Steering Committee shall formulate policy and procedure for the Conference.

Section 4.0 -- The Steering Committee shall **plan,** organize, and manage the ***Conference.***

Section 4.1 -- The Steering Committee shall:

***Section 4.1.1* -- Determine** subjects to be discussed.

Section 4.1.2 -- Determine committees to **be** formed.

Section 41.3 -- Select committee chair and obtain their approval and that of their agency for participation.

Section ***4.1.4*** -- Assign charges to the committee chairs.

Section 4.1.5 -- Recommend committee members to committee chairs.

Section 4.1.6 -- **Determine** individuals **from** the United States or other wuntries with soil science or related professional interest to be invited to participate.

Section 4.1.7 -- Determine the place and date of the Conference.

Section 4.1.8 -- Organize the program and select the **presiding** chairs for the sessions.

Section 4. I. 9 -- Assemble in joint session at least once during each Conference to conduct business of the Conference.

Section 5.0 -- **Steering** *Committee* work will normally **be** done by wrrespondence and telephone **communication.**

Section 6.0 -- **Fifty** percent of the **Steering** Committee shall wnstitute a quorum for the **transaction** of business. Items shall be passed by a majority of members present or wrmsponding. The **chair** does not vote except **in** the case of a tie vote.

Article VII. Meetings

Section 1.0 -- A meeting of the Conference normally shall be held every 2 years in odd-numbered years for the presentation and discussion of wmmittee **reports;** exchange of ideas; and **transaction** of **business.** It shall consist of wmmittee sessions and general sessions. Opportunity shall be. provided for discussion of items members may wish to have brought before the Conference.

Section 2.0 -- The time and place of **meetings** shall be determined by the Steering Committee.

Section 3.0 -- The Steering Committee is **responsible** for planning, organizing, and managing tbe **conference**.

Section 4.0 -- The Steering Conunittee shall meet immediately after **the conference** to **summarize** rewnuuendations and propose actions to be taken.

Section 5.0 -- Meetings of tbe Steering Committee, **other than** at the **conference,** may be called **with** the approval of the Steering Committee.

Article VIII. Committees

Section 1.0 -- *The wmmittees* of the Conference shall be determined by the Steering **Committee.** Permanent or standiig committees, ad hoc wnunittecs, and task force groups are considered to be committees of **the** Conference. The Steering Committee shall select committee chairs.

Section 2.0 -- Committee members shall be selected by the committee chairs. Committee members shall be. selected after considering Steering Committee recommendations, Regional Conference recommendations, individual interests, technical proficiency, and **continuity** of the work. They arc **not** limited to members of the National Cooperative Soil Survey.

Section 3.0 -- Each committee commonly conducts its work by correspondence among **committee** members. Committee chairs **shall** provide their committee members with the charges as assigned by the Steering Committee and procedure for wmmittee operation.

Section 4.0 -- Each wnunittee chair shall send **copies** of a draft wmmittee report to the Steering Committee prior to the Conference.

Section 5.0 -- Each wmmittee shall report at the Conference.

Article IX. Amendments

Section 1.0 -- The bylaws may be amended by ballot with a majority vote of the permanent members. An amendment shall, unless otherwise provided therein, be effective immediately upon adoption and shall remain in effect until changed.

Appendix A

Memorandum of Understandings with the Natural Resources Conservation Service in the National Cooperative Soil Survey Conference:

- Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture
- Bureau of Indian Affairs, U.S. Department of the Interior
- Bureau of Land Management, U.S. Department of the Interior
- Bureau of Reclamation, U.S. Department of the Interior
- Defense Mapping Agency, U.S. Department of Defense
- Economics and Statistics Service, U.S. Department of Agriculture
- Environmental Protection Agency
- Federal Crop Insurance Corporation, U.S. Department of Agriculture
- Forest Service, U.S. Department of Agriculture
- National Bureau of Standards, U.S. Department of Commerce
- National Oceanic and Atmospheric Administration, U.S. Department of Commerce
- National Park Service, U.S. Department of the Interior
- National Society of Consulting Soil Scientists, Inc.
- Office of Territorial Affairs, U.S. Department of the Interior
- Science and Education Administration, U.S. Department of Agriculture, Extension, CRIS
- Tennessee Valley Authority (quasi Federal)
- U.S. Army Corps of Engineers, U.S. Department of Defense
- U.S. Fish and Wildlife Service, U.S. Department of the Interior
- U.S. Food and Drug Administration, U.S. Department of Health and Human Services
- U.S. Geological Survey, U.S. Department of the Interior
- State Agricultural Experiment Stations

Remarks from Paul Johnson, the Chief of the Natural Resources Conservation Service

Thanks its good to be here today. I just got a call from the secretary's office and he says he wants me back there today. I wish he would have gotten down here so we could have met here instead of my having to go back there. I was planning to go out to the twin cities. But any way, thanks for the invitation to be with you today.

As I looked over the program I thought of how nice it would be if I could spend the whole week here, and how much I could learn if I did that. I need to say right out front that I am somewhat intimidated by being amongst what I think are some of the best scientists that we work with, and I feel somewhat inadequate in speaking to you. If you'll let me I'd like to take some time and just share with you some random ideas about my views on soils and how we all fit together in this effort to help improve the health of the land in this country.

Its been a long time since I've focused specifically on soils. I took my first course at the University of Michigan its probably 35 years ago now. It was "Buckman and Brady" at the time if I remember right. A book that I guess continues to be refined and get new authors and so on. Then, I had the opportunity to be a teaching fellow in soils in the School of Natural Resources there for a few years. I did my Masters in tree-soil-water relations in West Africa, working on buttressing of tree species there. I dug an awful lot of soil pits looking at the relationship between buttressing and soils and soil drainage in particular. I started farming in 1974, and the first thing I did was to pick up our soil survey of Winneshiek County and read it through. I'll have to confess I didn't learn a whole lot. I think we can do better with soil surveys, that's still on my mind, and I think that you all understand what I'm talking about. I think that it certainly provided us with some basic information, but for the person who uses the land, I think we can do much better. In fact we are today.

My first spring on the farm, I plowed gullies, trying to fill them up. We were, at that time, in the last fence row to fence row effort. The farmer before me certainly did go fence row to fence row. But at the same time, I also tried real hard to plow under every single corn stalk. So I had that first task of trying to put the land together, but I wasn't doing it in a very good way. We've come a long way just in the last 30 years, 25 to 30 years, in how we treat soil and how we deal with the land. Since taking this job, I've had the opportunity to be across the country and in fact in other countries looking at soil conservation work and have run into some very interesting issues as they relate to soils. Here in Louisiana, Don Gohmert took me out in some of the coastal wetlands, and for the first time I realized we had serious soil erosion under water. Not Something that the average American would understand I don't believe. After the 1993 floods, I had the opportunity to tour the Missouri River and look at places where we had 2, 3, 4 feet of sand deposited on some of those bottom lands and certainly overnight had a new soil. Our soil maps became well used.

Mt. St. Helens, we are dealing with it today as we try to deal with the new CRP and how we define soils there and highly erodible soils. A recognition that we had a blast occur. When was it, in 1980? And today as we try to deliver programs, because we have been unwilling to face up to the fact that soils have changed, we've run into some terrible complications there. Farmers in Washington are mad because we were looking at air quality issues and not paying attention to what happened in 1980. Our soils maps, or the way we're dealing with them, are not up to date.

To many Native Americans, many Indians in this country we look at their home places we have no soils maps yet. And so, we have some real concerns there and I deal with it everyday as they remind me of that fact.

In the Everglades, looking at some of the subsidence that's occurred there. Some of those soils have disappeared or continue to disappear.

Our apartment in Washington, D.C. sold about a year ago. Tenants in Washington have an opportunity to come together to form an association and buy a place when it comes up for sale. And so, I looked through it and there was the soil survey. It was the foundation for that building, and it was interesting to realize that your work and the work of our agency and our partners and the cooperative effort was the foundation for that very building.

I was in New York City recently and gave a speech to an extinction conference of the American Museum of Natural History. The people who came up afterwards were not terribly interested in my speech, but they were really interested in the fact that we were doing a soil survey of Central Park and New York City. They were all excited about that. It made me realize how important your work is, not just to farmers and ranchers, but to people who live in the city as well.

In another couple of years, your next meeting in fact, will be the hundredth year of this great institution of the National Cooperative Soil Survey. I think that's really exciting, and you've got some real opportunities. I hope this week you'll talk some about how you are going to address that. I think we have some terrific opportunities. These milestones become very important and give us an opportunity to speak out and be heard.

I recently stopped in at a used book store in Maryland and picked up a 1903 report, soil survey, and was fascinated by it. Almost all the discussion was about mapping soils to determine where we could get the best tobacco production and flavor of tobacco as well. So it made me realize that since the very beginning of our effort we've been looking at soil surveys in terms of how we can use soils and soil functions. I tbink as we look to the future were going to be doing that even more, and in fact, we probably need to do a much better job of reminding Americans and those we work with about the functions of soils. That's why, in fact a major reason of why, we do what we do in our agency and in your effort.

As I look to where we are today I get very frustrated and you probably do too. Soils are still not very respected on tbis earth. We have a Clean Water Act, we have a Clean Air Act, we have we have an Endangered Species Act, a Federal Insecticide - Fungicide - Rodenticide Act, we have a Super Fund, we have all sorts of enviromnental protection, and yet we have very little concern, still as a nation or in the world for that matter, about soils. About the very basis for all life, what Wendel Berry says is "the place where resurrection takes place day in and day out, where life continues".

It wasn't very many years ago that we were all excited about "T by 2000", remember that? Well 2000 is coming on very fast, and now in Washington its even politically incorrect to say T. The fact is that we should be setting some goals for ourselves and recognizing the importance of soils and that we have to deal with some of the basic issues associated with them. I get very frustrated about that, and we've got to figure out ways in which we can elevate the level of the importance of soils. We can continue to do soil surveys, and we can continue to provide information for people to utilize soil better, but I think that we need to get on the other side of it as well and get the nation and get the world to understand the importance of soils. Not just, here's a map here's how you can use it. But rather, its time we start taking care of it.

In my lifetime the population has doubled twice on this earth. If you just stop and think about how we are scratching it, and gouging it, and dealing with it, and then look to the near future and how we want to continue to do that. If we're not careful, much of it's going to be gone before we even have a chance to map it. I think its up to you to take on some of the responsibility of getting users to understand soils better, not just understanding soil maps, but understanding how soils function.

With the 1996 Farm Bill we did a kind of a rogue effort within our agency. I took a couple of people and told them to lock themselves into a room for a month, or what ever it took, to put together the perfect 1996 Farm Bill from the standpoint of conservation. So they went to work on it. I had the blessing of the Deputy Secretary, but no one else knew about it because we had a whole lot of ideas coming in and we wanted to get our two bits into it as well. They came back with their ideal Farm Bill. It led off with the National Soil Quality Act. We put it on the web and it circulated around and we got a whole lot of attention from a lot of people across the country. We obviously didn't get a National Soil Quality Act in the 1996 Farm Bill, but I would throw out the challenge to you to think about it and to think about ways we can elevate those issues. As we look to the future and look to where we're going, whether it be clean water, clean air, biological diversity, global climate change, all of these things, we need to elevate the understanding and the respect for soil.

You probably didn't like the fact that we changed the name of the Soil Conservation Service to the Natural Resources Conservation Service, and I must confess I didn't either. We have a proud history of SCS, but on the other hand, we've been at it for 60 years now and although we've done a lot of good we still don't seem to be breaking through to the American public. I've said over and over again that I think that if we had started as a water conservation service we probably would have more soil conservation today than we do, simply because people do identify with things like water, and you can't have clean water and you can't have good water unless you have good soil. And so, to focus on things like water would have forced us to focus on soil rather than the other way around. And that's where we are probably going as we look to the future. We will deal with the importance of things like water and air and biological diversity, and then perhaps we'll understand the importance of soils and how they function.

I think as we look to the future we're going to have to get out of the boxes that we've been in. One of them is to certainly look at soil, not in the sense that we have in the past so much in terms of increasing resistance to erosion, but rather looking at it in terms of all of the functions. We've talked a lot about that and its certainly nothing new for you to start looking at soils in terms of their functions. We classify them, we map them, but I think we also need to push much harder to get people to understand the uses and the functions of soils . Go back to my 1903 book, we started out by talking about it in terms of what kind of tobacco can it grow. Today we're going to be looking at it in terms of how it filters water, how it buffers some of the pollution within our systems and so on. Certainly production of food and fiber is an important part of soils and our use of them and the reasons for mapping them. But, as we tried to point out in our new publication, The Geography of Hope, farming and ranching is far more than just the production of food and fiber. That its also a place where we produce water and we can do it well or other wise, we produce wildlife and we can do it well or other wise. We deal with air quality well or other wise. And all of this comes right down to the use of that soil, what it can be used for, how we can manage it so we can produce food and fiber and at the same time have that massive filter working properly and the buffer the same way.

One of the other major issues I deal with now deals with application of wastes to land, or some cases wastes and in other cases things such as animal manures. We need you to help us figure out how we can deal with these issues. We just had a front page story in the Washington Post a week or so ago on animal manures in the headwaters of the Potomac and the fact that we were probably are overloading the systems, or we are about to overload tbe systems there. I went back to our NRI people and I asked them to put together some maps for me of where animal manures are being produced today, from the concentration of livestock production, and what kind of land we had to apply it to. And they came back with maps that were tilled with very red counties. Clusters of red counties where we, for example, were producing over 5 times the amount of phosphorous that could be absorbed in our agriculture systems there in the soils. These are the kinds of things we are going to be faced with.

EPA will be coming out in a couple of months with a national assessment of watersheds . Although we'll all criticize it and argue about it, none the less its going to be out there in the American public. How even we take it immediately, using the soils knowledge that we have, and start addressing some of the problems. Some of those red watersheds that they are going to lay out in front of the American public. That's our challenge.

I recently had to testify on air quality. EPA is proposing new standards for air quality. Looking at PM -2.5, PM- 10. These are soils issues in may cases and fortunately we got EPA to take another look at the science there. Recently had a letter from Carole Browner suggesting that perhaps their science wasn't good enough to say that agriculture was 30% of the problem. In fact they backed off and said agriculture was probably not an important part of the problem, but never the less its one of those issues that you have to help us deal with as we move forward.

I met about a month ago with Tim Wirth in the State Department. He's negotiating Global Climate Change Treaties with the rest of the world. And I tried to tell him that we had some opportunities if we looked at soil in terms of sequestration of carbon. I hope I'm not too far out on a limb. You need to tell me if I am. But I think we have some terrific opportunities and its win win for all of us as we manage our soils better. Most people have not even looked at soils as an important part of the carbon cycle outside of you and a few people who have started to think about it, but when I went out and we tried to get data on it we have some but its probably not enough to make real definitive suggestions on what we could do. None the less its an important part of our future and we've got to continue to work on it.

We've got a number of other boxes that were trying to get out of, were trying to stretch ourselves and think about soil differently. We moved out and said that we ought to be looking at soils on a landscape basis, or in our case on MLRA's, and I know its got some of you a little upset because its broken beyond some of the political boundaries that have kept us much better defined. I get frustrated everyday that many of out programs are based on where somebody put a fence around a piece of land 150 or 200 years ago. Somehow we've got to escape the grid. We have to get away from the fact that somebody put lines around nature and said this is how we ought to operate. Fortunately we are able to do that with some of the new technology. Were moving ahead with GIS systems that are not bound by a fence line or by a political line, but yet we still think that way in terms of our institutions. How can we break out of that, and how can we recognize the fact that that's not the way the natural system does work? We have the box of our own institutions and how do we break out of that? NRCS is one institution, the Forest Service is another, BLM is another, Bureau of Indian Affairs is another, and we seem to, of course our land grant system is another, how do we share it. You started that almost 100 years ago and yet still today we have those turf battles that seem to continually plague us as we try to deal with these issues.

Within our own agency and the work that we do dealing with soils we've put ourselves in boxes that are hard to get out of. And 1 think that one of the most difficult ones were facing right now, and we rely on good soil science to get us out of it, is this whole issue of wetlands, and drainage and irrigation, how we manage water. You don't manage water without understanding soil. And yet we are constantly **redefining** how we deal with landowners and with the land based on discrete units. This is a wetland or no this is not a wetland. Drainage and irrigation the same way, and as we talk about these issues and as we look to the future were going to have to deal with them more in terms of functions of the whole landscape, and not just putting something on the map and saying now we'll treat this differently than we treat something else. I look forward to the day when were back out there looking at drainage and helping improve drainage where its appropriate, and at the same time capturing those functions within a landscape somewhere else. So its not a wetland or a what we froze in 1985, but rather lets look at the larger landscape, lets recognize the functions of soils within that landscape and then lets look at putting together systems with landowners so that we capture values and functions. And at the same time are productive in the traditional sense of producing food and fiber.

I think as we look to the **future,** mitigation will be the word that will be most on our minds in the near future and of course to do that, soils become a very very important part of doing that.

As you look to the soil survey I would ask you to debate whether or not as you continue to do sweeps across the landscape you focus primarily on what you have been focusing on for the last 100 years or whether you broaden it to more natural resources soil surveys. And **I** don't mean that every soil scientists has to define the migratory birds that fly over it, but were putting a lot of effort into looking at that landscape and out of comes a map of the various soil series and soil types. There is a lot of knowledge that's in your heads that never gets put on paper that the land owner really needs, or that we all need if were going to do a good job of managing that land. And is there some way, that as you put your teams together out there and produce an inventory of what s there that we can expand it or we can partner together with others so that in the end we have a much more holistic look at the landscape than we do with what you finally put on paper. I challenge you to do that. Some of you have heard me quote **Aldo** Leopold when he talks about trying to get landowners to do better and says it by saying "learn to read the land and once you learn to read the land I have no fear of what you'll do to it and I know of many good things it will do for you". Your reading the land day in and day out, and much of what you read never gets put in a form that can be used by the land owner. That gets back to my original reading of our **Winneshiek** Co. Soil Survey. I know that the people who put that together had a heck of a lot more knowledge than was ever written in that soil survey, and I needed that information if I was really going to manage that land well. In fact, as I sit in Washington and think about my farm I realize every day how little I knew about it even though I had these wonderful degrees in natural resources. And even though I farmed it for the last 25 years, I know just a fraction of what's there. That's a rich place, its tilled with life, its a, treasure isn't it? Every bit of land is a treasure. Yet I being like most farmers go out and do my job every day and never really understand what's there. How can you contribute to a better understanding of land so that those who use it understand it better and in so doing treat it much better? I think that's a major challenge that we have. You in the end put together a survey that's either in a bound or today is on a CD ROM that we can access, but still it only tells a fraction of what's in that land and what's important to the person who uses tbat land. Its a challenge, and I throw it out to you because you're better at it than any body else at putting together these efforts.

As we look to the future I think we need to look at new ways of telling the story of soils and how we can utilize them better. I just met with Mike Dombeck, the Chief of the Forest Service, and we decided it was time to start sharing some of our public affairs people. They've got visitors centers all across this country. Fish and Wildlife Service does as well BLM does as well. There no literature, no material in there that the passer by can pick up that can start teaching them about things like soils. Particularly soils on private lands. We put public lands over here and they have visitors centers, and we have private lands over here which is most of the land and there is very little information. What can we do, what kind of materials can we put together to put in those racks so that when people visit those places and are thinking conservation and are thinking environmental protection where they can pick up something and where they can learn something.

We've all talked about working better with children and many of you are doing that and I think that's extremely important. We've got a lot of new people on the land today. The landscape is changing very rapidly in America. Everywhere you look we've got these little ranchetts and farmetts developing. In many cases these people know very little about that land. And yet that 10 acres or those 40 acres that they own are very very important. What can we do to reach out to them? What can you do to reach out to them so they can understand that they are setting on top of a very precious piece of soil that functions in these ways if they treat it well, or if they don't, what it means.

Every year were faced in Congress with defending your budgets or the budgets for soil survey. I had to deal with it again this year when one of our chief examiners from OMB said you've been around it for 100 years, we don't need you any more. Believe it or not these are people who decide our future. If they've got the attitude that we don't understand what you're about and we perhaps don't need to continue to put that 85 million dollars a year toward soil survey because we've already gone across the country. We've been there done that, don't need to do it again, then we've got a problem, and you've got to help. We've all got to take it seriously and figure out how members of Congress and people who in the end make decisions on our budgets, how we can get them to understand what we are doing much better.

We've got some opportunities ahead of us. 1999 as I said, its the 100th anniversary. Lets make a big deal of it and I'll commit to you that our agency will do everything it can to provide the resources to really make a big deal of 1999. I think it gives us an opportunity to reach out to people get them to understand soil s better. Lets set some major goals for 1999 and talk about it this week, figure out ways in which we can elevate the importance or the understanding of the importance of soils in our country. IN 1999 we am also going to be **hosting** the International **Soil** Conservation **Organization's** meeting. They meet every couple of years, **met last** year in **Bonn.** We offered to host it this year. It will be in May at Purdue University. In Bonn we had **122** countries represented at that meeting. **Think** of the opportunity, that **week,** to highlight the importance of soils world wide, not just in this country. Were **trying** to work with a **number** of agencies and departments of federal **and** state govermuent and **as** you talk about your own celebration this week lets talk about ways we can make that ISCO **meeting** in 1999 something that gets on the national radar screen.

At the local level and at the state level, I think we have a wonderful **opportunity** right now to talk about soils and to elevate the **importance** of soils. I know we heard this morning that states don't seem to want to support it as much anymore. Were reaching out to **commodity groups** and to private interests to help us. We shouldn't let that happen! States are in much better **financial** condition than they were 5 years ago. Most of them have surplus budgets in tact. We keep **looking** to the federal government saying that we need to increase our efforts them, and those of us who are working at the federal level certainly will continue to work at that But don't forget your state effort and state legislatures. That's you home place and **if people** at their home place can't get excited about it then **were** really in trouble. **In** our agency were pushing what were calling locally led conservation right now. Getting people at the local level to assess their home place. To look at it and to look at where they are au then to set some goals and to use the various programs to address those goals. Soils ought to be an important part of every single one of those town meetings, and we expect to have thousands of them every year across every part of the country if this system really works. Plug in right there. **Tha'st** where it all begins. As I say, **if** people at the local level can not feel that tbis is **an** important effort then I don't think were ever going to get there at the national level, and I think the national level will follow if you can really encourage people at the local level to do it. Let us know at the national level how we can support your state and local levels as well. I think that we have some **wonderful** opportunities.

I think at this time **I'll** wiud down. Again I want to say **thank** you for the work tbat you've been doing. I want to **commit** our agency to continuing to partner **with you.** I think its perhaps one of the most importaut issues that we face as we look into the next millennium. The importance of soils. The importance of protecting and enhancing those soils. I look forward to hearing what you come up **with** this next week and how our agency can plug in together with you **and** support you as you continue your work

Thanks a lot.

THE NATURAL RESOURCES CONSERVATION SERVICE AND THE NATIONAL COOPERATIVE SOIL SURVEY: A LOOK TO THE FUTURE [1]

by

Horace Smith
Dir, Soil survey Division
NRCS, Washington, DC

Thank you Jerry for that introduction. I, too, want to join with the others in welcoming you to this conference. I want to give a special welcome to our colleagues from outside the United States. It is good to have you in this country and you honor us by being a participant in this meeting. This biennial conference is unique in that it gives my total support and the resources of the division to the NCSS' continued success and rich tradition as we look towards the 21st Century.

During my career and most of this **century,** the NCSS has drawn heavily on the work of its founding pioneers, mainly the works Drs. Milton Whitney, Curtis **Marbut,** and Charles Kellogg. As we prepare to move into a new millennium, we will **continue** to refine, tweak, and repackage the work of these founding giants, **but we** will also be making some **major** paradigm shifts. We will, by necessity, need to strengthen our traditional partnerships and bring in new and different cooperators and partners, especially the nontraditional ones. The NCSS will need to find ways to leverage its limited resources. The information **technology** age has afforded the NCSS an unprecedented opportunity to become better known by the general public and to get its products into the hands of more customers, particularly nontraditional ones.

Hem are a few issues that I consider priority and we in the Soil Survey Division will concentrate on them during my **tenure** as Division **Director:**

- Ensure that all activities within the division **are** science-based. The division's reputation and **credibility** stand on the quality of the products and services that it produces. Therefore, it is imperative that all activities within the division be defensible and have a sound science-based foundation.

- All activities within the division will be compatible with and in support of NRCS' strategic plan and NRCS Chief Paul Johnson's publication: "Geography of *Hope ".* *Staffing* plans and budgets at all levels within the agency are tied to the strategic plan.

- Encourage an interdisciplinary approach to activities within the division. We will invite and welcome the input of individuals from other disciplines in our activities at National Headquarters **(NHQ)** in Washington, DC and at the National Soil Survey Center **(NSSC)** in Lincoln, Nebraska. We will also encourage other disciplines within the agency to incorporate the expertise of soil scientists into their activities.

- Support sabbatical assignments of prominent scientists to work within the division at NHQ and at the NSSC on special topics and projects. We will also encourage sabbaticals for select scientists within the division when it is mutually beneficial to the employee and the agency.

- Renew and strengthen relations with NCSS cooperators. I will be personally visiting and meeting with cooperators over the coming months to discuss areas of mutual concern and ways we can strengthen our partnerships and leverage our resources.

- Establish a Cooperators Advisory Croup to the Soil Survey Division This group will serve as a sounding board for the division and provide advice on strategic issues and emerging topics.

- Establish a Field Soil Survey Advisory Group. This group will consist of field-based individuals, representing a cross-section of disciplines. The group will provide **valuable** feedback to the division relative to the usefulness **and** impacts of various soil survey products and policies at the field level.

- Continue to actively participate in international activities that help to refine and strengthen Soil ***Taxonomy*** and that give support to programs that lead to sustainability of agriculture and protection of the environment around the globe.

- Reorganize the Soil Survey Division management team at NHQ and NSSC, establishing function areas and clear lines of responsibility. Since coming to this position, I have received many **questions, comments,** and recommendations relative to the management structure at the NSSC. Several individuals have also imquired about how the Soil Survey Division fits into the **reorganized** NRCS. Two organizational charts at the end of this presentation provide an overview of the NRCS management structure at NHQ and a proposed management structure for the Soil Survey Division, **including** the NSSC.

- Strengthen and elevate soil survey technical services. On the cover of the Soil Survey Division Program Plan, the mission statement reads: " Helping People **Understand** Soils". This is really what technical soil services is all about. We will elevate this activity at the field level and put it on a par with production soil survey, soil classification, etc.

- Bring the 1890 Universities and Tuskegee University in as full partners of the NCSS. A great **number** of the employees that make up the NCSS are products of the 1890 Universities. These universities can add a unique dimension to the NCSS.

- Involve the Hispanic Associated Colleges and Universities **(HACU)** and Tribal Colleges in the NCSS. A major objective during the coming year is to get these colleges and universities involved in the division's digitizing initiative.

- Ensure that a diversified cadre of soil scientists are hired regularly. Due to tight budgets and other priorities, the NRCS and other Federal partners in the NCSS have not hired many entry-level soil scientists during the past years. This is becoming a serious problem as we do not have a large reservoir of talent to fill behind experienced personnel when they move on to greater responsibility or retire.

- Refine the **MLRA** concept for production soil survey. The MLRA concept for developing legends and producing correlations along major physiographic boundaries was initiated by the NCSS in the mid 1980s. A management structure was paced on this concept in 1995 by the NRCS reorganization. Tbis concept is still evolving and will continue to be refined.

- Digitize all ongoing and backlogged soil surveys. Since 1995, NRCS has been earmarking a specified amount of money to accelerate this process.

- Publish a revised hard copy version of Soil ***Taxonomy.*** A hard copy version of ***Soil Taxonomy has*** not been published since the initial version was issued, December 1975. The release of this revision will coincide with the Soil Survey Centennial.

- Establish a Soil Survey Division Technical Monograph Committee that would be responsible for preparing a scholarly paper on each of the emphasis area the division is responsible for such as interpretations, classification, technical soil services, soil survey laboratory, world soil resources, investigations, and operations. These papers would be similar to and **patterned** after those produced by Dr. Kellogg and others during the 1950s and 1960s and would **coincide** with the Soil Survey **Centennial.**

- **Establish** a "Soil Scientist of the Year Award" for field soil scientists involved in production soil survey and technical soil services. This would be an **annual** award and would recognize a NCSS soil scientist below the state office level who has made substantial contributions to production soil survey activities or **technical** soil services.

- Establish a "Soil Scientist Hall of Fame Award" for NCSS soil scientists involved in production soil survey. This award would be presented yearly to a uniquely qualified individual at an appropriate forum and would be equivalent to the Soil Science Society of America (SSSA) Fellow Award.

- Establish an NCSS Newsletter to be published quarterly. I have received a great deal of feedback as I move about the country that there is a need to improve communications within the NCSS. Hopefully, this newsletter will be a step in that direction.

- Encourage professionalism among soil scientists at the field level. Field soil scientists are encouraged to become active members of their State Soil Science Societies **and** Soil Classifiers Croups, and professional organizations such as SSSA, the Soil and Water Conservation Society, etc. I will also encourage field managers and supervisors to provide the time and resources, where appropriate, for field soil scientists to participate in nontechnical activities that would **make** them more **well-**rounded employees and enhance their professionalism.

- Continue the Request for Proposal **(RFP)** to support critical NCSS research issues that was initiated in 1997, but **limit** the **RFPs** to no more than $25,000.

- Support an interdisciplinary and interagency approach to research and field studies that would help the NCSS to better:
    1. Refine **the** hydric soil status of clayey soils;
    2. Understand soil-landscape functions and lateral flow of water within landscapes.
    3. Understand site-specific management (precision **farming)** and the role the soil survey can play;
    4. Understand the soil and regolith at depths greater than 2 meters for purposes of waste management, water quality, **modeling,** etc.;
    5. Define soil moisture-temperature relationships as they relate to soil behavior and soil quality;
    6. Understand the role soils play in global climate change and carbon sequestration, and the influences of NRCS programs such as the Conservation Reserve Program on the capacity of soils to perform this role; and
    7. Understand the properties and characteristics of anthropogenic soils and quantify background levels of heavy metals and trace elements in urban and related soils.

- Make soil survey information more readily available to customers by putting it in ***digital*** format and on the **internet.** We have a **Homepage** Team at the NSSC and we are well under way with this activity.

- Develop an aggressive marketing campaign for the soil survey and solicit input and support from **the** private sector.

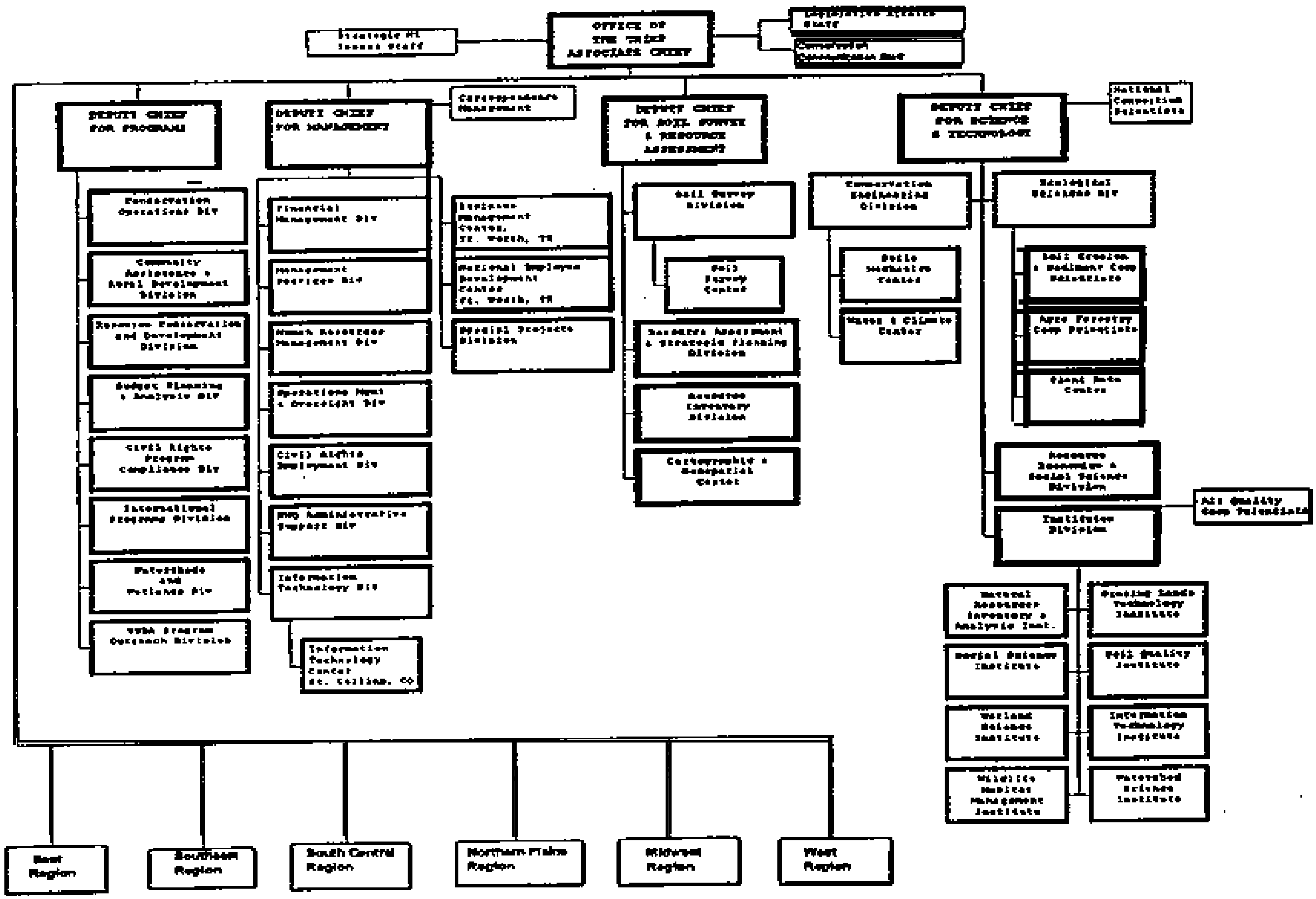
- Highlight the rich history and unique cooperation within the NCSS during the Soil Survey Centennial in 1999. This is a very important initiative and all States and entities of **the** NCSS are encouraged to participate.

All of these priority issues that I have discussed perhaps will not be completed during the first one or two years of my tenure as director, as many of them will extend over several years. I believe the entire NCSS can embrace most of these issues.

In conclusion, let me just say **that** soil surveys are the basic resource inventory that provides the necessary information to carry out the conservation and land-use planning and implementation **that** ultimately results in the environmental benefits society desires. As stated in ***Geography of Hope,*** "it is the achievement of these benefits for which society will remember us 50 years **from** now".

Have a great conference.

NATURAL RESOURCES CONSERVATION SERVICE

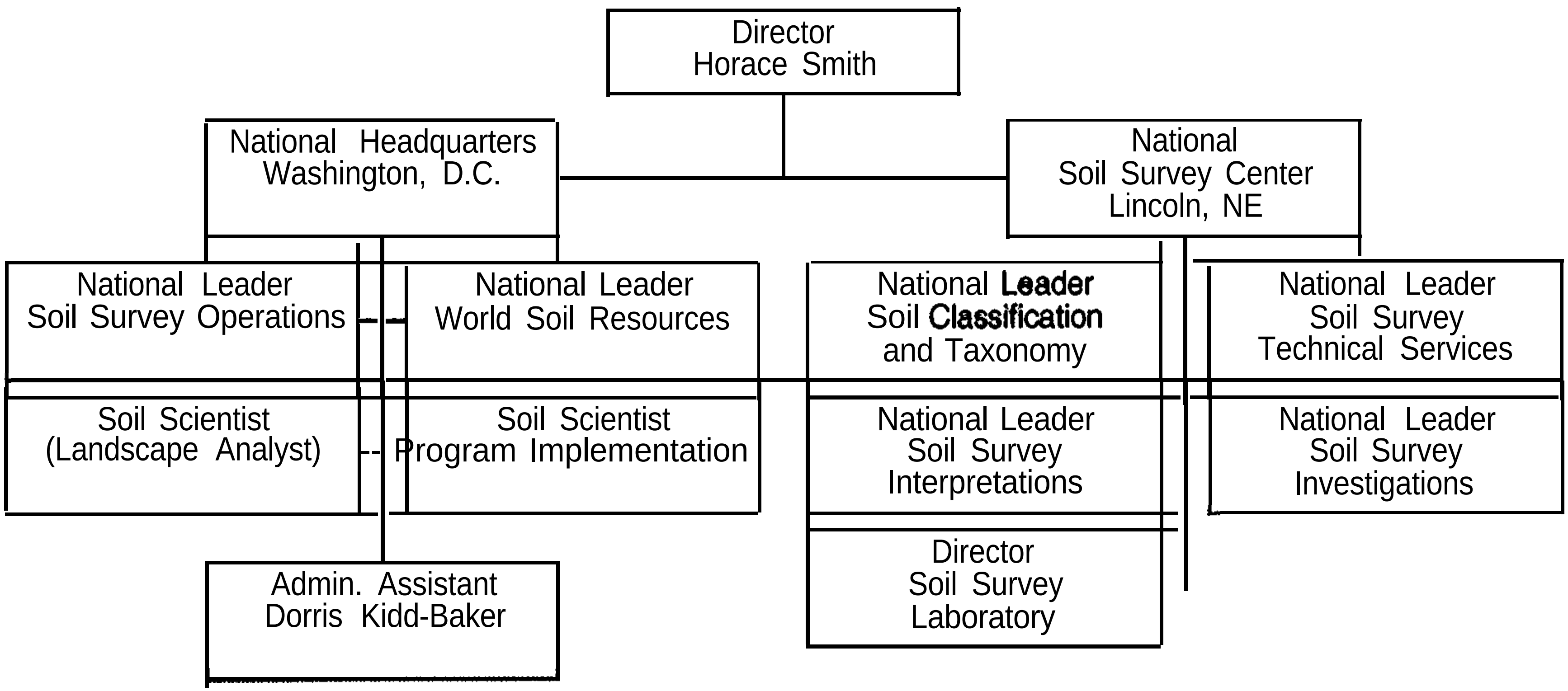


UNITED STATES DEPARTMENT OF AGRICULTURE!

Natural Resources Conservation Service

Proposed Organization of the Soil Survey Division

June 1997



Land Grant University response to the NCSS
NCSS conference

Wayne H. Hudnall
LSU Agriculture Center
Agronomy Dept.
LSU
Baton Rouge, LA 70803

WHAT ARE YOU DOING HERE?

If, after my words this morning, you fell like you have been to church and heard a sermon, it is because I remember the many Sundays I sat in church and listened to my father preach. It is difficult for a Baptist minister's son not to preach a little bit, especially when he is asked to speak on a subject that affects every thread of his life. I though about reading the scripture verses that inspii my thoughts, but decided that might be a little more than you are ready for this morning. However, some of you will probably recognize the theme as I progress.

This moming I want us to think about the future of the National Cooperative Soil Survey Program. You may not agree with me, but as the representative from the Land Graut University system to the National Cooperative Soil Survey Program, it is my responsibility to on comment on the partnership between the NCSS and the Land Grant University. Shakespeare wrote " a vision is like a vessel set to sea, with a captain to steer a course to a destination that all on board have signed-on to reach". This morning I ask you WHAT ARE YOU DOING HERE? I sometimes wonder if we are all on the same ship. If we are, are we all on the same course and do we want to reach the same destination.

I would like for us to think about our vision for the NCSS program. 1 ask you to think of a vision as a runner running a race. Tbe attributes of an athlete are analogous to the NCSS program. Each of you has a mental picture of a runner sitting in the starting blocks, a starter holding a gun about to start the race. Think with me and focus that runner in your mind. Just as tbat runner is focused upon the race and wanting to fulfill his dreams by winning the race, so we must also focus on our vision for the NCSS. It is my hope tbat we will seek out, press on toward the vision that has been set before us, lest we disappoint, not only ourselves, but we fail to reach the mark we set and fail to pass on the a program to the next generation of soil scientist. I ask you again, WHAT ARE YOU DOING HERE? Some of you may be here just because it seemed like a good thing to come to Baton Rouge on a trip someone else paid the cost, a "boondoggle" as a friend of mine would say. Others may be here because you were asked to give a report, or maybe you wanted to get away from the office. I know some of those who were invited did not come because they could not be bother with another meeting that did not bold great deal of promise for them. I am sure that some said I am not going because they do not listen to what I have to say and they are going to do what they want anyway. I want you to know I am here, not because I have to be here, but because I believe in the NCSS. The NCSS program was, and notice I said was; the best soil survey program in the world and the envy of every nation that has a program to inventory their natural resources. What happened? I believe we lost the vision. Not only NRCS, but your partners as well. Before we can understand what we lost or where we are going, we must understand what a vision is. I have described what a vision is like, but what is a vision?

A vision is the ability to foresee or to perceive something that is not visible. It is a mental picture. It is a seeing word. We should be able to close our eyes and picture what we think the NCSS need to be and do, tomorrow, next week and the months and years to come. A vision is described as to bring to mind a mental picture of a preferable future. Everyone wants their future to be preferable, not to be dark, or poor or derogatory. Those who have a mental picture of a preferable future, it is based upon: 1. The long range plan of the NCSS, which is based upon the mission of the NCSS and 2. They understand their finite limitations and capabilities.

If the NCSS program is going to succeed, it must be based upon the mission statement within the reahn of our limitations and abilities. Not only on the liitations and abilities of the NCSS, but those of its partners as well. Then, by necessity, NRCS must understand their partner's mission, limitations and capabilities. But if NRCS takes the attitude that they can do it by themselves, then they do not need us. If one thinks about the events that have occurred within NRCS over the past few years, it certainly appears that NRCS took that route. I am specifically referring to reorganization. What good does it do to have an advisory group, when their suggestions and input are ignored. Is it any wonder that many land grant universities and other partners have said why bother, they will do what ever they want to anyway. Those actions were not visionary, but implemented to satisfy an agenda, not a vision. Other actions by the NRCS, whether real or perceived, have left a sour taste in many partner's mouths. Other partners have tried to understand, have been patient and upheld their cooperative spirit. If the vision is to succeed, we must have a cooperative vision and recognize that we need each other. We must both understand that each has limitations and seek ways to utilii each strengths. Both have limited resources and cooperations is a must if maximum utilization is recognized from both human and monetary resources.

At one time, the one thing that stood above all other aspects of the NCSS program was cooperation. It has been said that the C has been removed. It is no longer the NCSS but the NSS. Some have asked, since reorganization, if it is the NSS or just the SS. Can you say this morning that the NCSS is the heart and soul of your life? If not, WHAT ARE YOU DOING HERB? Was cooperation so ugly that you had to kill it?

We do not have to sit around and decide what our vision is or where it is headed. We have a mission. We have set goals. We have agreed to cooperate. What we need to do is to get on with it! We must have one vision . There can not be several visions, there must be unity. When we do not cooperate, we go in different directions. Cooperation is like a team of horses pulling together. When one decides to go in a **different** direation or becomes lame and does no pull its load, the other horse have to pull extra and, more than likely, the mission will not be accomplished. Why? Because we **run** off in a hundred different directions and to hell with the vision. We can all complain that we have too much to do with too little. But that is not **being** visionary. My vision for the NCSS is that we will be a cooperative group, united together to accomplish the mission we started.

In order to accomplish our vision we must answer **another** question. Who are the end user of our product? By the why, What is the product of the NCSS program? What are we selling? If we are producing a product solely for our use, WHAT ARE WE DOING HERE.. We have a committee entitled "Marketing" as part of the program at this meeting. I hope that your answer is not that the products are lines drawn on paper we call soil maps, but knowledge and information that our clients need to conserve our naturals resources for future generations. If these are not our products, then we need to close the doors and go home, because there is no other program nor organization that has the knowledge and abilities assembled here this morning. This conference must serve the customers of the NCSS. We have to continually equip ourselves with new technologies so that we can satisfy the need of our customers.

Once the vision is directed toward a preferable future. We must decide how we will accomplish the vision. We notice that the runner has only one goal **and** that is to win. In order for him to win he must concentrate on the mission at hand. He **can** not be concerned with what others are doing, but concentrate on what he **know** works for him. The runner put everything else behind him as presses on to the mark before him. Nothing else matters. This brings to mind a movie I watched not too long ago entitled The Dead Poets Society. The lead role was played by Robin Williams. The movie is about a boys school that was dead and stale. It had become so complacent and where the status quo was the accepted norm that they had lost sight of their purpose and vision. There was no enthusiasm in the school. It was simply rituals and routine. Robin Williams come in as a dreamer, a visionary. He gathers around him a cadre of young men with a passion and whose souls were burning that they wanted to break out and accomplish a vision. But the institution keeps them pressed down. Robins bring this to the forefront in his discussion with the administrators of the institution; the **conflict** that happens between the dreamer and his close associates or colleagues on the faculty. He points out something that I had never thought about. That tension develops. The tension that develops between having a life with no vision and the inevitable death that come when them is no vision verses the cost of the vision. When I think about vision, I don't think about cost. I think about pie in the sky type people, who dream about things up there. But when you take pie in the sky and put the pie *in* **the** *pan*, it gets hot in the kitchen. There is a cost to implementing dreams. I had never thought about that. That is why there is conflict when dreams are tumed into reality. Visions are costly. They take us from our ease, our time, our resources, our schedules and our **from** our false security.

When I came to LSU to be part of the NCSS program, it was costly. I asked my wife to move for the 15th time in 12 years. We were paying, at one time, rent and two house payments. We left friends and family. As I set one day on the porch of my house, I thought to myself, why do I need to push on, I have a great job and I knew that I would be able to move up the ranks in the university. Why move! I knew that if I did not move I would regret it the rest of my life because I had not been willing to follow my dream. My friends and colleagues, if you have a vision that you have not been willing to follow, or you have lost the vision, I pray that as a result of this meeting you will recapture you vision. We have an **opportunity** to effectuate the direction of the NCSS. WHAT ARE YOU DOING I-ERR?

We must not only press on with **confidence** and cooperation, but we must press on forgetting the past. The runner can not win if he is constantly looking behind him to see who is about to overtake him. So it is with the NCSS. We have had some glories past. We have accomplished much. But those days are gone. We are no longer living in the days of **Marbut,** Smith or Arnold. This **organization** has a great past, but we must move on. It is not that we do not want to remember our heritage aud the 'good ole days", but we can not live in them. We have to look toward the foture! The NRCS and the NCSS are not the "were", they "are". It is not the responsibility of the present director to help us forget what we were, but to help us over the perceived greatness before reorganization. I was told that at the state soils scientist meeting this year; someone said, referring to reorganization, "The ship has **left** the dock and it is not coming back". Were you left on the dock? These are the days of Paul Johnson, Carol Jett, Horace Smith, and other leaders, not to lead us back to the past, but to lead us into the future.

If you think you are the only organization that has undergone reorganization, you do not know or understand my situation. Within the past year, essential every administrator has changed. Last September my department head retired. I report to an interim head. Last July a new director for the experiment station and research was named. In January. Dr. Bill Richardson stepped down as Dean of the College of Agriculture to become Chancellor of the LSU Agricultural Center. The Dean has not been replace. The Chancellor of the Baton Rouge Campus **has** also changed as well as the provost, and **vice-**chancellor for academic affairs.

Earlier when I asked you if you were truly committed to the mission, I may have given the impression that NRCS was to blame for the loss of cooperation. That is not totally true. The partners are at **fault** also. We have not always done our part. I ask the same question to the partners of the NCSS. WHAT ARE YOU DOING HERE?. It is true that priorities have changed within universities. But who was responsible for those changes? What have we done to foster cooperation between us and the NRCS? Have you ever invited NRCS personnel to you home for **dinner?** Do you consider the state conservationist and state soils staff as friends? When choices for personnel are made are you asked for your input? On the same vain, what kind of relationship' do you have with the department **head** and other administrators? Have you ever **asked** your department head to attend a field review *or soil survey* dedication? Have you ever wondered why other **staff members** seem to have their requests granted and you do not? You can be sure that department heads are invited to attend wheat, corn and other commodity field days. They see and hear their **staff members** talking with their users. I have a tremendous responsibility and opportunity to explain to a new **administration** as to what I am all about and what the NRCS and NCSS is all **about. If we are** not willing to put forth the effort, is it any wonder that the department head or others administrators turn down your request and tell you to stop **spending** so much time on NCSS. I know the pressure we have to publish and to seek outside funding for our research. But with a knowledgeable and **understanding** department head and administrators as to the importance of the NCSS, there is no reason why we can not do both. So I ask you, WHAT ARE YOU DOING HERE?

The final picture of our runner is he has rounded the last curve and heading home. He is **straining** ever muscle. His legs are weary, his chest hurts and his head throbs because his body demands oxygen. But he presses on to reach the **finish** line. His whole beii is focused on fulfilling his vision. If we are to **fulfill** our vision, it can **only** be accomplished through cooperation. I believe we will write this chapter in the annuals of the NCSS that the ship that set out with a perfected future reached her destination. In order to accomplish our vision, we must stay focused, reach for the finish lme through cooperation. This can be accomplished with **understanding** and communication. We must **truly** know why we arc here. **WHAT** ARE YOU DOING HERE?

Regional Soil Genesis Field Trip

The experiment station representatives began hosting a regional soil genesis field trip several years ago. The 1997 trip was hosted by the states of Connecticut, Massachusetts, and Rhode Island on June 2-6. It was decided to hold this trip every two years, so the next trip will be held in the summer of 1999. The location has not been determined.

Research in the Northeast

The following list includes some of the major research projects being conducted by the individual northeastern states.

Connecticut
-Calibration of presidedress nitrate tests
-Effect of land spreadii sludge from water treatment plants
-Sorption phenomena occurring on soil and mineral surfaces
-Archeological studies

Maine
-Water-soluble soil organic matter interactions with ions in soil solution and with soil surfaces
-Effects of atmospheric pollution on the biogeochemistry of forested ecosystems
-Determination of the controlling effects of soluble carbohydrates on nutrient transformation in soil
-Development of methods to separate Humods from Orthods
-Relationship of Humods to landscape position

Maryland
-Impact of sea level rise on soil quality in coastal areas
-Soils developed in freshwater marl sediments in the Hagerstowu (Great) Limestone Valley
-Mineralogical determination for family placement of soils on the Maryland coastal plain
-Pedo-geomorphic assessment of sulfidic materials in Anne Arundel County landscapes
-Submerged soils in shallow water habitats
-Comparison of chemical properties of soils under forest and agricultural land management: or the case for cultural Alfisols
-Carbon storage in submerged upland tidal marsh soils of the Chesapeake Bay

Massachusetts
-Plant-Soil-water relationships
-Iron cycling in sandy soils
-Growing season definition

New Jersey
-Heavy metal solubijtv
-Effects of zinc contamination on soil microbial ecology

-Effects of soil aggregation on sequestering of organic matter and/or xenobiotics and movement of bacteria in the soil
-Interaction of management practices on subsidence of organic soils
-Leaf mulch effects on soil aggregation
-Physical properties of soils related to drainage

New York
-Quantitative modeling of soil forming processes (pedodynamics)
-Mapping pesticide leaching potential with integrated data bases and simulation models
-Map of the rainfall erosivity of Honduras
-Ecological sustainability of slash-and-burn agriculture on the island of Borneo in Indonesia
-Development of computer-based soil science tutorials

Pennsylvania
-Soil temperature with depth
-Saturated hydraulic conductivity of Pennsylvania soils
-Renovation of atmospheric acid deposition by soils formed in different geologies
-Hydrodynamics of fragipan soils formed in glacii till materials with perched water tables

Rhode Island
-Heavy metal concentrations in soils
-On-site waste water training program
-Importance of riparian buffer zones in attenuating pollutants, primarily nitrogen

West Virginia
-Characterization and classification of acid sulfate soils
-Physical properties and erodiiity of fly ash used as a topsoil substitute in mine land reclamation
-Treatment of wastewater by minesoils
-Minesoil development 15 years alter reclamation
-Carbon distribution of frigid soils
-Properties of soils in natural and constructed wetlands
-Heavy metal concentrations in soils

HIGHLIGHTS OF BLM SOIL SURVEY ACTIVITIES
NCSS CONFERENCE, BATON ROUGE, LA
JUNE 16. 1997
SCOTT DAVIS, COLORADO STATE OFFICE

Maitland Sharp, Assistant Director, Renewable Resources & Planning Staff for the Bureau of Land Management (BLM), Washington D.C.. Headquarters has committed the BLM to assessing the potential for the National Resource Inventory (NRI) in meeting the BLM need to evaluate and report on the Health of Public Rangeland. The BLM seeks a proven method to evaluate rangeland and woodland that can be integrated with other resource information. The BLM's objective is to provide answers to congress and the public about rangeland health.

Colorado has been selected as the BLM NRI pilot project for 1997. The effort is being coordinated with the Natural Resources Conservation Service (NRCS) at the National and State level. This year 300 Primary Sampling Units (PSU's) containing two points each will be intensively inventoried and sampled to test and measure status and resource trends over broad areas. The sampling scheme strategy is based for interpretations to be made at a state level.

Vegetative production, ground cover. soil verification and quality data are being collected. A qualitative health assessment consisting of ecological attributes is also being tested. All data will reflect soil, water and biotic plant communities condition. Additionally, ecological site prescriptions will be noted for upgrading and soil map units will be assessed for accuracy. Indicators of individual or combined rangeland health problems such as weed infestation and/or soil erosion will be recorded.

Statistical analysis involving the variability and number of points for data collection will determine the validity of the NRI. After initial data collection additional points will be added if necessary to insure a high level of validity of NRI interpretations.

At the completion of the Colorado NRI test the BLM will draft an internal report evaluating four topics:

1) The operational aspects-process, protocols, & logistics of the NRI.
2) The ability of the NRI to populate a data base that provides a picture of ecological processes and rangeland health.
3) Identification of the appropriate number of points for a statistical accuracy of a high confidence level for interpretation of data.
4) Analyses of utility and cost effectiveness of NRI to BLM.

ACCELERATED SOIL SURVEY DIGITIZING PROCESS -A Panel Discussion

"Historical Perspective and Compilation Bases"

INTRODUCTION

Tommie, thank you for inviting me to participate on this **panel,** along with you and Mike. This is the fourth NCSS Conference I've attended since being in National Headquarters. I've found that workshops **and** conferences such as this are much more enjoyable **. . . and,** much more relaxing ... when ALL of the time is spent on the other side of the podium ... Nonetheless, I'm delighted to be here and to have the opportunity to participate on this panel.

Tommie has asked me --- **as my part of the panel** --- to focus on some of the background of the Accelerated Soil Survey Digitizing process --- and especially, the base maps for compilation, and --- as a digitizing base.

However, ... Before I begin to talk of imagery, **. . . and** map compilation, .. and orthophotography, and digitizing, --- Before we consider formats and scales ... and status data . . . **and, standards** and specifications, --- Before we ponder the direction we are headed **with** our National Cooperative Soil Survey Program --- Before **we** do this ... Indulge me for a few minutes ... Travel with me back in time . . .

"TIME TRAVEL"

Travel with ***me*** back to 1869. We are in the Utah desert, at a railroad camp. Two great locomotives lie facing each other --- with a single gap of track separating them . . .

The Union Pacific had moved westward across the Great Plains, from au "initial" point --- which is now Omaha, Nebraska --- to some "unspecified" point where it was to unite with the Central Pacific, which was chartered in California to **run** eastward, ... from the San Francisco Bay area.

As we stand there, we observe the **final** cross tie being nestled into place on the railroad bed of crushed **rock** and gravel --- a cross tie of California polished laurel. The last rail is laid and the final spike is driven --- a spike of California gold. The Nation is joined --- for the first time --- from the Atlantic to the Pacific. The first transcontinental railroad is complete.

"Historical Perspective and Compilation Bases", James H. Ware, Soil Survey Division, NRCS, Washington, DC. Presented as part of a Panel Discussion: Accelerated Soil Survey Digitizing Process, at the National Cooperative Soil Survey Conference, Baton Rouge, Louisiana, June 15, 1997.

This event in the Utah desert marked the end of a great National Project, and the **beginning** of an em when the Nation would be laced with connecting networks of railroads --- A railroad system that had profound significance for transportation, commerce and development.

SO, . . . what does all of this have to do with the topics at hand? What am the **parallels** between railroads and trains, **... and,** maps and soil surveys? --- and, digitizing?

HISTORICAL PERSPECTIVE

#1 SLIDE - Status of Soil Surveys - July 1995 (color)

We have made great progress in mapping and **classifying** the Nation's soil resources. Over 75% of the country is mapped --- over 90% of the private **lands,** . . . **and,** many States have embarked on an aggressive update program **...** **which,** includes **digitizing** as an integral part of the process. **IN** FACT, it is the demand for digital soils data that is **driving the update process** in most instances.

Like the early railroads, our Nation's soil surveys represent a **patchwork** --- a patchwork of resource information, **...** produced **over time** --- for uses and management --- AT **THE TIME** . . . We offer no apologies for the differences and inconsistencies between a survey produced 35

#3 SLIDE - Classification of Wetlands and Deepwater Habitats of the U. S., **front** cover (color)

AND, . . . What really IS the characteristics of a "wetland" --- and, "Hydric" Soils? . . . .

Where. do we go from here? What is the next great Challenge to the NCSS, and our National Soil Survey Program?

#4 SLIDE - Status of Vector Digitized Soil Surveys - Digitizing QIT Report (color)

The demands of our soils data from users are clear . . . they want more detail **... and,** higher quality data, --- in an electronic format . . . The rapid development of computers, GPS and GIS technology --- along with "digital" orthophotography **... has created this** demand.

Like the earlier railroads, --- and our soil surveys, --- early efforts at digitizing soils data have been fairly independent, and **limited** to specific or singular uses on a local level. These **pioneer efforts** have paved the way for development of a National set of Standards and Specifications ... and Procedures, --- for producing digital soils data.

SOIL SURVEY DIGITIZING INITIATIVES

#5 SLIDE - FY 95 **EARMARKE**D SOIL SURVEY DIGITIZING STATUS, as of **10/1/95** (color)

In **fiscal** year 1995, the Soil Survey Division designated $2.5 million dollars to sponsor a national initiative to increase the digitizing of soil surveys -- especially, published soil surveys. About 100 surveys were earmarked, additional computer equipment and **film** writers were purchased at Fort Worth, and selected individuals from 7 states received intensive **training** in digitizing procedures.

Again in fiscal year 1996, we designated an additional $2.6 million for about 150 high priority surveys.

#6 SLIDE - STATUS OF SOIL SURVEY DIGITIZING (SSURGO), as of **6/6/97** (color)

This fiscal year --- 1997 --- NRCS received $10.0 million dollars as ***"Congressional Earmark and Presidential Initiative "*** funding for the expressed purpose of soil survey digitizing and acquisition of digital orthophotography, --- to support implementation of USDA Field Service Centers. We are currently tracking about 600 high priority surveys to digitize and certify to **SSURGO Standards and Specifications**.

#7 SLIDE - SSURGO: FOUNDATION for a GEOSPATIAL AGENCY - QIT Report Cover (color)

"SSURGO" --- Soil Survey Geographic databases . . . The acronym has become synonymous with both the Standards and Specifications, . . . as well as the Certified Soil Survey.

In NRCS Field Offices and USDA Field Service Centers, we envision the SSURGO data layer to be the **Foundation Layer in a GIS**.

But, even more basic than the SSURGO digital soils data, ... is the base map . . . The base **map** --- digital orthophotography.

It is here, . . . then ... **that** comparisons **with railroads** and trains become most vivid ... If the gauge of the track and the train are not the same, . . . OR, if the rails are not joined --- well, you get the picture .... Likewise, in **an** electronic world --- if formats, **and** standards aud **specifications** are not compatible, ... **GIS capabilities become limited**.

Each digital orthophoto acts as a rail --- to join the landscapes across the Nation. The digital ortbo **must join --- and any spatial or line data digitized from this base must join ... or, the limits** of GIS **capability** become defined. They **must also** be compatible wlth specifications for digital data capture.

NATIONAL AERIAL PHOTOGRAPHY PROGRAM **(NAPP)**

#8 SLIDE - NAPP - "Putting Fii in the Can"

The primary source of **film** to produce ortbophotography comes **from** NAPP --- the National Aerial Photography Program ... **What I call "Putting Film in the Can"**...

#9 SLIDE - NAPP OVERVIEW

NAPP is funded and **administered** primarily by 5 Federal agencies, with States participation. Currently, the NRCS, FSA, FS, NASS and USGS are the principle funding agencies, **and** they comprise the NAPP Steering Committee. Contracting for Sights is to the private sector, and is administered by the USGS.

#10 SLIDE - NAPP SPECIFICATIONS

NAPP is flown at 20,000 feet above mean terrain --- in a North-Sough direction, ... **and,**

NATIONAL DIGITAL ORTHOPHOTOGRAPW PROGRAM (NDOP)

#12 SLIDE - NATIONAL DIGITAL ORTHOPHOTOGRAPHY PROGRAM (NDOP)

NAPP **film** is the primary source for producing orthophotography. **Beginning** in 1993, the techniques and procedures, and standards and specifications for producing orthophotography "digitally" were completed by USGS. Since that time ALL ortho produced under the NDOP has been digital.

#13 SLIDE - DOQ TECHNICAL CHARACTERISTICS

Not surprisingly -Technical standards and specifications, and characteristics are the same as those for flying NAPP **film...** i.e., NAPP imagery, Quarter Quad, UTM Coordinates, and NAD 83.

#14 SLIDE - NDOP PROGRAM STATUS, as of **6/97**

There are over 216,600 quarter quads **(DOQs)** in the "Lower '48". To-date, 24% are complete ... -and, another 32% has been **funded** for "In-Work" production. I estimate the total --- complete and In-work --- to approach **70-75%** by the end of this fiscal year.

#15 SLIDE - DIGITAL ORTHO **QUADRANGLES --- Status as** of May 1997 (color - red & blue)

This visual will give you some indication of where **DOQs** are complete and In-work The red areas are **DOQs** that have been completed and are in the database. The blue areas are under various states of production.

#16 SLIDE - DIGITAL ORTHO QUADRANGLES --- Status as of April 1997 (color - red, blue, yellow, green)

The Soil Survey Program and **SSURGO** digitizing initiatives play an extremely important and active role in the acquisition and coordination with other Federal <u>**and**</u> State agencies. This visual (the yellow and green) indicates where NRCS has paid 50% or more of the cost of the DOQ -- primarily, for Project Surveys .. and, for SSURGO Projects.

SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE CHARACTERISTICS

#17 SLIDE - SSURGO Base Map Characteristics, NSH Part 647

Well, we have looked at Base Map Standards and Characteristics for NAPP - "Putting Film **in the Can"** ... and, NDOP - Producing digital orthos. Would you be terribly surprised to see much of the <u>same stuff</u> for SSURGO?! I hope not! ... **It is not by accident --- it is by design -indeed, . . . it is by necessity!**

Since 1991 ow Soil Survey Policy for new and update surveys has been to use either the **Full** Quad or Quarterquad formats at either **1:24,000** or 1: 12,000 scale, respectively:

#18 SLIDE - Spatial Data Format, NSH Part 647

And, . . . **What** about the format for Spatial Data Capture for SSURGO? **--- Quad/Quarter-**quad, UTM Coordii, NAD 83, Vector Data Structure, with NO **x_** or **y_** coordinate shifts.

SUMMARY: COMMON STANDARDS - NAPP, NDOP, & SSURGO

#19 SLIDE - 'TIES THAT BIND" -- **NAPP, NDOP, &** SSURGO Standards and **Specifications**

Am I beginning to sound like a broken record? --- I hope so ... Itisthecommonformats between NAPP, NDOP, and **SSURGO** that **ensure** a proper fit and positional accuracy of spatial soils data. It is the application of these common formats . . . along with the correct application of SSURGO Standards and Specifications that **will** determine the usefulness and boundaries of ow **digitized** soils data in GIS enviromnents.

CLOSING --- SHARE TEE VISION

#20 SLIDE - SHARE THE VISION

Where do we go from here? What are the present and future challenges to the Soil Survey Program, and to **this** National Cooperative Soil Survey? I submit that the greatest challenge is yet ahead --- It is to digitize ow Nation's soil resources with **correlated** links to ow interpretative data.

Several years ago, the Soil Data Base at Iowa State was estimated to be worth over $5.0 billion dollars. This **merely represents** the attribute portion of SSUBGO . . . Who will estimate the worth of ALL of ow Nation's soil spatial data? And, ... who, here, will be so bold as to estimate the compounded value of Certified SSURGO Data Sets across the NATION --- Attribute Data, Spatial Data and accompanying **Metadata ---** available for GIS applications and analysis77 WHAT A NATIONAL ASSET!

SHARE THE VISION – Let's work together, ... toward this goal. __ The SSURGO Train has **left** the station!

Thank you for **your** attention, ... and for **sharing** the tide.

SUMMARY OF SLIDES

#1 SLIDE - **Status of Soil Surveys-July** 1995 (color)

#2 SLIDE - **Quality Joins QIT Report Front Cover (color)**

#3 SLIDE - Classification of Wetlands **and Deepwater** Habitats of the U. S., **front cover (color)**

#4 SLIDE - **Status** of Vector Digitized Soil Surveys - Digitizing QIT Report **(color)**

#5 SLIDE - FY 95 **EARMARKED** SOIL SURVEY DIGITIZING STATUS, as of **10/1/95** (color)

#6 SLIDE - STATUS OF SOIL **SURVEY** DIGITIZING (SSURGO), as of **6/6/97** (color)

#7 SLIDE - **SSURGO:** FOUNDATION for **a** GEOSPATIAL AGENCY - QIT Report Cover (color)

#8 SLIDE - NAPP - "Putting Film **in** the **Can'**

NATIONAL AERIAL
PHOTOGRAPHY
PROGRAM
(NAPP)

"'Potting Film **in** the Can"

#9 SLIDE - NAPP OVERVIEW

NAPP OVERVIEW

- Funded by Federal Agencies **(NRCS,** FSA, FS, NASS, USGS)
- NAPP Steering Committee
- State Agency Participation
- Administered by USGS – Contracted to Private Sector
- Considerations – **Funding,** Film Type (B&W vs CIR) Flying Season
- 7 Year Cycle

#10 SLIDE - NAPP SPECIFICATIONS

NAPP
SPECIFICATIONS

- Flown 20,000 **Feet Above Mean Terrain (1:40,000 Nominal Scale)**
- **North - South Direction**
- **Quarter** Quad Centered **(3.75' x 3.75' Lat. and Long)**
- **References – UTM Cord.; NAD 83**
- **Nominal 60% Forward Lap and 30% Side** Lap
- **Considerations ---** Sun Angle, Clouds, Ground Cover

#11 SLIDE - NAPP SEVEN YEAR ACQUISITION PLAN (color)

#12 SLIDE - NATIONAL DIGITAL ORTHOPHOTOGRAPHY PROGRAM (NDOP)

NATIONAL DIGITAL
ORTHOPHOTOGRAPHY
PROGRAM
(NDOP)

Conversion from ANALOG
to DIGITAL ORTHO
1993

#13 SLIDE - DOQ TECHNICAL CHARACTERISTICS

DOQ TECHNICAL
CHARACTERISTICS

- Specifications Endorsed by Base Cartographic Data Subcommittee of FGDC
- Source Imagery – NAPP
- Georeferenced - 1 Meter Ground Sample Distance
- Meets National Map Accuracy Standards for 1:12,000 scale (± 33 feet)
- Centered on 3.75' x 3.75' Geographic Cell
- UTM Coordinate System - NAD 83 Datum
- Ancillary Product is DEM
  USGS Sells Soft
-
-

#17 SLIDE - SSURGO Base Map Characteristics, NSH Part 647

SOIL MAP **DEVELOPMENT**
Part 647. NSSH

DIGITIZING (SSURGO) SPECIFICATIONS for
BASE MAP **CHARACTERISTICS:**

- Meet National **Map Accuracy** Standards
- Meet (Proposed) U. S. National Cartographic **Standards** for Spatial Accuracy
  (Defines spatial **accuracy** for map **products** at scales of **1:250,000 scale** or larger, produced by Federal agencies.)
- Reference (Spatial) system:
  - **NAD 83 or,**
  - NAD27
- **Map** Sheet (Spatial) **Formats:**
  - **Full** Quad (7.5') or,
  - **Full** Quarter Quad (3.75')

#18 SLIDE - Spatial Data Format, NSH Part 647

SOIL MAP DEVELOPMENT
Part 647, NSSH

DIGITIZING (SSURGO) SPECIFICATIONS for
SPATIAL DATA **FORMAT:**

- **Quadrangle Formats:**
  - **Full** Quad (7.5') or
  - **Full** Quarter Quad (3.75')
- **External** spatial **References:**
  - **Ground** Based **Projections -** UTM
  - **Horizontal** Datum **- NAD 83** or. NAB 27
  - Map Units in Meters
  - **Quadrangles** Retained in Grid Zones
  - No **x**_ or y_**Coordinate** Shifts
  - Data **Coordinate** Format is Real
- Internal Spatial Reference
  - Any Coordinate System During Digitizing
- Data Structure
  - Vector (Location of **lines,** points, area **boundaries** represented by strings of **x,** y **coordinate** pairs)

#19 SLIDE - "TIES THAT BIND" -- NAPP, NDOP, & SSURGO Standards and Specifications

"TIES THAT BIND"

NAPP
NDOP
and
SSURGO STANDARDS and SPECIFICATIONS

- FORMAT
  - Quarter Quad (3.75' x 3.75') Geographic Cell
- REFERENCE SYSTEMS and Projections:
  - lJlMCQordhw
  - NAD 83 Datum
- MEET NATIONAL MAP ACCURACY STANDARDS
- MEET FGDC (Federal Geographic Data Committee) STANDARDS
- ARCHIVED AS PART of NSDI (National Spatial Data Infrastructure DATA BASE FRAMEWORK

#20 SLIDE - SHARE THE VISION

SHARE THE VISION

A national Soil Survey Database (SSURGO), that is joined across county and state boundaries with MLRA-based legends.
The surveys are compiled and digitized from an (digital) orthophotography base in either full quarter-quad, or full quad format.
The digitized surveys consist of spatial, attribute and metadata that meet SSURGO standards.
The products are available for national distribution

Presentation to the NCSS Conference by:
Dr. Edward Huffman
Program Manager, Land Resource and Evaluation Program
Agriculture Canada

The Rise of Soil Survey in Canada

- some reference to soil conditions and distributions by explorers in the 1800's,

- first survey was in southern Ontario in 1914, by Coffey and Galbraith,

- surveys were soon established in all provinces, mostly under the guidance of graduates of American universities such as Illinois, Michigan and Cornell,

- the National (later Canada) Soil Survey Committee was formed in 1945,

- the first Canadian taxonomic system of soil classification was outlined in 1955, and published in 1970,

- development of a computerized soil information system (CanSIS) was begun in 1971 and digitization of maps was in full swing by 1978.

The Fall of Soil Survev in Canada

- by the early 1960's, land use issues focussed attention on the interpretation of soil data and the CLI essentially dominated soil science until 1975,

- by the late 1970's almost all agricultural land had been mapped and a number of re-surveys were underway,

- by 1990 almost all soil maps were digitized and entered into CanSIS and digitizing tables were lying idle,

- by 1996 there existed some survey work in the far north and some 'data upgrade' work in other areas,

- in 1996 a federal 'program review' reduced soil survey staff by about 50% and dramatically restructured the program.

Structure of the Canadian Soil Survey Program Prior to 1996

- a formallized network, with 'headquarters' in Ottawa and a 'Soil Survey Unit' in each province,

- each Unit was 'headed' by a federal employee who was responsible for administration, coordination and correlation at the national level, and reported to a manager in Ottawa,

- the scientific aspects of the network were governed by the "Canada Soil Survey Committee', consisting of the manager, Unit Heads and other invited participants.

ROLES:

Ottawa:

- financing
- support for the Canada Committee
- correlation & lab analysis
- data standards, quality control
- digitizing, printing, distribution
- data management

Provincial 'Units":

- within-province coordination (federal, provincial, university)
- soil survey, draft maps, reports
- representation on the E.C.
- local interpretations
- support for national interpretations

Structure of the Canadian *Land* *Resources* Program After 1996 "Program Review"

- an informal network of "Land Resource Units" administered by regional Centres of Excellence related to one or more commodities.

- each unit increasingly specializing on issues for a particular ecoregion or broad soil type.

- one of those regional Centres (Ottawa) has been given the mandate for the management of the NSDB, but there are no formal links to other regions.

- the federal members of the former soil survey units have formed an ad hoc Canadian Land Resource Network (CLRN) as a means of maintaining communication.

Brimarvt - e / a ted Activities:

Summer/and (Whitehorse, Agassiz):

- northern and mountain soils (characterization, capability),
- impacts of intensive crop and livestock operations on soil and groundwater quality,
- leadership of a national 'agri-environmental indicators' project,
- preparation of regional 'soil erosion by water' indicator.

Lethbridge (Edmonton):

- impact of irrigated cropping on soil and water quality,
- impact of intensive beef production on soil and water,
- preparation of regional 'soil erosion by water' indicator.

Swift Current (Saskatoon):

- partnership in the Saskatchewan Centre for Soil Research,
- support for research into sustainable dryland farming systems for the Brown and Dark Brown soils,
- finalization of maps, reports, attribute databases, layer and names files and a unified legend to complete 1:100k coverage for all agricultural areas,
- suitability maps for specialty crops and trees,
- salinity monitoring, prediction and mitigation,
- impact of soil variability on site specific farming,
- soil quality benchmarks,
- development of an indicator of the risk of wind erosion,
- content of Cd and other trace elements in soil,
- development of computerized farm decision support systems,
- impact of dryland farming on greenhouse gas emissions, nutrient cycling and soil carbon.

Brandon (Winnipeg):

- collaboration with U of Manitoba, province and PFRA,
- Centre of Excellence for resource conservation and production issues in the 'Parkland' (Black & Gray soils),
- some 'wrap-up' field work relating to sensitive land with irrigation potential,
- database enhancement & standardization,
- soil quality benchmarks,
- crop and irrigation suitability ratings,
- waste application & implications of heavy metals,
- insurance rating system for soils,
- environmental impact assessment,
- soil variability in precision farming.

Harrow (Guelph):

- resource conservation and production issues related to production of processing crops on heavy clay soils,
- Ontario SLC database upgrade (with Ottawa),
- non-point source pollution of the Great Lakes (IJC),
- development of an 'indicator of the risk of water contamination'
- integration of environmental and economic models for program and policy applications,
- leadership for the 'indicator of the risk of soil degradation',

Ottawa:

- management, upgrading, integration and public distribution of the NSDB and related products,
- leadership for the 'Soil Quality Benchmarks' project,
- development of tools for spatial data representation and distribution,
- remote sensing for soil condition characterization,
- soil organic carbon in Canada & North America (in cooperation with NRCS),
- V.2 of "Peatlands of Canada",
- development of a soil 'sensitivity to change' classification,
- development of a World Reference Base classification for Cryosolic soils (Gelisols) in cooperation with USDA and University of Wisconsin,
- 3rd edition of 'The Canadian System of Soil Classification'.

Ste. Foy:

- finalization of data upgrade of soil maps in the intensive vegetable-producing counties S. of Montreal,
- implications of soil variability for precision farming,
- implications of application of urban biosolid waste on soil and water quality,
- soil moisture mapping with satellite imagery,
- impact of the application of hog manure on soil and water quality.

Atlantic Canada (Charlottetown, Fredericton, Truro, St Johns):

- identification of areas suitable for expansion of potato production (requires some local upgrading of old 'reconnaissance level' soil surveys),
- forest site classification and soil capability for and changes under agro-forestry,
- soil, SOM and water quality under vegetable crops,
- riparian zone management,
- implications of soil variability on precision farming,
- municipal solid waste applications,
- environmental farm plans,

ADVANTAGES OF RESTRUCTURING;

- increased flexibility to react to local and regional issues,

- improved access to soils expertise by farmers and the agricultural service industry,

- better application of the "Think Global - Act Local" approach,

- improved short-term budget implications.

DISADVANTAGES OF RESTRUCTURING:

- more difficult to initiate and manage 'national evaluation' projects,

- impossible to retain, and difficult to rebuild, the expertise lost through retirement of many senior soil scientists,

- unknown long-term budget implications.

OVERALL COST EFFECTIVENESS ??

UNKNOWN !!!

SOUTH AFRICAN SOIL SURVEY ACTIVITIES

TE DOHSE

Institute for Soil, Climate and Water of the Agricultural Research Council,
Private Bag X79, Pretoria 0001, Republic of South Africa

1. INTRODUCTION

South Africa, the wedge which divides the Atlantic from the Indii Ocean, occupies the southern most part of the African continent. The country lies between the latitudes 22% and 35°S and longitudes 17°E and 33 °E. South Africa, sharing boundaries with Lesotho, Swaziland, Mozambique, Zimbabwe, Botswana and Namibia, comprises nine provinces namely North, North West, Mpumalanga, Gauteng, Northern Cape, Free State, KwaZulu-Natal, Eastern Cape and Western Cape Provinces (Map 1).

The natural agricultural resources, especially climate, soils and topography, make South Africa a land of great diversity. Conditions range from semi-desert to subtropical rain forests; from floods to severe droughts; from snow in winter to heat waves in summer; from winter rainfall to summer rainfall and from barren sand-dunes to soils of high productivity.

South Africa covers a surface area of 122 million ha. Approximately 87% of the total area is used for agriculture and forestry. The remaining land is used for urban and industrial development, transportation, mining and nature conservation. The hugest area of the agricultural land (74%) is under natural vegetation which varies from semi-desert vegetation to temperate grassland. Forestry occupies 2% of land area and arable land approximately 11% of the possible 13% arable land, only 3% is of high agricultural potential. Because of the country's unique geology, known for its mineral riches, much of the high potential land is underlain by exploitable coal deposits. The ARC-Institute for Soil, Climate and Water (ISCW), the National Department of Agriculture and Mining Houses concerned, jointly address the problem of rehabilitating and reclaiming these disturbed soils.

An estimated one-third of the country's landscape is level to undulating while nearly one-fifth is steep, rocky and mountainous. The coastal region is elevated to a central plateau which, in turn, rises to the highest parts of the highveld. The highveld is cut off sharply by the escarpment of the Drakensberg range which extends over 1000 km (Map 2).

2. OVERVIEW OF THE NATURAL AGRICULTURAL RESOURCES

2.1 Climate

Latitude and altitude, together with oceanic influences, are responsible for the diversity in climate conditions. Today, there is a wealth of climatic information available from computerized databases although the spread of recording stations is not yet adequate in all parts of South Africa.

Rainfall, both total and seasonal distribution, plays a dominant role in determining the resource situation, crop suitability and selection, yield horizon and risk of agricultural production. The average annual rainfall is 511 mm. Over 60% of the country receives less than 500 mm per annum while 21% receives less than 200 mm. Less than 10% of the country receives an annual rainfall of more than 750 mm.

There are three major rainfall areas, namely a winter rainfall area in the south-western part, an all year-round rainfall area along the south coast and a summer rainfall area which covers the remainder of the country (Map 3). Median annual rainfall increases from less than 125 mm along the arid west coast more than 1000 m east of the Drakensberg escarpment (Map 4).

Rainfall is extremely variable with wide deviations from the mean annual values, especially in low rainfall areas. Even within those areas receiving more than 500 mm per annum production risks may be high because of poor seasonal distribution and water stress at critical stages of crop growth. South Africa is characterized by the occurrence of regular droughts of varying intensity, some of which may have devastating consequences. Severe floods are not uncommon.

Temperature, influencing agricultural potential as well as animal and crop adaptability, is equally important. With the exception of the Drakensberg escarpment in the east and small high-lying areas elsewhere, South Africa is hot in summer with many cloudless days. In winter months, few areas are frost free. High summer temperatures also influence evaporation which varies from 1 100 mm to over 3 000 mm per annum.

2.2 Soils and terrain

The upsurge in pedological interest in the 1960's led to many investigations which have provided a better understanding of the soil resource base throughout South Africa.

South Africa's soil mantle is highly complex and diverse as a result of soil formation and weathering processes. Those weathered over a long period of time and in aeolian deposits, are deep and permeable while others are to shallow for agricultural production. As much as 80% of the land surface is characterised by slightly weathered and calcareous soils, while over 30% comprises sandy soils with leas than 10% clay content. Almost 60% of the soils have a very low organic matter content. Many soils are vulnerable to erosion and other forms of degradation and require special treatment and management to ensure sustainability. Shallow depth, extremes of texture, rockiness, severe wetness and high erosion hazard are among the most important limitations.

More than 70 different soil forms, some of which cannot be classified satisfactorily by international soil classification systems have been identified, classified and described (Map 5) by ISCW and other soil scientists. South African soil scientists developed a taxonomic soil classification system to accommodate the country's peculiar soils. ISCW maintains national soil databanks which form the basis of sustainable land use planning, soil suitability and agricultural potential.

Terrain form and slope have a marked influence on agricultural potential and management practices. Slope steepness infer *alia* affects soil erosion and arability.

The most pressing soil-related problems in South African agriculture are soil erosion, soil compaction and crusting, soil acidity and alkalisation, soil infertility, soil pollution and desertification.

2.3 Vegetation

The climate, soil pattern and aspect interaction have produced as many as **70 veld type in** South Africa, each differing greatly in form and structure.

Map 6 reflects the location of five major natural vegetation regions. The winter rainfall area is characterised by its macchia or "fynbos". Further eastward, where rainfall is considerably higher, natural indigenous forests extend almost to the coast. The vegetation of the dry, central part of the country (Karoo) is characterised by succulent shrubs with varying but limited amounts of grass. A relatively small area of true desert occurs in the far west, but extends north-wards into Namibia. The central inland plateau comprises pure grassland and extends to beyond the Drakensberg in the east. Temperate and subtropical forests occur along the eastern seaboard. The remaining large vegetation zone lies to the north and comprises the mixed savanna which is rich in *Acacia* and other thorn species and the Kalahari thomveld further to the west.

2.4 Water resources

Water is the most scare and strategic resource in South Africa and is essential to social development and economic progress. The supply is limited, variable and poorly distriited. Most of the total supply **(53 600 m³/ℓ)** results from surface runoff while about 15% comes from underground supplies. Particularly well-watered areas occur along the eastern seaboard and in KwaZulu-Natal, which occupies little more than 7% of the country's total area, 40% of the available water is to be found. Runoff is highly variable and, for this reason, only about 60% of available water can be economically exploited to meet the needs of all sectors.

3. AGRICULTURAL POTENTIAL

Agricultural potential is defined as a measure of possible productivity per unit area and unit time achieved with specified management inputs. For a given crop and level of management, agricultural potential is largely determined by the interaction of climate, soil and terrain. The diversity, nature and distribution of the resources make agricultural potential determination a multi-factor issue.

The generalised crop production potential of South Africa (Map 7) reflects the distribution of potential classes. It should be borne in mind that the extent of land suitable for cultivation, let alone high agricultural potential, may vary considerably within each potential class.

4. SOUTH AFRICAN SOIL SURVEY ACTIVITIES

Prior to the early nineties most of the soil surveys done in South Africa were surveyed by the then Soil and Irrigation Research Institute of the Department of Agriculture using government funding. A small proportion of surveys were carried out by private consultant firms, mostly in the so-called "homelands" of the old South Africa. These surveys were mostly funded by government on a tender basis. During this period, the Soil and Irrigation Research Institute were responsible for the following kinds of surveys and pedological activities:

- Reconnaissance soil surveys (1:50 000) for irrigation development purposes
- Detail soil surveys (1:5 000) for irrigation development purposes
- Irrigation planning
- 1:50 000 key area soil surveys for identification of important soil series in South Africa
- Development of Soil Classification, a Binomial System for SA (1977)
- Development of Soil Classification, a Taxonomic System for SA (1991)
- Pet-i-urban soil surveys on scale 1:50 000 for two metropolitan areas in SA
- The Natural Agricultural Resource survey of SA (Land Type Survey)

In April 1992 the research arm of the Department of Agriculture was semi-privatized into the newly established parastatal, the Agricultural Research Council, and the Soil and Irrigation Research Institute became the Institute for Soil, Climate and Water (ISCW). Since that date all surveys carried out by the ISCW are on client request only. There is no national program funded by government to carry out systematic soil surveys. The post nineties also saw the creation of many independent consultancy firms offering a professional service in soil science and related earth disciplines. Those firms together with ISCW compete for the very limited and ever decreasing funds available in the field of research. Clients include the forestry, agriculture, engineering and rural development sectors.

The ISCW is one of 16 Institutes of the Agricultural Research Council (ARC) in South Africa. The ARC is a scientific, parastatal institution. The ARC's focus on agriculture and related sectors is aimed at optimising the role of agriculture with respect to national growth and development for South Africa.

The mission of ISCW is to supply information on soil, climate and water through research, development, technology transfer and services.

ISCW strives to significantly contribute to the betterment of quality of life in South Africa through the quantification, characterisation and monitoring of the natural resources and sustainable natural resources management and thereby achieve international recognition as leaders in soil, climate and water research and technology.

Established in 1902 as the Division of Chemistry, ISCW developed into a multidisciplinary institution, maintaining its analytical capacity. Since 1925 ISCW established and maintained a national capability in major soil science disciplines. This capability was later expanded and supplemented by agrometeorology and soil-water management to ensure a holistic approach to the natural resource base.. The next development phase focused on high technology which included remote sensing, a geographic information system and fully automated analytical services with state of the art instrumentation like an Inductively Coupled Plasma Spectrometer and soil mineralogy equipment.

In early development, the Institute focused on natural resources surveys, inventories and analysis, mainly to determine the properties and distribution of South **African** soils and on establishing a national **agricultural** weather station network. Comprehensive national soil and climate databanks were developed during a next phase. These databanks, supplemented with real-time data and expanded as required, provide the frame for **cost-effective** information to clients and a competitive edge for our **multidisciplinary** Institute.

This national Institute with a **staff establishment** of 200, operates three major R&D centres with 70% of the Institute's staff R&D functions are supported by competent and experienced administrative, financial, marketing, public relations and **library** services. Today, **ISCW's** strength lies in scientific excellence, in its breadth and depth of scientific and technological skills, as **well** as its capacity to draw on a wide range or key disciplines required to provide innovative solutions to clients, to sustainable land use and to the conservation of natural resources and environmental quality.

Current soil survey and related activities carried out in South Africa are:

- Detail soil mapping for **irrigation** planning (100 m grid) in rural areas (small **farmer** irrigation development)
- Detail soil mapping (150 m grid) for forestry development, with accompanying land preparation, species and fertiliition recommendations
- Reconnaissance soil surveys for land acquisitions and rating of sites for various purposes e.g. **afforestation** potential, yield predictions
- Detail **soil** mapping (one to four observations per hectare) for assessment of land for specific crop suitability (e.g. viticulture, **sitrus)**
- Assessment of agricultural and/or **afforestation** potential of land zoned for urban/rural development
- Rehabilitation of disturbed soils (open cast mining)
- Rehabilitation of man-made soils (mine dumps and siltation dams)
- Monitoring of rehabilitated areas
- Design, construction and upkeep of sport fields
- Problem solving of marginal sites, demarcation of wet lands and establishment of conservation sites
- Assistance to civil engineers in drainage related problems in road and general construction
- Assessment and monitoring of ground water
- Assessment, design and management of polluted soils
- In multi-disciplinary teams develop
  Decision Support Systems **(DSS)** for various purposes

ACKNOWLEDGEMENTS

The following publications and persons are acknowledged:

ISCW Contribution towards Agriculture in South Africa, 1998. (5th ed.) (In press)

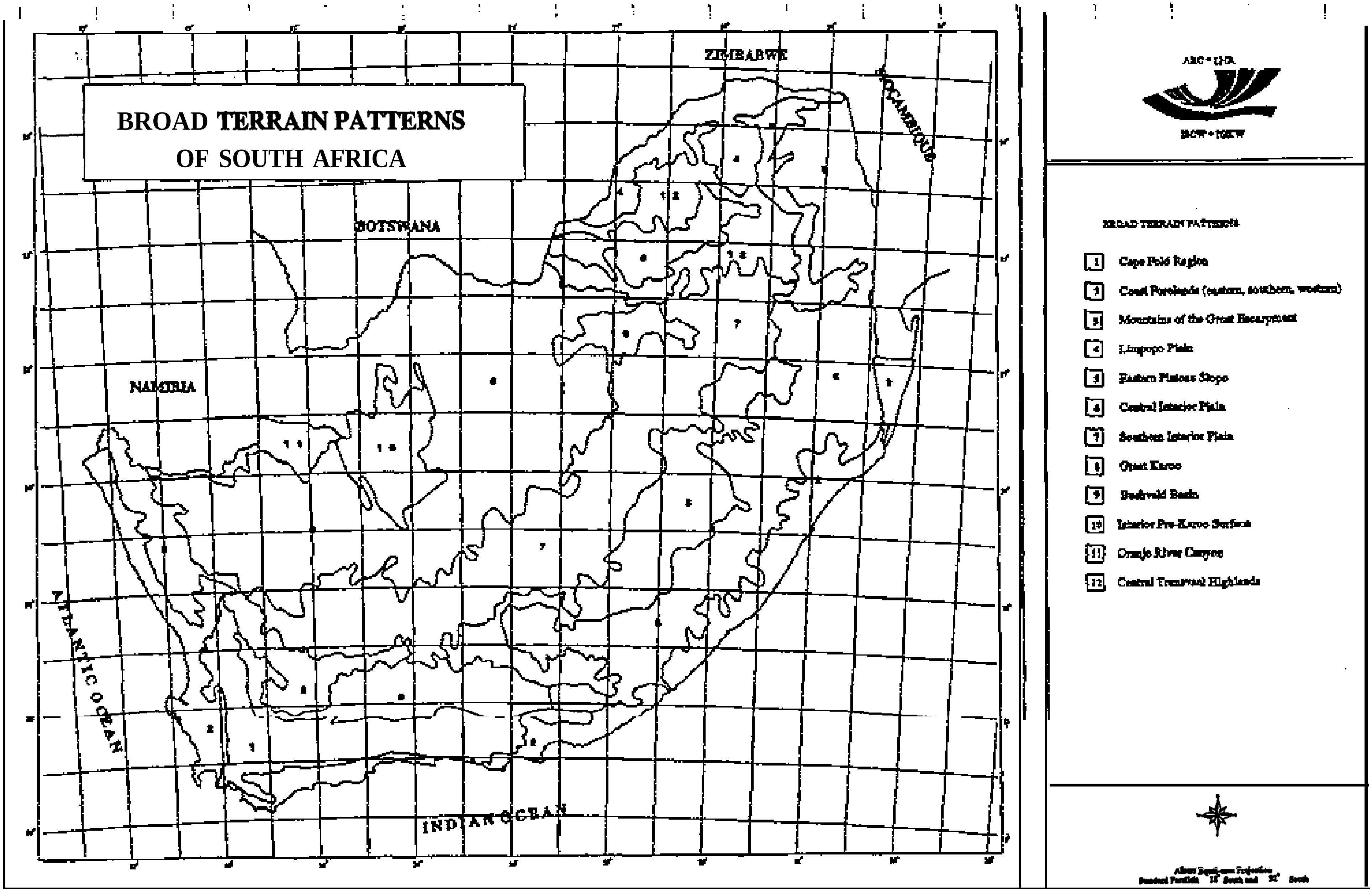
ISCW Staff 1997. Institute for Soil, Climate and Water Business Plan **1997/1998,** Pretoria.

Scotney, D.M., Volschenk, J.E. & van Heerden, P.S., 1990. The potential and utilization of the agricultural natural resources of South Africa. Department of Agricultural Development.

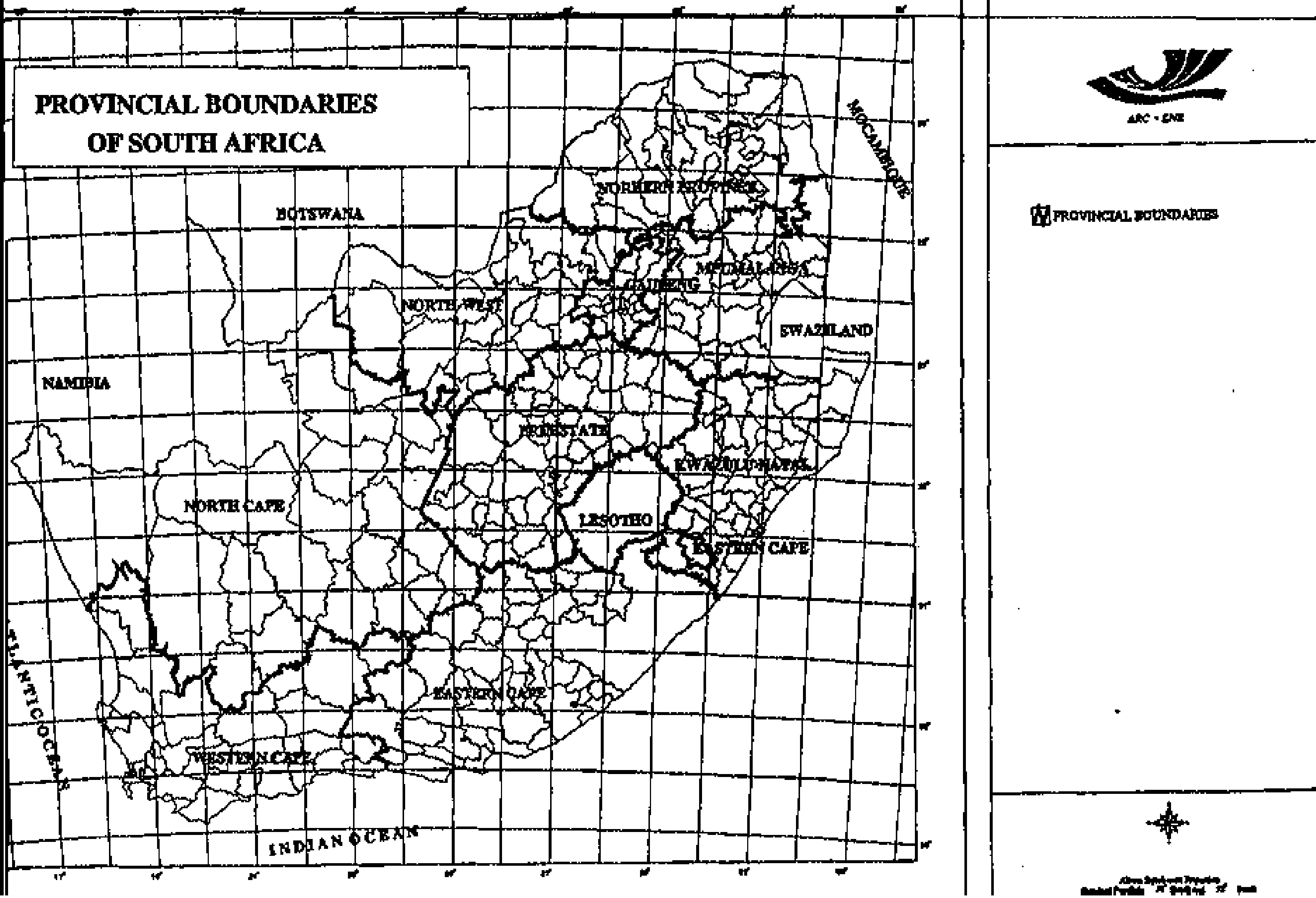
Lambrechts, J.J.N., 1997. University of Stellenbosch, Stellenbosch. Personal communication.

Snyman, K.C., 1997. Keith Snyman and Associates - Soil scientists and land use planners. Mtuzini. Personal communication.

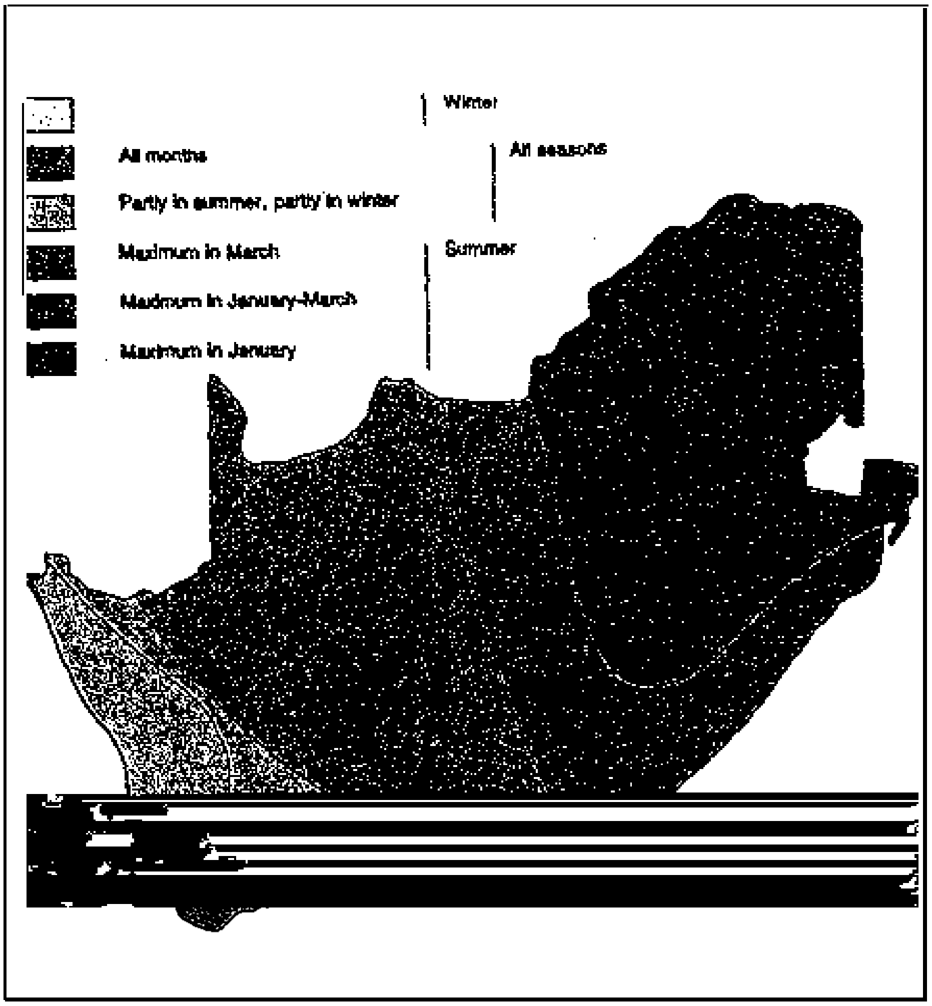
Van Deventer, P.W., 1997. Heydemych and van der Nest - Rehabilitation technologists. Welkom. Personal communication.



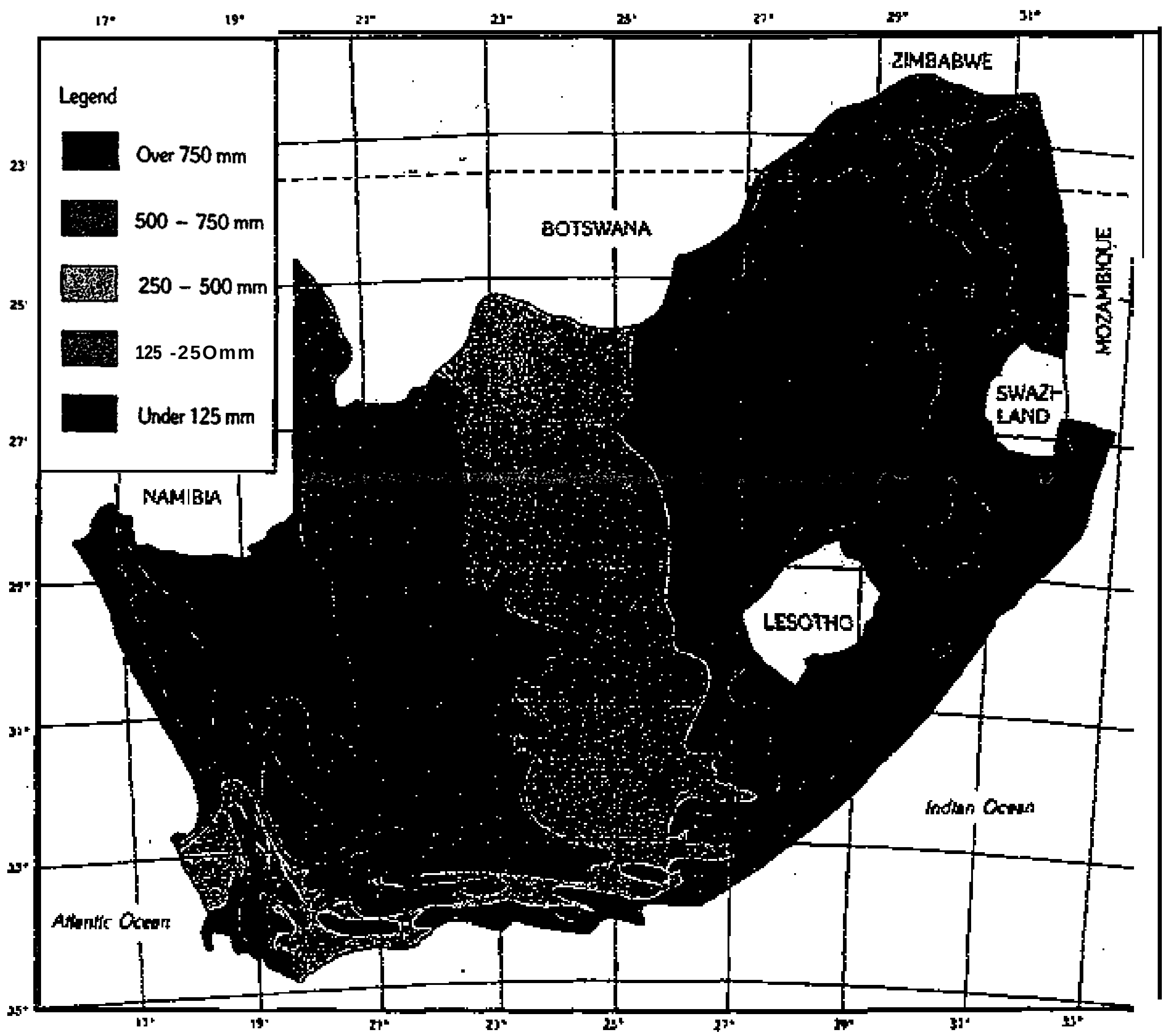
MAP 2. Broad terrain patterns of South Africa



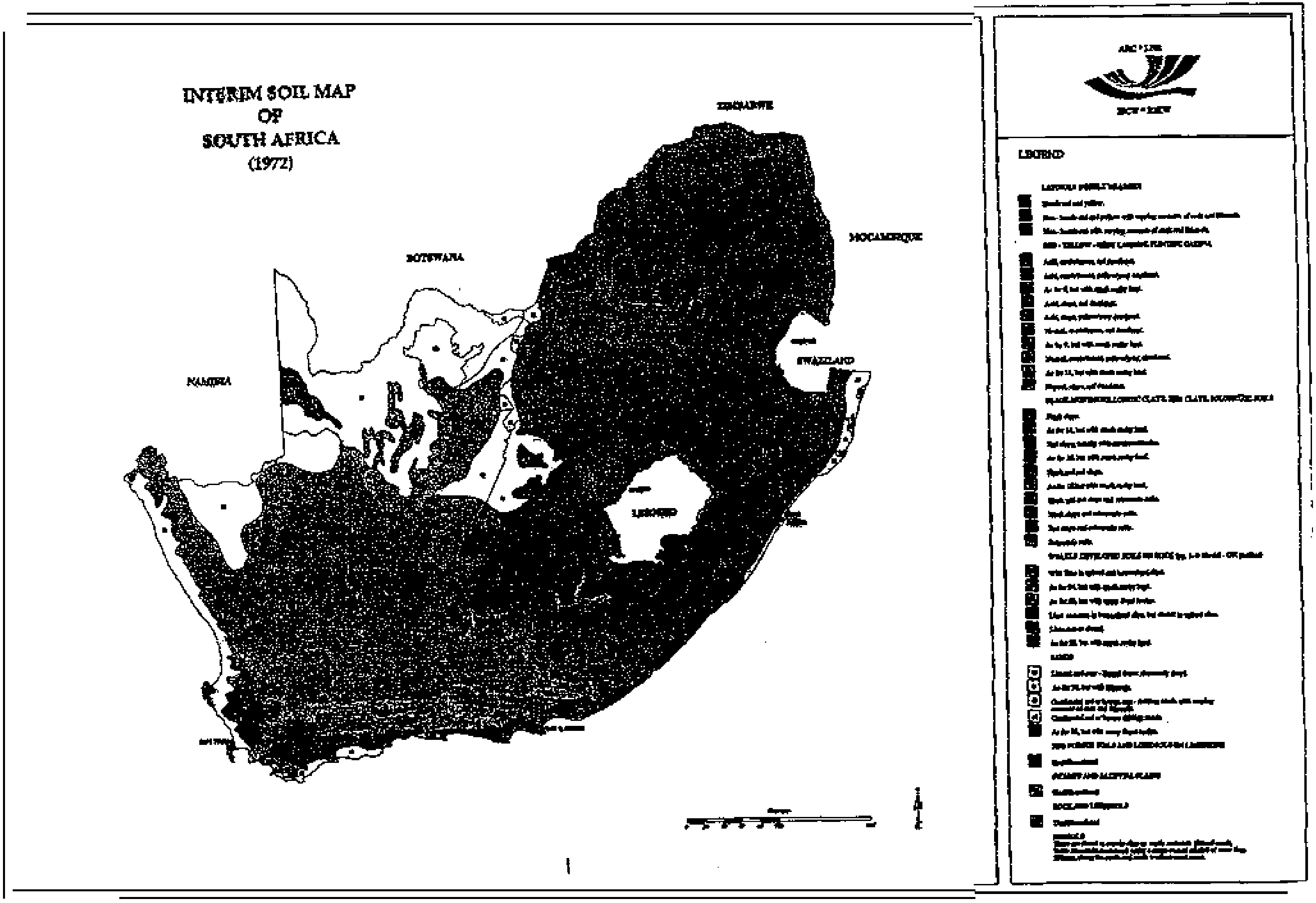
MAP 1. ndari Afri

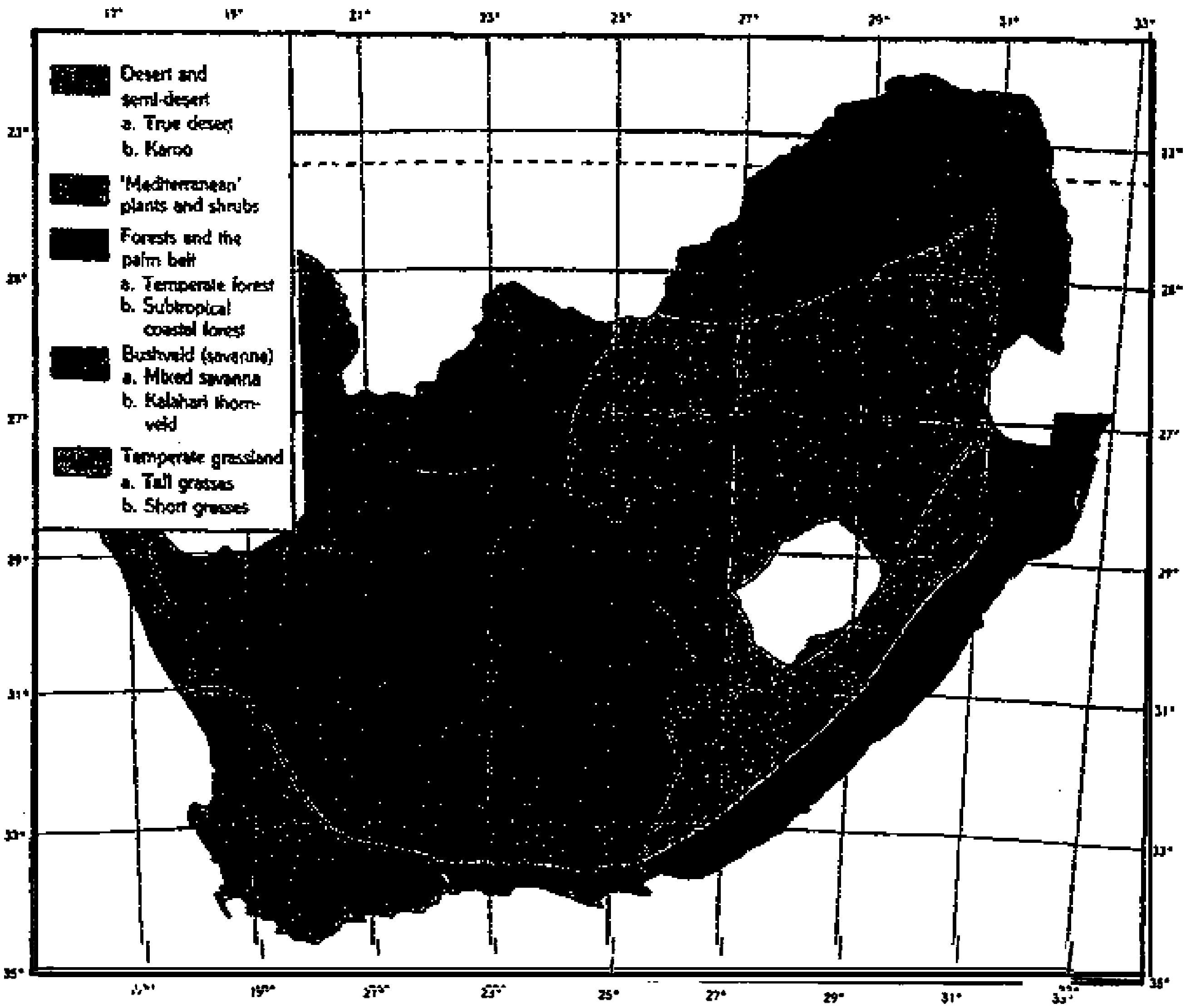


MAP3. Seasonal rainfall regions of South Africa

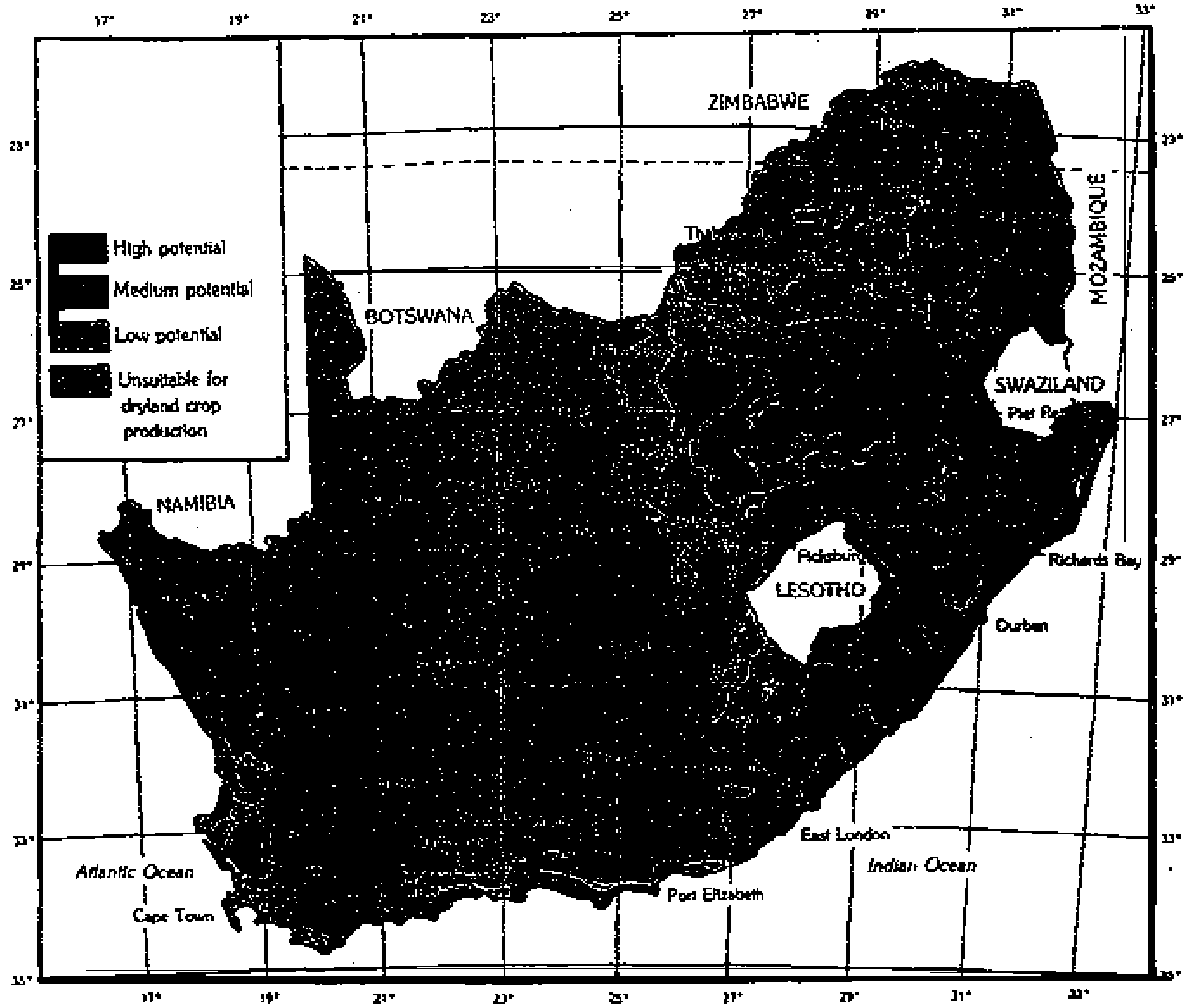


MAP 4. Average annual rainfall of South Africa


INTERIM SOIL MAP
OF
SOUTH AFRICA
(1972)
BOTSWANA
NAMIBIA
MOCAMBIQUE
SWAZILAND
LESOTHO
LEGEND



MAP 6. Major natural vegetation regions of South Africa



MAP 7. Generalized crop production potential of South Africa.

1890'S UNIVERSITY'S REPORT: Programs and Initiatives

Presented to National Conference of
Soil Scientist and Surveyors
by *Daniel Wims*
Hilton Hotel, Baton Rouge, LA
June 16, 1997

On behalf of my unit administrator, the Dean of the College of Agricultural, Family and Consumer Sciences at Southern University and A&M College. Dr. Bobby R. Philis, our System President Dr. Leon Tarver, and our Chancellor Dr. Marvin Yates, I extend greetings. We officially welcome the Soil Scientists, other NRCS employees and all conference attendees. I would like to thank the conference organizers, Mr. Jerry Daigie and Mr. Charles Guillory for the invitation to discuss current programs, projects and initiatives at 1890 landgrant universities. I trust that you have enjoyed our southern hospitality, our wonderful cuisine and the humidity. Again we are extremely honored to have the opportunity to address this conference, the soil scientists and other NRCS employees to discuss briefiy 1890's, our mission and activities.

The amended or Second Morrill Act of 1890 which was passed on August 30, 1890, included a provision that bestowed land-grant status upon selected Historically Black Colleges and Universities. This provision enabled and required the now 17 (Eighteen with West Virginia State University) 1890 landgrant universities to perform the triple pronged mission of research, instruction and public service. For over a century 1890 universities have sewed the citizens of their respective states and the Nation, with special focus and attention on the needs and problems of minority, disadvantaged and limited resource urban and rural residents. The various units. departments, centers, divisions and programs at 1890 Universities have attempted to fulfill the land-grant mission and function by addressing the needs of the institutions' constituency through the development of innovative, creative public service, outreach and technical assistance programs and projects, most often with iimlted capltai. coupled with insufficient human and Physical resources. The landgrant mission of the Universities, its various Colleges of Agriculture and Extension Programs, is simply to serve limitedresource clientele in a manner that results In an enhanced style and standard of living, by improving their economic status, quality of life and overall well-being.

The earlier or preceding Morrill Act passed in 1862 established Land-Grant

Universities as a means of providing formal instruction In agriculture and mechanical arts for citizens In every state of the union. However. at the time, the Act did not Include people of color, thereby making the 2nd Morrill Act (1890) necessary to broadened the role and scope of land-grant institutions. For those states that chose not to integrate thelr universities, the Act expanded its mission to include institutions serving people of color, with the stipulation that separate but equal would be the mode of operation for all land-grant institutions.

Historically, 1862 land grant Institutiona have devoted the majority of their attention and resources toward the majority population which are generally more economically stable with higher incomes, more wealth and assets. Southern University and its 1680 land grant counterparts on the other hand, have focused thelr limited resources and attention on addreseing the problems and concerns of minority. limited resource. socially disadvantaged and underserved rural and urban residents. With limited resources the universities have attempted to programmatically address sufficiently the myriad of social, economic and educational problems faced by minority and socially disadvantaged populations of the states and nation. Throughout the history of these institutions, efforts have been made to develop improved agricultural techniques which will. In turn, increase the economic well being of famlly farmers and improve their overall quality of life.

Now, desplte strenuous early efforts. it was not until 1967 that 1880 land-grant institutions received any money for agricultural research and extension activities. Furthermore, It was not until 1876 that funds ware increased at the federal level to the extent that 1890's could carry out research and extenslon. Almost no funding was granted to address the issues and problems facing small scale. limited resource and socially dlsadvantaged farmers until the passing and enactment of the now popular "Section 2501" of the 1980 Farm Bill.

The Section 2501 program, entitled "Outreach and Assistance for Socially Disadvantaged Farmers and Ranchers," evolved out of the "Small Farmer Training and Technical Assistance Program" which was initiated In 1983 as a response to the USDA task force on Black Farm of the nation. Approximately 90% of the 18,800 (Less than 1% of total although Blacks comprise 15-20% of total population) Black operated farms are in the South. Approximately 81% of the 8.300 Native American operated farms are west of the Mississippi River. Of the 8,100 Asian and Pacific islander operated farms, 79% are in California and Hawaii. Seventy-two percent (72%) of the 21,000 Hispanic operated farms are in California, Colorado. Florida, New Mexico and Texas. Finally, the 1992 Census of Agriculture identifies about 145,000 farms (8% of aii U.S. farms) with women as their primary operators, and they are distributed throughout the U.S.

The 1990 Farm Bill requires the Secretary of Agriculture to provide outreach and technical assistance to socially disadvantaged farmers and ranchers. The blii states that "the Secretary may make grants and enter into contracts and other agreements with institutions or entities to provide outreach and technical assistance," The groups or entities that may qualify for contracts with USDA include community based and non-profit organizations

(2)Enhancing clients farm **&** buslness management, **financial documentation** and **marketing skills;** and, (3) Developing farm and home plans for **self-sustaining farm operations.**

Many ask the **question** why should 18905 focus **this** clientele and why would USDA-NRCS have such a program. **Simply** stated, most U.S. farms are **small with** *more* than 60% of the 1.9 million U.S. farms having annual sales Of **less** than **$25,000.** Farms operated by **socially** disadvantaged farmer5 are more likely to be **small with** 70%' or more of the farms operated by Blacks, Native Americans, Hlspanlos and women selling less than $26,000 In **agricultural** products. Of the 1.9 **million** farms In the U.S. In **1992,** only 18.600 (Less than 1%) were Black operated, with Black farm and land owners controlling less **.003%** of the nation's farm land. By **1994,** there were less than 20,000 Black **producers** owning less than three **million** acres of land. Currently, over 36% of Black operators are at least 66 year5 old, **while** only 6% were under thirty-five years. The average age of Black **farmers is** 56. Early in the next century, Black farmer5 could be extlnot and Black people landless.

This Is an Issue that is our primary concern because many In **1890s** contend that land and farm loss has a strong **correlation** with **escalating** urban bllght, to Include overcrowdedness, **crime** and homelessness. One key to reenergltng rural economies Is a thrlvlng small farm community. Of course, In reality, less than 7% of all farm **sales** nationally are from small operations. But, two-thlrds of all farms are **classified** as small or **family** farms. Therefore the **economic** and social argument becomes corporate versus **small** farms, rural people and rural **life** over polltics. care, **consternation** and concern over cold **capitalism,** and an alternative style of **living and** way of **life** *over* urban **existence** and bottom line.

In rural America many continue to langulsh In poverty, **reside** In indecent **housing,** are unemployed, underemployed and unemployable. There **continues** to be a gross lack of **opportunity** and resources compared to urban and suburban **America.** As professionals it is our **responsibility** to effect change to the best of our ablllty. **If** we as **scientist, conservationists,** etc., don't have a mission or **constitution,** *we must* develop one, Necessary ingredients Include heavy dosages of humility, self-criticism and continual **self-examination.** If we do these honestly and forthrightly. I'm convinced a better day Is **imminent.** Thank you and enjoy your Stay In Baton Rouge.

SOIL TAXONOMY COMMITTEE REPORT

Robert J. Ahrens

Since the last National Cooperative Soil Survey Conference in San Diego, National Soil Taxonomy Handbook Issue No. 18 was approved and distributed in March of 1996. The number of changes contained in this handbook issue were significant and in order to effectively implement the amendment a new edition (7th) of the "Keys to Soil Taxonomy," was published. The 7th edition of the "Keys" can be accessed through the internet (www.statlab.iastate.edu:80/soils/keytax).

The changes contained in the 7th edition of the "Keys to Soil Taxonomy" came from several sources. Among these are state soil scientists and MLRA office (MO) leaders working directly with field soil scientists from various agencies, individuals or groups of people wishing to improve specific aspects of Soil Taxonomy, and the International Committee on Families (ICOMPAS).

Proposals from states/MO's

Proposals from state soil scientists and MO leaders came from the following states and regions.

Arizona (2)
California
Maryland
Midwest (2)
Montana
North Carolina
North Dakota (3)
Northeast
Oregon
South Dakota
Texas

As an example the densic contact was proposed by the northeast to recognize the contact between soil and non-cemented, unaltered, root-limiting material, such as dense till. Previously, this dense till was within the definition of paralithic contact. The definition follows.

Densic Contact

A densic contact (L. densus, thick) is a contact between soil and densic materials (defined below) that has no cracks or the spacing of cracks that roots can enter is 10 cm or more.

Densic materials were then defined to provide a term to describe the material below a densic contact that can be part of the series control section.

Densic Materials

Densic materials are relatively unaltered (do not meet requirements for any other named diagnostic horizons nor any other diagnostic soil characteristic) materials that have a non-cemented rupture resistance class. The bulk density or the organization is such that roots cannot enter except in cracks. These are mostly earthy materials such as till, volcanic mudflows, and some mechanically compacted materials such as mine spoils. Some non-cemented rocks can also be densic materials, if they are dense or resistant enough to prevent roots from entering except in cracks.

Densic materials are non-cemented and differ from paralithic materials and the material below a lithic contact because both of these are cemented.

Densic materials have at their upper boundary a densic contact if the densic materials have no cracks or the spacing of cracks that roots can enter is 10 cm or more. Densic materials can be used to differentiate soil series if the materials are within the series control section (defined below).

The paralithic contact was redefined below.

Peralithic contact
A paralithic (lithic like) contact is a contact between soil and paralithic materials (defined below) where the paralithic materials have no cracks or the spacing of cracks that roots can enter is 10 cm or more.

Paralithic materials were introduced to be able to name the material below a paralithic contact that can be part of the series control section.

Paralithic materials
Paralithic materials are relatively unaltered (do not meet requirements for any other named diagnostic horizons or other diagnostic soil characteristic) materials that have an extremely weakly cemented to moderately cemented rupture resistance class. Cementation, bulk density, and the organization is such that roots cannot enter except in cracks. Paralithic materials have at their upper boundary a paralithic contact if the paralithic materials have no cracks or if the'spacing of cracks that roots can enter is 10 cm or more. Commonly these materials are partially weathered bedrock or weakly consolidated bedrock such as sandstone, siltstone, or shale. Paralithic materials can be used to differentiate soil series if the materials are within the series control section (defined below). Fragments of paralithic materials, 2.0 mm or more in diameter, are referred to as pararock fragments.

Proposals from Individuals

The definition of lamellae proposed by Gene Mayhugh, retired soil scientist, is an example of proposals made by individuals or groups.

Lamellae

A lamella is an illuvial horizon less than 7.5 cm thick. Each lamella contains an accumulation of oriented silicate clay on or bridging sand and silt grains (and rock fragments if any are present). A lamella has more silicate clay than the overlying eluvial horizon.

Lamellic subgroups were introduced and the Psammentic subgroups were split between those with lamellae (Lamellic subgroups) and those with sandy argillic horizons (Psammentic subgroups).

ICOMFAM

The most significant changes to Soil Taxonomy were proposed by the International Committee on Families (ICOMFAM). ICOMFAM's charges were to:

Evaluate the control sections used at the family level
Evaluate the mineralogy classes and make improvements
Evaluate the format used in Soil Taxonomy for the family
Evaluate ways to provide better information for mixed families

Control Sections

ICOMFAW recommended that the control sections (particle-size, mineralogy, cation exchange activity class) for soils with argillic horizons be simplified to depths of 25-100 *cm.* This proposal received positive reviews. To determine the impact on soil series we reviewed approximately 10 percent of all series with argillic horizons and discovered that a number of series would need to be reclassified, but even more serious a large number of series would need to be split. We decided the recommendation was not worth the effort to revise soil series and did not change the depth requirements for control sections.

Mineralocfv Classes

A number of chanqes were made to the mineraloav classes and they are too numerous to reiterate here. Perhaps, one of the most obvious was to change the class, montmorillonitic to smectitic. Montmorillonite, beidelite, and nontronite are the dioctahedral expanding 2:1 minerals in the smectite group. All have been detected in the clay fractions of soils. In fact, montmorillonite and beidellite commonly occur together. The group name, smectite (smectitic), is more appropriate. The definition of smectitic was also clarified to require only more smectite than any other single kind of clay mineral.

Format,
All of the components of the family with the exception of the contrasting particle-size classes have been arranged in the form of a key. The key must be followed to correctly classify a soil. This format should eliminate confusion that has existed in the past *with* some of the components of the family.

Mixed Families
During the time that ICOMFAM deliberated there was support for including a mineralogical component into, or instead of, mixed mineralogy and to include a clay mineralogy component into loamy particle-size classes. In response, the apparent cation exchange capacity of the clay fraction was chosen as an alternative to qualitative clay mineralogy. Clay activity is a significant soil property that carries with it, or is, an accessory property that is useful for making soil interpretations. The precedent for using clay activity has been established in higher categories. In addition, quantitative clay mineral estimates have been and are being made on the basis of CEC. Using clay activity as criteria provides useful informationabout the mineralogy of the clay fraction without additional data and analyses.

The limits set for the clay activity classes were based on the doctoral dissertation by Max Lowale entitled "Quantitative Chemical and Physical Properties as Differentia for Soil Taxonomy Mineralogy Classes and a New Type of Class Nomenclature" (Auburn Univer., 1992).

Future Plans
Plans are to republish *Soil Taxonomy* in 1998. The new edition will include the recommendations from the International Committee on Permafrost-Affected Soils (ICOMPAS). Among the committees recommendations is a new soil order, the Gelisols. Gelisols are defined as

A. Soils that have:

1. Permafrost within 100 cm of the soil surface or;

2. Gelic materials within 100 cm of the soil surface and permafrost within 200 cm of the soil surface.
Gelisols

The Gelisols will be the first soil order to "key out."

New diagnostic characteristics associated with the Gelisols include:
anhydrous conditions
gelic materials
cryoturbation
glacic layer

Changes were also made to the definitions of permafrost and the cryic soil temperature regime.

The "Bor" suborders and great groups as well as the "Trop" great groups and subgroups will be eliminated in the new edition. Frigid and "iso" soil temperature regimes will be delegated to the family level.

Current proposals to Soil Taxonomy are being incorporated into appropriate chapters as the chapters are revised. Each chapter is then sent for review and comment. Chapters ready for review can be accessed through the internet (www.statlab.iastate.edu/soils/soiltax).

<u>Current International Committees</u>
Currently, we have two international committees, the International Committee on Soil Moisture and Temperature (ICOMMOTR) chaired by Dr. Ron Paetzold and the International Committee on Anthropogenioc Soils (ICOMANTH) chaired by Dr. Ray Bryant.

ICOMMOTR has sent 4 circular letters for review and comment. Response has been favorable to many of the committee's suggestions. However, there is a dire need for more data before the committee can make further progress.

ICOMARTH has produced 1 circular letter. There was little response to the first circular letter and the committee is in the process of writing a second circular.

During 1997 the following horizon designation and suffixes were approved.

Additions or changes to the suffixes

j Accumulation of jarosite.

This symbol indicates an accumulation of jarosite. Jarosite is a potassium or sodium iron sulfate mineral that is commonly an alteration product of pyrite upon exposure in an oxidizing environment. Jarosite has a hue of 2.5Y or yellower and chroma of 6 or more, although chromas as low as 3 or 4 have been reported.

jj Evidence of cryoturbation.

This symbol is used to indicate the presence of cryoturbation. Cryoturbation commonly is manifested by irregular and broken boundaries, sorting of rock fragments, and organic matter in the lower boundaries, especially along the boundary between the active layer and the permafrost table.

ff Dry permafrost.

This symbol is used for layers or horizons that are colder than 0°C, but do not contain ice. It is not used for layers or horizons that have seasonal temperatures below 0°C.

Change the following:

From:
"*f* Frozen soil"

To:
"*f* Frozen soil or water"

Addition to the Waster horizons

W layer: Water.

This is a layer of water within the soil. The water can be either frozen (Wf) or not frozen (W).

1899 Soil Survey Centennial 1999

Actions and activities 1990 to February 1997

Soil Science Society Symposia, presentations, and tours

These symposia and tours have brought to focus the soil survey within the tri societies. The meeting newsletters have highlighted historical pictures and information on the upcoming centennial. These symposia have also stimulated the documentation of the history in soil survey and many of these activities continue in the states and among individuals. The following tours and presentations have occurred within the scope and encouragement of the soil survey centennial.

1993 Symposium - The National cooperative Soil Survey: A Century in Retrospect

- The Evolution of Soil Science, 1862-1914. W.D. Rasmussen, USDA, Annandale, VA.
- Hilgard and Agricultural Survey In the U.S. R.Amundson and D.H. Yaalon, Univ. Of California-Berkeley end Hebrew Univ.
- The Role of the World's Columbian Exposition in the Development of Soil Science in the U.S. J.P. Tandarich and C.J. Johannsen, Hey and Assoc., Chicago, IL and Purdue Univ.
- Milton Whitney and the Early Development of the U.S. Bureau of Soils. D.S. Fanning, RG. Darmody, S.C. Watson, M. CB. Fanning, Univ. Of Maryland and Univ. Of Illinois.
- Founding the Division of Agricultural Soils. S. Phillips, D. Helms, and A. Effland, USDA-SCS. Washington, DC.

1994 Symposium - The National cooperative Soil Survey: A Century in Retrospect

- Pedological Cooperation Between Russia and the United States, Past to Present. A.N. Gennadiyeu and Ken Olson, Moscow State Univ., Russia and Univ. Of Illinois.
- Agricultural Geology and Soil Cartography in the 19th and Early 20th Century
-
-
-
-

1995 Soil Science Tour of Aspects of the History of Soil Science and Agriculture in Missouri including a visit to the Univ. Of Missouri and State Archives from the Curtis Marbut collection.

1995 Symposium - The National Cooperative Soil Survey: A Century in Retrospect

- Soil Survey in California -Au **Historical** Overview. Roger Poff, Cordon Huntington, Dave Smith, R. **Arkley, USDA-FS,** Univ. **Of California-Davies,** USDA-NRCS, and **Univ. Of California-Berkeley**
- **History of the Soil Survey Laboratories. Klaus Flach,** C. Steven **Holzhey, USDA-NRCS, Lincoln**
- **Historical Highlights of the Soil Survey in Texas. Charles Thompson, Larry Wilding,** USDA-SCS and Texas A **&** M Univ.
- History of Soil Survey in North Carolina. Stan **Boul,** Ralph McCracken, H. Byrd, Horace Smith, North Carolina State **Univ. And USDA-NRCS**
- **Soil Survey Tools of the Trade4899 to 1999. Gary B. Muckel, USDA-NRCS**

1995 Symposium-Aspects of the history of Soil Science and Agriculture in Miisouri

- **Early Geographic Perceptions of Missouri Important for** Agriculture. **W.** A. Schroeder, **Univ. Of Miisomi-Columbia**
- **Marbut, M.F. Miller, W.A.Albrecht, end H.H.Krusekopf and the Development of Soil Science** and Soil Survey **in Missouri.** John **Tandarich,** Chris **Johannsen,** R. D. Hammer, Hey and **Assoc, Inc,** Chicago, IL, **Purdue** Univ., and **Univ. Of Missouri-Columbia**
- **Some Aspects of the History of Soil and Water Conservation in Missouri. Chris** Johannsen, John **Tandarich,** Douglas Helms, **Purdue** Univ., Hey and Assoc. **Inc.** And USDA-NRCS

1996 Soil Science History tour to Earlham College archives for James Thorp and Allen D. Hole.

1996 Symposium for the Council on the History, Philosophy, and Sociology of Soil Science

- **Allen D. Hole: Earlham College's Pioneer of Soil Science and His** Diieipla. By Francis Hole, U of Wis., Madison
- **James Tborp and the Development of Modern Soil Survey** in China by John **Tandarich,** Chris Johannsen, D. Van Meter, Hey and Assoc., Chicago, IL, **Purdue** Univ.., and Ball State Univ.
- History of Soil Science at **Purdue University: The John B. Peterson Years.** J.L. **Ahlrichs, Purdue** Univ.
- **Tom Bushnell and Herb Ulrich: Breaking New Ground in the** Survey **of Indiana** Soils. M.F. **Baumgardner,** D.F. **Franzmeier,** H.M. Galloway, **Purdue** Univ.
- Historical Perspective **of Cartography and Soil Survey Publications. T.L.Parham,** D. Darling, NRCS, Ft. Worth, TX. (Rescheduled for 1997)

Video tape presentation

- **"History of Soil Survey as Seen Through the Tools of the Trade"** by Gary B. **Muckel, USDA-**NRCS, Lincoln, NE. Script and slide set converted to video by **Juan** Sutton of USDA-NRCS Ft. Worth, TX, narration by **Susan Casby-Horton,** Association of Women Soil Scientists, USDA-NRCS, Lubbock, TX. Completion scheduled for master copy by mid **June**

State Soils

- Loyal Quandt USDA-NRCS, Lincoln, NE leads this effort with a committee of Chuck Gordon, USDA-NRCS, MT, Frank Watts, USDA-NRCS, FL, Ronnie Taylor, USDA-NRCS, NJ, Dennis Potter, USDA-NRCS, MS This is a selection of soils representing the states in the US. Each selected state soil has a picture of the landscape and soil profile. The soil description and laboratory data is provided. This centennial project now includes 45 states. Teachers and students are the intended audience. The state soil selection process has proceeded through the state legislature for official designation in several states. Professional soil *science societies or the cooperative soil survey* participants have made designations in other states. An article published in the Journal of Soil And Water Conservation on State. Soils of the United States has received tremendous numbers of requests for reprints. The information *for State* Soils (profiles, landscapes, lab data) will all be used as illustrations and data for the new revised issue of Soil Taxonomy and also for training courses.

Historical item collection

- Historical items including equipment, pictures, references, and other items related to activities of the soil survey during the last one hundred years have been collected by Gary B. Muckel from contributions from all over the United States from NRCS, Universities, and individuals. A trophy case at the soil survey center displays some of the items. These materials were gathered and continue to be gathered to use in displays during the centennial year. Further use is projected for ties to holistic teaching, tying soil science with history and manufacturing. A list of the items collected has been on the WEB for two years plus handed out at various conferences and presentations. The collection has Curtis Marbut's glass photographic slides and projector from the 1928 lecture series and ranges to a red beret from Dick Arnold. The contribution of historical items has involved many soil scientists and friends into the historical aspects of soil survey.

Historical Volume on Soil Survey

- Doug Helms, National Historian, USDA-NRCS is coordinating this effort to document the history of soil survey in the United States. The book is intended to be historically accurate and fully referenced volume. An outline and most chapter authors have been assigned for completion by the centennial.
- Draft outline includes the following chapters:
    - Centennial of the National Cooperative Soil Survey
    - Administrative History - by time periods
    - Field Methods and Equipment
    - Development of Supporting Information
    - Contributions of Developments in Chemistry as Related to the Soil Survey Program
    - Cartography and Remote Sensing
    - Personalities in history of soil surveys-Whitney, Marbut, Kellogg, Bennett
    - Developments in Interpretations
    - Utilization - in development of agriculture, urban and regional planning, others
    - Evolution in classification systems
    - *Soil surveys in the* Forest Service
    - Soil Surveys in the Bureau of Land Management
    - SCS Soil Survey Program
    - Minorities in Soil Survey
    - Women in the Soil Survey
    - Future Plans for Soil Survey

Anecdotes within soil survey

- Henry Mount, USDA-NRCS, Lincoln, NE is collecting anecdotes about soil survey experience. He has collected over 175 to date.

Reprints

- In 1957 David Gardner for hi Masters in Public Administration at Harvard produced a history of tbe soil survey. Thii reference has had very little circulation and as an historic reference it is planned to be reprinted. Doug Helms has contacted both Harvard and John Gardner for permissions.
- Criss cross Trails by Macy Lapham was published in the 1920. Thii book recorded the experiences of a field soil scientist during the early days. Doug Helms has obtained a copy of the book and is exploring printing options.

Guy D. Smith Memorial Sli et

- Hari Eswaren is assembling a slide set of soils from around the world as an educational tool. The completion of this project will coincide with the centennial.

Soil Science Society of America Centennial Year activities

- SSSA celebrated the fiftieth anniversary in 1949 and the 75th in 1974. Plans for the meeting are not established at this time. The SST was started by the Soil Survey Workers in the US so has close alignment with tbe centennial. The 1999 meeting will be. in Salt Lake Cii. One of the first four soil survey areas began in 1899 was the Salt Lake Valley, so an opportunity exists to include a field tip of the soil survey area and possibly reprint the small report. The chair of division S-5 Pedology for that year will be chair of the centennial activities. Various speakers and symposium should highlight the. application of soil survey and maybe cover the significant benefit soil survey has made.

1999 International Soil Conservation Organization

- The meeting in May of 1999 at Purdue University can well utilize the soil survey centennial to highlight the application of soil survey to sustaining global farms. A tour has been proposed to the organizers to begin in Lincoln, Nebraska with a symposium on the history and application of soil survey. A tour following the meeting is proposed to visit various sites to view native and cultivated soils and historical sites related to Indian cultures and the opening of the West. The tour will conclude at Purdue. A display booth at tbe meeting would highlight the soil survey and tbe application of soils to land management. Presentations at the meeting would also be offered that point toward the usefulness of soil survey.

Soil And Water Conservation Society

- Probably more soil scientists in NRCS and other cooperating agencies belong to this society than the Soil Science Society of America. No plans have been initiated for highlighting the soil survey centennial. Jim Culver has agreed to coordinate actions directed to thii meeting and organization..

International Soil Science Society

- This organization's next meeting is in 1998 at Montpelier, France and should include at presentation through posters presentations of the history and present condition of the soil survey in the U. S. No firm plans have yet been established but several scientists from the NSSC will attend. Abstracts are due in April.

National Cooperative Soil Survey Conference

- This conference is meeting in 1997 and again in 1999. A presentation for the centennial is on tbii years agenda and plans will be developed for tbe centennial year meeting plus needs over all for the centennial.

Other activities

. A special logo is needed for the soil survey centennial. A contest is now initiated. Dean Reaktor is logo chair. Logos should be used for special pins for soil survey workers and use on soil surveys publications published daring the centennial and for stationary etc. Participation in the logo contest is being solicited at the meeting of the State Soil Scientists, National Soil Survey Conference, and through Soil Survey Horizons.

Commemorative postage stamp

- Lawson Spivey initiated action on this project but has since retired and generally enjoys his retirement. Karl Langlois of NHQ has agreed to follow-up on the project.

Women in soil survey

Marjorie Faber has agreed to gather information concerning the roles and contributions that women have made through the history of soil survey. This will involve the Association of Women Soil Scientists.

Special display

- A display at the Library of Congress may be within reach.

State and local activities

- Other displays and activities are anticipated to be conducted by local soil scientists and others within their own regions to expose and market soil survey information.

NRCS Soil Survey Centennial and Soil Public Awareness Campaign

- A budget initiative for $500,000 has been submitted for FY98 with anticipation of the need for another $200,000 in FY99. The proposal emphasizes using the centennial to market the soil survey and soil survey information to a greatly expanded audience.

Soil Survey Centennial Committee

Gary B. Muckel - chair since 1990
Ed Sautter - retired State Soil Scientist, Conn.
Chris Johannsen - Purdue Univ.
John Tandarich - Heys and Assoc. Inc., Chicago, IL.
Doug Helms -National Historian, USDA-NRCS, Washington, DC
Henry Mount - Soil Scientist, USDA-NRCS, NSSC
Loyal Quandt - Soil Scientist, USDA-NRCS, NSSC
Hari Eswaren - Director, International Conservation Division
Richard Arnold - Special Assistant to the Chief, USDA-NRCS
Gretta Boley - Soil Scientist, USDA-FS, Washington, DC
Mary Collins, Professor of Soils, Univ. of Florida
Jim Culver, Head National Soil Survey Center, Lincoln, NE
Dean Rector, State Soil Scientist, Richmond, VA
Karl Langlois, Ecological Sciences Division, NRCS, Washington, DC
Marjorie Faber, soil scientist, Connecticut

Representatives needed:
State association liaison
ISCO liaison and coordinator
SSSA activities chair - S5 chair for the centennial year?

Soil Survey Activities of Pedologists with the Western Agricultural Experiment Stations 1997

H. Curtis Monger
Pedology Lab
Dept. of Agronomy and Horticulture
New Mexico State University
Las Cruces, New Mexico 88003-8003

Research

Pedologists associated the Western Agricultural Experiment Stations are conducting various types of soil science research in the western states, Hawaii, and Mexico. In an attempt to discern human-induced impacts from natural cycles, Global Change research is being conducted in the High Plains of Colorado (G. Kelly), Chihuahuan Desert (C. Monger), and Palouse area (A. Busacca and G. Kelly). This research is primarily concerned with (1) the timing and magnitude of natural erosion events based on Quatemary paleosols, and (2) the dynamics between warm-season grasses (C4 plants) and other plants (C3 plants), both of which can be tracked by their isotopic signatures contained in soil organic matter and pedogenic carbonates.

Relationships between soils, geomorphology, and ecology, or Ecopedologic research, is being carried out on the Colorado Plateau (J. Boettinger), Mojave Desert, California chaparral (R. Graham), western High Plains (G. Kelly), and Chihuahuan Desert (C. Monger). One of the goals of this research is to help understand complex natural systems by quantifying interactions between geologic and biologic processes. It addition to scientific journal articles, this research contributes to the development of management tools. Such tools may, for example, identify geomorphic areas that are most and least ecologically fragile. As a result, land managers can know which areas must be managed with great care and which areas can withstand greater land use. This research also attempts to identify geomorphic settings where natural components of ecosystems might be stimulated for remediation. It is becoming apparent that, in many cases, managing natural ecosystem in accordance to ecological and geomorphical boundaries is more suitable than managing according to agronomic practices, involving techniques such as spraying, plowing in straight rows, and irrigating.

Several pedologists with the Western Agricultural Experiment Stations are also conducting Mineralogy research. For example, zeolites are being studied for their use in animal wastes and slow-release fertilizers (J. Boettinger). Bedrock weathering is being studied as it pertains to roadcut stability, its involvement in supplying deep water storage, and its transport of viruses through macropore fractures (R. Graham). Biogenic calcite in desert soils is being studied for its role in carbon sequestration (C. Monger). In addition, volcanic ash weathering is being studied by P. McDaniel, and saponite formation is being studied by R. Southard.

Soil-Atmospheric research is being conducted by R. Southard that deals with the transport of respiratory particles. He is also studying the eolian transport of pesticides adsorbed onto soil particles. Soil-Hydrologic research is an active area of study and is being conducted to understand perched water tables (P. McDaniel), nitrate movement in Oxisols (G. Uehara), saline irrigated-induced wetlands (J. Boettinger). and geomorphic-aquifer relationships in northern Mexico (C. Monger).

Funding

Much of the funding for the above pedologic research comes from the USDA-NRCS. They have provided funding to Utah State Univ., Colorado State Univ., Univ. of California-Riverside, and New Mexico State University. Other granting agencies include USDA-NRI, USDA-Forest Service, EPA, National Science Foundation, US Geological Survey, and the International Arid Lands Consortium.

Teaching

Pedologists in the western universities teach a variety of courses, including INTRODUCTORY SOILS, PEDOLOGY FIELD COURSE, SOIL JUDGING, SOIL MINERALOGY, PEDOLOGY, SOIL GENESIS, SOIL MORPHOLOGY, and SOIL CLASSIFICATION. Several of the pedologists also team teach ENVIRONMENTAL SOIL SCIENCE courses, which continue to be popular courses, bolstering undergraduate enrollment in colleges that increasingly have fewer soil science majors.

MINUTES

Southern Region Experiment Station
SRIEG-22

Wayne H. Hudnall, Vice Chairman

The Southern Region Experiment Station's (SRES) Soil Survey Information and Exchange Group (SRIEG-22) met at the Southern Region Soil Survey Work Planning Conference at Charleston, SC, April 15-19, 1996. Representatives from six of the 13 Land Grant institutions and one representative from an 1890 university were present. Jerry Daigle, NRCS and Everett Emino, Experiment Station Adviser to SRIEG-22 attended the meeting. Mary Collins, SRIEG-22, Chairperson conducted the meeting.

Committee Reports

1. Everett Emino, SRIEG-22 Advisor
   A. SRIEG-22 is now IEG-22 (Information and Exchange Group-22).
   B. CSREES - Cooperative State Research Education and Extension Service.
   C. Director of the Southern Association of Agriculture Experiment Stations. Dr. Tom Helm, Mississippi State University.

2. National Advisory Committee - Mary Collins
   Two meetings were held since SRIEG-22 met in 1994. Mary sent reports of those meetings to each SRIEG-22 representative. Issues discussed at the meeting included: research efforts related to NCSS; budget, both SRES and NRCS; and the dates the SRIEG meetings were being held.

3. 1995 National Work Planning Conference - Mary Collins was IEG-22's representative. Very few Experiment Stations were represented (8). However, this is about normal (two from each region are usually invited). See attached report.

4. Southern Region Soil's Bulletin and Map - Larry West
   No significant progress. Larry will continue to chair committee and work with Sharon Waltman for assistance.

5. Election:
   A. Chairperson -Wayne H. Hudnall
   B. Vice-chairperson -Tom Ammons
   C. Secretary - Larry West, elected

6. Soil Taxonomy Committee
   A. Bill Smith - January 1, 1994 thru December 31, 1996
   B. Tom Hallmark - January 1, 1995 thru December 31, 1997
   C. A. D. Karathanasis - January 1, 1996 thru December 31, 1998
      Elected in South Carolina
   D. Richard Griffin - January 1 , 1997 thru December 31, 1999
   E. Mary Collins - January 1, 1998 thru December 31.2000

7. Tommy Calhoun - NRCS-NCSS- Washington
   Tommy discussed some of the activities from headquarters. These included:
   A. Education: Possibility of a field camp on soils.
   B. Soil Quality: Soil Information
   C. Hydric Soils: Hydric Soils Indicators
   D. Eroded Soils: Effect on classification and how to handle in Soil Taxonomy.

NEW BUSINESS

I. Research Needs and Development Committee

Dennis Lytle asked that IEG-22 elect a representative to the NCSS Standing Committee for Research Needs and Development:

Wayne Hudnall was elected.

II. By-Law Changes

These were discussed briefly. Since a working committee (Committee 5) would report during the meeting, there was no further discussion.

III. Future of IEG-22

A. Several questions were asked. Most of the questions did not receive an answer. Dr. Emino stated that only members of IEG-22 could answer the questions. The most important question asked “Do we want IEG-22 to continue or should we disband?

   Other questions included:
   1. Why are we here?
   2. What is the purpose of this meeting?
   3. What planning was accomplished?
   4. Were the presentations helpful to you and your program?
   5. Should we continue to support and attend this meeting?
   6. What would you like to see on the agenda?
   7. Shoukl there be a technical session? i.e. Workshop on: Hydric Soil Indicators, Redoximorphic Processes, Soil Taxonomy updates or Soil Taxonomy proposed changes.
   8. What format should be used for the meeting?

9. How long should it be?
10. Why were so few experiment stations represented?
11. Are the regional and national Soil Taxonomy Committees being utilized?

B. Louisiana will host the 1998 Southern Region Soils Conference and the IEG-22 Meeting.

University Participants

Stan Boul	NC State University
Mary E. Collins	University of Florida
Richard W. Griffin	Prairie View A&M University
Wayne H. Hudnall	LSU Agricultural Center
David E. Pettry	Mississippi State University
Bill R. Smith	Clemson University
Larry West	Univ. of Georgia
Everett Emino, Advisor	University of Florida

1997 ICOMANTH Report: The Study of Human Modified Soils and Landforms
Presented to the National Cooperative Soil Survey Conference,
June 16 - 20, Baton Rouge, LA
John M. Galbraith, Cornell University

I believe this is the dawning of a new era for Soil Taxonomy, when we make it more useful for mapping and interpreting soil surveys for human modified and transported soils (which I will now call Anthrosols). These soils occur in all areas of the globe where human activity profoundly affects soil properties, but are concentrated in urban areas where interpretation needs are highly specialized. ICOMANTH is poised to propose modifications that will address Anthrosols while preserving the logic within Soil Taxonomy and following the convention in using Soil Taxonomy for making soil surveys.

Traditionally, soil scientists have observed landscapes to separate landforms as a basis for identification and classification of polypedons. Our identification and classification of soils are influenced by all the evidence that we observe; the physical and chemical properties of the soil, the relationship and shape of the landforms, the aerial photographs, and topographic maps of the area. We cannot ignore information once we observe it or are exposed to it. For example, this shallow soil with an A, AB, and Bw horizon occurs above hard bedrock. By now, we have each conceptualized a categorization for this soil based upon our knowledge and previous experience. However, when we step back and identify the setting, our category changes because of the realization that it is a soil formed in transported material. We were told that there is historical evidence the soil was deposited less than 200 years ago, yet it has the apparent properties of soils deposited many tens of thousands of years before that.

We are trained to observe and measure soil properties at the pedon level, yet we must take into account information from the polypedon and the entire setting (such as soil moisture and temperature regime) to identify the class of many soils. There are several types of clues we can use to identify Anthrosols. Some Anthrosols contain evidence in the soil, such as artifacts and refuse. Other soils have several feet of transported soil material over thick layers of coal ash. Many Anthrosols have buried horizons and layers with different levels of organic carbon, or they contain fragments of soil or parent materials from offsite. The material above the buried horizons is on landforms that are not associated with geologically recent colluvial or fluvial processes.

Another key to identify Anthrosols is their presence on artificial landforms, which we define as a truncated or filled area of 50 cm or more. Examples of artificial landforms are pits and quarries, leveled paddy soils, and landfills. Most of us would agree that Liberty Island is an artificial landform, but there is little evidence in the soil to confirm this without historical evidence. The easiest way to identify this very sandy soil as dredged material is to observe photographs which show that the island it formed on did not even exist until about 50 years ago.

Currently, ICOMANTH is developing proposed modifications to incorporate Anthrosols in Soil Taxonomy. We are charged with making changes that are practical, logical, and can be consistently applied. Current objectives of ICOMANTH are to develop concepts of types of Anthrosols, define identification limits between Anthrosols and other human affected soils, and propose suborders for Soil Taxonomy.

Conceptualizing classes of Anthrosols is a challenge because they are spread throughout the world in highly visible places, and opinion about them is as diverse as their location. Anthrosols in urban environments are highly variable and discontinuous over short distances. While humans have had some affect on most of the soils of the world, and it is difficult to define what minimum affect should constitute separation of a new class from existing classes that identify natural genetic soils.

There appear to be solutions to each of these challenges. In the 7th edition of the Keys, deeply mixed soils are already recognized as the Arents suborder. Diagnostic Anthropic or Plaggen epipedons, Anthraquic conditions, and Agric horizons have already been recognized in Soil Taxonomy. Several of the definitions and classes which use these differentiae should be reviewed and revised to provide internal consistency with logical conventions in Soil Taxonomy. For example, right now the Plaggepts suborder has no great groups, only one Typic subgroup. Different thickness requirements are used for Anthropic and Plaggen epipedons and the extragrade classes that use them.

The definition of buried soils should be standardized to 50 cm, and the definition of “new material” that forms a mantle should be expanded to include human-transported, human-mixed, and artifactitious material.

These materials plus artificial landforms should be defined and limits set for their identity. Historical evidence and comparative landform study should be useable to identify Anthrosols and their presence on artificial landforms should be used when materials and morphology do not. For example, in Cape Cod, there are commercial cranberry bogs in operation since the 1800's. The landform is the same shape as before, but the Histosols have been buried by up to two feet of sand added on top of by humans. Historical record is needed to verify human transportation of the sand.

There are four major types of Anthrosols: soils with 50 cm or more of human transported parent material, soils with 50 cm or more truncation by human activity, soils mixed by human activity to a depth of 50 cm or more, and soils with Anthraquic conditions. For the first three types, the effect of human modification is to reset the time clock for soil formation or to negate the effect of previous soil development. The effect of Anthric saturation and some continuous farming is the acceleration of natural soil forming processes. In all cases, human activity is the major controlling soil forming factor.

The proposed classes of Anthrosols would go one step further and separate the transported materials into two types: spolic material that is dominantly artifactitious material, and accumic material that is dominantly earthy material. A new soil order will be proposed to the ICOMANTH members that keys out before Histosols and has three suborders: Turbanths (formerly Arents), Spolanths (transported spolic material), and Accumanths (transported accumic material). The deeply truncated soils, soils with Anthraquic conditions, soils with Agric horizons, and soils with Anthropic and Plaggen epipedons will become extragrades and intergrades in other orders.

ICOMANTH will work with the Soil Taxonomy staff in Lincoln and through Circular Letter #2 to get feedback for these proposals. Future plans include questions of how to classify and identify highly eroded soils, highly limed soils, and polluted soils. Please take the Liberty to ask questions and make comments. Anyone who has formal suggestions should feel invited to comment by writing to Dr. Ray Bryant at Cornell who is chairman of the committee. His address is 709 Bradfield Hall, Cornell University, Ithaca, NY 14853. His email is rbb1@cornell.edu, and phone is 607-255-1716.

SOIL SURVEY UPDATES
AN INTRASTATE APPROACH

BY

Warren G. Henderson, Jr.

SOIL SURVEY UPDATES
AN INTRASTATE APPROACH

During the mid

needed updated information for inclusion in the Field Office Technical Guides and other manuals. Some of the needed information included single phase interpretations or tables, hydric soils modules, highly erodible (he) and potentially highly erodible (phe) lists.

OBJECTIVE

Our major objective for updating these old surveys was to build upon and improve the existing information. The soil scientists who mapped and correlated soils back in the 50’s and 60’s were just as conscientious and competent as today’s soil scientists. But with time comes change and we responded by updating some of the counties where the demands on the soil resource was greatest. The Orange County area is an example of a rapid growth area. Disney World has definitely caused a chain reaction in this county.

Prior to starting the update process for any of the counties, we developed a plan of work and proceeded to get the job completed in the most efficient manner possible.

PROCESSES

- Staff Selection
  Resource Soil Scientists, GPR specialists, Soil Correlators and State Soil Scientist

- Map Imagery and Scale
  National High Altitude Program (NHAP) 1:20,000 and 1:24,000

Field Procedures

- A ground penetrating radar (GPR) System was used to document the type and variability of soils occurring within each of the map units established in the previous surveys. An average of about 10 random GPR transects per map unit were conducted.

- Composition of map units was determinded along each transect line by correlating the graphic profile produced by the GPR with ground-truth data obtained with the soil auger.

- Sufficient transect data was collected in the field to characterize all map units and permit probability statements to be made concerning their composition at high levels of confidence.

- In smaller areas, urban areas or depressional map units, the composition was determined by soil auger alone.

- During the progress of field studies, soil boundary placement was observed to determine their accuracy.

- Transferred Lines to Updated Imagery

- Determine Map Unit Composition
  Map unit composition was not considered in the map unit descriptions of the older surveys. The descriptions for the updated surveys incorporated data from the GPR transects into the detailed map units. In addition to a statement on confidence limits occurring in the map units, a table was developed to show the average composition of selected map units.

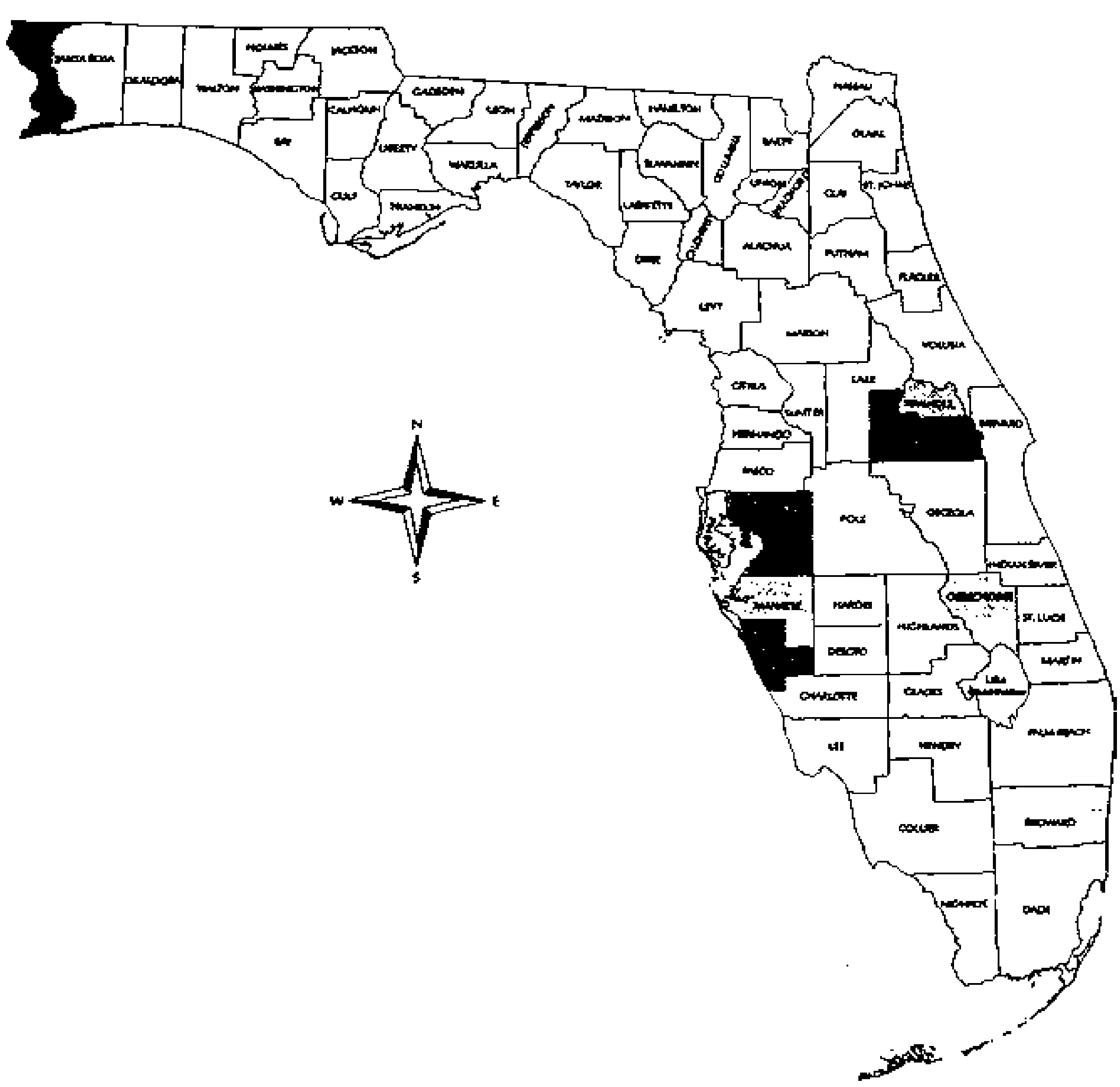
- Update Classification and Interpretations by Recorrelating
  Most of the soils from the old surveys were only characterized to about 13Ocm (52 inches) or less. In the update process, we updated the series and appropriate interpretations to meet national standards.

- Joined Surveys
  After recorrelating, we were able to join with adjacent modern surveys.

- Provide Interim Report

Updated **County**	**Published**
Hillsborough	May 1989
Manatee	April 1983
Orange	August 1989
Sarasota	September 1991
Seminole	March 1990
Escambia	Waiting for Correlation
Okeechobee	Waiting for Correlation

LOCATION OF
UPDATED SOIL SURVEYS
FLORIDA



USDA-Natural Resources Conservation Service
Printed June 1997

Number of Random Ground-Penetrating Radar (GPR) Transects in Selected Surveys

Hillsborough - 660

Manatee - 500

Orange - 518

Sarasota - 400+(conventional)

Seminole - 401

Classification Update

Old System	Soil Taxonomy
Ground-water podzols	Spodisols
Low-Humic Gley	Alfisols
Humic Gley	Mollisols
Bog	Histosols

SOIL LEGEND

Alpha legends were used in the old surveys. The updated surveys contained numeric legends.

Correlation Document -

Contained an alpha and numeric legend to assure that every map unit from the old survey was captured in the update.

DEFINITION:

Confidence limits - Statistical expressions of the probability that the composition of a map unit or a property of the soil will vary within prescribed limits. Confidence limits can be assigned numerical values based on random samples.

Map symbol and soil name	Transects	Soils	Compo- sition	C i	C		Compo- sition
			Pct				
20. Immokalee fine sand			53				5
			40				2
21. Lake fine sand. 0 to 5 percent slopes						Tavares----------	2
22. Lochloosa fine sand			68				
			30				
23. Malabar fine sand							
25. Okeelanta muck							1
							3
26. Ona							9
							7
							3
							5
							2
							4
						Floridana--------	2
							4
							9
							4
							1
							8
							6
						Wabasso----------	9
						Immokalee--------	1
						Archbold---------	
						Basinger---------	
						Sanibel----------	
						Holopaw----------	
						Ona--------------	
						Samsula----------	
						Hontoon----------	
						Basinger---------	4
						Ona--------------	3
						Wabasso----------	3
						Other------------	1

fine sand

Field symbol	Publi-cation symbol	Field symbol	Publi-cation symbol	Field symbol	Publi-cation symbol
Aa	27*	Ld	7*		
Ab	23	Le	8		
Ac	760 *	Lf	7*		
Ad	25*	Lg			
Ae	25*	Lh			
Ba	61	Lk			
Bb	53	Ll			
EC	54	Ma			
Bd	2*	Mb			
Be	26	Mc			
Bf	15*	Md			
Bg	59	Me			
Bh	5	Mf			
Bk	5	Oa	33		
Bl	6	Ob	52		
Ca	27*	oc			
Da	17	Pa			
Db	15*	Pb			
Ea	25*	PC			
Eb	25*	Pd			
Fa	15*	Pe			
Fb	26	Pf			
Fc	18*	Pg			
Fd	18*	Ph			
Fe2	5	Pk			
Fe3	5*	Pl			
Ga	19	Ra			
Gb	19	Rb			
Ia	21	Rc			
Ib	29*	Rd			
IC	5	Re			
Id	5	Sa			
Ka	2*	Sb			
Kb	38*	SC			
La	23"	Sd			
Lb	7	Se			
Lc	7*	Sf			

Map Symbol Mapunit Name	Component(C)/ Inclusion(I)	Hydric	Local Landform	Hydric Soils criteria: Hydric Criteria Code	Meets Saturation Criteria	Meets Flooding Criteria	Meets Ponding Criteria	FSA Criteria and Information: Natural Condition of Soil	Needs On-Site	Acres
22:										
LOCHLOOSA FINE SAND---										
95%	LOCHLOOSA (C)	No								1445
5%	WABASSO (I)	No								
23:										
MALABAR FINE SAND-----										
60%	MALABAR (C)	Yes	Slough	2B1	YES	NO	NO	Wooded	Yes	20766
35%	MALABAR (I)	No								
5%	WABASSO (I)	No								
24:										
MILLHOPPER-URBAN LAND COMPLEX, 0 TO 5 PERCENT SLOPES--------										
50%	MILLHOPPER(C)	No								14161
40%	URBAN LAND(C)	No								763
5%	SEFFNER (I)	No								
5%	TAVARES (I)	No								
25:										
OKEELANTA ""CK--------										
60%	OKEELANTA (C)	Yes	Marsh	1,3	YES	NO	YES	Neither	No	637
20%	OKEELANTA (C)	Yes	Depression	1,3	YES	NO	YES	Wooded	No	159
10%	SANIBEL (I)	Yes	Depression	1,3	YES	NO	YES	Waded	No	
10%	TERRA CEIA(I)	Yes	Marsh	1.3	YES	NO	YES	Neither	No	
26:										
ONA FINE SAND---------										
80%	ONA (C)	No								4801
5%	FELDA (I)	Yes	Slough	2B1	YES	NO	NO	Wooded	Yes	
15%	ONA (I)	Yes	Marine Terrace	2B1	YES	NO	NO	Wooded	No	

[redacted]

Soil name		Frequency	Duration	Months	
7, 8: Candler					
Urban land.					
9*: Canova					
10: Chobee				b	
11: Floridana				p	
Chobee				b	t
12: Emeralda				b	t
Holopaw				b	t
13: Felda					t
14: Felda				Jul-Feb	t
15: Felda				eb	t
16: Floridana		Frequent	Very long.	ct	t

See

bone -

An "Almost Seamless" Approach to Updating Soil Surveys

William E. Puckett
-Soil Scientist
USDA-NRCS

Definitions

"Seamless" Soil Survey

A soil survey that has exact map unit joins across political boundaries based on unified MLRA legends.

"Almost Seamless" Soil Survey

A soil survey that has best map unit joins across political boundaries based on unified MLRA legends.

Objectives

- To encourage the development of map unit legends based on MLRAs.
- Recompile soil surveys based on new MLRA legends before digitizing.
- Encourage the continued support of Technical Soil Services.

Concept

Blending two processes:

- MLRA process of updating soil surveys
- Accelerated Soil Survey Digitizing Program

Alternatives

Recompile and Digitize Soil Surveys;

- Exact joins, or
- "As is" with no attempt to join or change map unit legends, or
- Minor cartographic and correlation changes, or
- Unified MLRA map unit legend with best joins and correlation changes.

Process

- Acquire stable base.
- Develop unified MLRA map unit legend with common symbols.
  - Criteria
  - Map unit symbol nomenclature
  - Consolidate the new legend

- Recorrelate **all** Soil Survey Areas within MLRA based on new map unit legend.
  - Do not force map units to join
  - Compare soil data for each map unit
  - Use **collective** knowledge and experience of soil scientists

Process

- Recompiled all soil survey areas based on new unified MLRA map unit legend.
- Digitize recompiled soil survey.
- Process new tabular soils database (based on unified MLRA legend) as part of new **digital soil** survey.

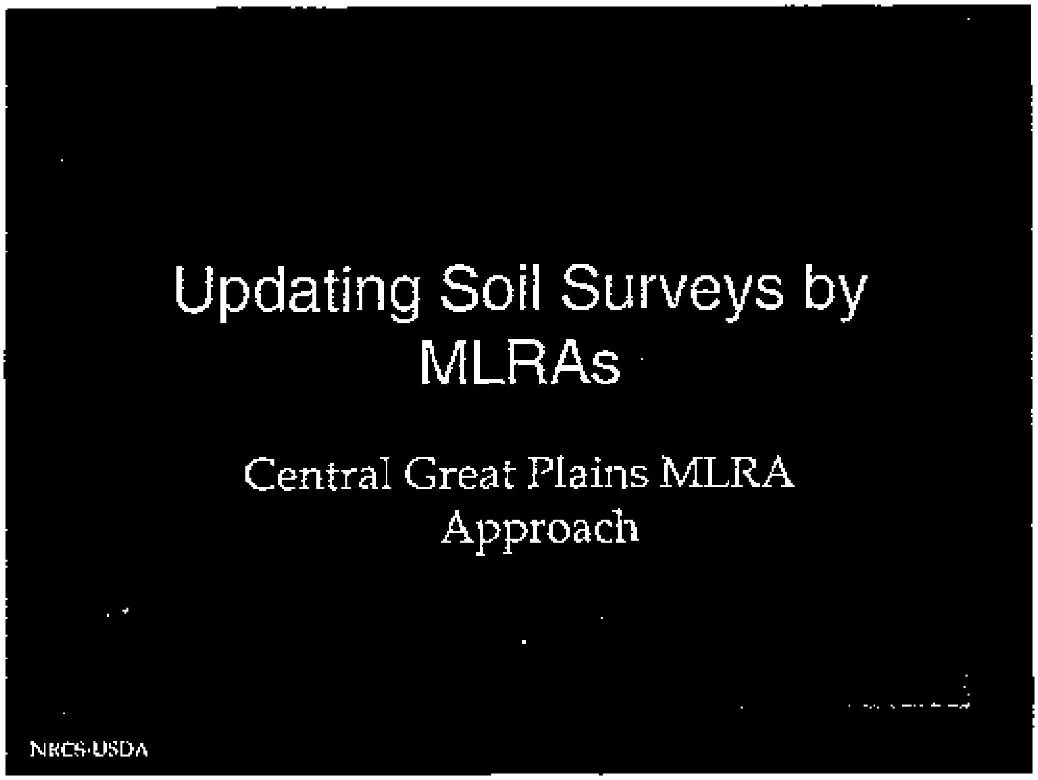
Technical Soil Services

Once digitizing is complete, the work has just began;

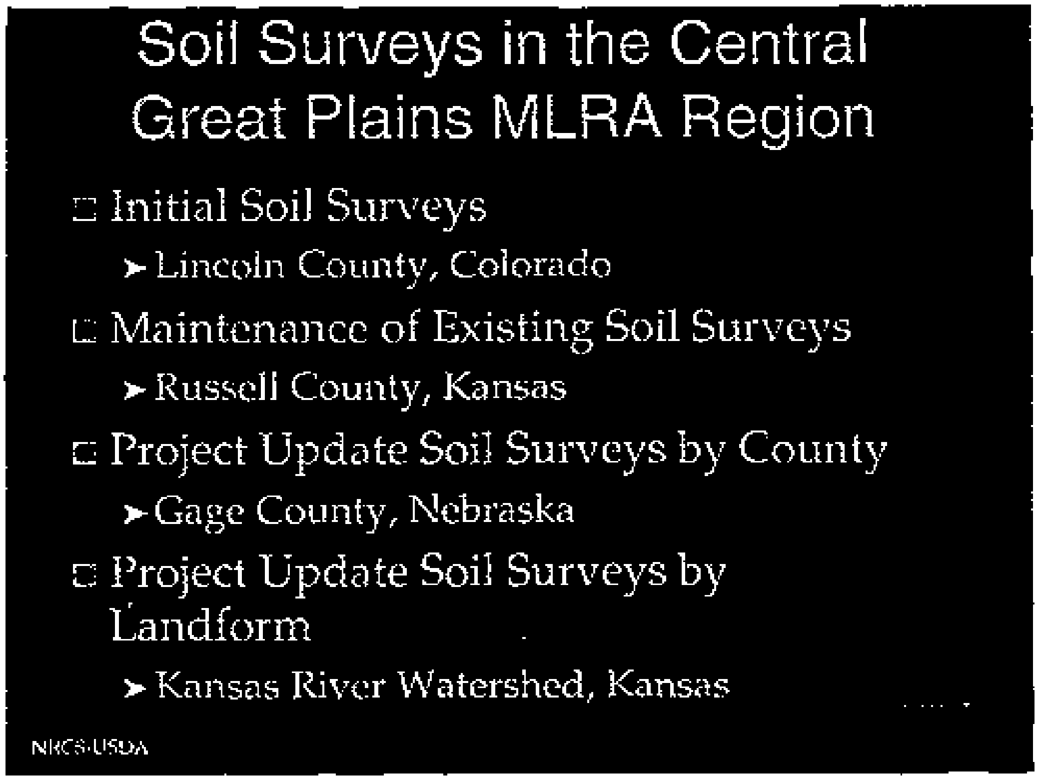
- Proper distribution of digital and tabular data to multiple users
- Education on proper use of data
- Update and maintenance of data

Summary

- Recompile the approximately 2,600 soil surveys using MLRA map unit legends.
- Achieve best joins based on knowledge and experience.
- A larger commitment of resources devoted to Technical Soil Services to meet the challenges of increased soil data use.



This discussion is on the methods of updating soil surveys in the Central Great Plains MLRA Office. The Central Great Plains MLRA Office is located in Salina, Kansas. The MLRA area encompasses portions of Kansas, Colorado, Missouri, Nebraska, Oklahoma and Wyoming. There is currently one MO/SSS, 2 Soil Data Quality Specialists, 1 Technical Soil Scientist and 1 editorial assistant.



In the Central Great Plains MLRA Region, there are four types of MLRA based soil surveys.

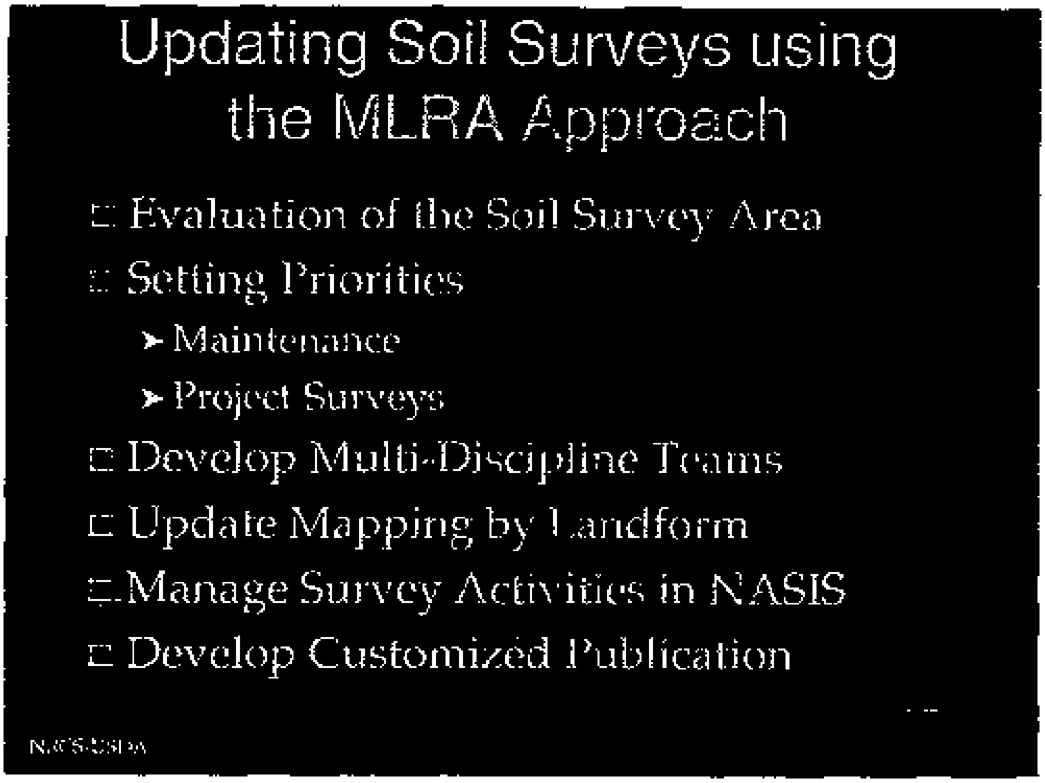
Initial Soil Surveys: There are three initial soil surveys, with Lincoln County Colorado being an example.

Maintenance Soil Surveys: There are several projects of soil survey maintenance. In Russell County, one particular map unit was identified by the landowners within the county in need of updating. The technical soil scientists evaluated the map unit, identified the needs for updating and are in the process of gathering documentation. This map unit will be split into three map units, each with its own components and properties.

County Updates: There are six update soil surveys with county boundaries. Gage County, NE is one example. Gage county is within MLRA 106. The survey will complete Gage County as a political boundary, but all mapping units will be MLRA units that will carry into and out of the political boundary.

Landform Updates: There are two update soil surveys by landform: the Kansas River Watershed and the Missouri River Watershed. These surveys were initiated after the 1993 flood. They have been continued on as part of the MLRA 106 update process.

The important feature of all the soil surveys is the use of the MLRA concept in mapping. All surveys are using the MLRA approach of map unit design and correlation.



All soil surveys are evaluated prior to the update process. Evaluations are typically instigated through customer inputs.

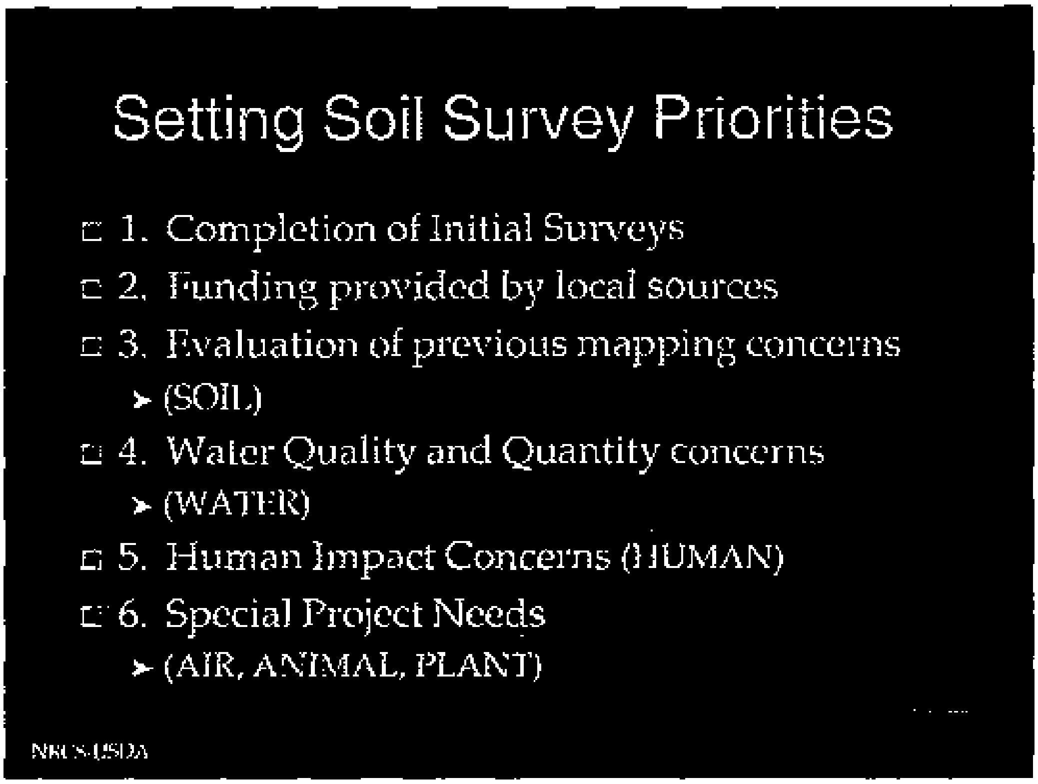
After evaluation, the method of update is considered and the priority is determined.

Multi-discipline teams are then created. Each soil survey level has a team for support and management.

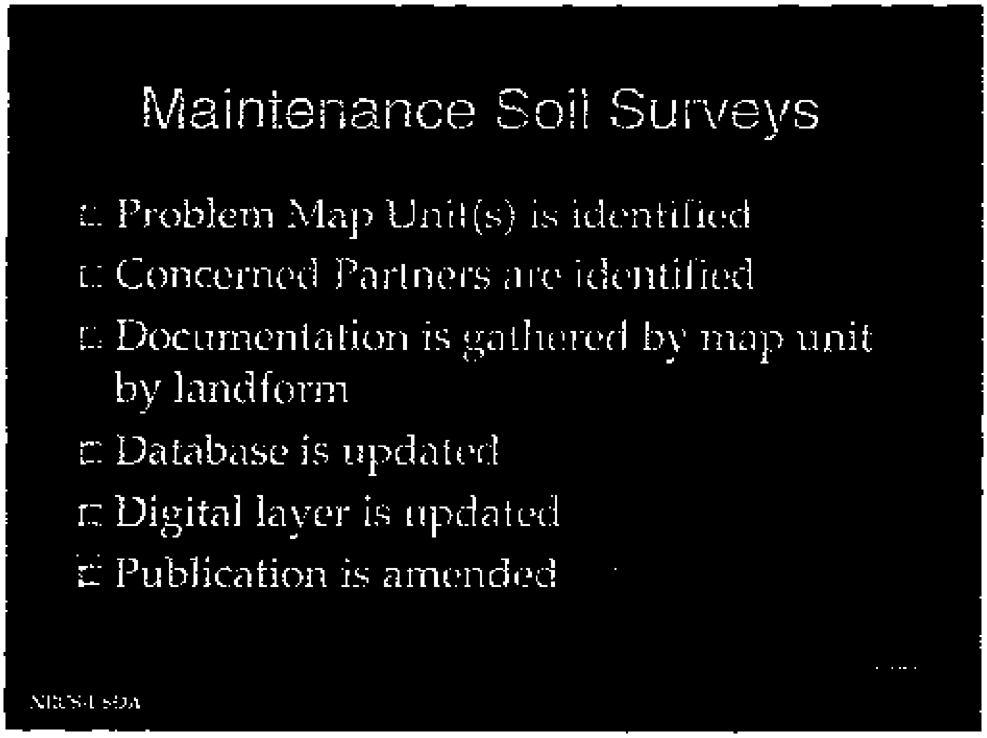
All mapping and documentation is completed by the landform. This provides for the consistency of map unit design across political boundaries.

All management of the survey is maintained using NASIS. NASIS allows for documentation of MLRA legends, map unit and component properties, correlation decisions and interpretations.

Through the process of evaluations and development of soil survey partners, publication plans are developed and tailored to customer needs.



Initial soil surveys and those surveys with local funding have <lhighest priority.lFollow



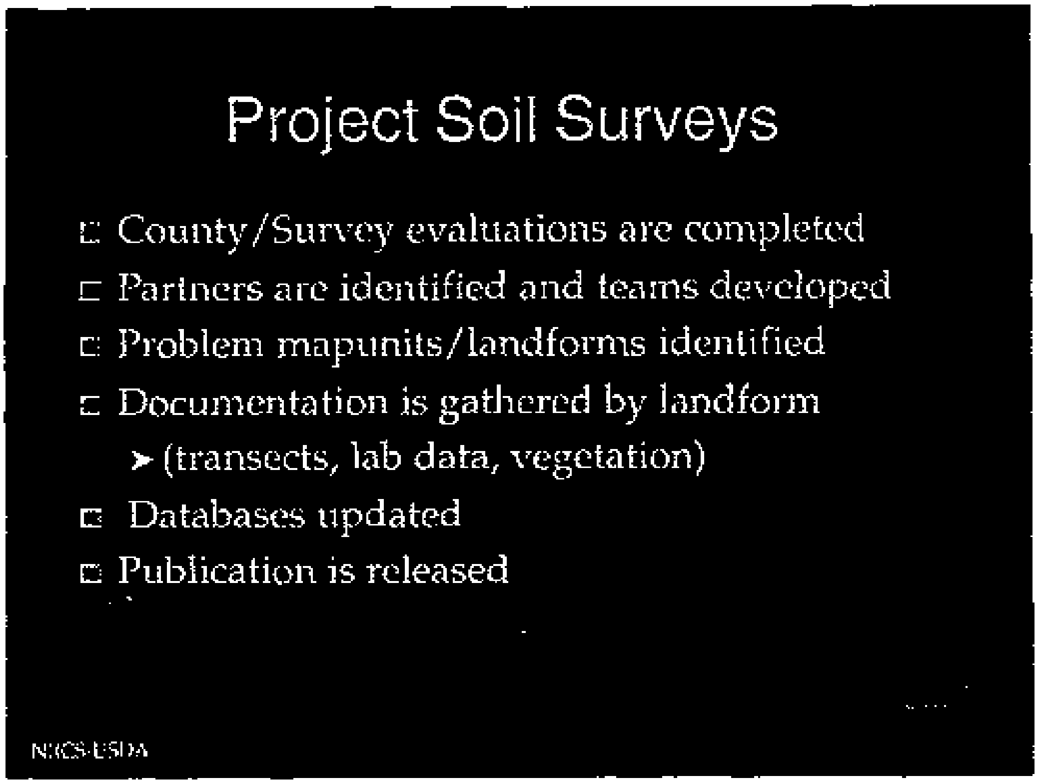
For maintenance soil surveys, the problem landform and/or mapunit(s) is identified. Concerned partners are identified and brought into the team concept.

The multi-discipline team collects the data for the update. This can entail soil and vegetation transects, field notes, site notes, lab analysis, hydrology studies, etc.. Soil survey maintenance uses the MLRA concept. Mapping units are followed throughout the landform, as it flows across political boundaries. This allows for a complete join. Once completed, the mapping units are correlated. Amendments to the original correlation are completed.

The NASIS database and the MLRA legend is used to record all management decisions of the update process. This information is copied into the county legend for further use. Additional map units for the survey use the MLRA map unit symbols.

The digital database is updated with the polygon edits. In almost every case, there will be some movement of linework.

The publication is amended by providing supplements to the Field Office Technical Guide and/or published soil surveys. Those partners involved in the update process are informed of the amended product.

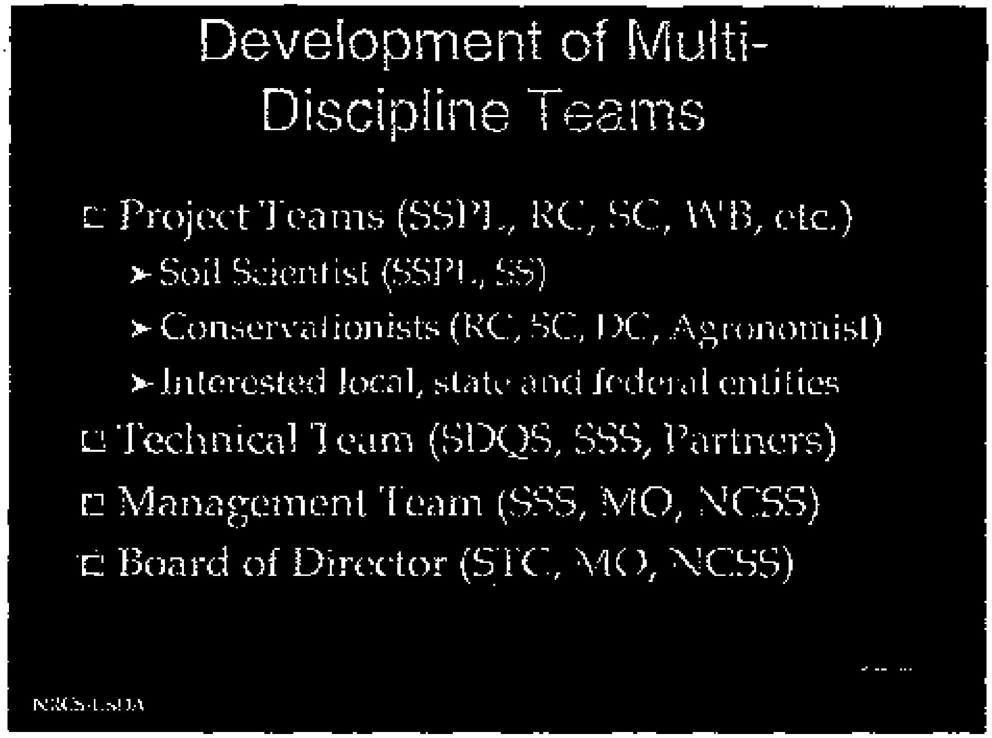


The emphasis for a project (county) soil survey is slowly being replaced with landform updates. These update surveys are, typically, locally funded projects. The survey area is evaluated and prioritized for the update process. The partners are identified and multi-discipline teams are developed at all levels of the survey.

Using the evaluations, map units and/or landforms are prioritized. Data collection proceeds until the landform is completed. Use of older survey notes or information is one tool used to establish a base level and to determine documentation needs. ARCVIEW is another tool used that can develop map unit distribution maps to help identify data collection locations. These maps can assist in developing the survey workplan. All disciplines are encouraged to collect and update data pertinent to their field.

The databases (digital, PEDON and NASIS) are then updated as work proceeds across the landform.

The publication is then prepared for the survey area using the information contained in these databases.



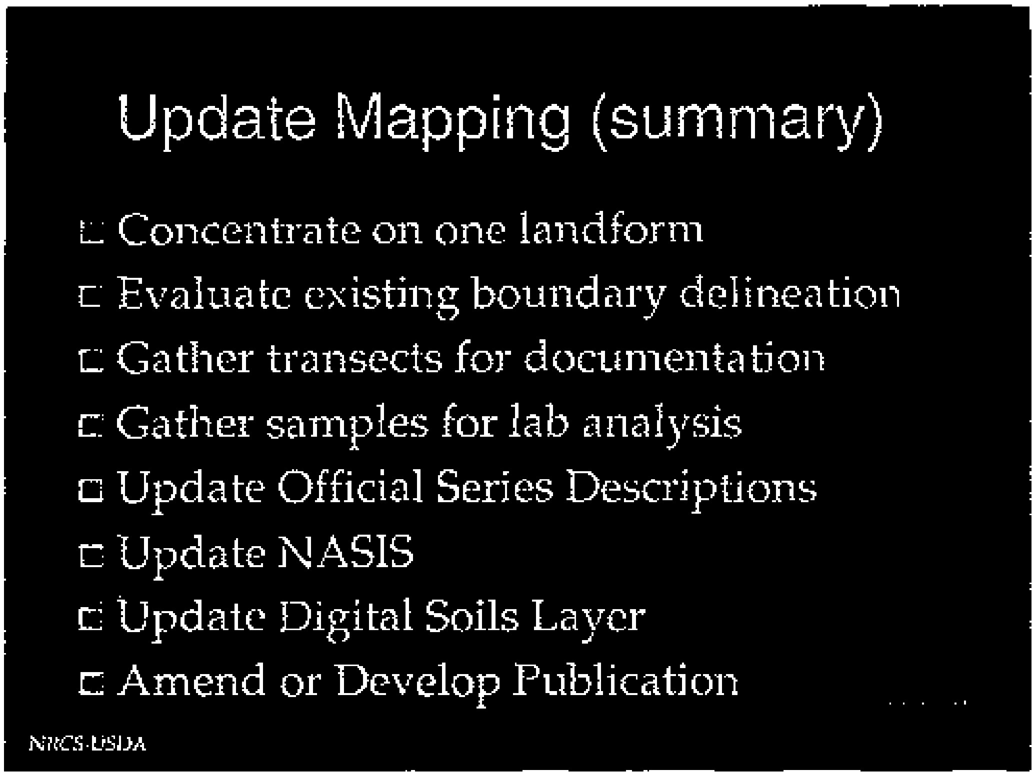
Success of the MLRA approach depends on communication. The development of multi-discipline teams become critical in keeping everyone informed at the various levels of the survey operations. It is not uncommon to find a one page cc (carbon copy) list for all correspondence on a given MLRA update. There are four levels of "Teams":

The Project Team consists of conservationists, soil scientists, foresters, etc. that are directly involved in the data collection for the soil survey.

The Technical Team is composed of those interested parties charged with the overview and quality assurance of the survey. The team is comprised of the State Soil Scientist(s), Soil Data Quality Specialist(s), Extension, Local Funding Source Representatives, etc.

The Management Team is composed of the State Soil Scientist, MLRA Leader and interested NCSS Partners. This team has a broader scope of the survey. This level of involvement is a coordination of how the particular survey impacts or is impacted by the state program.

The Board of Directors is composed of the State Conservationists within the MLRA Region Boundaries. Their involvement is at the program level. Their concern is that the survey program is functioning within guidelines and budgets.



In summary, all updates of soil surveys follow roughly the same procedure. The attempt is to concentrate on a single landform at a time. The current map unit boundaries are reviewed and adjusted, if needed.

Documentation, both soils and vegetation, is gathered by a multi-discipline team approach. Data collected (transects, field notes, etc.) is entered into the PEDON program. This data is then compiled and analyzed.

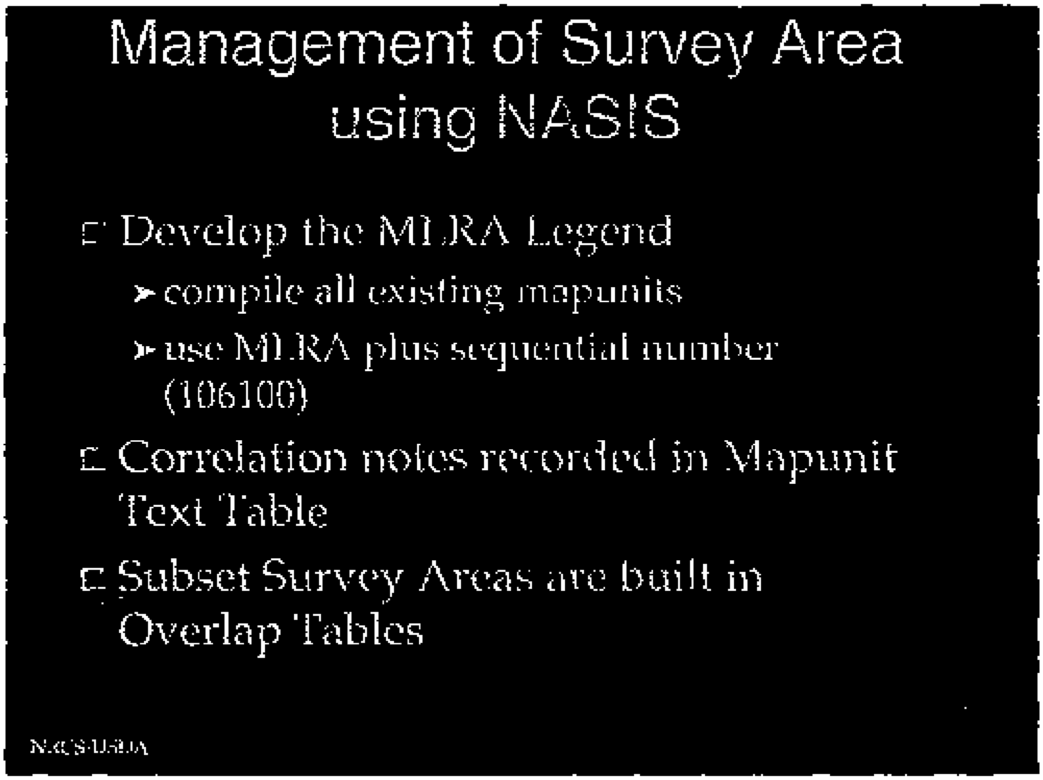
Lab samples are collected for analysis to document soil properties.

All of the information is then used to update or create Official Series Descriptions.

It is also used to update the NASIS database used to contain map unit information. When NASIS becomes accessible to the Field Soil Scientist, all notes and information will be entered directly. This will allow the capture of all information the soil scientist has of the survey area.

Once mapping is correlated, the digital soils layer is then updated.

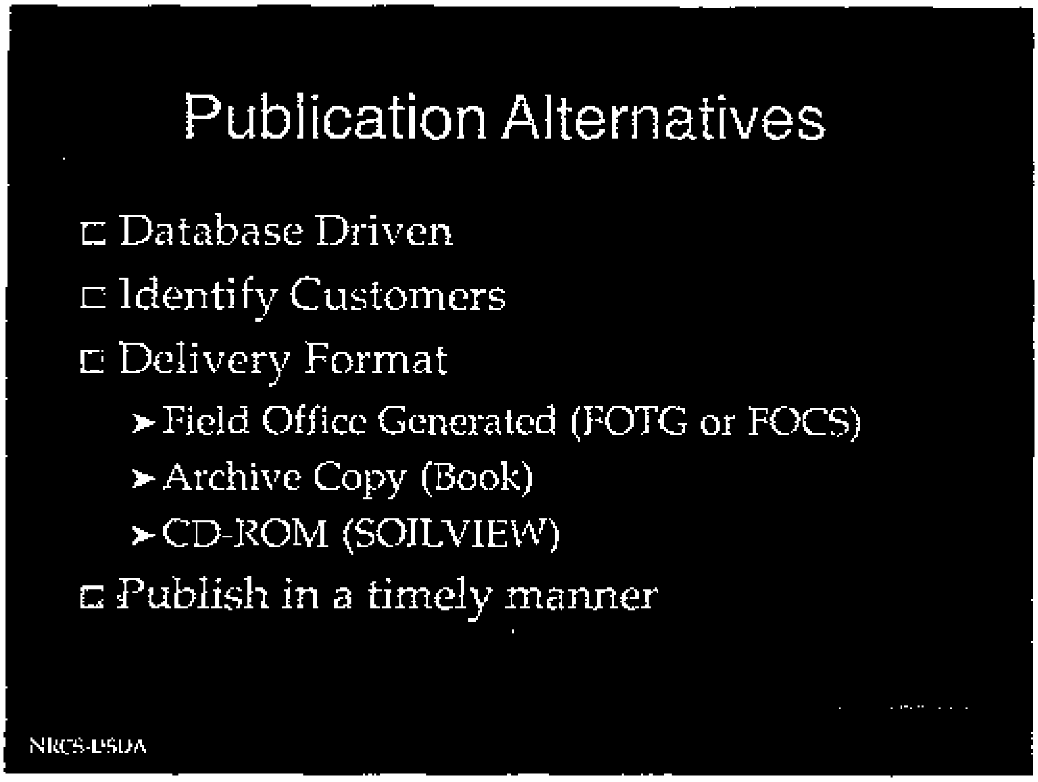
The publication is either amended or a new publication is printed, depending on the type of update soil survey.



NASIS is the database used as a management tool by the MLRA office staff for all soil survey activities. NASIS allows the correlator to develop a MLRA legend. The MLRA legend is built by compiling all mapunits assigned to a particular MLRA into the MLRA legend. After all mapunits are in the legend, the map unit symbols are renumbered using the MLRA symbol plus a sequential numbering.

Using the MLRA legend, all correlation decisions are tracked for each map unit. Notes are captured in the database for each map unit, or for each legend. NASIS becomes the historical archive of all management decisions for a soil survey. This information can be viewed by all NASIS users and is available to be printed for attachment to field review reports.

Under the "umbrella" of the MLRA legend, county or survey subsets can be developed as an "overlap area". Establishing an "overlap area" allows for organization of map units within a subset. This allows the MLRA staff to develop legends for the customers use, for example, county publications by the state office using an alphabetical legend or a legend for a county tax appraiser using a numeric symbol for their GIS layer.



The methods of Soil Survey Publication are rapidly changing. Alternatives that were not available less than one year ago are now becoming reality. One factor that is important in future publications is the use of the database. NASIS is the database for development of the map unit description report. Future release of NASIS will allow for development of the manuscript itself. NASIS allows for the field soil scientist to capture all the ideas and thoughts of the map unit and the ***survey*** area. Once in the database, the notes can then be exported to the publication process.

Prior to the publication process, it is important to identify the customers of the survey. A database driven publication allows for the report to be tailored to the customer needs.

Delivery formats are changing. One constant is that the field office has been designated as the official delivery point of NRCS publications. As such, the survey must have the capability to be generated or stored at the Field Office in either the Field Office Computing System (FOCS) or within the Field Office Technical Guide. Beyond the field office, there is also the need for small numbers of the archive copy. This archive copy could be a book or the new CD-ROM version using " SOILVIEW".

In any event, the most important aspect of publication is to get the report into the hands of the customer in a timely manner.

PANEL DISCUSSION ON FIELD INDICATORS OF HYDRIC SOILS

Introduction: Russell Pringle Soil Scientist, NRCS Wetland Science Institute, Louisiana State University, Baton Rouge, LA.

Since November of 1996 about 15,000 copies of the publication "Field Indicators of-.

S

Field Indicators of Hydric Soils

NCSS Conference Panel Presentation
Jerry J. Daigle
June 17, 1997

A query was made of the states in the NRCS South Central Region to determine what is working and what is not working with the ***Field Indicators of Hydric Soils in the United States.*** A common response throughout the region was that the Indicators, for the most part, are working well. There are, however some areas of concern.

The ***Indicators are*** currently posted on the Internet. There is no mechanism, however, to indicate where the most recent changes were made. The user has to read and compare the entire document with the previous revision to ascertain differences. A procedure should be established to indicate at a glance where changes were made.

The time has come to abolish the ***Hydric Soils List. This*** list was a very good and timely tool for when it was developed and what it was developed for. That time and use are no longer valid. The List was of tremendous value in allowing USDA to make a very large number of off-site wetland determinations in a short period of time. This was done in order to satisfy a political agenda. Off-site determinations are now virtually a thing of the past. A hydric soils list is not needed for on-site delineations. The ***Hydric Soils List has*** been misused in many instances. It has also become a crutch for those persons not comfortable with their knowledge of on-site hydric soil identification. It has existed beyond its usefulness.

The ***Field Indicators of Hydric Soils,*** to be a successful tool, must have authority. A field delineator can use the ***Indicators*** to determine the presence of hydric soils and confirm an area as a wetland. But what if the call is appealed or challenged in court? The ***Indicators are the*** official tool of the USDA and have been endorsed by the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency. But will they stand up in court? What is their legal basis? What is the possibility of getting the ***Indicators on the*** Federal Register? Is there enough concurrence on their use to push for legal authority? These issues must be resolved.

The Field Indicators use terminology similar to ***Soil Taxonomy*** or the ***Soil Survey Manual*** but these terms are defined differently. An example is the "Faint, Distinct, and Prominent" terms used to describe contrast. This has caused much confusion for delineators and others who try to use the ***Indicators*** but are also familiar with the definitions of other similar terms. This is unacceptable in the eyes of the users of the ***Indicators. The*** definitions of these terms must be made consistent or the terms themselves should be changed.

Though these terms are well defined in the Indicators, they have confused many because of their similarity. A parallel concern is the absence of a corresponding term to represent the oxidized portion of the soil matrix. There seems to be support for the term "Oxidized Matrix." A "Reduced Matrix / Oxidized Matrix" combination is the preferable choice of terms for some of the respondents. An interagency committee has to be the mechanism to address this and many of the other issues surrounding the ***Hydric Soil Indicators. The*** National Technical Committee On Hydric Soils could serve in this capacity or it may be time to form a parallel committee or committees the address these issues.

Briefly, several ***Indicators*** were listed by the respondents as specific problem areas. Of greatest concern was the soils formed in red parent material. There are no ***Indicators*** that do an adequate job of identifying these soils as either hydric ***or*** non-hydric. Areas such as the Red River Valley in Louisiana, Arkansas and Texas, where wetland issues are of paramount importance, contain large extents of these problem soils. Yet, the soils in these areas lack identifiable characteristics that can be used as indicators of their hydric status. Wetland delineators and the NRCS Wetland Science Institute are in dire need of assistance with this situation.

The respondents from Texas report the indicator "F8" does not work well in the depressional areas of west Texas and New Mexico. Arkansas, Louisiana and Texas report the test indicator "TF1 1" is not yielding consistent results. Indicator "F3" may still be more reliable and consistent in the Delta. There have been problems reported in frequently plowed areas. The plowing operation apparently destroys, or masks, existing indicators. Serious problems are reported with Vertisols and soils with low hydraulic conductivity. Researchers cannot agree or do not have sufficient data to come to consensus on the saturation aspects of these soils. There is a desperate need for more research in this area. Finally, there is confusion and frustration with the existence of several pH/eh correlation curves to determine when a soil is reduced. There seems to be an outcry for one curve agreed on by all to be the standard.

As stated by members of the Wetland Science Institute, "all these problems can be solved with three things... data, data, and data." But it is difficult to get an adequate amount of reliable data. Several good research projects have been initiated. The collection of much good data has begun. Data collection however, especially that of monitoring type data, takes a substantial amount of time to collect and analyze. Given adequate time, good results will be achieved and many questions will be answered. However, the political agenda has not been generous with its allocation of time. Such has been the case throughout the wetlands initiative. This has created a dilemma that may have no end. Scientist have little choice except to persevere; to go about the business of using good science to answer the questions that can be answered within the time frame that allows ***them to*** do so.

Field Indicators of Hydric Soils and Identification of Hydric Vertisols in Texas Gulf Coast Prairie MLRA

W. L. Miller
Natural Resources Conservation Service, Victoria, Texas

Vertisols cover about 9 million ha in the continental U.S., with over half of this area in the state of Texas. Most Vertisols in Texas that have wet soil conditions are located in playas of the High Plains region, flood plains of certain major rivers, and depressional and low lying areas on uplands in the Texas Gulf Coast Prairie MLRA.

Vertisols in flood plains and in uplands in the Texas Gulf Coast Prairie MLRA typically have a wide range of surface and subsurface spatial variability. Surface variability is expressed as gilgai microrelief in undisturbed areas.

Gilgai microrelief occurs as depressions or "microlows" and mounds or "microhighs". The microlows are circular or oblong depressions 3 to 5 m in diameter and make up 25 to 50 percent of a landscape. Relief varies from 10 to 50 cm between the bottom of the microlow to either the intermediate microhigh or the top Of the microhigh. Microlows often pond water for periods ranging from a few days to several months each year.

Subsurface variability is expressed in both the vertical sequence of horizons and in lateral physical and chemical characteristics of the soil within distances of 2 to 5 m from any point. Gray or red colored chimneys or "diapirs" that are often more alkaline and/or calcareous than soil in the microlow extend from depths of 1 to 2 m below the surface of the microlow to either 5 to 10 cm below the surface or to the surface of the microhigh.

Surface and subsurface variability is also expressed by deep wide cracks and shear planes that extend from the surface to depths of at least 2 to 4 m when Vertisols are dry. Water movement is initially very rapid down the open cracks, often to depths of 1 to 2 m during high precipitation events. When the soil matrix is moist and the cracks are closed, water movement is slow along the closed cracks and shear planes. Because of the "bowl' shaped nature of the cracks and shear planes in the microlows, water movement and accumulation is always greatest in the microlows. Water movement is always very slow in the very fine pores of the soil peds. The shrinking and swelling characteristic of Vertisols changes the relative distribution of macro and micro pores. and the changes are dynamic in both time and space.

Because of the variability in water movement and accumulation in Vertisols, reducing conditions and redoximorphic features are also often highly variable within short distances in the soil matrix. This variability makes identification of "typical" redoximorphic features and use of the current Field Indicators for Hydric Soils very difficult in many cases.

Several long term studies of Vertisols in the Texas Gulf Coast Prairie indicate that there are periods of 50 to 60 percent saturation and less than 10 percent reducing conditions in the upper part of the soil based on the test for Fe(II) with the chemical alpha, alpha dipyridyl. Field studies in Victoria County show that from dry conditions, periods of wet soil conditions and ponding of 4 to 8 weeks pass before Fe(II) is detected with alpha, alpha dipyridyl in the upper 5 to 10 cm of the microlows. Laboratory studies of wet soil samples from the same areas indicate periods of at least 3 to 4 weeks pass before anaerobic and/or Fe(II) conditions form based on both Eh readings and alpha, alpha dipyridyl test.

The reasons for the divergence in saturation and development of reducing conditions is not easily explained. Possible explanations include unavailability of forms of C as readily available microbial energy sources for reducing conditions to develop. The bimodal pore distribution of both macro and micro pores may play a part. Large cracks and shear planes with relatively high water conductivity wet and saturate quickly, while the very fine pores of the soil peds with very slow water conductivity require long periods to wet and saturate. In some cases soil reaction may also play a part, with more alkaline soil systems requiring longer periods of reducing conditions or more intense reducing conditions before redoximorphic features form in the soil.

Vertisols in the Texas Gulf Coast Prairie in well defined depressions that pond water 4 to 6 months each year usually have high value, low chroma, and iron accumulations in the upper part to meet Hydric Soil Field Indicator F3, Depleted Matrix. Field Indicator F3 is a reliable indicator for Vertisols that are at least slightly to moderately acid in the upper part in these landscape positions.

Other Vertisols in similar landscape positions with neutral to moderately alkaline reaction and/or slightly sodic conditions in the upper part may have either a dark surface or colors of 10YR 4/1 or 10YR 4/2 in the upper 30 cm. These soils usually do not have any iron accumulations to meet Field Indicator F3, or other Field Indicators such as F4, Depleted Below Dark Surface, or F6. Redox Dark Surface. Additional field studies are needed to adequately document and develop field indicators to identify Vertisols that are hydric in these landscapes.

Vertisols in the Texas Coast Gulf Prairie part of the Brazos and Colorado River flood plains also are difficult to classify baaed on current Field Indicators of Hydric Soils. These Vertisols formed in red clayey fluvial deposits, are dark colored and have over 60 percent clay content in the upper part, and reaction is neutral to moderately alkaline. Vertisols in these landscapes should have good redoximorphic features based on landscape position, frequency and duration of flooding and ponding, and plant communities. However, many of these Vertisols either do not have any redoximorphic features, or the redoximorphic features are weakly expressed in the upper part of the dark colored soil matrix. Additional field studies are also needed to adequately document and develop field indicators to identify Vertisols that are hydric in these landscapes.

The 1997 National Cooperative Soil Survey Conference
June 16 -- 20. Baton Rouge, Louisiana

Report by Travis Neely. State Soil Scientist/MLRA Region 11 Team Leader, Indianapolis, Indiana

Field Indicators of Hydric Soils and how well they fix the Guide for Identifying and Delineating Hydric Soils.

We are still in the earliest stages of our testing of these indicators. During our fall tour that is schedule for September between the state of Illinois and Indiana Professors Soil Classifiers to further test these Field Indicators.

Problems we have observed thus for with these Field Indicators of Hydric Soils in MLRA Region 11 are as follows:

Page 14. (Field **Idicators of Hydric Soils in the United States)**

F5. Thick Dark Surface. For Use in all LRRs except LRRs W, X, and, Y; for testing in LRRs W, X, and Y. A layer at least 15 cm (6 in.) thick with a depleted matrix that has 60 % or more chroma 2 or less (or a gleyed matrix) starting below 30 cm (12 in.) of the surface. The **layer(s) above 30 cm (12 in.) of surface. The layer(s) above the depleted or gleyed matrix have hue N and value 3 or less to a depth of 30 cm (12 in.)** and value **3** or less and chroma 1 or less in the remainder of the epipedon.

Indicator F5 requires a hue of N to a depth of 30 cm (12 in.). This will exclude most of our poorly and very poorly drained aquolls that have mollic epipedons more than 12 inches thick.

I am proposing that the hue of 10YR with value of 3 or less and chroma of 1 or less be considered for adding to the definition of indicator F5 (Thick Dark Surface).

Here are a few Soil Series that we have some major concerns on. We would like to know how these Indicators will be rewritten to correct these concerns in this Region.

EXAMPLE&

OSD	Date OSD	State	Mollic Thickness (in.)	Color
Ambraw	4/86	IL	14	10YR 3/2 + 3/1
Ashkum	9/87	IL	16	10YR 2/1 + 3/1
Brookston	9/97	IN	16	10YR 2/1 + 3/1
Bryce	9/87	IL	13	10YR 2/1
Chalmers	7/84	IN	13	10YR 2/1
Cyclone	9/79	IN	14	10YR 3/1 + 2/1
Drummer	4/96	IL	19	10YR 2/1 + 3/1
Free	4/85	IN	16	10YR 2/1
Gilford	12/86	IL	14	10YR 2/1 + 3/1
Iroquois	12/85	IN	16	10YR 2/2 + 3/2
Lyles	2/85	IN	20	10YR 3/1
Mahalasville	5/88	IL	12	10YR 3/1
Milford	9/95	IL	22	10YR
Millgrove	8/95	OH	12	
Millsdale	6/79	OH	16	
Montgomery	8/96	IN	15	
Patton	12/86	IL.	15	
Pella	9/95	IL	13	
Peotone	9/87	IL	28	
Pewamo	4/92	MI	13	
Ragsdale	6/81	IN	15	
Reddick	9/84	IL	13	
Rensselaer	1/85	IN	15	
Sable	9/95	IL	23	
Selma	10192	IL	16	
Sloan	7/94	IN	15	
Treaty	7/84	IN	12	
Wolcott	10/79	IN	15	
Zadog	9/86	IN	17	

National Cooperative Soil Survey Work Planning Conference
Baton Rouge, LA
June 16-20.1997

Panel on Hydric **Soils**
Tuesday, June 17, 1997

Comparative Field Study of Wetland Boundary Indicators
Mascoma Headwaters, Dorchester, New Hampshire
Presented by Steve **Hundley,** State Soil Scientist

Background

In May 1995, the soil science community in New England developed and published **the** Field Indicators of Identifying Hydric Soils in New England. This publication was the culmination of several years of effort involving the Natural Resources Conservation Service, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, as well as many other soil scientists in the private and academic sector.

During this same period of time, the Natural Resources Conservation Service and the National Technical **Committee** for Hydric Soils were in the process of developing a National set of hydric soil indicators in conformance to the 4-agency Memorandum of Agreement (MOA) pertaining to the identification of wetlands.

According to the **4-agency MOA,** the policy of the Natural Resources Conservation Service was to recognize only the National ***set*** of hydric soil indicators when identifying and delineating wetlands. However, it was the overwhelming consensus of the soil science community in New England that the Regional set of hydric soil indicators more adequately represent the soil morphology indicative of wetland conditions in New England. In order for these morphologies to be recognized by the National **Technical** Committee on Hydric Soils, consistent and reproducible field documentation needed to be presented.

Early in 1995, the soil survey **staff in** New Hampshire submitted a proposal to the National Wetland Science Institute, seeking financial support to conduct a field study **and** comparison of both the National and Regional Field Indicators. In **the** Fall of 1995 acknowledgment and support for the project **was** received from the National Wetland Science Institute.

Scope of the Project

A 40 acre **site** was **selected** in the town of Dorchester, New Hampshire on land owned by the Lyme Timber Company. A grid to **serve** as intensive ground **control** points was installed over the entire 40 acres. With the use of a global positioning system, each control point, and the parcel boundary itself, was digitized into the New **Hampshire** NRCS GRASS Geographic Information System. Soil temperature probes were installed at 6 inch and 20 inch depths. **Watertable** monitoring wells were installed at subsurface, subsoil and substratum depths and a program was initiated to monitor **weather** and site conditions.

In the Spring of 1996, teams of scientists mapped and recorded the boundary of the three criteria used to identify and delineate wetlands. A 1:1,200 base map was used to delineate the boundary of wetland hydrology, hydrophytic plant communities and the hydric soil boundary using both National and Regional Field Indicators.

Findings, 1996

The results of this first year study show variability in the placement of wetland criteria boundaries due, in part, to ambiguity in the wording of certain field indicators. This ambiguity requited the individual mapping teams to establish their own field mapping protocol on how to interpret certain field indicators. In addition, it was very apparent that soil temperature at 20 inches is not an accurate indicator of growing season in this part of the country which adds to the variability in criteria boundaries. Additional factors affecting criteria boundary placement were recognized and documented in the 1996 Report on Findings. As a result of the first year study, specific recommendations are being made to enhance both the National and Regional Field Indicators of Hydric Soils.

Continued Studies

The 1997 field season is being used to collect more field documentation, further test the recommended changes in field indicators, and recalculate the start of the growing season. Through a proposal submitted to the Global Change Initiative, instrumentation will be installed within the study area to collect more precise data on evidence of hydric conditions. In the Spring of 1998, the wetland criteria boundary plots will be redrawn based on recommendations made as a result of this study and after setting more uniform mapping protocols.

Entry for minutes at work planning conference for contribution of Steve Sprecher, US Army Corps of Engineers, on Hydric Soils Panel, Tuesday, June 17:

"The US Army Corps of Engineers is using the regional hydric soil indicators ('NTCHS indicators") as an adjunct to the 1987 *Corps of Engineers Wetlands Delineation Manual.* Almost all of the NTCHS indicators can be correlated to the COE delineation manual, but when contradictions occur, the COE must follow their own manual.

"The most useful NTCHS indicators are those that address "problem soils." These are already standard COE tools in the SE Coastal Plain where the NTCHS indicators have been used for several years now. The COE has high hopes that equally useful indicators can be developed for Mollisols and other soils with thick, dark A horizons.

"The indicators still frighten off most COE employees, because of "soil science anxiety." However, the NTCHS indicators will eventually sell themselves if they prove to be useful. The COE definitely needs useful tools for field work."

Soil Resilience/Soil Quality

Cathy A. Seybold and Maurice J. Mausbach, USDA-NRCS
Jeff Herrick, USDA-ARS

Introduction

Soil degradation refers to the decline in the soil's inherent capacity to produce economic goods and perform ecologic functions (Lal, 1993). Causes of degradation include deforestation, overgrazing, agricultural practices, over exploitation of the vegetative cover, and bioindustrial and industrial activities. The ability of a soil to recover from degradation, referred to as "soil resilience," and ways of measuring it are important for sustainability of the soil resource base (Szabolcs, 1994a).

The term "resilience" has been used in the ecological literature since the late sixties and early seventies, and ecologists have regarded it as a subjective term because it has not been well defined and will vary depending on the scientist (Blum, 1994). Resilience has been defined in two different ways in the ecological literature (Holling and Meffe, 1996): the first concentrates on the stability near an equilibrium steady-state, where speed or rate of return after disturbance to the equilibrium are used to measure resilience--referred to as "equilibrium resilience"; and the second is the magnitude of disturbance that can be absorbed or accommodated before the system changes its structure by changing the variable and processes that control system behavior--referred to as "'ecosystem resilience." However, much of the ecological literature uses the equilibrium definition of resilience (Holling and Meffe, 1996).

The term "soil resilience" was only recently introduced into soil science, mainly to address soil ecology and sustainable land use issues (Blum, 1994). It was introduced to create a common theory that describes the reaction of soil to a range of impacts or disturbances (Table 1). Because of the complexity of soil systems and the many ways in which soil can react to an external disturbance, it has not been operationally defined (Blum, 1994). A precise definition of soil resilience, methods for measuring it, a description of its processes, and its significance and development are lacking (Szabolcs, 1994a).

The objectives of this presentation are to (1) clarify and review the concept of resilience as it pertains to soils, (2) review the literature on its assessment and quantification, and (3) examine its relationship to soil quality.

Definition and concept of soil resilience

Two general definitions of soil resilience emerge from the soils literature; the first is the ability of soil to resist changes after a disturbance (Rozanov, 1994; Lang, 1994); and second, as the ability of soil to recover or restore itself after a disturbance or degradation event (Lal, 1993b; Szabolcs, 1994a; Eswaran, 1994; Sombroek, 1994; Blum and Santelises, 1994; Pimm, 1984; Herrick and Wonder, 1997). In the first definition, the soil resists change, where "resistance" is defined as the capacity of a system to continue to function without change through a disturbance (Pimm, 1984, Herrick et al., 1997). This concept has been referred to as "soil stability" by some (Lal, 1993) or just "soil resistance" by others (Herrick and Wonder 1997; Herrick et al. 1997). This differs from the second definition, where the soil's ability to recover or bounce back after a disturbance is evaluated. The second definition is also the preferred or most used version (Lal, 1993; Eswaran, 1994, Herrick et al., 1997). With this in mind, the following definition is suggested (Herrick et al., 1997): ***the capacity of a soil to recover its functional and structural***

integrity after a disturbance. A disturbance is generally defined as any event which causes a significant change from the normal pattern or functioning of an ecosystem (Forman and Godron, 1986). Functional and structural integrity refers to a soils capacity to perform vital soil functions such as those proposed by Karlen et al. (1997): (1) sustaining biological activity, diversity, and productivity; (2) regulating and partitioning water and solute flow; (3) filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric deposition; (4) storing and cycling nutrients and other elements within the earth's biosphere; and (5) providing support of socioeconomic structures and protection for archeological treasures associated with human habitation. Structural integrity is linked to soil function, and deals with the physical arrangement of primary soil particles and their aggregation. The soils capacity to recover has two components; the rate of recovery, and the degree of recovery (Fig. 1) (Herrick and Wonder, 1997). The rate of recovery is the amount of time it takes to recover after a disturbance to its original potential or to some stabilized lower potential (Fig. 1). Also, the soil can undergo irreversible degradation, where the disturbance can be to drastic and the soil cannot restore its capacity to function within any reasonable time frame (human life span). The greater the rate and/or degree of recovery, the more resilient the soil system would be for a specific disturbance.

The capacity to recover after a disturbance (soil resilience) is dependant on soil type, climate, land use, the type and degree of disturbance, and time allowed to recover (Lal, 1994b; Herrick et al., 1997). Soil resilience is an inherent characteristic of soil and will vary with soil type Soil properties that will effect soil resilience will be dependant on the type of disturbance, but in general they include soil organic matter content, nutrient status, and soil structure (Lal, 1994a). Table 2 lists soil properties that could be important for soil resilience. Herrick et al. (1997) includes soil depth, total plant cover, functional species composition, spatial distribution of existing plant communities, and soil seed bank as possible indicators for soil resilience against erosion on rangelands.

There exists a close relationship between climate and soil resilience; the dryer the climate (aridity) the less resilient the soil system is against various disturbances (Lal, 1994a). Climatic factors that need to be considered include precipitation, radiation, temperature, seasonal fluctuations, and length of growing season.

Land use and management affects soil resilience and is directly correlated with the sustainability of land use (Szabolcs, 1994b); therefore, soil resiliency can be enhanced through best management practices. Sustainability deals with performance at certain acceptable levels over a given time frame (Eswaran, 1994), and is based on the maintenance of certain soil function for sustainable use. Soil resilience will indicate the degree with which a soil will recover from a particular cropping or management system.

Soil resilience, without knowing the type and degree of disturbance, has no absolute meaning in terms of soil value (Szabolcs, 1994b). In other words, resilient against what? This is important when comparing resiliency among soils. The disturbance regime can be characterized in terms of disturbance type, spatial scale, frequency, intensity, and predictability (or regularity) of each event (Herrick et al., 1997). The type of disturbance can be natural such as fires, earthquakes, high winds, or high intensity storms, or caused by human use and management such as logging, grazing, tillage, or annual cropping. Each type of disturbance will effect the soil in a different way; therefore, it is necessary when expressing soil resilience, to indicate against what. Soil resilience for a specific kind of soil may vary depending on the type of disturbance. For example, a soil's ability to restore itself after a disturbance of fire will be different than after tillage.

Soil resiliency is dependant on temporal and spatial scales. If the disturbance occurred on a square meter, the rate and degree of recovery would be greater than if it occurred across a watershed. The time it takes for a soil to recover could be 1,000 yrs and considered resilient on a geologic time scale. When dealing with sustainability, a human life span is more relevant, and for economic planning, 5 to 10 years or less would be considered relevant (Lal, 1993b). Time allowed to recover after a disturbance also needs to be considered. If a soil is annually cropped, the soil may recover from this cropping system in a hysteric manner, where it does not quit recover before the next cropping system is imposed. Each year the same hysterric effect occurs until eventually, the capacity to restore itself and soil quality are much degraded (Fig. 2).

Frequency and intensity of the disturbance will impact the recovery of the system. For example, the ability of a soil to recover from frequent compactive disturbances, such as by cattle, is lower than if the disturbance was occasional. The timing of the disturbance is important. If the compaction by cattle occurred when the soil was wet, the ability to recover will be lower than if it were dryer.

Relationshiu of soil resilience to soil quality

The concept of soil resilience is different from that of soil quality. Soil quality has been defined as "the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation" (Karlen et al., 1997). Quality with respect to soil can be viewed as: (1) as inberent properties of a soil--referred to as inherent quality, and (2) as the dynamic nature of soils as influenced by climate, and human use and management, where quality is measured by the change in the capacity of the soil to function relative to some reference or baseline condition--referred to as dynamic quality or burrowing). To identify indicators, long-term process level studies are required. Indicators of the process are measured in a system; the system is disturbed; and the ability to recover is measured and correlated to the process indicators.

Quantification and assessment of Soil Resilience

Very little is known about soil resilience and how to measure it, both quantitatively or qualitatively (Rozanov, 1994). Soils are not static, they develop, so they are constantly changing. The rate of change may be very slow, and some changes may be noticed only on a geologic time scale. Soil resilience, therefore, depends on a soil's ability to maintain a favorable balance between (Lal, 1994a): (1) restorative and degradative processes, (2) rate of new soil formation and soil loss, (3) inputs and outputs from the soil system. In addition, the assessment of soil resilience can be examined in different modalities of time, function, entropy, and spatial scale (Sombroek, 1994). Herrick and Wonder (1997) emphasized that the time scale of interest, nature of the disturbance, level of recovery expected, and the type and amount of inputs to support recovery need to be known for assessment of soil resilience. Overall, soil resilience is a dynamic property that is very dependant on the soil's status at time of assessment.

Soil resilience was quantitatively expressed by Lal (1993, 1994a) as: $S_r = S_a + \int(S_n - S_d + I_m)dt$; where S_r is soil resilience, S_a is antecedent soil condition, S_n is soil renewal, S_d is soil degradation rate, I_m is inputs, and "t" is time. A mass balance is computed by assessing the restorative and degradative processes, and knowledge of antecedent soil conditions (Fig. 4). Factors they considered to affect soil resilience were: (1) intrinsic soil properties, (2) external factors such as climate and socioeconomic conditions, (3) land use, and (4) inputs (Lal, 1994a).

Soil resilience in drylands was assessed by using the degrees of a specific degradation process most characteristic for a type or class of land use (Rozanov, 1994); for example, soil salinization for irrigated croplands. The theory for assessment was based on the fact that inherent soil resilience characteristics of soils cannot be measured directly, and that the results of degradation may constitute a reliable base for evaluation against a particular degradation process. General soil resilience groups were developed that can be modified based on various soil degradation processes in different land use systems; an example is given for irrigated cropland in the drylands in Table 3.

Rozanov (1994) attempted to quantify soil resilience based on general laws of physics. A force responsible for bringing soil back into its initial state would be proportional to the induced change: $\partial A/\partial x = -kx$; where "A" is an amount of work required for moving the soil between states, "k" is the resilience coefficient, "x" is the variable, and the minus sign shows that work is required against an impact of the acting force.

Lal (1994a)

maximum recovery in structural form and rate at which recovery occurred. The maximum recovery in a given state is defined as the "resilience potential."

The National Soil Survey Center has developed near-surface indices of fragility, which relates to soil resilience. Fragility pertains to the magnitude of loss in function that would result from deterioration of near-surface conditions. The index assumes that if the initial near-surface conditions are favorable, than the fragility would be higher, etc. Soils are rank for proposed deterioration due to (1) truncation, (2) near-surface compaction and/or crust formation, and (3) '0' horizon obliteration. Indicators of each are placed in classes from 1 to 5 with 5 having the lowest fragility. The index was used to rank soil survey information with respect to fragility.

Conclusions

Soil resilience is the capacity of a soil to recover after a disturbance. Indicators for assessing soil resilience require long-term process level studies. The development of soil resiliency rates based on land use for specific disturbances would be useful for sound land use planning and management, and for sustainability. It is recommended that more information be obtained or pursued on the development of quantitative measures or indices of soil resilience, and possible development of soil resiliency classes based on those indicators.

Table 1. Common soil stresses and related degradative processes (Bezdicek, 1996).

Stress	Principle degradative processes
Heavy loao' due to vehicular traffic.	Physical degradation such as crusting, compaction, structural decline, and poor soil tilth.
High intensiy rains and overland flow, high wind velocity.	Accelerated erosion by water and wind.
High evaporative demand and salt conc. in the profile	Drought, aridization or desertification, salinization or sodication.
Intensive cropping.	Chemical degradation, nutrient imbalance, soil organic matter depletion,
Intensive use of agrichemicals and monoculture	Biological degradation, acidification. reduction in Soil biodiversity.

Table 2. Potential indicators for soil resilience (Bezdicek, 1996).

Soil structure
soil water
retention and transmission properties
CEC
exchangable cations
soil organic matter content
transformations
nutrient supplying capacity
soil pH
rooting depth
soil biodiversity

Table 3. Examples of general and specific soil resilience classes (Rozanov, 1994).

General soil resilience classes

Non-resilient	soils are very severely affected after continuous use
slightly resilient	soils are severely affected after continuous use
moderately resilient	soils are moderately affected after continuous use
highly resilient	soils are non-affected or slightly affected after continuous use

Specific soil resilience classes

soils resilient to salinization: none, slightly, moderately, highly
soils resilient to sodification: none, slightly, moderately, highly
soils resilient to acidification: none. sliahtlv. moderatelv. hiehlv

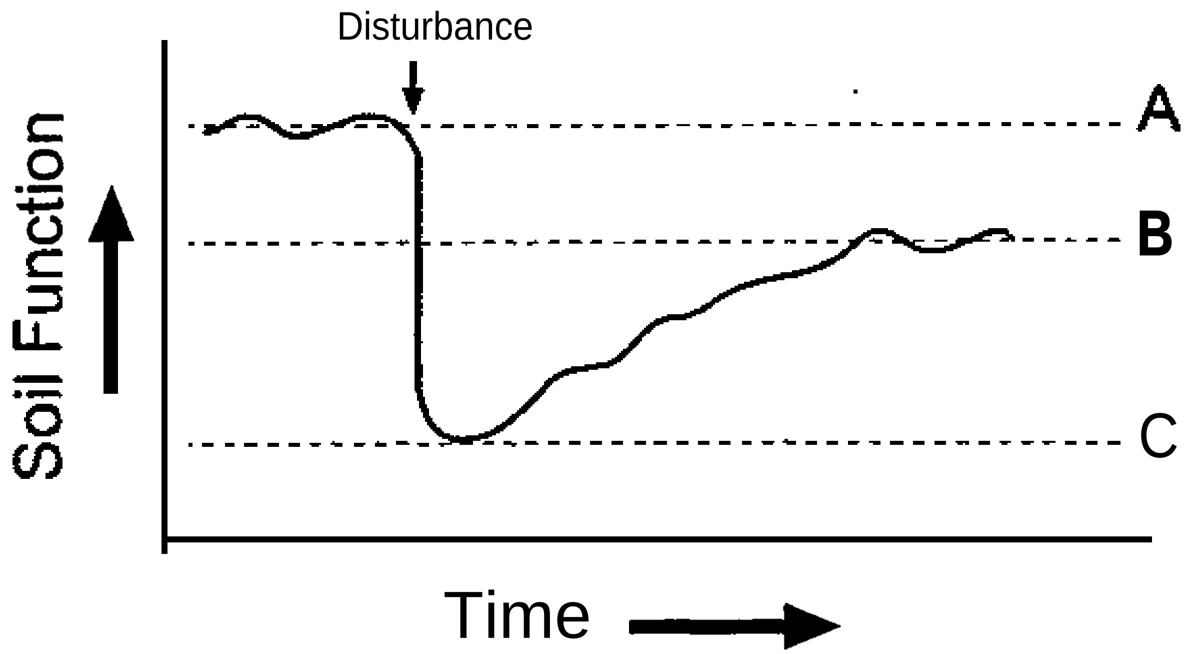


Figure 1. **Concept of soil resilience, both rate of recovery and degree of recovery, and relationship to soil resilience: Resistance = C/A; Resilience (degree of recovery) = (B-C)/(A-C); Resilience (rate of recovery) = d[(B-C)/(A-C)]/dt (after Herrick et al., 1997).**

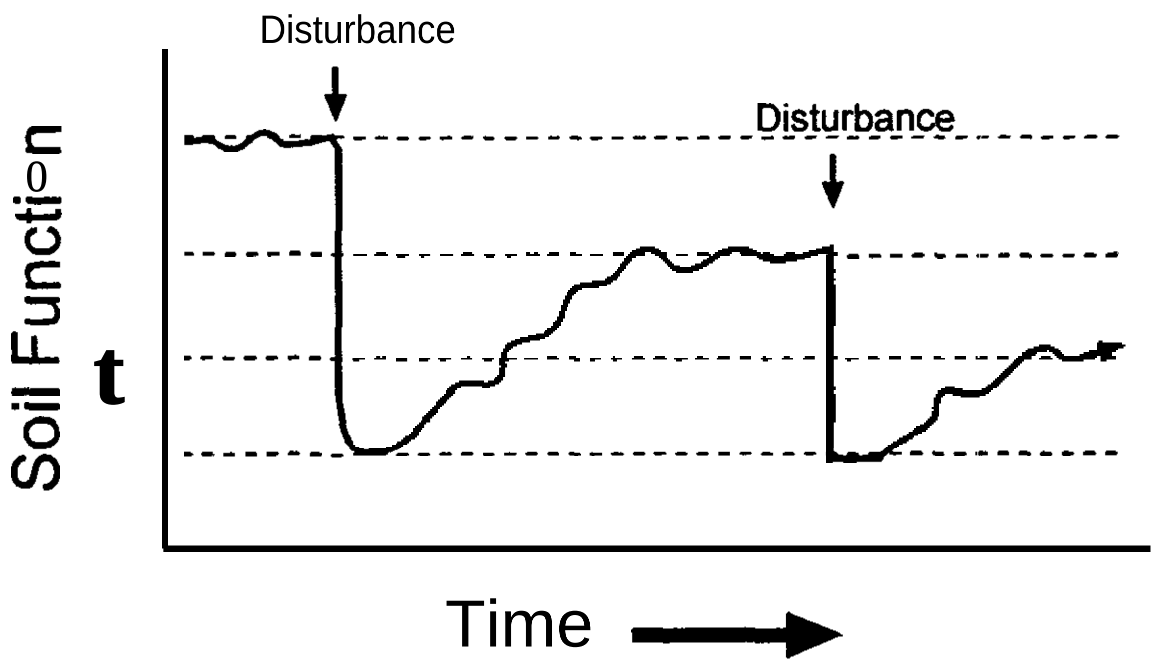


Figure 2. Soil quality is defined as the "capacity tofunction." This diagram is showing what can happen to soil quality and soil resilience decreasing over tie after repeated disturbances.

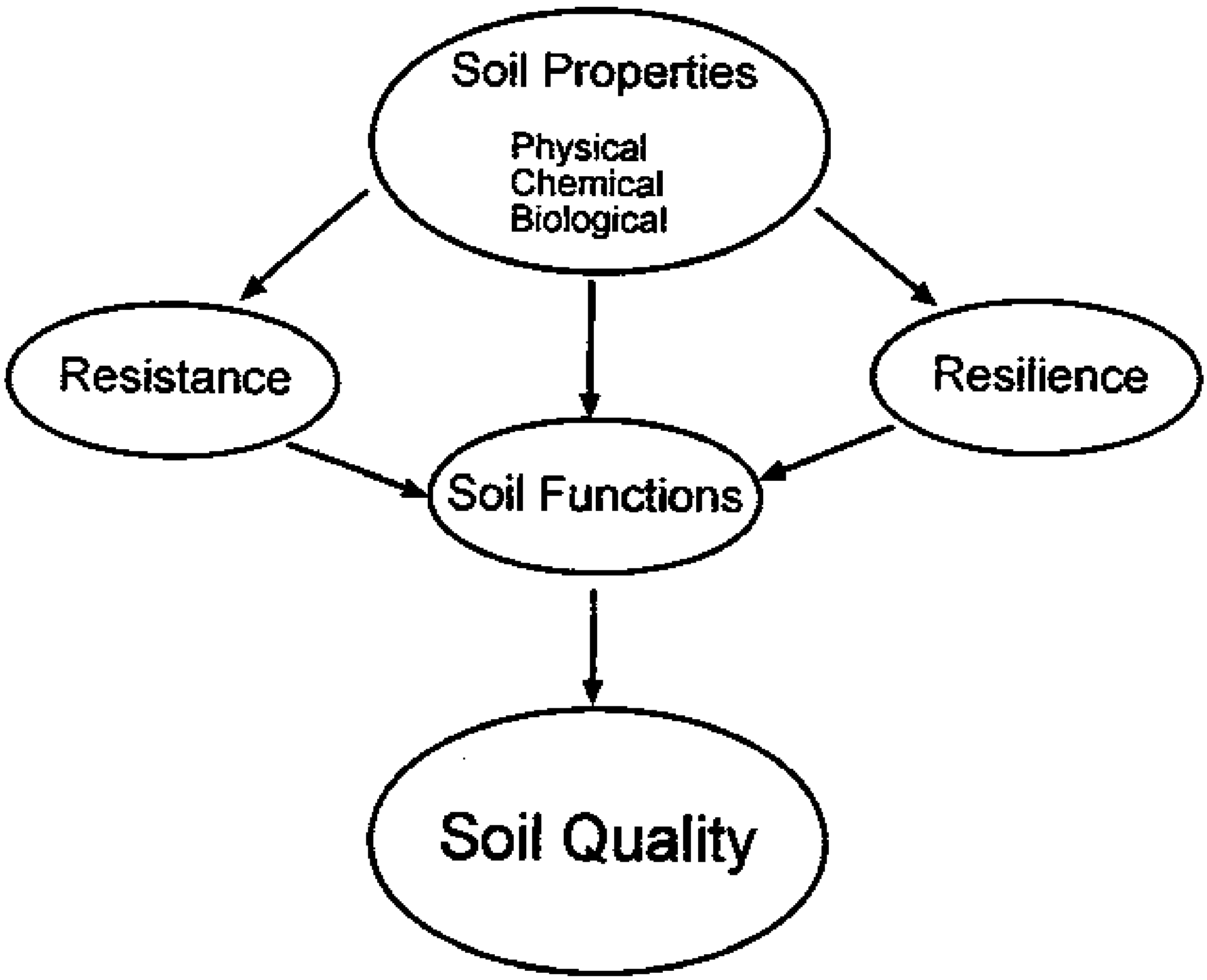


Figure 3. Conceptual modal of the relationship between soil quality, soil resilience, and soil resistance (after Herrick et al., 1997).

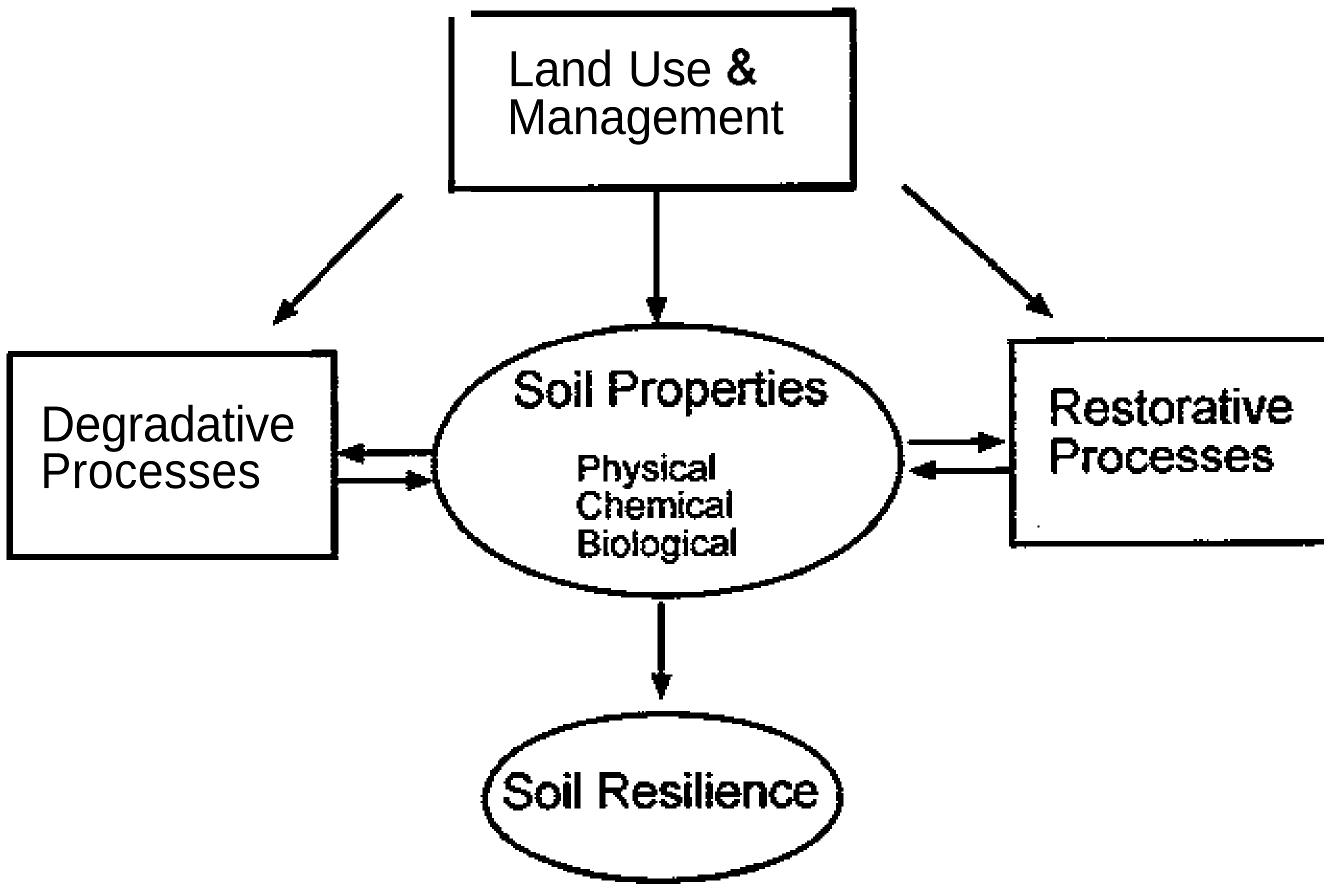


Figure 4. **Conceptual model of the relationship between landu use and management, soil processes and soil resilience (after Lal, 1994b).**

References

Acton, D.F. and L.J. Gregorich. 1995. Understanding soil health. p. S-10. In: D.F. Acton and L.J. Gregorich (eds.) The Health of our Soils: Toward Sustainable Agriculture in Canada. ZCentre for Land and Biological Resources Research, Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario.

Bezdicek, D.F., R.I. Papendick, and R. Lal. 1996. Introduction: Importance of soil quality to health and sustainable land management. p. l-8. In: J.W. Doran and A.J. Jones. (eds.) Methods for assessing soil quality. SSSA Spec. Publ. 49. SSSA, Madison, WI.

Blum, W.E.H. 1994. Soil resilience - general approaches and definition. p. 233-237. In: Proc. 15th World Cong. of soil Sci., Acapulco, Mexico. 10-16 July 1994.

Blum, W.E.H. and A.A. Santelises. 1994. A concept of sustainability and resilience based on soil functions: the role of the International Society of Soil Science in Promoting Sustainable Land Use. p. 535-542. In: D.J. Greenland and I. Szabolcs (eds.) Soil resilience and sustainable landuse.

Doran, J.W., M. Sarrantonio, and M.A. Liebig. 1996. Soil health and sustainability. p. l-54. In: D.L. Sparks (ed.) Advances in Agronomy, Vol. 56. Academic Press, San Diego, CA.

Eswaran, H. 1994. Soil resilience and sustainable land management in the context of AGENDA 21. p. 21-32. In: D.J. Greenland and I. Szabolcs (eds.) Soil resilience and sustainable landuse. CAB Int., Wallingford, Oxon, England.

Forman, R.T.T. and M Godron. 1986. Landscape ecology. John Wiley & Sons, New York.

Herrick, J.E. and M.M. Wander. 1997. Relationships between soil organic carbon and soil quality in cropped and rangeland soils: the importance of distribution, composition and soil biological activity. p.000-000. In: B.A. Stewart (eds.) Advances in Agronomy. CRC Press,

Herrick, J.E., M.A. Weltz, J.D. Reeder, G.E. Schuman, and J.R. Simanton. 1997. Rangeland soil erosion and soil quality: role of soil resistance, resilience and disturbance regime. Paper presented at the “Soil Quality and Erosion Interaction” symposium (Soil and Water Conservation Society Conference, Colorado, July 7-10 1996).

Holling, C.S. and G.K. Meffe. 1996. Command and control and the pathology of natural resource management. Conservation Biology 10:328-337.

Karlen, D.L., M.J. Mausbach, J.W. Doran, R.G. Cline, R.F. Harris, and G.E. Schuman. 1997. Soil quality: A concept, definition, and framework for evaluation. Soil Sci. Soc. Amer. J. 61:4-10.

Kay, B.D., V. Rasiah, and E. Perfect. 1994. Structural aspects of soil resilience. p. 449-468. In: D.J. Greenland and I. Szabolcs (eds.) Soil resilience and sustainable landuse. CAB Int., Wallingford, Oxon, England.

Lal, R. 1993. Tillage effects on soil degradation, soil resilience, soil quality, and sustainability. Soil & Tillage Research 27:1-8.

Lal, R. 1993b. Agricultural sustainability and soil resilience. Desertilication Bulletin 23:7-14.

Lal, R. 1994a. Land use and soil resilience. p. 246-260. In: Proc. 15th World Cong. of soil Sci., Acapulco, Mexico. 10-16 July 1994.

Lal, R. 1994b. Sustainable land use systems and soil resilience. p. 41-67. In: D.J. Greenland and I. Szabolcs (eds.) Soil resilience and sustainable landuse. CAB Int., Wallingford, Oxon, England.

Lang, I. 1994. Soil resilience in stressed agro-ecosystems. p. 217-220. In: Proc. 15th World Cong. of soil Sci., Acapulco, Mexico. 10-16 July 1994.

Larson, W.E. and F.J. Pierce. 1991. Conservation and enhancement of soil quality. p. 175-203. In: Evaluation for Sustainable Land Management in the Developing World, Vol. 2: Technical papers. Bangkok, Thailand: International Board for Research and Management, 1991. IBSRAM Proceedings No. 12(2).

National Research Council. 1993. Soil and Water Quality: An Agenda for Agriculture. National Academy Press, Washington, DC, 516 pp.

Pierce, F.J. and W.E. Larson. 1993. Developing criteria to evaluate sustainable land management. p. 7-14. In: J. M. Kimble (ed.) Proceedings of the Eighth International Soil Management Workshop: Utilization of Soil survey Information for Sustainable, Land Use. May 3, 1993. USDA Soil Conservation Service, National Soil Survey Center, Lincoln, NE.

Pimm, S.L. 1984. The complexity and stability of ecosystems. Nature 307:321-326.

Rosanov, B.G. 1994. Stressed soil systems and soil resilience in drylands. p. 238-245. In: Proc. 15th World Cong. of soil Sci., Acapulco, Mexico. 10-16 July 1994.

Sombroek, W.G. 1994. The work of FAO's land and water division in sustainable land use, with notes on soil resilience and land use mapping criteria. p. 521-534. In: D.J. Greenland and I. Szabolcs (eds.) Soil resilience and sustainable landuse. CAB Int., Wallingford, Oxon, England.

Szabolcs, I. 1994a. Introduction to the symposium on "stressed ecosystems and soil resilience". p. 218-220. In: Proc. 15th World Cong. of soil Sci., Acapulco, Mexico. 10-16 July 1994.

Szabolcs, I. 1994b. The concepts of soil resilience. p. 33-39. In: D.J. Greenland and I. Szabolcs (eds.) Soil resilience and sustainable landuse. CAB Int., Wallingford, Oxon, England.

and causes problems in classification in several soil orders 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 committee, over time, developed the following list of properties associated with eroded conditions for all soils as compared to their uneroded counterparts. The surface horizon refers to the Ap horizon or the upper 18 cm (7 inches) of the soil after mixing.

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 below the surface horizon.
6. Decreased solum thickness.
7. Shallower depth to the base of a subsurface diagnostic horizon.
8. Higher clay content in surface horizon.
9. Depth distribution of clay in profile. (Depth to clay maximum decreases with increasing erosion)
10. Shallower depth to carbonates.
11. Concentration of coarse fragments, if present, in or on surface horizon.
12. Soil chemical subsoil properties similar to uneroded sites.
13. Presence of gullies.
14. Deterioration Of structure in surface horizon.
15. Dark organic stains in upper part of the argillic horizon.

Committee 2, formed at the Des Moines conference in 1992, made the following proposed additions to Soil Taxonomy for eroded Mollisols:

Soils that have an Ap horizon or the upper 18 cm of soil, after mixing that (1) meet all of the requirements of a mollic epipedon except thickness; and (2) do not have andic soil properties; and 3) have two or more of the following:

1. In crushed and smoothed moist samples, the color changes abruptly at the lower boundary of the Ap horizon. The underlying horizon is not an E, AE, E/B, OR B/E horizon. The combined difference in value and chroma is 2 or more or there is a difference in hue between the two horizons.
2. There is a clay decrease from the Ap horizon to a subjacent cambic or argillic horizon.
3. Has a lower organic carbon content as compared to a non-eroded horizon.
4. Structure has deteriorated as compared to a non-eroded horizon.
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.

It is the recommendation of this committee that the following action be taken:

The proposed criteria listed below be tested in at least the following states for a period not to exceed two years:

Illinois
Iowa
Kansas
Michigan
South Dakota
Ohio
Wisconsin

Proposals to be tested

1. Recognize accelerated erosion as a diagnostic soil characteristic and define it in Soil Taxonomy under the section entitled "other diagnostic soil characteristics". A listing of proposed diagnostic characteristics has been developed.

2. 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 used to waive the requirements for a specific category. The same procedure could be followed for other categories.

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. Modify 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 [illegible]

-is under the overall direction of Fee Busby who works closely with Carol Jett and Tom Weber
-the National Consortium Scientist's job will be to assist in managing the Consortium's activities in whatever way possible
-the Consortium will have a Board of Trustees
-and we'll work closely with our National Conservation Partners

SLIDE 8
-The Board of Trustees will help set the overall direction we will take in carrying out Consortium activities
-Members will not be Consortium administrators (Division Directors, etc.)
-and their functions will be to recommend goals and assess our performance, and to review/recommend the needed support structure available to us, principally from within the various states.

SLIDE 9
-Our National Partners will play a big role in our activities. We'll coordinate closely with
*colleges and universities
*other Federal agencies
*non-profit organizations, such as The National Cattleman's Assoc, and
*other organizations, such as the Equipment Manufacturer's Institute
-Their functions will be to help us define the role of science and technology in NRCS and to work with us on needed research and applications.

SLIDE 10
-I'll start with the Institutes today since they are a completely new concept within NRCS. They occupy only a small part of the total Consortium, however, comprising about 10% of our staff.
-The Institutes were established to assure that NRCS will either become, or continue to be, a NATIONAL LEADER in a special emphasis area and to enhance our technical expertise in that area
-They will be the primary vehicle for technology development and acquisition in these special emphasis areas.

SLIDE 11
-And they will provide the initial training (to State Office and Multi-State Office personnel) for their products
-They will also provide a direct line of communication to customers. We have had several meetings with representatives from State and Field Office personnel where we sought feedback on the needs of the field and we will continue to have such meetings in the future.
-Recall that a focus on field operations (meaning state offices and field offices -- and including MLRA units, community assistance offices, etc.) was one of the principal reasons for establishment of the Institutes
-In total, we now have about 3 1/2 dozen scientists working in around 20 locations throughout the U.S.

SLIDE 12
(Self-explanatory) -- Their purpose is....Their locations are....Their immediate projects are....

1 NRCS NATIONAL SCIENCE AND TECHNOLOGY CONSORTIUM

June 19,1997

Lee Herndon, National Consortium Scientist & Director, Institutes Division

2 WHAT IS THE NS&T

7 OPERATION OF S&T CONSORTIUM

- Deputy Chief for Science and Technology
  - Close Coordination and Cooperation with Deputy Chief Soil Survey&Resource Assessment and Deputy Chief Management
- National Consortium Scientist
- Board of Trustees
- National Conservation Partners

8 BOARD OF TRUSTEES

- Help Set the Direction for Consortium
- Not Administrators within Consortium
- Functions
  - Recommend Goals and Assess Performance
  - Review/Recommend Support Structure

9 NATIONAL PARTNERSHIPS

- Colleges/Universities
- Other Federal Agencies
- Non-profit Organizations
- Other Organizations
- Functions
  - Help Define Role of Science and Technology in NRCS
  - Work with Us on Needed Research

10 EIGHT INSTITUTES

- Totally new concept for NRCS
- To assure that NRCS will either become, or continue to be, a NATIONAL LEADER in a special emphasis area and to enhance our technical expertise
- Primary vehicle for technology development and acquisition in these special emphasis areas

11 EIGHT INSTITUTES

- Primary trainers for delivery of products to NRCS state offices
- Direct line of communication to end-users and primary customers
- Focus on field operations (state and field offices) of NRCS
- About 3 1/2 dozen scientists in 20 locations

12 SOIL QUALITY INSTITUTE

- MAURICE MAUSBACH
- To provide leadership in soil quality, build partnerships, and develop, acquire, and transfer soil quality information and technology
- Locations (Ames, IA; Auburn, AL; Corvallis, OR)

14 WETLAND SCIENCE INSTITUTE

- BILLY TEELS
- To develop, adapt, and transfer science and technology to protect and restore wetlands
- Locations (Laurel, MD; Baton Rouge, LA; Oxford, MS; Lincoln, NE)
- Hydric Soil Indicators; Wetland Hydrology Tools; Regional Models for Wetland Functional Assessments

15 SOCIAL SCIENCE INSTITUTE

- FRANK CLEARFIELD
- To develop and transfer information, procedures, training and guidance related to the social and economic aspects of human behavior
- Locations (Greensboro, NC; Madison,

20 WATERSHED SCIENCE INSTITUTE

- Develop Technical Release on Agricultural Sustainability; Develop Materials on Innovative Urban Conservation Practices

21 GRAZING LANDS TECHNOLOGY INSTITUTE

- RHETT JOHNSON
- TO acquire, develop, coordinate and transfer of economically and ecologically sound grazing lands technology
- Locations (Fort Worth, TX; University Park, PA; Corvallis, OR)

22 GRAZING LANDS TECHNOLOGY INSTITUTE

- National Handbook for Grazing Land Ecology and Management; User Manual and Training Program for Grazing Lands Application Sofhvare; Procedures and Description of Rangeland Health

23 TWO NEW INSTITUTES - - FY '97

- INFORMATION TECHNOLOGY INSTITUTE
- WILDLIFE HABITAT MANAGEMENT INSTITUTE

24 INFORMATION TECHNOLOGY INSTITUTE

- EMIL HORVATH
- To explore, develop, and transfer the science and technology of state-of-the-art automated processes and tools
- Locations (To be determined)

25 WILDLIFE HABITAT MANAGEMENT INSTITUTE

- PETER HEARD
- To cooperate with conservation partners in acquiring, developing, and transferring wildlife habitat restoration and management technology
- Portland/Prineville, OR; Ridgeland, MS; Ames, IA; Fort Collins, CO; Laurel, Md.

26 COOPERATING SCIENTISTS

- To address new and emerging subject areas
- Air Quality - Davis, CA; West Lafayette. IN; Washington, DC; Ft. Collins, CO
- Agroforestry - Lincoln, NE; Fort Worth, TX; Seattle, WA
- Soil Erosion & Sedimentation - West Lafayette, IN; Manhattan, KS; Boise, ID

27 NATIONAL CENTERS

- Produce and provide products/services for which NRCS is uniquely capable
  - **Primarily production oriented**
  - **Mainly staff at one location**
- Eight National Centers -- They are:
- National Cartography and Geospatial
- Soil Survey

28 NATIONAL CENTERS

- Soil Mechanics
- Plant Data
- Water & Climate

29 NATIONAL CENTERS

- Information Technology
- Employee Development
- Business Management

30 SOIL SURVEY

- JIM CULVER
- To provide national leadership for and assist Regional, State, and MLRA Regional Offices in utilizing policies, procedures, and guidelines for soil surveys, including the national cooperative soil survey; soil survey standards; and soil survey research, lab. analysis, and tech. development
- Lincoln, NE

31 PLANT DATA

- SCOTT PETERSON
- To design, develop, manage, provide access to, market, and maintain a comprehensive plants database for use by NRCS and others
- Baton Rouge, LA

32 WATER AND CLIMATE

- JON WERNER AND WIL FONTENOT
- To lead the development and transfer of water and climate information and technology which support natural resources conservation
- Portland, OR and Beltsville, MD

33 INFORMATION TECHNOLOGY

- BERNARD SHAFER
- To provide the information technology infrastructure and application information systems to support the delivery of NRCS programs and services
- Fort Collins, CO

34 NATIONAL DIVISIONS - SCIENCE AND TECHNOLOGY

- Ecological Sciences - Marc Safley (Acting)
- Conservation Engineering - Richard Van Klaveren
- Resource Economics and Social Sciences - Peter Smith (Acting)
- Institutes - Lee Herndon

35 NATIONAL DIVISIONS - SOIL SURVEY AND

RESOURCE ASSESSMENT

- Resource Inventory - Jeri Berc (Acting)
- Soil Survey - Horace Smith

36 ## ROLE OF NATIONAL DIVISIONS

- Policy Leadership
- Partnerships and Relations
- Technical Leadership

37 ## ACCESSING CONSORTIUM INFORMATION

- With **ftp programs -- ftp.ftw.nrcs.usda.gov**
- User name -- anonymous
- Password -- Your e-mail address
- Files -- **/pub/nstc/presents**

38

National Cooperative Soil Survey
Biannual Meeting

Baton Rouge, LA
June 19, 1997

Report on Activities of the
National Society of Consulting Soil Scientists

by
Sidney Davis, President

It is a pleasure to represent the NSCSS as a cooperator in the NCSS program As cooperators from the private sector we are here to lend our support in advancing soils related programs and to provide input from development and user perspectives, and to promote business opportunities as professionals.

NSCSS currently has about 120 active members, nation-wide, representing business that employ other soil scientists, allied professionals, technicians and staff. Shop sizes range from 1 to over 50 staff and employees. Some of our members are staff of international firms. Our members reside in most of the lower 48 states, with the exception of two Canadian members. We have 13 directors, including the executive Board of Directors: the President, Past President, President-Elect, Secretary and Treasure, and Regional Directors: Northeast, Southeast, South Central, North Central, North West and Southwest. There are also two Chapters: Georgia and Pacific Northwest.,

NSCSS Committees include: Bylaws and Resolutions, Ethics and Professional Conduct, Nominating, Business and Marketing, Education, Membership, High Intensity Soil Survey and Site Specific Soil Investigations, Newsletter, Technical Advisory, Computer Tech, Wetlands and Hydric Soils. Each committee is active and reports to the President semi-annually. You may find us on the internet at http:/ / www.wolfe.net/ ~psmall/nscss.html.

This year we have founded the NSCSS Liability Insurance Program. This program offers errors and omission insurance and general liability coverage to our membership at a rate of approximately 2.2 percent of gross receipts, on a claims made basis. This is a very good program, and has already expanded our membership by almost 20 percent.

The NSCSS Board of Directors will be looking into a health insurance program for our members and also a retirement fund program. Many people who might consider private consulting in our field are staying in nonsoils related positions due to lack of benefit packages in the private sector. “Fear of the unknown” keeps many people in noncreative or in unrelated work situations because of a lack of private sector benefits packages. People who are covered under a benefit program in federal agencies or other large firms often times resist small business opportunities because of lack of coverage in the private sector. NSCSS's goal is to make a business of soils, and we think that developing benefit alternatives in the private sector will have positive effects on our industry to inspire small private ownership of soils consulting business.

Over the past year, our Past President, Mr. Mark McClain, has been active in review of and submittal of the High Intensity Soil Survey standards. Much of the information was advanced due to the hard work and diligence and preparation of the Site-Specific Soil Mapping Standards for New Hampshire and Vermont, prepared by the Soil Science Society of Northern New England. As Chair of the committee, Mark has asked the NCSS Steering Committee to retain the High Intensity Soil Survey Committee in tact for two more years to obtain feed back on the standards as presented at the break out segment during the annual meeting.

NSCSS recognizes the importance of the NCSS and the Natural Resources Conservation Services's soil survey program. We rely on the mapping and standards to carry out our work in the private sector. It is vital to both the public and private sectors to maintain and continue to advance quality products, tied to standards. We are in an age where nearly everything related to the environment is regulated to some degree, from the Clean Water Act, Endangered Species Act, Nonpoint Source Pollution, and the list goes on... . NSCSS believes that the NCSS program is under funded at the national level, and we offer our services to support better funding, in the way of lobbying or making contacts at the state and local level, to get our legislators better informed about the importance of soils information. We have members in nearly every state that can be contacted on critical issues.

To give you an example of what is happening in the West, I am currently the Chair of the Soil Information and Landuse Committee for the California Association of Conservation Districts. I will be meeting with state and federal agencies, in conjunction with our legislator's staff to draft language for increased funding for cost sharing of the soil survey program in California. At the current rate of federal funding for California, it is estimated that it will take another 50 years to complete the once-over mapping and updating of existing survey information. Our goal is to get better state participation and then perhaps achieve greater monetary support from the federal government. It is important for NSCSS members to become involved with the Resource Conservation Districts, for they direct the soils programs at the local level. Once there is interest at the local level, the federal level will come along. Knowing that the private sector is interested will help drive our legislators into action for better soil survey funding.

NSCSS brought its highest officers, the President, Past President and President-Elect to Baton Rouge to the NCSS biannual meeting to show our support for the national effort and to provide continuity for our leadership into the future. Mr. Don Smith, our current President-Elect operates his private consulting firm out of Chantilly, VA and is available to make contacts on Capitol Hill, as appropriate. Please contact either Don or myself if there is a need from the private sector for support for the NCSS program.

On behalf of the NSCSS, it is a pleasure to support the NCSS program.

Sidney Davis,
President

North Central Soil Survey Conference
Report to the National Cooperative Soil Survey Conference
June 16-20, 1997

by Kenneth R. Olson

INTRODUCTION

This report summarizes both the 1996 North **Central Soil Survey Conference** and the research activities of the North **Central Agricultural Experiment Stations** which relate to the National Cooperative Soil Survey program. Details of the 1996 NCSSC have been published in a proceedings and copies are available from Jerry Schaar (USDA, NRCS in Huron, SD).

1996 **North Central Soil Survey Conference** was held in Rapid City, South Dakota on May 19-23, 1996. The committees were as follows:

Committee 1: Soil Data Delivery System Recommendations:
-CD's should be explored as medium to publish soil survey.
-The Internet should be used to distribute soils information.
-A limited number of hard copies should still be published.
-All soil survey related data should be placed on the Internet including new data elements.
-Standards for electronic data entry, storage and retrieval, and ownership were addressed.

Committee 2: Soil Research Needs Recommendations:
-Established a North Central Regional Cooperative Research Committee (NCRCRC) with 11 members from FS (I), BIA(1), AES (3), NRCS-NSSC(l), NRCS-MO (2), NRCS-State offices (2), and ARS (1).

Committee 3: Eroded Soils and Classification Recommendations:
-Accelerated erosion needs to be recognized as a diagnostic soil characteristic in Soil Taxonomy.
-Various categories of Soil Taxonomy that are affected by accelerated erosion need to be modified.

Committee 4: Soil Correlation and Classification Recommendations:
-Current methods of review and comment are adequate; however, a few suggestions for improving the process and reducing the time required were made.
-Development and formalization of a procedural guide with specific standards for modernizing soil surveys is need.

NC **Agricultural Experiment Station** regional committee (NCR-3) activities related to NCSS:
1. Proposed Definition of Hydric Soils in North Central Region.
2. New Soil Map being prepared for the North Central Region. Legend reviews, digitization, and publication are the remaining tasks.
3. Continue to provide members on:
    - National Soil Taxonomy Committee.
    -Eroded Soil Committee
    -National Soil Survey Center Advisory Committee
    -National Soil Survey Standards Committee
    -National Cooperative Soil Survey Research and Development Agenda Committee
    -Steering Committee for the NCSSC
    -Soil Survey Standards for Precision Farming

NC Agricultural Experiment Station Research Activities related to National Cooperative Soil Survey Program:

Illinois - Ken Olson:

1. Develop methods to study soil erosion and sedimentation using fly ash from coal tired locomotives and steam engines as profile markers.
2. Evaluation of conservation

2. Impact of accelerated erosion on soil properties and productivity.
3. Impact of cultivation on spodic horizon properties.
4. Development of methods and guidelines for local wetland protection and related land use planning.

Minnesota - Jay Bell:

South Dakota - Doug Malo:

1. Established a site specific farming project, in cooperation with several agencies that includes surveys with an electromagnetic conductivity meter and GPS instrumentation.
2. Evaluation of the impact of long term irrigation on soil properties in Spink County.
3. Parent material stratigraphy and soil genesis in eolian materials along the Big Sioux River in Brookings County.
4. Development of a classification key for SD soils.
5. Data base development of basic soils information for the major series found in SD (jointly funded by NRCS and SDAES).

Wisconsin - Kevin McSweeney:

1. Tree-throw affected soil landscapes NE Wisconsin.
2. Fate and transport of agricultural chemicals in sandy soils.
3. Chronosequence studies on raised marine terraces, Oregon.
4. Genesis and classification of permafrost affected soils.
5. Land evaluation for sustainable land management in the tropics, Costa Rica, Honduras, and Zimbabwe.
6. Soil landscape analysis in support of precision agriculture.

Current status of North Central State soil surveys compiled fro NCR-3 reports.

State	No. Counties	Published	In Press	In Progress (Updates)	Waiting (Updates)
IL	102	79	21 + 2 updates	22	0
IN	92	90	2 + 5 updates	4	5
IA	99	90	9	4	2
KS	105	105	0	4	3
Ml	83	59	8	10	6
MN	87	53	18	10	28
MO	114	67	21	13	3 no mapping + 11 updates
NE	93	88	5	7	86
ND	53	18	12	3 updates 2 progressive	18
OH	88	77	3	7	13
SD	67	60	12	3	2
WI	72	50	4	19	0

Global Climate Change Activities in the Soil Survey Division

By: John Kimble, Research Soil Scientist
National Soil Survey Center

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 SSD has put 1.5 million into global change related activities for each of the last several years, projects have been in-house and with NCSS cooperators. There have been projects in all states. A summary of the major on going projects follow at the end of this introduction.

The projects 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.

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: ***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: ***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 Bay 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 Lameshur 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 landfonn setting; (3) To determine how 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) Sites 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. 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: 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, [illegible]

Objectives: (I) 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 he operational for a limited number of measurements in the summer of 1996.

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

Process 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, 1995 1996 and 1997. 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: ***Soils of the central plains experimental range station (CPER).***

Objectives: (1) Implement new applications for existing technology to soil survey at the CPER; (2) Provide suitable soil-landscape model for soil survey; (3) Evaluate soils data collected to determine appropriate spatial scales for modeling; (4) Test the significance and viability of reconstructing recent terrestrial enviromnents using isotopic techniques to provide high resolution paleo-enviromnemal information; and (5) Provide prototype ecosystem approach containing a strong soils component for use at other LTBR sites.

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

Stains: 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: ***MLRA 77 - southern highplains***

Objectives: (1) Compile available historical and proxy data for the Southern High Plains; (2) Compile a reconnaissance sampling of surficial soils throughout the MLRA 77; (3) Provide soil-landscape models for areas (particularly those with problems in mapping) of the southern High Plains; (4) Study past effects and predict future effects of clitic change on soils and landscape evolution; (5) Determine the stratigraphic relations of the surficial sediments and inferences to soil properties.

Contact: C. Olson, NSSC, Lead Scientist in cooperation with NRCS and university scientists in MLRA 77.

Status: This project began in 1990 and was scheduled to run 10 years. It has 2 parts: I. Compilation of baseline data and II. Investigations addressing the relation of soils, geomorphology and surficial features in MLRA 77. Baseline data and a literature review have been conducted. A listing of all soils sampled in MLRA 77 by subregion was compiled and released in FY 1990. Version 1.0 and 2.0 of a literature review were released in FY 92 and FY 93. A series of small-male surficial geology, drainage and bedrock maps have been completed. A text is being written to accompany these maps. The booklet should be released this fall. New information obtained from investigations over the course of the MLRA update will be added to these initial maps and a final set of maps prepared at the conclusion of the project.

Project: ***Soilprocess response to climate.***

Objective: To develop predictive models of soil process response to climate change by quantifying mass flux of elements and mineral transformations as soils develop under different clitic 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 mineralogical 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: **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 pmductivity; 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: 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 WAE's will be hired to help in the entering of SCS-Form 8's , pedon descriptions, and to determine locations of the pedons.

Meetings

Several meetings have been organized by the NRCS-SSD working with ARS, FS, EPA, NASA, and others on topics related to global cliite change. The first was in 1992, then another in 1993, a major one in 1996 at Ohio State University and three more are planned for 1997 and 1998.

EXECUTIVE SUMMARY AND RECOMMENDATIONS
NITT December 10-13, 1997 Work Session

The National Interagency Technical Team (NITT) for a common spatial framework of ecological units met in Atlanta, Georgia on December 10-13, 1997 to:

-evaluate the process and materials necessary to prepare a draft of common ecological units of the United States for distribution to State/Regional Coordinators,

-prepare an action plan to finalize the 1:1,000,000 map of common ecological units, characterization data and interagency database for FY97, FY 98 and beyond. and to

draft a process paper for interagency mapping and characterization at a scale of 1:1,000,000.

Participants included Sharon Waltman and Thor Thorensen, USDA-NRC& Jim Keys. Don Haskins, Sheila Logan and Bii Clerk, USDA-FS; Jii Omernik, US-EPA; Glen Bessinger and Steve Gregonis, DOI-BLM; and Jerry McMahon, DOI-GS.

The majority of the work session centered around details of preparing the reference spatial data base and attributes for the effort, updatiug the short term aud long term work plans and drafting an interagency process paper for state/local meetings. NITT members present were given assignments for data preparation and pltting necessary for drafting 1:1,000,000 ecological units that will be distriited to coordinators for use at state/local meetings. In July, the NITT plans to draft ecological units for the United States using the reference spatial data base and metadata which include Forest Service Ecological Units (Sections), EPA Regions (Level III), and NRCS revised Major Land Resource Areas and twelve other geographic data sets (see attached minutes). The draft of ecological units to be distributed to state/regional coordiirs will represent a coincidence of agency lines and identify areas needing additional agreement and review at state/regional meetings. Metadata will also accompany the draft map of ecological units and will include a statement of significance for each ecological unit.

The short term (scale of 1:1,000,000) and long term (scale of 1:250,000) work plans were updated to include current resource needs to accomplish the intent of the MOU for a spatial framework of ecological units. Plotting and NITT participation at state/regional meetiugs will cost approximately $25.000 while ecological mapping and characterization at the 1:250,000 scale will cost approximately $100,000 for operations. A project manager is needed to coordinate day to day operations, and those costs, as well as agency labor, are not reflected in the short term (1: I ,000,000) and long term (1:250,000) work plans.

An interagency process paper was drafted for use at state/regional meetings in the 1: 1 ,000,000 mapping and characterization effort. The paper explains the purpose of the Interagency spatial framework of ecological umts, addresses source materials including use of spatial geographic data sets and other local to regional information, and proposes a process for reviewing and reaching agreement on ecological units. Additional edits of the process paper will be required and a review by the National Interagency Steering Committee (NISC) before sendii to state/regional coordiitors for their review.

A communication plan is being developed and will be proposed to the NISC at a joint NITT/NISC work session in the spring. The plan addresses access of the interagency spatial base, a homepage for sharing meeting documentation other information, agency team presentation materials, review of interagency process, official as a working group of the Federal Geographic Data Committee (FDGC), and publication of mapping and characterization data.

In summary, the

plan, and interagency process paper interagency

2) for long

3) anofficial working group of the

4) of agency reps assignment of a manager

NITT WORK SESSION MINUTES
December 10-13, 1996 - Atlanta, Georgia

MEETING OBJECTIVES

-To evaluate the process and materials necessary to prepare a draft of common ecological units of the United States for distribution to State/Regional coordiitors,

-To finalize a process paper for interagency mapping and characterization at a scale of 1:1,000,000., and

-To prepare an action plan to finalii the 1:1,000,000 map of common ecological units, characterization data, and reference database for FY 97, FY 98 and beyond.

PARTICIPANTS

-Jim Keys	USDA-FS	Atlanta, GA
-Bill Clerk	USDA-FS	Atlanta, GA
-Sheila Logan	USDA-FS	Redding, CA
-Don Haskins	USDA-FS	Redding, CA
-Sharon Waltman	USDA-NRCS	Lincoln, NE
-Glen Bessinger	DOI-BLM	Denver, CO
Steve Gregonis	DOI-BLM	Denver, CO
-Jim Omernik	US-EPA	Corvallis, OR
-Thor Thorensen	USDA-NRCS	Portland, OR
-Jerry McMahon	DOI-GS	Raleigh, NC
-Trish Foster	GA-EPD	Atlanta, GA

I. <u>WORK PLAN</u> - Below are tasks for the short term (1:1,000,000 scale) and the long term (1:250,000 scale) efforts. The NITT will be working with national geographic reference data in preparation for the July 1997 work session (short term effort) in Denver, CO where a "coincident coverage" or premap of 1: 1,000,000 ecological units will be used to document differences or a coincidence in agency framework concepts (NRCS revised MLRAs, EPA Level IV Regions, and FS ecological units, Sections). Rationale for all units will be documented before sending the coincident coverage to State/Regional coordinators for *review and refinement* by local to regional experts. A process for state/regional work sessions is enclosed as Attachment 1. State/Regional coordiitors consist of NRCS MO leaders who will coordinate the review of their assigned area includii coordinating with adjoining MO reviews of the coincident coverage. Recommendations from state/regional work sessions will be published as a 1: 1 ,000,000 map and with attributes, and a first approximation of the interagency spatial framework meeting the intent of the national MOU.

The long term effort involves a similar process including 1:250,000 geographic reference data or information aggregated to that mapping and characterization scale, and refinement of the shot term product -1:1,000,000 map and associated attributes. Work sessions are expected to occur within each state or a combination of states similar to the short term effort.

The Work **Plan** consists of tasks identified for the short and long **term** e&logical mapping and characterization efforts as well as the **development** of the process paper for **state/regional** work sessions. Tasks have been **summarized** in Tables 1 through **5.**

Table 1. Process Paper Task Assignments from December 10-13, 1997 Meeting, in Atlanta, GA.

TASK ASSIGNMENT Process paper tasks	PERSON RESPONSIBLE	DUE DATE X = Completed
[redacted]		
IV. Background	Jim Omernik	7/14/97
V. Source Materials	Thor Thorensen, Jim Keys	7/14/97
VI. Guide for Meeting	Thor Thorensen, Jim Keys	7/14/97
VII. Products/Results	Sharon Waltman, Jerry McMahon	7/14/97
VIII. Definition of EU's	Bill Clerk, Steve Gregonis, Jim Omernik	7/14/97
IX. Mapping Convention	Sharon Waltman	7/14/97
X. QA Review Process	Don Haskins, Jack Holcomb	7/14/97
XI. References	ALL	7/14/97
XII. Appendices	ALL	7/14/97

Table 2. Pre-July 21-25, 1997 Meeting Task Assignments.

TASK ASSIGNMENT Pre July Meeting Tasks	PERSON RESPONSIBLE	DUE DATE X = Completion
Disseminate Minutes	Jim Keys	6/ 2/97
Work Plan	Jim Keys, Steve Gregonis, Sharon Waltman	6/ 2/97
Draft Official NISC letter	Jim Keys, Steve Gregonis	6/ 2/97
Secure $25,000 for plotting for USFS in Atlanta, GA	NISC	6/ 2/97
Hardcopy Map Tiles to Jim Omernik	Jim Keys, Mike Hamby	6/16/97
Process Paper Review by NITT	NITT	7/14/97
Hardcopy Map Tiles to NITT	Jim Keys, Mike Hamby	7/21/97
Denver Summit Meeting Organization and Agenda	Steve Gregonis, Glenn Bessinger	7/21/97

Table 3. Post-July 21-25, 1997 Meeting Task Assignments.

TASK ASSIGNMENT Post July Meeting Tasks	PERSON RESPONSIBLE	DUE DATE X = Completion
Finalize Ecological Framework Charter	NISC	7/31/97 _
Seek FGDC endorsement of Ecological Framework Work Group	NISC	7/31/97 _
Home Page Development	Sharon Waltman	7/31/97
Populated Secure FTP Site	Steve Gregonis	7/31/97
Process Paper Review by S-RC	EcoFrame Project Manager	8/29/97 _
Secure/Disseminate $100,000 for State-Regional Meetings sponsors	NISC	9/30/97 _
Prepare Agency specific letters for use with Intro Packet	NITT, NISC	9/30/97 _
Assemble 7.5M scale reference maps	Jim Omernik, Jim Keys, Sharon Waltman	9/30/97 _
Assemble Communication Plan	EcoFrame Project Manager	9/30/97 _
Assemble S-RC Introduction Packet (brochure/homepage)	EcoFrame Project Manager	9/30/97 _
Digitize Interagency Linework and plot 1:1M maps with symbols	Jim Keys, Mike Hamby	9/30/97 _
Prepare Legend Spreadsheets for S-RC	Sharon Waltman	9/30/97 _
Prepare Narratives and attributes list	NITT	9/30/97 _
Disseminate 16 EcoFrame Map Tile Communications Plan packets	NITT	10/31/97 _
Schedule time lines with EcoFrame Map Tiles leaders and partners	NITT	10/31/97 _

Table 4. Spatial Framework of Ecological Unit Development Milestones for Fiscal Year 1998.

TASK ASSIGNMENT	PERSON RESPONSIBLE	DUE DATE
[illegible]	[illegible]	[illegible]
2. Receive Communication Packet for Map Tile	NRCS MO Leader	[illegible] _
3. Review Communication Packet Materials and consult EcoFrame Home Page	NRCS MO Leader	11/14/97 _
4. Consult EcoFrame Home Page	Member Agency State-Regional Coordinators	11/14/97 _
5. Select State Representative for each State within Respective Map Tile	NRCS MO Leader and Other Member Agencies	12/1/97 _
6. Establish Fed and Appropriate State and Local Agency Contacts, set date for Interagency Review Meeting	NRCS MO Leader and Respective State Representatives	1/15/98 _
7. Hold Interagency Review Meeting following Meeting Guidelines	Designated State Representative	2/98-6/98 _
8. Review/assemble all review comments	Designated State Representative	7/1/98 _
9. Submit review comment package to MO Leader	Designated State Representative	8/1/98 _
10. Correlate/Join Maps and Legends for Map Tile with neighboring Map Tiles	MO Leader	9/1/98 _
11. Submit Correlated Map, Legend and Narrative materials to NITT representative	MO Leader	9/30/98 _

Table 5 Spatial Framework of Ecological Unit Development Milestones for Fiscal Year 1999.

TASK ASSIGNMENT FY 98 Tasks	PERSON RESPONSIBLE	DUE DATE X = Completion
**(1:250K Process Paper Starts in Parallel to Publication of 1:3.5M)	NITT with State and Regional Coordinators	2/98 __
12. NITT Assembles Correlated Map Tiles into National Map and Legend	NITT	3/1/98 __
13. Plot 1:3.5M Draft Map and Legend	NITT	4/1/98 __
14. Submit Draft Map and Legend to S-RC for peer review and comment	NITT	5/1/98-6/1/98
15. Review Comments are incorporated	NITT	8/1/98 __
16. 1:3.5M Map and Legend Narrative prepared and sent to USGS for publication (digital and hardcopy)	NITT	9/1/98 __
17. 1:3.5M Map and	USGS	12/1/98

II. **INFORMATION/DATA - 1:1,000,**<u>000 Short Term Effort</u> **- Preparing** for the 1: **1,000,000** ecological mapping and characterization effort involves the gathering of spatial and other information appropriate for **this** level of work. Maps (spatial information) will be projected at ?????I

A. **Basemaps -** The **NITT** and State/Regional Coordinators will use the same basemaps. Each **basemap** will have the following:

-A **1:1,000,000** scale format (4 o x 6 o tile **1"250K)** or
-**Albers** projection state groups **1: 1M &**
-**terrain** map 500 meter? (overlay)
-stream net
-gee-political (state, county)
-**100K** hypsography overlay
-ticks (computer generated)

B. Geographic reference data - The NITT **will** establish an Anonymous **FTP** site **with** BLM in Denver with the following selected national data sets available to participants by July 31. 1997. **Potential** users will be directed to this FTP site **from the NITT** Home Page via NRCS-NSSC Home Page **(ULR** is **??http://www.statlab.iastate.edu/soils/nssc/ecoframe.htm??)** The anonymous **FTP** site address is **: ??ftp.ecoframe.blm.gov??**

Geographic Reference Data **is** presented **with** metadata which describes its development in national covet-ages **sharing** an **Albers** Equal Area Projection in ARC **export** format. **?However,** metadata is presently lacking on most geographic reference data. This will need to be corrected by **choosing** among FDGC standards (simplest) as an example format.?

UGSG-NRCS Hillshade (500 meter **resolution)**
USGS **DEM** data (digital elevation model 500 meter resolution)
1. NRCS **STATSGO - MLRA units**
NRCS **MLRA** units as shown on national map (1997)
3: DLG **(Digital Line Graph) data/county** and state boundaries. **transportation**
4. **Kuchler's PNV (Potential Natural** Vegetation)
5. Land Cover **characteristics /** NDVI **- AVHRR/** Anderson level I **&** II data
6. LUDA (land use **disturbance** areas) by **USGS**
7: **FS** cover map (AVHRR at **1KM)**
8. USEPA Level **III/IV** regions
9. USFS regions and subregions at the US sections 1994 and after
10. USFS Ecological Units of the **Eastern** US **-** first approximation 1995
USGS **Fenneman's** Physiographic Provinces
***USFS** region/state subsection maps (West-wide coverage of U.S.)
***NLUAS (Marschners** 1933) maps

* Coverage-s available **10/1/97**

Other associated information includes a Bibliographic **listing** of these sources and minimum metadata record (using ARC Document).

Other desired sources of lnformation for this effort that could be contributed to the Anonymous FTP site as made available **include:**

Quaternary and/or bedrock geology at 1: **1M** scale
State geological maps
- **Hammonds** map of land surface forms
- Habitat regions of the state
- Available Remote Sensing (SPOT, **DOQ)**
- Habitat Regions - Mississippi
- Bedrock Geology **- 1:2.5M**
- New land use maps available by state **(MLRC?)**
- GAP Products - Biodiversity
- Water Quality Maps
- Hydrology Maps

C. Overlays of source maps - Computer generated ticks will be used to register overlays of source **maps.** Overlays may be plotted on matte or clear mylar **film.** Agencies who will need a set of overlays of source maps include: **BLM** USFS USGS **NRCS EPA (4 or 5 complete sets ... x 22 = 264 plots).**

All overlays of source maps should be labeled and include a legend using numeric symbols and explanation- An associated paper document can be provided to support **map legends. EPA,** FS and NRCS framework maps will be plotted as overlays.

D. **1:1,000,000** Premap of **Ecological** Units

1. Narrative for **1:1,000,000 draft ecological** map **-** The narrative **will** descrii what **makes** one ecological unit significant **from another** and describe the method used **(NRCS,** [illegible]

MEMORANDUM OF UNDEMANDING

AMONG THE

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
FOREST SERVICE
AGRICULTURAL **RESEARCH** SERVICE

AND THE

U.S. DEPARTMENT OF THE INTERIOR
BUREAUOFLANDMANAGEMENT
U.S. GEOLOGICAL SURVEY
FISH AND WILDLIFE SERVICE
NATIONAL BIOLOGICAL SERVICE
NATIONAL PARK SERVICE

AND THE

U.S. EIWIRONMENTAL PROTECTION AGENCY

RELATIVETO

DEVELOPING A SPATIAL **FRAMEWORK OF ECOLOGICAL** UNITS OF THE **UNITED STATES**

This Memorandom of Understanclmg **(MOU)** is entered into by the **Department** of Agriculture, Natural Resources Conservation Savice **(NRCS),** Forest Service **(FS),** and **Agricultural** Research Service (ARS); the U.S. Department of **the** Interior, Bureau of Land Management **(BLM),** U.S. Geological Survey (USGS), Fish and Wildlife Service **(FWS), National** Biological Service (NBS), **and National Park** Service **(NPS);** and the U.S. **Environmental** Protection Agency (EPA)).

I. PURPOSE

This MOU documents **and** defines the responsibilities **of the** cooperating agencies to develop a common spatial **framework** for **defining** ecological **units** of **the** United States. It also provides a vehicle for other Federal **agencies** with **natural resource** management interagency coordiition and will permit individual agencies to structure their strategies by the regions within which natural biotic and abiotic Capacities and potentials are similar. These ecological units transcend local, State, and national boundaries.

2. Considering the broad responsibilities and interests of all agencies, it is desirable and mutually beneficial to cooperate and integrate interdisciplinary technical infiition on environmental factors such as soils, vegetation, geology, geomorphology, water, climate and others into a common ecological framework, with associate descriptions and digital data bases. Development of a common ecological framework will be consistent with standards developed by the Federal Geogmphic Data Committee (FGDC) accordmgto the Office of Management and Budget (OMB) Circular A-16 and Executive Order 12906 (Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure) signed April 11, 1994.

3. Cooperating agencies will use the framework for defining ecological units, with associated narrative descriptions and digital data bases to (a) reduce duplication of effort and promote effective, efficient and scientifically sound management of natural resources; (b) geographically organize and share research, inventory and monitoring information; (c) facilitate coordinated approaches to characterization and assessment of the Nation's land and water; and (d) enhance program management and technical coordination among parties representing private, tribal, State and Federal interests.

B. NRCS will benefit from a common national framework for defining ecological units in the coordiition and delivery of its ecosystem-based assistance (EBA) strategy through enhanced technical assistance for all of its activities and programs that affect the environment. Furthermore, NRCS is charged with pmvidii direction and kadershlp for the National Cooperative Soil Survey and for the production and delivery of soils and certain other related natural resource data to the Nation. Collaboration to develop a common national framework for defining ecological units will significantly contribute to refinement of the State Soil Geographic Database (STATSGO) for all States and to the update of the Agriculture Handbook 296, Land Resource Regions and Major Land Resource Areas of the United States.

C. FS has adopted a national Hierarchical Framework of Ecological Units to facilitate an ecological approach to natural resource management. FS expects that involvement in a collaborative effort to develop a common interagency framework for defining ecological units will serve to enhance the coordiition of multi-agency plans and ecological assessments. Further, the collaborative effort will enhance resource management partnerships, enable more effective and efficient application of research results, sharing of data and spatial information with others, and improve quality of technical assistance to State and private forestry interests.

D. BLM recognizes that in discharging obligations for the management of public lands under their jurisdiction, the Agency has a need for information on the nature, distribution and interrelationships of soil, vegetation, geology, and other biological and physical components af the environment that may contribute to and influence the health and sustainability of these lands.

E. USGS has a commitment to the development of scientifically credible, objective information on natural hazards, stream flow, and water quality, energy, minerals, geology, geography, map information, and digital cartographic data bases. Within the context of this commitment, the Agency recognizes the need for a common ecological mapping framework for the communication and integration of information on the Nation% resources. A common framework will serve to ensure the relevance of USGS earth science -research in addressing tbe most important needs of the Nation

F. FWS has adopted an Ecosystem Approach to Fish and Wildlife Conservation. The Service manages over 90 million acres in over 500 National Wildlife Refuges and further provides for the conservation of fish and wildlife through Ecological Services, National Fish Hatcheries and Fishery Resource Offices nationwide. The Service has adopted a regional organizational structure that focuses all programs on watershed groupings clustered into 53 ecoregions. A common spatial framework will allow the integration of fish and wildlife resource data. Linking of these data to those of other agencies will assist the stewardsbip of these resources at a variety of scales and with regional and local partners and stakeholders. A common spatial framework supports the Service's approach rather tbau replace our Hydrologic Unit Map based foundation for organizing and managing our diverse staff resources and program capabilities.

G. NBS works with others to provide the scientific understanding and technologies needed to support the sound management and conservation of our Nation's biological resources. Consistent with this mission, NBS will (1) perform research in support of biological resource management; (2) inventory, monitor, and report on the status and trends iu tbe Nation's biotic resources, and (3) develop the ability and resources to transfer the information gained in research and monitoring to resource managers and to others concerned with the care, use, and conservation of the Nation's natural resources N'BS realizes that a common spatial framework for resource data will enhance its abii to develop and share biological information with resource managers and tbereby support informed resource management decisions.

H. NPS will benefit from the development of a common national framework for defining ecological units through its ability to more effectively and efficiently carry out its mission of conserving, unimpaired, the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The framework will promote a collaborative and participatory approaeh that integrates ecological knowledge of park resources and the regional context within which they operate. The framework will also enhance tbe Service's ability to develop partnerships with its neighbors to identify common interests, develop common goals, and devise compatible solutions to issues of individual or common concern Working together in this manner, the NPS and its partners will be in a much better position to pool their scientific, educational, and technical skills and apply them throughout the ecosystem to meet a variety of challenges to both public and private interests.

I. EPA is developing an Ecoregion approach to assist States in structuring their regulatory programs, particularly regarding water quality. Principal uses have been the development of biological criteria and water quality standards and establiig non-point source pollution and lake management goals. Recently, the uses have expanded to address ecosystem management and, on a North American scale, the representativeness of protected areas and of North American Free Trade Agreement (NAFTA) decisions tbat may have au effect on ecosystem quality.

J. ARS will benefit from a common national framework for dctining ecological units because this will provide a common basis for the coordination and delivery of natural resources and other ecologically sensitive technology to action agencies and research partners. Furthermore, this collaborative effort will help identify research to address enhanced resource management, the selection of ecologically sensitive technology partnerships, allow enhanced application of research results, facilitate the sharing of spatial and other similar data, and contribute to the overall quality of technology transfer efforts by ARS and in its collaboration with other Federal and State agencies and partners.

III. RESPONSIBILITIES

A. A common spatial framework for defining ecological units of the united states based on naturally occurring and

...d procedures
developed for the entire

C. As part of the initial and ongoing effort, maps of ecological units will be developed and published at common scales, along with text in an appropriate format. Projected scales are 1:3,500,000 for a national map, 1:1 $00,000 for regional or State level maps, and 1:250,000 for more detailed maps. All cooperating agencies and key participants will be liied as authors on all published maps and descriptive materials. Any maps and interim products will be clearly marked with caveats as drafts or approximations, and the extent to which use and interpretations can be made for the given scale. Digital data sets in formats meetmg available FGDC standards will be published.

D. Participating agencies will make final maps and associated descriptions and digital data bases available to the public, nongovernmental organizations, and other government agencies.

IV. ORGANIZATION AND FUNCTIONS

A. Signatory agencies will collaborate in the development of a common spatial framework for defining ecological units at all levels, as appropriate, to establish policy, develop technical guidelines, and assure consistency and quality of final products.

B. The following organizational structure, with each team consisting of representatives from each signatory agency of this MOU, will guide the interagency effort:

1. A National Interagency Steering Committee, with primary functions to include: (a) development of strategie interagency policy and guidelines; (b) pmviding national coordination and guidance to the National Interagency Technical Team; (e) seeking

partners.

C. Other Federal and State agencies and conservation organizations will be encouraged to become partners or participate at the national, State or regional levels, as appropriate.

V. FUNDING

This MOU defines in general terms the basis on which signatory agencies will cooperate, and as such, does not constitute a financial obligation to serve as a basis for expenditures. Expenditure of funds, human resources, equipment, supplies, facilities, training, public information, and expertise will be provided for by each signatory agency to the extent that their participation is required and resources are available.

VI. PERIOD AND TERMS OF MOU

A. This MOU shall become effective on the date of the last signature. The MOU will remain in effect for a period of five years, at which time it will be reaffirmed, if appropriate, Agencies not specifically named above may become participants by agreeing to the terms of this MOU, as stated, and by providing a separate and dated signatory page for incorporation (see addendum). The effective date of their participation shall be the date of their signature.

B. This MOU may be amended, extended, or modified through an exchange of correspondence and upon full agreement with all signatory agencies.

VII. PROVISION

All activities under this MOU will be in compliance with the Drug Free Workplace Act of 1988 (Public Law

VIII.

F. FWS -The Fish and Wildlife Coordination Ad of March 10, 1934.48 Stat. 401.16 U.S.C. Sections 661 et. seq. (P.L. 79-732). Fish and Wildlife

Act of 1956 (16 U.S.C. 742a-d, 742c-j-2. Federal Land Management Act of 1976 (FLPMA), 43 U.S.C. Section 1701 et. seq.

G. NBS - Fish and Wildlife Coordiiatioo Act of March 10, 1934, 48 Stat. 401.16 U.S.C. Sections 661 et. seq. (P.L. 79-732). Fish and Wildlife Act of 1956 (16 U.S.C. 742a-d, 742c-j2. Federal Land Management Act of 1976 (FLPMA). 43 U.S.C. Section 1701 et. seq.; P.L. 94-579 (October 21.1976) Section 307(a) Studies, Cooperative Agreements and Contributions (43 U.S.C. Section 1737 Implementation Provisions).

H. NPS - The National Park System Organic Act of August 25, 1916, 39 Stat. 535. as amended.

1. EPA - Clean Water Act of June 30, 1948 (62 Stat. I 155, as amended, including Federal Water Pollution Control Act Amendments of October 18, 1972 (86 Stat. 896), and the Water Quality Act of February 4.1987 (101 Stat. 76); 33 U.S.C. 1251-1387.

J. ARS - Department of Agriculture Organic Act of 1862 (7 U.S.C.

NRCS **A-3A75-6-34**

PAUL W. JOHNSON
Chief
USDA Natural Resources Conservation Service

22 Nov 95
DATE

JACK WARD THOMAS
Chief
USDA Forest Service

14 Dec 95
DATE

MICHAEL P. DOMBECK
Acting Director
USDI Bureau of Land Management

14 Dec 95
DATE

for GORDON EATON
Director
USDI Geological Survey

14 Dec. 95
DATE

ROBERT J. HUGGET
Assistant **Administrator**
Office of Research and Development
U.S. Environmental Protection Agency

May 7, 1996
DATE

for ROGER KENNEDY
Director
USDI National Park Service

12.19.95
DATE

NRCS A-3A75-6-34

14 Dec. 95
DATE

for MOLLIE BEATTIE
Director
USDI Fish and Wildlife Service

14 Dec. 95
DATE

RONALD PULLIAM
Director
USDI National Biological Service

26 March 96
DATE

FLOYD P. HORN
Administrator
USDA Agricultural Research Service

Total Pedosphere Description and Survey
Deep Investigations Team

Background:

At work planning conferences in the last few years, committees have established a need for description and survey of materials below 2 meters. A NSSC team called Deep Investigations was recently established to begin discussions on this issue. The team has developed an outline of ideas and information that would be a part of the preparation of protocol for description and survey below 2 meters.

Action:

This outline is presented here for discussion and review. The team is also soliciting additional members from NRCS and NCSS who are. seriously interested in pursuing the development of guidelines for description of materials below 2 meters.

Please send comments and indicate your interest in becoming a member of the team to the team leader, Carolyn Olson, 402-437-5377, fax 402-437-5336 or colson@nssc.nrcs.usda.gov.

Deep Investigations Team:

Carolyn Olson, Team Leader
James Doolittle
Dennis Nettleton
Philip Schoeneberger
Douglas Wysocki

Total Pedosphere Description and Survey

Current inventories describe soils to a depth of approximately 2 m and are patterned after instructions that are now essentially obsolete. Soil quality and water quality assessments, waste containment and disposal and agricultural and environmental practices are all concerns that impact soils and sediments to much greater depth. Surficial geology maps provide a measure of the information needed but the detail and areal distribution of these is limited. In addition, they are produced under different map Unit design constraints and terminology and therefore are not well linked to soil survey information. In order to plan for long term management of areas at scales from the farm field level to the regional or national scale. a protocol, a consistent set of instructions, needs to be developed to provide the linkage between standard soil survey data and underlying materials. With the outline below, we are beginning the process of providing this linkage.

To allow this to be a manageable effort, our initial emphasis is on field morphologic criteria. that is, criteria that can be described in the field. However, it should be recognized that field descriptions are only a part of the entire endeavor. This effort has been advocated by NCSS cooperators for some time and their participation in the form of official representatives will be a part of the next phase in team activities.

Protocols. descriptions and ideas for sediments below 2 m depths

I. Descriptors

- A. Morphologic descriptors used in soil survey
  - Sources: Soil Survey Manual, Field Guide to Soil Descriptions, Soil Survey Handbook
- B. Differential weathering
  - 1. Weathering zones
    - Ruhe, 1969; Hallberg et al., 1978
  - 2. Saprolite descriptors
    - Stolt et al.. 1992
  - 3. Bedrock type vs. exposure time
- C. Nomenclature for paleosols
  - Wysocki, in preparation
  - Buol, 1994
- D. Bedding structures
  - Dutro et al., 1989; Quade et al., 1996, Maley, 1994
- E. Hydrologic properties
  - 1. Redox features
    - Vepraskas, 1992; Vepraskas et al., 1991
  - 2. Hydraulic conductivity
  - 3. Porosity, permeability
  - 4. Seasonal water table measurement

F. Lithofacies description
    Eyles et al., 1983
    Maley, 1994
G. Rock fragment distribution
    Boellstorff, J.D., 1978
H. Joints and Fracture patterns
    Strike and dip
    Patterns
        Maley, 1994
        Engelder, T. 1993
I. Carbonate system
    Gile, 1961; Gile et al., 1965; Machette, 1985
J. Other criteria
    1. Interrelationships of materials, depth to bedrock, slope etc.
    2. Chemical/Mineralogical criteria
        a. Sulfides
            1. Acid systems
            2. Gypsum systems
        b. Tephra
        c. Fe-Mn-Al systems

II Sampling equipment
A. Invasive equipment
    Drilling.
    Excavation equipment (backhoe, trenching, etc)
B. Non-invasive
    Geophysical equipment
    Remote sensing

III. Field protocol
A. Locate and document all exposures and pre-existing information
    1. Field - Excavations, pipelines, quarries, road cuts, stream cuts, borrow pits, building sites,
    2. Library - Drill logs, historical data, agency and university open files
B. Map geomorphic surfaces
C. Map surficial deposits
D. Correlate surfaces, deposits, exposures
E. Use and evaluate remote sensing techniques
F. Devise sampling plan
G. Excavate and drill boreholes
H. Describe and sample
I. Develop modeling approaches

IV. Scales of Management

A. Regional soil-vadose zone interpretations and long-term management

Impact of data on basin-wide or physiographic region (e.g. Des Moines Lobe, Mississippi Valley, karst systems, Ogallala aquifer regional assessment)

B. Site-specific information and extrapolation

C. Hazards

Mass movement

Saturation

D. Limitations on data and data collection

V. Spatial distribution relationships and modeling

VI. Integration into NCSS and Soil Survey Division Plan - (We have the tools and know how to do it but the need must exist at administrative levels.)

A. Recommend for all MLRA updates

B. Need philosophical and fundamental change in approach and uses for soil taxonomy

C. Pressure from environmental and water quality needs

D. Correlation support

1. Formation identification

   Existing series to underlying units

2. Genetic interpretation
3. Spatial Distribution
4. Relation to paleosol classification

E. Revamping of technical manuals

F. Laboratory support

1. Unconsolidated material
2. Consolidated material

This outline is only a beginning. Suggestions for additions and rearrangement of topics are welcome. The sections will evolve as input is received. The outline will be gradually replaced by detailed discussions. The inclusion of NCSS cooperators as members is strongly encouraged.

References:

Bachman, G.O. and Machette, M.N. 1977. Calcic soils and calcretes in the southwestern United States. Open-File Report U.S. Geol. Survey 77-794:163.

Boellstorff. J.D. 1978 Procedures for analysis of pebble lithology, heavy minerals, light, minerals and matric calcite-dolomite of tills. *In* Hallberg, G.R (ed.) Standard procedures for the evaluation of Quatemary materials in Iowa. Iowa Geol. Surv. Tech. Info. Ser. no. 8, p. 31-60.

Buol. S.W. 1994. Saprolite-regolitb taxonomy -an approximation. *In* Cremeens, D.L., Brown, R.B., and Huddleston, J.H. (eds.) Whole regolith pedology. Soil Science Society of America, Special Pub. No. 34, p. 119-136.

Dutro. J.T.. Dietrich, R.V. and Foose, R.M. 1989. AGO data sheets: for geology in the field. laboratory, and office. Amer. Geol. Institute.

Engelder. T. 1993. Fracture Mechanics. Course Notes. GSA Short Course series.

Gile. L.H. 1961. A classification of Ca horizons in soils of a desert region, Dona Ana County. New Mexico. Soil Science Society of America 25:52-61.

Gile. L.H.. Peterson, F.F. and Grossman, R.B. 1965. The K-horizon: A master soil horizon of carbonate accumulation. Soil Science 99:74-82.

Eyles. N. Eyles. C.H. and Miall, A.D. 1983, Lithofacies types and vertical profile models: An alternative approach to description and environmental interpretation of glacial diamict and diamictite sequences. Sedimentology 30:393-410.

Hallberg, G.R., Fenton, T.E. and G.A. Miller. 1978. Standard weathering zone terminology for the description of Quatematy sediments in Iowa. *In* Hallberg, G.R. (ed.) Standard procedures for evaluation of Quatemary materials in Iowa. Iowa Geol. Surv. Tech. Info. Ser. no. 8, p. 75-109.

Machette. M.N. 1985. Calcic soils of the southwestern U.S. Geological Society of America Special Paper 203.41 p.

Maley. T. 1994. Field Geology illustrated. Mineral Land Publications. Boise ID, 3 16 p.

Quade. D.J., Kemmis, T.J. and E.A. Bettis. 1996 Terrace stratigraphy and geomorphology of the Okoboji Lake outlet. *In* Bettis, E.A., Quade, D.J. and

Kemmis, T.J. Hogs, bogs and logs: Quatemary deposits and environmental geology of the Des Moines lobe. Geological Survey Bureau Guidebook Series no. 18. p. 115-123.

Ruhe, R.V. 1969. Quatemary landscapes in Iowa. Ames: Iowa State University Press, 255 p.

Stolt, M.H.. Baker, J.C., and Simpson, T.W. 1992. Characterization and genesis of saprolite derived from gneissic rocks of Virginia. Soil Sci. Soc. Am. J. 56:531-539.

Vepraskas. M.J. 1992. Redoximorphic features for identifying aquic conditions. North Carolina Agricultural Research Service Tech. Bull 301, 33 p.

Vepraskas. M.J., Hoover, M.T., and Bouma, J. 1991. Sampling strategies for assessing hydraulic conductivity and water-conducting voids in saprolite. Soil Sci. Soc. Am. J. 55:165-170.

Wysocki. D. 1997. Title. (Subject: Classification of Paleosols)

Additional Titles:

Alexander. L.T. and Cady, J.G. 1962. Genesis and hardening of laterite in soils USDA Tech. Bull. 1282.

Chadwick. O.A.. Hendricks. D.M. and Nettleton, W.D. 1987. Silica in duric soils: 1. A depositional model. Soil Sci. Soc. Amer. Jr. 51:975-982.

Daniels. R.B. Gamble, E.E., Buol, S.W., and Bailey, H.H. 1975. free iron sources in an Aquult-Udult sequence from North Carolina. Soil Sci. Soc. Amer. Proc. 39:335-340.

Gile L.H.. Peterson, F.F. and Grossman, R.B. 1966. Morphologic and genetic sequences of carbonate accumulation in desert soils. Soil Sci. 101:347-360.

Harden. J.W.. Taylor, E.M., Reheis, M.C. and McFadden, L.D. 1991. *In* Nettleton, W.D., Allen. B.L. and Hallmark, C.T. (eds) Occurrence, characteristics, and genesis of carbonate gypsum and silica accumulations in soils, Soil Sci. Soc. Amer. Special Pub. No. 26. Madison. WI, p. 1-16.

Jenny. H.. 1980. The soil resource, origin and behavior, Springer Verlag, NY. p. 175-183.

Kittrick. J.A.. Fanning, D.S. and Hossner, L.R. (eds) acid sulfate weathering. Soil Sci. Soc. Amer. Special Pub. No. 10. Madison, WI, 234 p.

Monger. H. C., Daugherty, L.A. and Gile, L.H. 1991. a microscopic examination of pedogenetic calcite in an Aridisol of southern New Mexico. In Nettleton, W.D., Allen. B.L. and Hallmark, C.T. (eds) Occurrence, characteristics, and genesis of carbonate gypsum and silica accumulations in soils, Soil Sci. Soc. Amer. Special Pub. No. 26, Madison, WI, p. 37-60.

Milnes. N.R.. Thiry, M. and Wright, M.J. 1991. Silica accumulations in saprolites and soils in South Australia. In Nettleton, W.D., Allen, B.L. and Hallmark, C.T. (eds) Occurrence, characteristics, and genesis of carbonate gypsum and silica accumulations in soils. Soil Sci. Soc. Amer. Special Pub. No. 26. Madison, WI, p. 121-149.

Nettleton. W.D., Nelson, R.E., Brasher, B.R. and Derr, P.S. 1982. Gypsiferous soils in the western United States, *In* Kittrick, J.A., Fanning, D.S. and Hossner., L.R. (eds) acid sulfate weathering. Soil Sci. Soc. Amer. Special Pub. No. 10. Madison, WI, p. 147-168.

Reheis. M.C. 1987. Gypsic soils cm the Kane alluvial fans, Big Horn County, Wyoming, U.S. Geol. Survey Bull., 1590 - C

National Cooperative Soil Survey Standards Committee
Report to the national Soil Survey Conference
Baton Rouge, Louisiana, June 16-20, 1997

Review of Committee Charges:

1. Define what standards are or what NCSS means by NCSS standards.

2. Receive recommendations from other committees and be the clearinghouse for issues dealing with standards.

3. Establish subcommittees to deal with issues identified.

4. Consider establishing subcommittees to deal with the following areas which are issues of immediate importance:

   a. NCSS Data Management Standards (spatial and attribute data).

   b. Soil landscape terminology.

5. Develop a methodology for distributing standards and make recommendations to the Steering Committee on disposition of issues raised, and

6. The Standing Committee with report its activities at each National Conference.

Summary **of on going activities.**

This committee has been in place for at least six years with C. Steven Holzhey as its chair until this spring when I was asked to chair the committee after Steve's retirement. My first activity was to contact the existing committee members which was done by a letter on March 11, 1997. Committee members were Mickey Ransom, Tom Ammons, Ed Ciolkosz, Gary Muckel, Janis Boettinger, Scott Davis and Gretta Boley. Replies were not received form Gretta Boley or Tom Ammons, and Ed Ciolkosz asked to be removed from the committee and suggested his Del Fanning replace him, I contacted Del and have not had a firm answer yet. A general consensus of he committee was it had not been active since the last Work Planning Conference in 1995. There was a general question as to the direction the committee needed to go. This will be addressed in detail later in the report.

In 1995 in its report the committee recommended dropping charge 3 as it was completed.

It suggested that the NCSS consider as provisional those procedures and these descriptive classes that have not undergone extensive field testing and formal NCSS verification of merit. Also in 1995 the committee again defined what standards are as they had done in 1993. These ideas have not changed and are as follows:

> ***National Cooperative Soil Survey Standards relate to:***
> ***-quality ofproducts, and***
> ***-Quality of communications.***
>
> ***Quality ofproducts can be broadly broken into:***
> ***(I) quality of information gathering processes, and***
> ***(2) quality of derivations and interpretations.***
>
> ***The committee easily agreed that (1) above is within the scope of the charge, including such things as descriptions, documentation, and map complain. However, (2) above merges with activities outside NCSS, and the committee will look at several individual examples before recommending how to make the distinction among standards, procedures, and guidelines relative to derivations and interpretations. (This*** has not been done or if so no documentation has been found it the tiles).
>
> ***Quality of communications relates to consistent and effective uses of terminology, concepts, codes, including data dictionaries, Federal Data Transfer Standards, and descriptive terminology.***

Gary Muckel provided Draft Standards which were included it the 1995 National Work Planning Report. A copy is attached here and it will be furthered review and updated by Gary Muckel. Many of the items are included in the recently published National Soils Handbook which serves as a base for many of the standards.

A question has come up regarding how standards should be published. Much of what is done can now be place on the WWW where-as it was always done in hard copy in the past.

Pedon-descriptons were discussed as how they related to or fit into the NCSS standards n 1995 and the issue is still hot. Janice Boettinger again raised the issue regarding the PEDON PROGRAM with the comment Z ***wonder if the efforts to streamline this process are only serving to create more work while limiting accuracy of data digitized, this*** is in regards to transfer of field data to digitized data. This topic will need to be addressed by the committee. The overlying questions is it within the committee's responsibility to have input on such things as the collection of soils data and input of information into the pedon program. The committee would like a clarification of tbis by the steering committee

Charge 3 relates to establishment of subcommittees. Here we suggest that a subcommittee be established to look at order one mapping. Several groups bave worked on this in the past. We suggest that Henry Mount be appointed as a chair of an order one mapping committee and that he contact others interested in this and establish a working committee to and that they prepare a report by January 1, 1998. This may be a very hard task as Gary Muckel points out mapping standards are hard to write but they are needed as the issue of Order 1 is becoming larger. There will be a greater demand for this as we move in to site specific fuming and without standards problems will develop very quickly.

Charge 4. Completed in 1995.

Charge 5. This needs to be done. It is suggested that the NCSS standards be published on the WWW. At what site, when, and by whom need to be addressed and this is an item the revitalized committee will start working on as soon as possible.

Charge 6 is a report. This is it, very short as the committee has not been that active in the last two years. The members have said agreed to serve and we will now go forward.

Need some recomendations

PANEL DISCUSSION ON MLRA ORGANIZATION IN SOIL SURVEY

Panel Moderator Dave Smith, Soil Scientist, NRCS West Regional Office, Sacramento, CA

NRCS reorganized soil survey program activities in 1995 as *follows:*

Seventeen MLRA Soil Survey Region Offices (MO's) provide quality assurance for all soil survey production activities including field data collection, development of soil data bases, soil correlation, manuscripts, and spatial data. They lead all field reviews, maintain OSD's and SC file, and sign correlation documents. MO's conduct functions formerly conducted at NTC's, NSSC, and some functions formerly conducted at State Offices.

State Office soils staff provide support in the use of soil survey information through focusing on a TSS program. They also identify responsibilities and set priorities for soil surveys within the state, identify technical specifications and interpretations needed within the state, maintain relationships

Comments by Kalven Trice, State Conservationist, NRCS, Little Rock, AR

Mr. Trice was asked to discuss the mtionale behind the NRCS-wide reorganization ond the MLRA soil survey region offices (MO) concept.

NRCS Reorganization

USDA Reorganization brought a new name and a different organization structure to the former Soil Conservation Service. These changes did not occur without a great deal of frustration and pain on the part of our employees, and in some cases, frustration and pain on the part of our partners and customers.

- Driving forces for **NRCS** Reorganization included:

  - New program **responsibilities (WRP,** Water Bank, **FIP,** etc.);
  - Declining staff at the customer service level (Field Office)
  - Mandated personnel reductions;
  - Budget reductions;
  - Increasing demand for environmental technical assistance;
  - The need to better serve previously under-served customers, Native Americans, Limited Resource Farmers, and others; and
  - The need to provide the **technology,** training and skills needed to address the increasingly complex natural resource problems of the Nation.

- NRCS Reorganization **Objectives:**

  - Downsize and flatten the organization;
  - Provide more staff, expertise, and decision making closer to the field level;
  - Reduce paper work and red tape; and
  - Put more emphasis on customer service at the field level.

- Key Points on **NRCS Reorganization:**

  - Reduced staff levels at National Headquarters and state offices;
  - Elimination of the four National Technical Centers and transfer of functions to the states;
  - Increased proportion of staff at the field **office** level;
  - Established six regional offices;
  - Established eight institutes (Soil Quality, wetlands Science, Watershed Science, Social Science, Grazing Land Technology, Information **Technology,.Natural** Resources Inventory and Analysis, Wildlife Habitat Management); and
  - Maintained the National Soil Survey Center, and the National Cartographic and **Geospatial** Center, but at reduced levels of staffing.

Soil Survey Program Reorganization

- Prior to NRCS Reorganization the Soil Survey Division had instituted the MLRA approach to conducting project soil surveys.

- NRCS Reorganization provided a narrow window of opportunity to reorganize the Soil Survey Program based on the MLRA Soil Survey Region Office concept.

- Major points on the MLRA Soil Survey Region Offices concept:

  - Provide soil survey correlation and quality assurance from 17 MLRA Soil Survey Region Offices set up on resource area-based boundaries instead of 52 offices on state boundaries.

  - MLRA Offices provide quality assurance for all soil survey production activities includii field data collection, development of soil data bases, soil correlation, manuscripts/publications,. and spatial data.

  - MLRA Offices lead all field reviews, maintain the Official Series Descriptions (OSD's) and Soil Classification Files (SC), and sign correlation documents.

  - MLRA Offices responsible for many functions formerly the responsibility of the National Technical Centers (NTC's) and the National Soil Survey Center.

  - State Offices responsible for working with National Cooperative Soil Survey (NCSS) partners to set priorities for soil surveys within thestate and for identifying technical specifications and interpretations needed within the state.

  - State offices responsible for maintaining relations with institutions and agencies within a state, and coordination with NCSS partners and MLRA Offices

  - State Offices provide support to customers in the use of soil survey information by focusing on the Technical Soil Services Program.

- Rationale behind Soil Survey Program Reorganization

  - The concept of updating, and maintaining soil surveys based on MLRA's instead of county and parish boundaries was already in the process of being implemented.

  - Moving quality assurance and correlation functions for soil surveys, formerly at the National Soil Survey Center and National Technical Centers to MLRA Offices which are closer to the field, would improve efficiencies and overall quality of soil survey data and products.

  - There is increasing need for soil scientist to provide support to implement programs for which NRCS has responsibility. There is also an increasing need for soil scientist to provide support in the use of soil survey information to customers outside NRCS.

  - Establishing MLRA Offices to provide soil survey quality assurance functions enables state office soil staffs to focus more on the Technical Soil Services Program in order to provide more support to customers that use soil survey information.

- **How well is the reorganized soil survey working?**

  - The National Soils Program Evaluation that is currently under way will help answer this question.

  - During Fiscal Year 1997 data will be gathered from the following MLRA Offices for this, evaluation: Phoenix, AZ; Bozeman, MT; Morgantown, WV; and Little Rock, AR.

  - Primary objectives of this program evaluation are to assess:

    the overall efficiency, effectiveness and equity of the soil survey program in meeting NRCS's mission;

    the degree to which accomplishment and product preparation & delivery are commensurate with allocated funds; and

    the overall quality of products and services being delivered.

  - Field visit interviews will be conducted at these MLRA Offices as well as at selected state offices, project offices, field offices, and NCSS cooperator offices.

  - Findings from this evaluation will be used to determine adjustments that may need to be made in the soil survey program.

- Closing Thoughts

  - The reason that we have a national soils inventory that is envied by other countries in the world is the long successful history of the NCSS.

  - The future of the NCSS is dependent on maintaining and improving these partnerships and these efforts must take place at the state level.

  - Most agree that updating and maintaining soil surveys based on the MLRA concept and providing quality assurance and correlation functions through MLRA Offices is a good on duct b

Comments by T.E. Fenton, Agronomy Department, Iowa State University, Ames, IA

Dr. Fenton was asked to discuss perceptions! experiences, and reactions to the MLRA soil survey region offices (MO) concept.

NCR-3 CONCERNS REGARDING THE NATIONAL COOPERATIVE SOIL SURVEY

ABSTRACT

The reorganization of the National Resources Conservation Service (NRCS) and the establishment of 17 Major Land Resource Area (MLRA) Regional Offices (MO's) have raised some concerns from non-federal partners in the National Cooperative Soil Survey (NCSS) program. Public Law 89-560, one of the laws authorizing soil surveys in the U.S., states that the soil surveys shall be COOPERATIVE with the states and should MEET THE NEEDS OF THE STATES AND OTHER PUBLIC AGENCIES. The 17 MO offices were established to provide soil correlation and quality control. This arrangement is less "user friendly" to non-federal partners in that some states have to establish and maintain communication with multiple MO offices, in some cases up to four.

THIS NEW ARRANGEMENT INVOLVES SEVERAL MAJOR CONCERNS:

1. Thirty three states have need to travel out-of-state to conduct soil *survey* business and attend meetings. Technical soil expertise within the state NRCS staff has been greatly decreased and correlation responsibility assigned to people in the MO office who may not be familiar with the soils and landscapes for which they are responsible. Also, there are concerns about the effect of state and county funds contributed for soil surveys on the total soil survey budget in the state. It is suspected that there have been reduction in federal dollars received in some states because of the availability of state and county funds.

2. The reorganization of NRCS and the establishment of 17 Major Land Resource Area (MLRA) Regional Offices (MO's) have raised some concerns from non-federal partners in the National Cooperative Soil Survey (NCSS) program. Prior to the reorganization, correlation of soil surveys was the responsibility of the state. The 17 MO offices were established to provide soil correlation and quality control. This arrangement is less "user friendly" to non-federal partners in that some state have to establish and maintain communication with multiple MO offices, in some cases up to four. This arrangement has the potential to make it much more difficult to maintain consistency and continuity within an individual state. It also means that 33 states have need to travel out-of-state to conduct soil survey business and attend meetings. This is a cost in both time and money.

3. Major emphasis since the reorganization has been within a specific MLRA and quality control within that MLRA. However, all states have multiple MLRAs and maintaining consistency in soil correlation and information delivery is a major concern within our individual states, across MLRA boundaries.

4. Public Law 89-560, one of the laws authorizing soil surveys in the U.S., states that the soil surveys shall be cooperative with the states and should meet the needs of the states and other public agencies. Technical soil expertise within the state NRCS staff has been greatly decreased and correlation responsibility assigned to people in the MO office who may not be familiar with the soils and landscapes for which they are responsible. In general, the NRCS people who in the past have been responsible for correlation within a state have been reassigned to other activities and in many cases moved out of the state where they were familiar with the soils and landscapes.

5. It is essential for the states to continue to have the responsibility for correlation. From a technical point of view it is important that the correlator be familiar with the soils, landscapes, soil and crop management practices, environmental laws and regulations, and the infrastructure of knowledge about these variables that are available in the state. Reestablishment of this position within the states would also aid the consistency within states, across MLRA boundaries, and aid communications with cooperating agencies since their primary communication could be with one person and not several different offices.

6. Our educational programs in agriculture and related natural resources are based upon the quality of our soil information. Under the new organization, the "ownership" of the soil series and soil data are at the MLRA office and not in the state. The structure in place prior to the reorganization was much better for the states. Recall that Public Law 89-560 states that the soil survey program should meet the needs of the states, not the MLRA.

7. There are concerns about the effect of state and county funds conmbuted for soil surveys on the total soil survey budget in the state. Regional offices now control the budgets and it is suspected that there have been reduction in federal dollars received in some states because of the availability of state and county funds. However, to date we have not had access to information about distribution of federal funds for soil survey.

8. A major concern about the reorganization is the time lost and the dollars spent moving people to new locations. Also, based on our judgement, technical qualifications for specific positions were not given the highest priority. There is a backlog of soil survey reports that have not been published. In some of these surveys, the field work was completed nine to ten years ago. As cooperators this publication lag is not acceptable and we know that it irritates users of soil surveys but we have no control over publication schedules. A part of this backlog we believe is related to the cost and inefficiencies of the reorganization.

There are many good things that result from the National Cooperative Soil Survey but our administrators need to be aware of the problems in the program. We hope this document will stimulate some discussion and action.

Comments by Bill Dollarhide, MLRA Soil Survey Region Office (MO) Leader, NRCS, Reno, NV

Mr. *Dollarhide was asked to discuss the concept of MLRA project soil surveys.*

A MLRA project soil survey is an area based on (bounded by) a landscape or ecological break. It is not an area based on an administrative boundary.

A MLRA project soil survey is handled as one survey area legend that can be subset into smaller areas in order to deliver information based on administrative boundaries if needed (i.e. County subset, BLM resource area subset, watershed area subset, etc.). It is not handled as an accumulation of all the formerly separate soil survey areas within the MLRA.

Advantages of MLRA project soil surveys:

- With an assessment of each of the formerly separate survey areas within an MLRA, a MLRA project survey work plan can be developed to systematically (and therefore more efficiently) accommodate the full range of status of subset survey *needs (i.e.* from updating needed, to no changes needed to no previous work done, and all gradations in between).
- Can react to priorities faster and more efficiently
- Less MOU's to manage.
- Increases data quality and provides better opportunity to flll data gaps by viewing and considering soil taxonomic units and soil map units on a landscape or geographic region basis (rather than adjusting to fit correlation and publication rules as influenced by administrative boundaries).
- The quality of data and interpretations developed through estimates and "thunderbooks' can be better assessed, and plans made for improvement.
- Allows for easier incorporation and continuous management of all data with the MLRA into a database (rather than in tile drawers, etc.).

Whv conduct MLRA proiect soil survevs within MO #3 (Northern Basin and Ranee Region)?

- There will be 9 soil survey area databases to manage, rather that 84.
- There will be 9 soil survey area MOU's to manage requiring 40 signatures, rather than 84 MOU's requiring 420 signatures.
- There will be an estimated 80 percent fewer soil taxonomic unit descriptions and a significant reduction in the number of soil map unit descriptions to write and manage.
- There will be zero join issues, rather than 24,192 join issues.

Comments by Tim Gerber, Division' of Soil and Water Conservation, Ohio Department of Natural Resources

Mr. Gerber was asked to discuss perceptions, experiences, and reactions to the concept of MLRA project soil surveys.

I first learned about the concept of soil surveys being managed by MLRA's in June 1990 at the Midwest Regional Cooperative Soil Survey Conference held at Iowa State University. Within about one week of that Conference, a steering committee meeting composed of NCSS cooperators from Michigan, Indiana, and Ohio was organized to discuss a MLRA 99 project soil survey. Later that month, the Wood County Conservation District asked the Ohio Soil Survey Inventory Board to consider starting a soil survey update project there (within MLRA 99). It is the last such request that has resulted in a project in Ohio.

Some background and reasons why the MLRA project soil survey concept was attractive to Ohio Deoartment of Natural Resources (ODNR):

- Ohio has 4 Land Resource Regions composed of 8 MLRA's (map shown).
- During the 1980's, the number of ODNR and NRCS (then SCS) soil scientists dropped from 44 to 27. Five of these were assigned to technical soil services.
- In 1990, half of the county soil survey projects in progress were update projects; managing each update project separately preserved what Larry Ratliff likened to a "patchwork quilt".
- An analysis showed more than 1,500 miles of joins between survey areas that were completed more than 10 years apart.
- Considering the points mentioned above, it became obvious to ODNR that staffing and managing soil survey update projects by MLRA was a good idea.
- Ohio has been divided up into 4 MLRA project work areas (combiition of geology and "soil regions" as designated in-state) for purposes of managing soil survey work. There are 4 offices that serve as "hub locations".

Since 1990, ODNR has demonstrated a commitment to maintaining soil surveys by MLRA In June 1991 ODNR abandoned plans to convert project staff to resource soil scientists in order to support MLRA project soil survey work.. By June 1993, all 10 ODNR staffwere located in "hub locations" for MLRA projects. ODNR has argued to state administration in Ohio for continuation of the soils program by showing advantages of MLRA projects, and has marketed advantages of MLRA projects to Conservation Districts.

The pace of progress in implementing MLRA project soil surveys in Ohio has been slower than hoped. ODNR expressed disappointment about this to the NRCS State Conservationist in 1994. The status of implementation today (seven years after ODNR first gave support) includes two county update contracts signed in 1992 with MLRA adaptations, a MLRA 111 steering committee meeting in 1992, a MOU for MLRA 99 project signed in 1993, a tri-state NRCS soil scientist pilot begun in 1994, and a Ohio Soil Survey Redeployment plan approved and distributed in 1995. However, enhanced quality and efficiency in soil survey product delivery have not yet been demonstrated (the backlog of update work and publications still remains). ODNR remains supportive of the MLRA project soil survey concept, but it's a little too early to boast about accomplishments.

SSSA S-5 **committee proposal for a** book on
"WHAT WE KNOW **ABOUT THE U.S. PEDOSPHERE"**

The committee met in Baton Rouge June 17, 1997 at 7:00 PM. Discussion centered on the readers and the content of the proposed book. We agreed that the book should be written for scientists like ourselves as a compilation of our generation's contribution to soil science. A series of maps of soils of the U.S. should be in the introduction. A Pedocal-Pedalfer Map from the Atlas of American Agriculture could be the first. This could be followed by a Great Soil Group Map of Soils and Men and an Order Map by the current Soil Taxonomy. Our experience is that many teachers outside soil survey still are using the first two named maps. Relating the three maps and showing the merits of the new one would be an important contribution to the field of education.

In many ways the content of the book would resemble the ideal chapter on Soil Formation in a Soil Survey Report. It should concentrate on the knowledge our generation has gained through the use of the tools of our time. In particular it should emphasize field studies of soils and their geomorphic relationships. Hard copies of the maps should be in the book and should be included as a compact disk.

Members Appointed bv SSSA S-5.

Richard W. Arnold
Edward J. Ciolkosz
Larry P. Wilding
Thomas E. Fenton
Richard D. Hammer (absent)
Wiley D. Nettleton. Chair

WILEY D. NETTLETON
Research Soil Scientist

June 22, 1997

COMMITTEE 1

NCSS STRUCTURE

COMMITTEE MEMBERS:

Robert V. Rourke, Chair

Gerald A. Neilsen
Mary Collins
Dwight Holman
William H. Craddock
James H. Brown
Charles Gordon
Donald P. Franzmeier
Richard L. Schlepp
Dennis K. Potter
William E. Dollarhide
Jerry J. Daigle

Charge 1:

Review the structure and make-up of the steering committee.

BACKGROUND:

The recent changes in the Soil Conservations Service leading to the formation of the National Resources Conservation Service necessitate a review of the NCSS structure and By-laws. At the same time the structure of many of the NCSS Cooperators has been undergoing revision and changes in emphasis. The outcome of these changes has resulted in the possible need for revision of the roles of the various agencies or institutions in the NCSS.

COMMITTEE RECOMMENDATIONS:

1. Article VI-Section 1– representation from the 1890 schools and from the tribal Universities should be added to the Steering Committee.

2. Article VI-Section 4 the introductory statement should be modified to read: The Steering Committee shall: (dropping "The Steering Committee shall plan, organize, and manage the Conference" as being redundant).

Charge 2:

Determine the role of Ag. Experiment Stations, 1890 and Tribal Universities, and other (Non-NRCS) Cooperators in the future of the NCSS.

BACKGROUND:

As a result of changes in priorities of Experiment Station research, the emphasis on laboratory and field **identification** and characterization of soil survey map units has been diminished. Research relating to diagnostic horizon understanding, or interpretation, **as** well as remote sensing of landscapes and their composition must continue with **funding from** new or alternative sources. Cooperative **efforts** behveen NRCS and **Experiment** Stations concerning understanding and planning soil landscapes as well as water management have the opportunity to increase. One role of the **Experiment** Station representative to the NCSS will be as an informed consultant to others that are seeking assistance in soil selection on which to do research thus assuring **transfer** of knowledge on a soil **taxonomic** basis.

To enhance the soil survey **MLRA** approach there needs to be developed regional projects tbat **will** assist soil survey activities in the **MLRA** regions. This activity would be **enhanced** if **funds** for research through **MLRA Offices** were established to be used by two or more Cooperators working together to address regional concerns that have been established by the **MLRA Office.** The Cooperators would submit a joint proposal to **perform** the needed **research.** Regional **projects** could address research needs in soil problems such as: soil map unit identification, understanding or interpretation in a **manner** that assures continuity across state or other political boundaries. The development of surface water **contamination** related to soil management both from non-point source and point source sequences, or combiions of the two, wig in many instances require cooperation between two or more political entities allowing **interaction** between neighboring Cooperators and the NCSS.

Soil characterization will evolve to respond to various needs of users. New researchers wig be **forced** to **find funding from** industry or granting agencies that may be only marginal to soil survey.

COMMITTEE RECOMMENDATIONS:

1. Explore the use of **split** appointments between the Cooperating agencies and the NRCS whereby both of the organizations gain expertise at a reduced cost as compared to each hiring **full** tune personnel to fill parallel positions that are not adequately **funded.**

2. Establish potential funding sources for projects that meet the needs of the NCSS.

3. Involve Cooperating agency representatives in at least one **MLRA** Office meeting each year to discuss soil survey needs in the management area and to cultivate ideas and build relationships.

Charge 3:

Review membership and participation sections of the By-laws and make suggestions for change if needed.

COMMITTEE RECOMMENDATIONS:

!. Throughout the By-laws references to "Director of Soils, NRCS" should be changed to "Director, Soil Survey Division" .

2. Article III A -- change "Chairman" to "Chair".

3. Article III B. Add " 4. Soil scientists from each of the six regions in NRCS are included as members."

Charge 4:

Suggest mechanisms for technical transfer of research and other information important to all cooperators in the NCSS.

BACKGROUND:

A method of conveying research results to the field soil scientist is needed. Currently the results of research are published in professional journals which are often technical and seldom allow authors to reflect on the significance of the activities and findings to field scientists; A reviewer of the journals could contact the author and through conversation develop an interpretative summary. This information could be made available through a less technical review published as a quarterly, biiual, or annual report or placed in an appropriate position and format on the INTERNET. Future use of electronic communication will probably be utilized to a greater extent. Electronic communication would be available to all interested soil scientists, regardless of employer, and allow for easier and more rapid spread of information. Possibly the review of research and interpretation could be a service performed by one of the Institutes within NRCS.

COMMITTEE RECOMMENDATIONS:

Develop a method of conveying research results to field soil scientists through either electronic transmissions or published reviews that are presented in a less structured format. A designated reviewer should be established to contact authors, and with their cooperation, develop a popular summary of the research results for dissemination and use by field soil scientists, A Partial Report

National Cooperative Soil **Survey Work Planning Conference**
Baton Rouge, LA
June 16-20, 1997

Technical Committee #2
Site Specific Soil Mapping Standards

The New Hampshire *Experience*

Presented *by Steve* **Hundley,** *State* **Soil Scientist**

PART I

Background

For many years, New Hampshire has required site specific soils information as part of the permitting process for a number of different land uses. The requirements include setback requirements from poorly and very poorly drained soils, soil based lot sizing for subsurface waste disposal_ and high intensity soil surveys for subdivision review. In order for municipalities to comply with state permitting procedures, soil maps were required that were more detailed than the NRCS county soil survey. With the lack of any uniform state-wide standards, municipalities were requesting and receiving a wide range in soil map products ranging from NRCS county soil maps blown up to a scale of I: 100, to USGS topoquads with wetland areas highlighted. During the late 1980's and early 1990's, the consulting soil scientists in New Hampshire realized the need to develop standards that could be implemented state-wide that would produce high quality, multi-purpose soil map products. The consulting firms approached the NRCS and the National Cooperative Soil Survey to assist in developing Order 1 soil mapping standards that the private soil consultant could use and would fall within the technical standards of the National Cooperative Soil Survey. The consultant had a desire to use NCSS standards as the basis for the activities and services they provide because the mapping standards and supporting interpretations are scientifically based, technically sound, and legally defensible.

Development of Order 1 Standards and the Memorandum of Understanding

In 1990 a technical subcommittee was fonned within the Society of Soil Scientists of Northern New England to develop Order 1 soil mapping standards. This subcommittee was made up of NRCS soil scientists fiom New Hampshire, private soil consultants and state representatives from the New Hampshire Office of State Planning and the New Hampshire Department of Environmental Services. In 1993 the final draft of the Order 1 Soil Mapping Standards was approved by the Society of Soil Scientists of Northern New England and was published as an official document for use by the private soil consultant in New Hampshire.

Shortly after the adoption of the Order 1 mapping standards the subcommittee reconvened to work up a Memorandum of Understanding between the NRCS in New Hampshire and the New Hampshire State Board of Certification of Natural Scientists to address the mechanism by which the Order 1 standards will be carried out. This MOU was signed in 1994 and serves four primary purposes: 1) It provides for a library of NCSS documents to be maintained at the New Hampshire Department of Agriculture library for easy access and use by the consultant. The library contains all of the NCSS manuals, handbooks, bulletins, soil descriptions , soil taxonomy and soil interpretations that contain the various aspects of the standards of the National Cooperative Soil survey. The MOU ensures that no more than 10 percent of these documents will be more than 6 months out of date. 2) The second function of the MOU is to provide for an NRCS soil scientist to serve on the NH Board of Natural Scientists, in an advisory capacity, to address issues pertaining to the National Cooperative Soil Survey. This feature of the MOU provides for a continuous communicationlink between NRCS/NCSS, the private soil consultant, and tbe New Hampshire State Agencies. 3) In order for the private soil consultant to keep abreast of the latest technology, standards and policy of the National Cooperative Soil Survey, the MOU requires that every soil scientist must receive a certain number of Continuing Education units (CEUs) on the NCSS, every year, in order to maintain his or her license to practice soil mapping in New Hampshire. This training is provided through courses provided by the University of New Hampshire, through workshops and meetings sponsored by the various soil scientist societies in New Hampshire and surrounding states, and through invitation to attend NRCS conferences and training sessions. 4) The fourth purpose of the MOU is to provide a vehicle for [illegible] control/quality assurance on soil map products produced by the private soil consultant. Since Federal employees cannot review the mapping completed by a private consultant, there needs to be a mechanism for NRCS to have mapping reviewed for quality control when the need arises. The MOU allows for the NRCS to send correspondence to the New Hampshire Board of Certification requesting that a particular soil map be verified as being in compliance with the New Hampshire Order 1 Soil Mapping standards.

The Order 1 Soil Mapping Standards and the Memorandum of Understanding has been place for three years now and have proven to be very successful. The standards have received endorsement from the state agencies, they are in wide use by soil consultants and many municipalities have incorporated them into zoning and land use ordinances.

The update of the order 1 standards to these site-specific standards basically serve four purposes. Fii is to update the standards with current-day terminology. Second is to initiate a phase-out period for an older set of high intensity mapping standards that were established in New Hampshire in the mid 1980's. Third is to establish drainage class interpretive limits based on the Field Indicators for Identifying Hydric Soils in New England. The regional field indicators is another whole topic by itself. Briefly, the New England field indicators for identifying hydric soils have been universally adopted by the soil science community and various state agencies including the New Hampshire Office of State Planning and the New Hampshire Department of Environmental Services. By making drainage class interpretive limits agree with the regional indicators of hydric soils, we eliminate considerable confusion, and makes the implementation of state land use regulations based on drainage class and/or hydric soils much more easily applied and enforceable. The fourth function of this update is to change the format of the document to allow other states to adopt these standards resulting in uniform standards across state lines. During the updating process, the State of Vermont expressed a desire to have site specific standards developed. There was agreement between the two states that that the basic standards should remain the same and perhaps only a portion of the standards be refined to be specific to individual state needs.

The subcommittee developing the update agreed to a format that recognizes 'boiler plate" site specific mapping standards while in&ding individual state supplements to these standards that allow for each state to recognize refinements to the boiler plate standards that ate applicable to their individual state. This procedure has received wide acceptance and some of the other New England States have expressed an interest to establish similar standards and be included in tbe state supplements.

Conclusion

The Order 1 Soil Mapping Standards for New Hampshire have been in place for four years and the Memorandum of Understanding between the NRCS in New Hampshire and the New Hampshire Board of Natural Scientists have been in place for three years. Both documents have proven to be very successful. The NRCS and the consulting soil scientists communicate frequently and issues are addressed as they come up. This cooperative effort has allowed the soil science community to provide technical soil services, soil map products and soil interpretations to meet public needs with the assurance they are receiving the best product available today. As the NCSS continues to experience reductions in fimdii and staff, it becomes increasingly more important to use the private sector as an extension of our expertise, providing services that NRCS simply cannot handle, nor has a desire to handle because of overwhelming workloads in other areas. Having a uniform set of standards that is within the technical standards of the National Cooperative Soil Survey provides the mechanism to accomplish this goal.

During the technical committee breakout session, questions were asked about how these standards are functioning in New Hampshire. The accompanying document lists a few of these questions and the answer I provided at the conference. My written response to the questions in the following document are more elaborate, and hopefully more clear, than what 1 provided at the conference.

National Cooperative Soil Survey Work Planning Conference
Baton gouge, **LA**
June 16-20.1997

Technical Committee **#2:**
Site-Specific Soil Mapping **Standards**

The New Hampshire Experience

Presented by Steve **Hundley,** State Soil Scientist

PART **II**

During the technical **committee breakout** sessions on Tuesday **afternoon,** a **number** of questions were **raised concerning** the Site Specific Soil Mapping Standards for New **Hampshire,** NRCS relations **with** the consulting **soil** scientist and the practical application of **these standards. This** document identifies a few of the questions **raised** and tbe response that I provided at the **conference.**

Question:
It **is possible** for **a consulting** soil **scientist to map soils indefinitely without ever having a quality review of the map products he or she produces.** There is no assurance that the map products are **within** the **technical standards of the National Cooperative Soil Survey. As tbe State Soil Scientist, responsible for the National Cooperative Soil Survey Program in New Hampshire, bow can you feel comfortable that the integrity of the NCSS standards is safe?**

My **Response:** It is true that some consultants could go through theii career without having their work officially verified and documented as being within the technical standards of the National Cooperative Soil Survey. Throughout the National **Cooperative** Soil Survey, NRCS soil scientists have only a very negligible percentage of their mapping actually field checked to ensure it meets NCSS standards. Through conversation, correspondence, work products, and day-today contact with soil scientists, one becomes **aware** of the professional capability of an individual, never-the-less, the vast majority of the field mapping completed by the employee goes unchecked. The NCSS relies on the professional integrity of the **soil** scientist to maintain consistent high quality soils mapping regardless of where they are, and regardless of whether or not them is any likelihood that the mapping may be subject to a quality review.

Unlike the NRCS soil scientist, every time a consultant produces a soils map, he or she is putting his or her career on the line. It would be foolish for a certified, professional soil scientist to fake a soils map or **fraudulently** produce a product **knowing** he or she could loose their job, their certification, and the right to work in New Hampshire not to mention costly litigation fees.

There will always be "less-than-scrupulous" individuals in every profession, and no degree of quality control will totally eliminate these individuals. The New Hampshire Association of Consulting Soil Scientists is a self-policing organization that will *not allow any member to tarnish* their professional standards. Likewise. the New Hampshire Board of Natural Scientists maintains oversight on the activities of the professional soil scientist. These two deterrents, alone, keep the "less-than-scrupulous" soil scientist to non-existent or minimal levels.

The statement that the soil scientist's mapping is never checked is not entirely true. In fact, more often than not, the soils mapping undergoes intensive scrutiny. First, the client, or land owner is going to review the soils map and soils report. One can be surprised at how knowledgeable a land owner is about the soils on his or her pmperty. If there are critical errors or omissions in the soils mapping, many land owners have the ability to pick them out. Many town planning boards will review the soils mapping. Building contractors will use the soils map, septic system installers, sometimes the Corps of Engineers and/or EPA are involved in on-site review procedures. I would think any soil scientist that is not sure of what they are doing would be pretty nervous about having their work scrutinized to this degree.

My answer to this question is Yes, I feel very comfortable with the quality of the mapping produced by the private soil consultant in New Hampshire. I know most of them, if **not** all of them, and I am proud to stand behind and support the individuals who produce Order 1 or site-specific maps. I am also very confident that tbe National Cooperative Soil Survey in New Hampshire would more than adequately pass any review or inspection held by the National Office to evaluate the operating procedures of the program.

Question:
When you provide a new state (soils) legend number to a private consultant, without going through the formal NCSS correlation procedure, those map units cannot be considered "official" therefore, this practice is not within the standards of the National Cooperative Soil Survey. How do you justify this activity is within the standards of the National Cooperative Soil Survey?

My Response: First of all, the field documentation and data collection required by the National Cooperative Soil Survey often results in soils being described with a particular set of soil properties that is not currently recognized in the state soils legend or catina key. Many time, these soils can be classified to the series level identifying a soil series occurring in an adjoining state but not currently recognized in New Hampshire. This documentation is a necessary part of the progressive soil survey program. Just because the soil never gets officially correlated in the state does not mean the activity is outside NCSS operating standards. The same would hold true for providing state legend numbers to consultants doing soils mapping for a client.

Secondly, the statement placed on the soil map products produced by the consulting soil scientist states "This is a special purpose product, produced by a private soil **consultant** and is not a product of the USDA Natural **Resources** Conservation Service." This statement documents the activities associated with producing the soils map was not associated with the NCSS progressive soil survey program. It would not be reasonable, or even desirable to try and officially **correlate** a soil into the NCSS progressive soil survey that was **recognized on** a map product produced for another purpose outside of the progressive soil survey pmgram.

Question:
Under the new structure of the National **Cooperative Soil Survey, the soil survey program is now managed out of the MLRA Regional Office in Amherst, Massachusetts. Tbe current NCSS policy states that all progressive soil surveys will convert to an MLRA soils legend maintained by tbe Regional Office. How cad you continue to maintain the New Hampshire State-Wide Legend, which does not support the MLRA concept, and still say you are conducting soil survey operations within the technical standards of the National Cooperative Soil Survey?**

My Response: Under the new structure of the National Cooperative Soil Survey, the pmgram has been divided into two separate operations. One is **the** progressive soil survey program, the other is Technical Soil Services. Under this **structure,** the technical oversight for the progressive soil survey mapping and MLRA soil legend development is the responsibility of the MLRA Regional Office in Amherst. The adrniniitive over-site for the soil survey pmgram in New Hampshire is still my responsibility and I am fully responsible for the **Technical** Soil Services **provided** in New Hampshire.

The National Cooperative Soil Survey in New Hampshire does not need the site specific soil mapping standards in order to **carry** out the mission of the program. It already has sufficient Order 1 standards in place to carry out what limited Order 1 mapping the NCSS does do. Therefore, the Site Specific Soil Mapping Standards **fall** under the responsibility of the Technical Soil Services portion of the NCSS as this activity is **providing assistance** to the private **sector,** to units of government and promotes the proper use of NRCS soils data and interpretations. Subsequently, the New Hampshire state-wide legend falls into the category of **Technical** Soil Services as it is **an** integral part of the Site Specific Mapping Standards. The State Soils Legend remains a needed component for carrying out Technical Soil Services in New Hampshire, for which I have responsibility.

I have been in close communication with Bruce Thompson, MLRA Team **Leader in Amherst,** Massachusetts in regard to the New Hampshire State Legend and its compatibility with the MLRA legend. The New Hampshire State Legend, in **fact,** makes up a portion of the first approximation of the MLRA legends for MLRA **143, 144A,** 144B **and** 145. A conscientious effort will be made to keep the New Hampshire State Legend and the MLRA legends compatible. The NCSS National Soils Database (NASIS) has the capability of maintaining multiple soils legends and will be doing this for most, if not all of the country. In New Hampshire NASIS will manage three separate soils legends for any given parcel of land. First will be the published county soil survey legends, some are numeric legends others are alpha legends. The second is the New Hampshire State-wide legend and the third will be the MLRA legend. All three legends will be "official" and the determination as to which legend to use when providing a soils map will be determined by the needs of the customer.

Question:
There have **been situations in the West where a client, after receiving a soils map he didn't like, will hire a second consultant to remap the area, resulting in pitting one soil scientist against the other. How do you (and NRCS) handle this situation when both map products state they were completed within the technical standards of the National Cooperative Soil Survey?**

My Response: To date, we have not experienced this situation in New Hampshire. Personally I think it would be foolish for the second soil scientist to knowingly accept a request of this nature if the first mapping was completed using the site specific standards. Never-the-less, the MOU between the NRCS in New Hampshire and the NH State Board spells out the procedure to be used for verifying that soil maps are within the technical standards of the National Cooperative Soil Survey.

I would need to receive a verbal or written request to have the soil maps verified. I would subsequently send a written request to the State Board, explaining tbe situation, and request that a private sector soil scientist be selected to review the soil maps and verify they were completed withii NCSS standards. According to New Hampshire state law, the Board is obligated to verify the mapping upon receiving a written request.

All of us know that two soil maps of the same area will never look exactly alike, Even if done by the same individual at different times, or walking different transects, the maps will not look alike. However, if the maps are completed under NCSS standards, they should agree on an interpretive basis. Placement of soil lines will not precisely agree, however, the reviewing soil scientist or team of scientists should be able to determine if the maps adequately represent the soil/landscape relationships within the parcel and whether or not one of the soil maps was completed in an unprofessional manner. Further investigations and discussions with the soil scientist should provide an indication as to whether or not tbe unprofessional map was completed in an intentional or fraudulent manner.

When soil lines on two different maps (drawn in good faith) do not agree and the placement of these lines are critical for the implementation of land use regulations (setback requirements, etc.), then it may be wise for the Board to send two or more soil scientists out to review the controversial boundary. The NRCS liaison to the board, although not authorized to partake in the field evaluation, may be consulted on particular areas of the NCSS mapping standards. A compromise may be the most appropriate solution to final line placement, and I would suspect the decision of the Board, and its representatives making the field review, would be final. If this process does not satisfy the client, then the issue may move into litigation.

Generally speaking, I believe the acceptance of the Site Specific Soil Mapping Standards for New Hampshire, and the degree of specificity required by these standards, will help to prevent this situation of occurring.

NATIONAL COOPERATIVE SOIL SURVEY (NCSS) RESEARCH AGENDA STANDING COMMITTEE

National Cooperative Soil Survey Conference
Baton Rouge, LA, June 16-20, 1997

John Kimble, Co-Chair
Larry P. Wilding, Co-Chair

A. INTRODUCTION

A Standing Committee was formally established for the NCSS Research Agenda by the NCSS Conference Steering Committee as per a recommendation approved by the Steering Committee (8/8/95), published in the Proceedings of the National Cooperative Soil Survey Conference, San Diego, CA, July 10-14, 1995.

Implementation of this recommendation occurred via correspondence from Tommy Calhoun, Program Manager, Soil Survey Division, (1/8/97) and Horace Smith, Director, Soil Survey Division, NRCS, (2/5/97). John Kimble, Supervisory Research Soil Scientist, National Soil Survey Headquarters, NRCS, and Larry Wilding, Professor of Pedology, Texas A&M University were asked to serve as Co-Chairs of this Standing Committee. Suggested membership constituencies, membership composition and charges were suggested

idert. Na bys oedin-Tm (Chavia abo secorrespondtitittee.)Tj 3890231 Tc7229673 Tw 0.9545 0 0 1 56377

B. STANDING **COMMITTEE MEMBERSHIP**

The **following** members were **appointed** to this committee by Horace Smith, Director, Soil Survey Division, **NRCS**.

John **Kimble**, Co-Chair
Supervisor, Soil Scientist
NRCS, **NSSC, MS** 33
Lincoln, NE
jkimble@gw.nssc.nrcs.usda.gov

Dennis J. Lytle
Supervisory Soil Scientist
NRCS, NSSC, MS 32
Lincoln, NE
dlytle@gw.nssc.nrcs.usda.gov

Curtis Monger, Jr.
Department of Agronomy, Box **3Q**
New Mexico State University
Las **Cruces, NM** 88003
cmonger@nmsu.edu

Robert Powers
USFS, PSW Forest Experiment Station
2400 Washington Ave.
Bedding, CA 96001

Allan E. **Tiarks**
2500 Shreveport Hwy.
USPS, Southern Forest Experiment Station
Pineville, LA 71360
fswa/s=a.tiarks/ou=r08f06a@mhs.attmail.com

Peter L. veneman
Department of Plant **&** Soil Sciences
19 Stockbridge Hell
University of Massachusetts
Amherst, MA 01003
veneman@pssci.umass.edu

Larry P. **Wilding, Co-Chair**
Soil **& Crop Science Department**
Herman Heep Center, Boom 543A
Texas **A&M** University
College **Station,** TX 77843
wilding@tamu.edu

Ronald D. **Yeck**
Soil Scientist
NRCS, NSSC, MS 35
Lincoln, NE
ryeck@gw.nssc.nrcs.usda.gov

C. CHARGES TO COMMITTEE:

The following five charges were assigned to the Committee to establish a formal mechanism within the NCSS to:

1. Identify, document, prioritize, and address the critical research and development issues **within** the NCSS;
2. Identify opportunities for partnering on priority research **needs;**
3. **Identify** opportunities for funding priority**research** needs;
4. Increase the visibility and credibility of NCSS; and
5. Ensure the technical excellence of the **NCSS;**

During the interim that this Standing Committee has been active most effort has been given to item 1. General aspects of charges, **2-5** have been considered but **future** work of the committee will address these charges.

D. COMMITTEE RESPONSE TO CHARGES

1. CHARGE: IDENTIFY, **DOCUMENT, PRIORITIZE,** AND

- Develop decision aids and on-line access to pedon data to enhance watershed management strategies for soil and water conservation, biomass productivity, and off-site damages from non-point source pollution.

(b) Priority 2 - Develop Integrated Scaling of Research Using a Landscape Approach

Justification

Soils form an interactive network on landscapes comprisii links like those of chains. Processes that perturb higher surfaces directly affect soil processes an adjacent lower surfaces. Hence, to understand and mode1 the dynamic driving forces in a threedimensional interactive system over a hierarchy of temporal and spatial scales, research observations on soil individuals, or components thereof, must be integrated or scaled up through research plots, ecological units and small watersheds, to soilscape relationships that aggregate to a landscape model. This is a cost-effective means to develop a systems approach for landscape interpretations. It improves the ability to extrapolate information and provides for a hard set of soil attributes for modelers. It further elucidates principles, defines concepts and provides early wanting systems for land degradation. The impact at one upslope landscape component directly or indirectly affects downslope portions of the system.

Critical Research and Development Issues

- Develop sampling strategies and operational policies to comprehensively characterize research sites for parent lithology, soil, vegetation, topography and
-
-
-

Justification

quality is even more **difficult** than **defining** it because it will require soil scientists to identify the critical functions that soils perform **within** and across **ecosystems**.

Critical Research and Development Issues:

- Develop protocols for measuring soil parameters that would indicate **changes** in sustainability **over** time;
- Develop quantitative and qualitative assessments of soil quality for various soil **functions** based on baseline information so simulation models will be able-to predict whether a soil is being **degraded or aggraded;**
- Develop lahoratory methodologies to obtain low levels of baseline **nutrients** and chemicals, including heavy metals and other toxic **pollutants;**
- Develop soil health indices that provide early **warning** systems of soil **degradation** and remediion for fragile soils,
- Document background levels and loading **rates** of waste products, including heavy metals, that soils may accommodate without **declining** in soil **quality;** and
- Develop methods and formats to report soil **survey** information and databases for soil quality interpretations by natural **resource** managers.

(d) Quantify Biological Processes in Soil Systems

Justification

Traditionally pedological research **within** the NCSS has **under-emphasized** the importance and role of biological processes to **pedogenesis.** It is well established, however, that biological processes are directly or **indirectly** determinants of: mineral weathering, oxidation-reduction reactions, nutrient transformations, nutrient **cycling,** nutrient use **efficiency,** soil health, macroporosity, water transmission, soil remediion, greenhouse gas emissions, bioremediation, and global C and N sequestration. Because of **these** important pedogenic functions, greater attention to biological processes is warranted in NCSS research agenda.

Critical

- **Characterize** subsoil forms and quantities of micro- and macro-organisms that may help predict the success of soil enviromnents for **bioremediation;** and

  Determine how soil biological processes may augment **abiotic** processes in pedogenesis of soils (e.g. carbon **sequestration --** inorganic carbon by biomineraliion, and stability of organic carbon in carbonate-rich soil systems).

(e) **Quantify Paleo Versus Modem Properties and Processes in Soil Systems**

Justification

For mesningful interpretations of soil behavior, development of remediation **strategies,** and projections of future soil environments from paleosols, it is important to **differentiate** those processes and markers of pedogeneeis which are modern **from** paleoenviromnental relicts. This is **especially** important in **establishing** paleosols that serve as geomorphic time **stratigraphic** units. It also -is critical in determining whether the soil markers of wetness are **paleo** or contemporaneous **features** in determining hydric soils. **Likewise,** if paleosols are to be used as markets of chronology or pedogenic **rate functions,** a clear separation between **paleo** features, modern features and the combiion of the two welded into **polysequel** soils must be established.

Critical Research and Development Issues:

- Identify and determine stability of soil attributes to differentiate relict from contemporaneous counterparts (e.g. redoximorphic soil indicators);

- **Establish** conditions of **paleoenvironments** that may serve as predictive markers of **future** management **strategies;**

- Establish a minimum set of soil attributes that may be used to define a **paleosol** and its corresponding **paleoenvironment;**

- **Establish** enviromnents where **paleo** features are more likely to be preserved and **confound** modern attributes; and

- Determinate **paleo** features which may be used to improve our knowledge of soil landscape evolution, pedogeneeis and soil survey mapping.

(f) Develop New Methodologies and Techniques to Enhance Research Capabiities and Delivery of Soil Survey Services

Justification

information end numerical databases will depend heavily on the development of **geostatistical, geospatial, GIS and** remotely-sensed technologies that establish **statistical** reliability, **multiple** delivery formats, and soil survey services on a user-friendly basis. The computer information em allows significant **opportunities** and challenges in this **behalf.**

Critical Research and Development Issues:

- Develop scientifically valid and operationally feasible geophysical **geospatial** and **geostatistical** technologies to document and **portray** variability of surface and subsurface soil **attributes,** and pedofimctions within soil map units and landscape units;

- Develop GIS methodologies to predict soil **functions** and **aggregate** point observations in **scaling from** site **specific** to more **general** levels of resolution **(pedon** to large-scale maps to watersheds to small-scale maps to global dimensions);

- **Re-examine the state of satellite and lower-altitude remotely-sensed imagery, image analysis, and GIS technology for its application to soil survey operations to improve mapping accuracy and mapping efficiency, especially in developing end updating order 3 and 4 soil surveys;**

- **Develop soil survey procedures to increase the depth of observations and accuracy of interpretations** below **two** meters in soil and geological materials; and

- Develop **methodologies** to **evaluate** the impact of specific ped surface structural feature8 (e.g. soil **aggregation** end ped coatings) on fluid, solute and gas flux into and out of soil matrix.

2. CHARGE: IDENTIFY OPPORTUNITIES FOR PARTNERING ON PRIORITY **RESEARCH** NEEDS

Conventions on **Biodiversity, Desertfication** and Gas **Emirssions** are being sponsored by. the United Nations and/or through national **initiatives.** It is important as global issues emerge, to **identify** areas where soil science expertise **and outreach can contribute to these mandates. The identification of critical research priorities would nicely complement the above unconventious efforts. As soil scientists, we need to be in the forefront if our expertise is to be utilized by these international partners.**

Monies to support priority **research** needs will necessarily be heavily dependent on developing **contractual** grant support from &nor agencies such as USDA, **NSSA,** NSF, **EPA, USAID,** USGS and other government, private and foundation sectors. In order to be competitive in these research proposals it is frequently **necessary** and desirable to develop synergistic partnerships among cooperators of the NCSS. **Partnershiping should be enhanced and nurtured among scientists in 1890 Colleges and Universities (Historically Black Colleges and Universities --HBCU's) and Minority Institutions --MI's (which include American Indians and other minorities), to assure diversity in the research cadre and institutions engaged. Partnershiping capitalizes on shared expertise, leverages funding sources (hard money and in-kind services), and provides a research agenda end scope that will have a high probability of relevance to the cooperating entities. An example of this partnering would be EPA/USDA/Universities in global climatic change projects such as wet soil monitoring end carbon sequestration.**

3. **CHARGE: IDENTIFY OPPORTUNITIES** FOR **FUNDING**

-

-

-

- **Publish** research results in refereed scientific outlets that subject research **results** and **interpretations** to peer reviews;

- Develop soils exhibits in natural science museums for viewing by students and the general public;

- Institute workshops, school lectures and field trips with K-12 students to enhance their interests and **scientific** literacy about geoscience systems;

- Partner with NASA in its GLOBE (Global Learning and Observation to Benefit the Environment -- Soil Measurements component) for K-12 **education;**

- Draft educational **materials** and provide simple **demonstrations** for **secondary-level** science teachers that would enhance student instruction about soil systems (e.g. soil composition, soil texture, soil water retention, cation and anion exchange **capacities** (use bar magnets), biological activity, color inferences, etc.); and

- Participate and present research papers in **international,** national, regional and statewide professional and **scientific** outlets.

5. CHARGE: ENSURE THE TECHNICAL EXCELLENCE OF THE NCSS

If research of relevance to national priorities and the NCSS are conducted in a manner that meets **scientific** scrutiny and is reviewed **within** the scientific community, then the technical excellence within the program will be **continuously** upgraded. It is important that the prioritized national research agenda:

- Establish long-term monitoring that considers perturbations and dynamics in soil processes to facilitate a factual data base for landscape units;

- **Enhance** opportunities for employment of scientists withm the NCSS at all levels of academic training, but especially to attract leaders with national and international scientific recognition;

- Provide incentives for **partnershiping** among the NCSS cooperators, especially those engaged in private consulting professions; and

- Provide incentives for **scientific** creativity, professionalism and excellence.

E. **RECOMMENDATIONS** AND **UNFINISHED** BUSINESS

The NCSS Research Agenda Standing Committee **have** items of unfinished business because it was assembled **too** late **to** comprehensively address all of the charges. Further, recommendations for future consideration are as follows:

- Broaden the current composition of the committee membership to ensure representation from all NCSS regions, **the** private sector professionals, and cooperator constituencies **which** will serve as partners in **the research** agenda

- Develop **liaison** representation to NCSS for the agency/departmental **research** partners who currently are not considered NCSS cooperators;

- **Re-examine charges 2-5** to determine which are of most relevance and germane to the **Standing** Committee on the NCSS **Research Agenda;**

- Develop a **mechanism** to update the **research agenda** and its prioritization revolving in 2 to **4 year** cycle;

- Develop a **mechanism** whereby the Standing **Committee** may serve as a **clearinghouse** for inquiries on NCSS **research;**

- Identify areas where NCSS **research, expertise** and outreach are germane to emerging global issues such as food **security,** biodiversity, **desertification** and gas emissions;

- Establiih a **Mapping Techniques Committee** to **evaluate** new technologies for soil survey **operations and researach agenda;** and

- Develop a protocol to measure performance of research **agenda milestones** and progress.

- Draft a **resolution commending** the USDA-NRCS **Soil** Survey Diiion for its **successful** development of a **RFP** and **enlist** political support to enhance the **funding** commitments to this **research funding source.**

F. RESOLUTION

Be it **resolved** that the National Cooperative Soil Survey **(NCSS)** Soil **Research** Agenda Standing Committee **commends** The USDA-NCRS Soil Survey Division, and its leadership, for its **successful** development of **a Request** for Proposal **(RFP #126-FW-NRCS-97)**

APPENDIX A

January 27, 1997

Research Needs Summary[1]

	S	W	NE
Water tables & water movement through soils	X	X	
Waste applications to land - loading rates, effects	X		X
Hydraulic conductivity and partitioning of water	X		X
Heavy metals in soils	X		X
Human activity on OM, Db, forest prod & interps, Soil Taxonomy	X		X
Soil health/quality indicators		X	X
Develop, refine hydric soil indicators		X	X
Soil interpretations (substantiate, quantify)		X	X
Water quality/pesticides	X		
Apply tech transfer tools/GIS		X	
Landscape modeling		X	
Large scale maps of soil moist/temp to refine soil, MLRA boundaries			X
Resolve the fragipan/dense till controversy			X
Soil erosion (movement of soil particles)			X
Investigate deep weathering			X
Predict acid mine drainage potential			X
Separate present and relic redox features, including anthropic			X
Improved soil genesis model (s)			X
Study effects of riparian buffers			X
Develop methods to quantify organic carbon sequestion			X
Temperature studies for frigid/mesic/cryic breaks			X

[1] Compiled by R. Yeck from reports of the 1996 regional Soil Survey Conferences. The North Central report did not itimize research needs.

APPENDIX B

Soil Research Priorities Meeting
National Soil Survey Center, Lincoln, NE, September 26-27, 1996

Purpose

Identify, and to some degree, prioritize the pedological research that is most needed from the soil survey community in today's world.

The discussions necessarily brought up a number of more operational things needed in the NCSS. These are listed in the main body of the notes, and in the parking lot at the end of the notes. Most of the discussions were in the context of research that could strengthen NCSS and the NCSS scientific community.

Contents

Note that the NCSS Technical Advisory Committee to the NSSC met for 1/2 day before the larger group began deliberations about research priorities. These notes are principally from the [illegible]

NCSS Technical Advisory Committee to the NSSC, and Soil Research Priorities Meeting

September 26-27, 1996
Federal Building, Room 397B

AGENDA

September 26, 1996

Technical Advisory Committee Meeting
8:00 - 1:15 -

Meeting Format 8:00 - 8:15
Holzhey

Agency Highlights & Issues
≤20 minutes each

BLM	Volk
NRCS	Culver & Arnold

NSSC Roles in NRCS 9:05 - 9:35
Lytle

Break 9:35 - 9:55

AES Issues By Region
≤20 minutes each

South	Collins
Northeast	Bryant
North-Central	Smeck
West	Southard

Discussion 11:15 - 11:50

Lunch 11:50 - 12:50

Agency Highlights & Issues 12:50 - 1:15
USFS Russell

Soil (Pedological) Research Topics and Priorities
1:15 - 4:45

Soil Information Needed in the Ecological Arena Elliott

Research at the NSSC Staff

Break 2:30 - 2:50

Discussion and round robin forum about (pedological) research still needed and why.

September 27, 1996

Round robin forum, cont. 8:00 - 11:30

Lunch 11:30 - 12:30

Prioritizing topics and completing rationales 12:30 - 4:30

Prioritizing topics *One hour*

Discussing and preparing rationales *Two hours minus break*

Summary and recommendations
Arnold *45 minutes*

Participants: ***Dick Arnold, Ray Bryant, Stan Buol, Mary Collins, Ted Elliott, Walt Russell, Neil Smeck, Randy Southard, Bill Volk, Larry Wilding, NSSC Staff.***

Introduction of Topics - Topics Now Being Partially Addressed at the NSSC

NSSC TECHNICAL PROJECTS - ASSEMBLED 1996

This is a summary of projects within the Soil Survey Division at the NSSC or being done by cooperators of the NCSS. The projects are grouped into broad categories as follows: Soil - Geomorphic Processes; Genesis/Taxonomy; Field, Laboratory, and Geospatial Methods; Soil Water and Temperature; Use Dependency, Soil Quality, Heavy Metals; Carbon Sequestration and Biological Process; Interpretations; and Facilitating Activities.

SOIL - GEOMORPHIC PROCESSES

1. A transect across a typical Southwest Missouri landscape

DeWitt, W.D. Nettleton, and P.J. Schoeneberger

A representative transect crosses from a loess-capped channel sandstone high of 347m across two pediments overlying siltstones, shales, and limestones to a low of 320m.. The loess cap is thin so that a Fragiudult is welded into it and the underlying quartz dominated channel sandstone. The paleosols in the buried pedisediment are welded into Fragiudults at the top of the transect, Hapludults on the backslope, and red clay Paleudalfs and Paleudolls across the lower part of the transect.

2. Soil-geomorphic relationships, Three Mile Prairie, Southwest Missouri

Schoeneberger, W.D. Nettleton, L.E. Kichler, and D.K. Potter

The area lies south of the Missouri River within the Springfield subdivision of the Ozark Plateau. The bedrock is calcareous siltstone dominated by micaceous clay and is capped by two strata. The

STATUS: Completion FY 98

5. MLRA 77 - Southern High Plains

Objectives: (1) Compile available historical and proxy data for the Southern High Plains; (2) Compile a reconnaissance sampling of surficial soils throughout the MLRA 77; (3) Provide soil-landscape models for areas (particularly those with problems in mapping) of the southern High Plains; (4) Study past effects and predict future effects of climatic change on soils and landscape evolution; (5) Determine the stratigraphic relations of the surficial sediments and inferences to soil properties.

Contact: C. Olson, NSSC, Lead Scientist in cooperation with NRCS and NCSS university scientists in MLRA 77.

Status: This project began in 1990 and was scheduled to run 10 years. It has 2 parts: I. Compilation of baseline data and II. Investigations addressing the relation of soils, geomorphology and surficial features in MLRA 77. Baseline data and a literature review have been conducted. A listing of all soils sampled in MLRA 77 by subregion was compiled and released in FY 1990. Version 1.0 and 2.0 of a literature review were released in FY 92 and FY 93, version 3.0 is planned for FY97. A series of small-scale surficial geology, drainage and bedrock maps have been completed. A text is being written to accompany these maps. The booklet should be released this fall. New information obtained from investigations over the course of the MLRA update will be added to these initial maps and a final set of maps prepared at the conclusion of the project. Numerous presentations have been made at professional meetings. Several manuscripts are in preparation.

6. PROJECT: Mountainous and Steep Terrain Analysis

OBJECTIVES: 1) Improve soil-geomorphic models for high elevation and steep terrain Develop consistent landscape terminology for steep terrain and alpine regions, in particular terms for landform and positions on the landform.

SCIENTISTS - C. Olson, D. Wysocki, NSSC, NRCS, Lincoln, NE; N. Peterson, G. Hoffman, NRCS, Idaho; K. Hipple, H. Halsdorf, NRCS, Washington State.

STATUS: New Project FY 97. Projected to run 2 to 5 years in conjunction with active mapping and MLRA updates. Project was requested by the Western Soils Consortium to address soil landscape problems in steep terrain. Several different mountainous areas will be included in the project. The first two field areas are planned in the Coastal Ranges of Washington State and the Rocky Mountains and Columbia Basalts of Idaho. The Gifford Pinchot National Forest is a 5-year soil survey project to begin FY 97 and the Orofino Idaho survey has just begun and will continue at least 3 years.

7. PROJECT: Nested Geomorphic Surfaces: The Significance of Nick-Points in Ephemeral Stream Channels and Associated Shoulders on Adjacent, Stepped Interfluves in Erosional Landscapes.

OBJECTIVE(S): 1) Establish the relationship of nick-points in ephemeral streams to roll-over (shoulders) on adjacent interfluves, thereby identifying nested geomorphic surfaces on a local scale. 2) Demonstrating the presence and viable delineation of nested geomorphic surfaces on a local-scale, in erosional landscapes. 3) Demonstrate applications of these geomorphic relationships to small and mid-scale soil surveys.

SCIENTISTS: P. Schoeneberger, NSSC; R. Daniels, NCSU.

8. PROJECT: Pedo-Geomorphic Assessment of Sulfidic Materials, Coastal Plain, MD, MLRA 149A

OBJECTIVES: (1) To study the character and distribution of sulfide materials within the soil-regolith column derived from unconsolidated Coastal Plain sediments in Anne Arundel County (2) Develop a soil-geomorphic model for predicting the location, depth and distribution of sulfidic materials within landscapes underlain by unconsolidated Coastal Plain sediments (3) Determine criteria for deep sampling protocol for the NRCS Deep Investigations team.

SCIENTISTS: C. Olson, NSSC, NRCS, Lincoln, NE; M. Rabenhorst, D. Fanning, Univ. of Maryland, College Park, MD; J. Brown, other Party Leaders, NRCS, Maryland.

STATUS: New Project FY 97. The soil survey update in Anne Arundel County is scheduled to begun and will proceed for approximately 3 years. Sulfide-bearing soil material, when disturbed and improperly handled creates land management problems. The update in MLRA 149A provides the mechanism to combine conventional soil survey activities with studies emphasizing observations at depths greater than those traditionally studied. The timing is critical as Anne Arundel County is rapidly being urbanized due to proximity to Washington, D.C. A relational table of soil properties associated with sulfidic materials, a general potential hazards map keyed to soil survey maps and a geomorphic model to assist users in evaluating the likelihood of [illegible]

10. Sequential soil development, Mt. Vernon hill country, S. Illinois

plants. Study of 90 Midwestern soils shows that soils with 10 cm or more of Bt horizon having >10% Al saturation occur mostly in the area of thin loess over Sangamon paleosols. They are not in the Ultisols or in ultic subgroups. So these soils may be conveniently separated from other soils. Their taxonomic separation on the basis of Al saturation groups similar soils and improves technology transfer.

14. Tephra weathering in Spokane flood terraces, Bonner County, Idaho
Brownfield, W.D. Nettleton, C.J. Weisel, N. Peterson, and C. McGrath
Except for differences in amorphous material content no difference in development of any one of three soils on the six distinct terrace levels is apparent. Soils on the younger terraces contain several times more allophane than soils on the older terraces. Differences in tephra content and not differences in amount of weathering account for the differences. It is postulated that each succeeding flood eroded some tephra from the older terraces and deposited it on the younger ones.

15. PROJECT: Chemistry of Pan Cementation on Andesite and Basalt-derived Soils in the Olympic Peninsula, Washington
OBJECTIVE(S): Recent work has shown that certain Andisols in the Olympic National Forest have subsoil horizons cemented with noncrystalline aluminosilicates, with kaolinite and gibbsite acting as accessory cements. The purpose of this study is to examine soils with cemented pans developed from either andesite or basalt in order to elucidate processes involved in pan formation and to better characterize the chemical components of the cement.
SCIENTIST(S): M.A. Wilson, R. Burt, J. Sasich, and K.W. Hipple
STATUS: Ongoing. Thus far, one SSSA presentation, one SSSAJ publication.

16. PROJECT: Hydrothermal Soils of Yellowstone National Park
OBJECTIVE(S): Soils forming in hydrothermally-altered Quaternary-aged rhyolite compose over 16,000 acres in Yellowstone National Park and have unique soil properties with distinct plant communities. We are (a) characterizing the chemical and physical properties of soils forming in two distinct chemical systems: acid sulfate and neutral chloride; and (b) studying siliceous mineral transformations due to both hydrothermal alteration and soil formation. This research will help natural resource managers of Yellowstone to better understand soil properties and improve land use management.
SCIENTIST(S): M.A. Wilson, A. Rodman, D. Thoma, and H. Shovic
STATUS: Ongoing.

17. Torrands-are they oxymoronic?
Chadwick, C.G. Olson, D.M. Hendricks, and W.D. Nettleton
The Torrand great group fits a logical niche in Soil Taxonomy, but it should not exist based on soil-process predictions. The central concept for Andisols is the existence of a clay-size mineral assemblage dominated by organically bound gels and minerals with short-range crystal order. In contrast, aridic soils have low chemisorptive activity, high base saturation, and high Si/Al secondary clays.

18. Glacial till study
Glocker and W.D. Nettleton

Loamy and clayey soils developed in glacial till are identified throughout Laud Resource Region M. Over a long period of mapping the ranges in characteristics broadened and the series now overlap. Soils data and geologic maps are being studied to redefine the soils and to show their distribution.

19. Stratigraphic and geomorphic controlled age estimation of Central Kansas soils
Nettleton, C.G. Olson, C.E. Watts, M.A. Wilson, and R.M. Murphy
Soils in the Great Bend area range in age from Holocene to late Pleistocene. Eolian sands, loess, river deposits, and pedisediment ate all present. Earlier ^{14}C dating has shown that the sands are late to middle Holocene, the

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 coordinate international mapping** efforts and development **of common legend, will be filled in 1995 for** a **minimum** of two years. A soil **map** at a scale of **1:10,000,000** is being developed by a team **from** the U.S., **Canada, and** Russia **A test area will be completed in June 1996.**

22. PROJECT: Soils of the central plains **experimental range** station (CPER)
Objectives: (1) implement new **applications** fix **existing technology** to soil survey at the **CPER;** (2) Provide suitable soil-landscape model **for soil survey;** (3) Evaluate soils data **collected** to **determine appropriate spatial scales for modeling; (4) Test the significance and viability of reconstructing** recent **terrestrial environments** using isotopic **techniques** to provide high resolution **paleo-environmetnal information; 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** [redacted] **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.**

FIELD, LABORATORY, AN[redacted]

23. **PROJECT:** Development of **Uses for Geophysical Techniques** within the Soil Survey **Program**
OBJECTIVE(S): Evaluate the **suitability** of **ground-penetrating** radar end **electromagnetic** induction **techniques for soil investigations. Develop uses, field procedures, and standards for these** techniques. **Train soil scientists on the uses and operation of these techniques. Research designed to evaluate and demonstrate ways in which geophysical techniques can be used within the soil survey program to increase the frequency of observations, extend depth of observations, and strengthen levels of confidence in soil and site assessments. Studies will attempt to integrate** geophysical **techniques** with **other existing** end available soil survey teclmiques.
SCIENTIST(S): J. A. **Doolittle.**
STATUS: **Ongoing.**

24. PROJECT: Bulk Density Methods for Fragile **Surficial** Horizons
OBJECTIVE(S): To develop **field** methods **for determination** of bulk density of thin soil horizons **not sufficiently coherent for displacement methods.**
SCIENTIST(S): R **Grossman,** NSSC. NRCS, **Lincoln,** NE
STATUS: [illegible]

25. **PROJECT:** Total Elemental Analysis

OBJECTIVE(S): To develop and update the traditional soil survey laboratory procedures of total elemental analysis of soils and clays.

SCIENTIST(S): M. Wilson. R Burt, L. Klameth, and W. Lynn.

STATUS: Routine characterization procedure completed Feb., 1995. Additional work is required for heavy metal analysis.

26. **PROJECT:** Trace Metal Analysis of Soils by ICP-AES

OBJECTIVE(S): Trace metal content in soils from both natural and anthropogenic sources is recognized as an increasingly important aspect of soil characterization. Obtaining information in this area is possible with development of instrumentation which has the capability of simultaneously determining multiple elements at low levels. The objectives of this project are to (1) develop an appropriate digestion method to solubilize the total content of selected metals (Cd, Cr. Se, Hg, Mn, Pb. Co, and Zn) in soils; and (2) adapt existing laboratory instrumentation (inductively coupled plasma spectroscopy) for the determination of these elements, including definition of method detection limits

SCIENTIST(S): R Butt, M.A. Wilson, W.C. Lynn, M.D. Mays

STATUS: On-going

27. **PROJECT:** Deep-

OBJECTIVES: (1) Develop the protocol to be used in deep investigations (2) Develop a glossary of terms as needed to assist protocol.

This paper has progressed far enough to show that field texture descriptions of Andisols correlate well with the O.C. corrected 1500 kPa water content of the samples. These corrected water contents may be substituted for clay contents using the field descriptions and median clay contents of the

SOIL WATER AND TEMPERATURE

31. 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 how long each year and at what depths the [redacted] monitoring is established on a catena; and (6) To select sites in 1996 that will be sampled for biological/carbon movement which is being led by 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.

Status: Inexpensive protective shelters were designed and fabricated for the mini-loggers. Sites were established in the Tennessee smoky Mountains, in west vii on Edisto Island, South Carolina, and in the Catskill Mountains of New York during the summer of 1996. Data will be collected from the loggers one year after their installation. The data will be processed and the technology and techniques will be evaluated.

36. PROJECT: Cinnamon Bay climate study, Puerto Rico
Objective: (1) To monitor soil moisture and temperature and selected climatic parameters in a tropical island environment with a north aspect; (2) To test cell phone technology as a means of transmitting continuously collected climatic data; (3) To compare various resistance type soil moisture sensors; (4) To monitor soil moisture and temperature, both spatially and temporally, on a transect perpendicular to the slope on a heterogeneous slope; and (5) To compare the site with Lameshur Bay Watershed (south aspect), which has vegetation representative of a much drier environment.
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. An early hurricane in 1996 damaged the wind sensor and one of the solar panels. Repairs will be made this fall.

37. PROJECT: Climate study on St. John Island (Lameshur Bay watershed), Virgin Islands.
Objective(s): (1) To monitor soil moisture end temperature and selected climatic parameters in a tropical island environment; (2) To develop soil climate maps for the NRCS Caribbean Area; (3) To look at ground water saturation for flooding predictions.
Sciis): H. R Mount end R F. Paetzold, NRCS NSSC in cooperation with NRCS, USGS, and NPS Scientists in Puerto Rico and the Virgin Islands.
Status: Sensors and automated data collection equipment has been operational for five years. Corroded metal i[redacted]t cabinets will be replaced with fiberglass cabinets this fall. The LAM2 site will be upgraded by replacing several sensors, and adding a Campbell Scientific datalogger this fall. Several publications are available upon request.

38. 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, end Scientists from the University of Georgia and USGS, Atlanta, Georgia.
Status: Field sampling end mapping completed in 1994. Work has continued into 1995. GIS analysis is ongoing.

39. PROJECT: Soil Moisture and Temperature Models

OBJECTIVE(S): (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; (2) to develop a data base which can be used in global circulation Models (GCM's).
SCIENTIST(S): H. Eswaran, International Conservation Division Director, NRCS, Washington, D.C.
STATUS: Ongoing.

40. PROJECT: Wisconsin Dense Tii 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 are in operation. Eleven sites were automated with Campbell Scientific data collection systems in 1995. Eight additional conversions will be made in 1996. A general field calibration of the sensors is underway.

41. PROJECT: Application of Field Morphology to Water Transmission
OBJECTIVE(S): Analyze the effects of morphology as described in routine field descriptions on response of soils to precipitation, tillage, and traffic with respect to movement and storage of water. Devise protocols for the quantitative prediction of behavior from descriptions of morphology.
SCIENTIST(S): Robert Grossman

USE DEPENDENCY, SOIL QUALITY, HEAVY METALS

42. PROJECT: HEAVY METAL SOIL CONTAMINATION IN TWO SURVEY AREAS OF MONTANA
OBJECTIVE(S): To investigate the chemical properties and soil fertility implication for selected soils in Deer Lodge and Silver Bow Counties, Montana which have been highly contaminated with heavy metals for over a century. investigations of field and laboratory indicators of metal accumulation in soils, as well as determination of landscape dispersal patterns and within pedon translocation of metals in these soils, are being conducted.
SCIENTIST(S): R Burt, T. Keck, B. Daugherty, and J. Lii
STATUS: On-going

43. PROJECT: Heavy Metals
OBJECTIVE(S): To investigate the chemical properties and soil fertility implications for selected soils in Butte, Montana, that have been highly contaminated with heavy metals.
SCIENTIST(S): R Burt, D. Heil, B. Daughtery, and C. Gordon
STATUS: NRCS Montana is presently mapping these areas of heavy metal contamination. Investigations of field and laboratory indicators as well as the accumulation and movement of contaminants in these soils are being conducted.

44. PROJECT: **Use-Dependent Data Base**
OBJECTIVE(S): Evaluation of the **effects** of lend **use** and concomitant systems of management practices on soil **properties.** Support of the Use Dependent Data Conversion **Team.**
SCIENTIST(S): Robert Grossman

45. **PROJECT**: Water Quality
OBJECTIVE@): Evaluate the effects **of soil properties, including** properties as **modified** by **land** use and **management,** on the movement and storage of water. **Quantify** the implications of these effects on water quality.
SCIENTIST(S): Nielsen, Grossman

46. **PROJECT:** Water **Quality**
OBJECTIVE(S): **Provide soil attribute data and interpretations that support NRCS water quality initiatives and programs. Potential users are FOCS, resource planners and other.**
SCIENTISTS(S): **R.** Nielsen, **F. Geter - IRMD** Fort Collins et **al.**
STATUS: Initial **implementation** in FOCS.

47. Runoff end **micromorphological properties of** grazed **Haplargids** near **Cobar, N.S.W., Australia**
Greene, W.D. Nettleton, C.J. Chartres, J.F. Leys, and R.B. Cunningham
We investigated the effects of two different grazing regimes. The emphasis was on the surface soil properties. The sites were in a dune field land system in the semi-arid woodlands of eastern Australia. It is proposed that high intensity grazing, by forming physical crusts, may concentrate water into the dune-swale interface where it is available for uptake by unpalatable shrubs. A rainfall simulator was used to measure hydraulic properties of soil surfaces. Undisturbed samples of the upper 5 cm of the surface were taken to follow the fabric changes. O.C. Measurements of the plots were also made to follow the changes. The hypothesis is supported by the results..

48. **Texas** Phosphorus **Project:**
The NSSC-SSL is working **cooperatively** with **the** Texas NRCS, **Texas Institute** of Applied **Environmental Research, and the Texas A&M Research and Extension Center at Stephenville to characterize dairy waste-amended soils in the Bosque River watershed. The goal is to 1) develop background levels of soil phosphorus for "native" and waste-amended soils in representative geologies and landscapes of the watershed, 2) obtain soil physical and chemical characteristics needed for application of management-level simulation models in the watershed, and 3) evaluate the role that soil mineralogy plays in phosphorus sorption/desorption in intensively managed waste amended soils. This will assist researchers, extension personnel, and producers in development of nutrient management practices enabling producers to manage their animal waste while protecting water** quality **in** the **Bosque** River **and its tributaries.**
TM **Sobecki (NSSC-SSL)** end J.L. **LeMunyon, (NRCS-Texas)**

49. **PROJECT:** Effects **of Land-use** on the Physical **Characteristics** of Selected **Fersiallitic** Soils **in Zimbabwe**
OBJECTIVE(S): 1. To compare properties among **selected fersiallitic soils.**

To compare properties between paired pedons that differ in land management.
Erosion, as the result of intensive hmd use systems.

CARBON SEQUESTRATION AND BIOLOGICAL PROCESS

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 Kimble, Franks, and Samson-Liebig, 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 doii 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.

55. 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. Bliss, EDC USGS, Tarnochi, Agriculture Canada, and Francisco Orosco, INEGI, Mexico
status:

soils; (2) Estimate the buffer coefficients for a selected group of soils from Indonesia; (3) Estimate
[redacted] and one with low

57. PROJECT: Carbon Sequestration in Arid and Semi-arid Environments: A Case Study of Texas.
OBJECTIVE(S): (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 thereby 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

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

58. **PROJECT: Carbon Sequestration** in Soil - An International Symposium
OBJECTIVE(S): This international symposium which is jointly organized by the USDA-NRCS, FS, ARS, and the Global Change Program Office, US-EPA, end the Ohio State University end co-sponsored by the Soil Science Society of America and the International Society of Soil Science will address the importance of world soils in carbon sequestration, define the. relationship between soil quality and carbon sequestration, describe mechanisms and processes of carbon sequestration in soil, identify cultural practices and policy issues to enhance the capacity of soil for carbon sequestration, end explain the role of conservation tillage and CRP in carbon sequestration.
SCIENTIST(S): J.M. Khnble, NSSC, NRCS, Lincoln, NE
STATUS: Conference 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. Work is being completed on proceedings to be published in March of 1997.

59.

62. PROJECT: Organic Carbon Data Collection Project for New England States.
OBJECTIVE(S): (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 Spodosois in the New England region.
SCIENTIST(S): L. Quandt, Lead Scientists, NSSC, working with NRCS and University Sciauists in New York, Vermont, New Hampshire, and Maine.
STATUS: Field sampling completed in 1995. Samples under going analysis and evaluation.

63. PROJECT: Soil-C Storage Within Soil-Profiles of the Historical Grasslands of the USA.
OBJECTIVE(S): (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 precipitation 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.
SCIENTIST(S): R Follett and E. Pruessner, ARS; For& Collins, CO, S. Samson-Liebig, and J. Kimble, NRCS, Lincoln, NE
STATUS: Initial field sampling in fall of 1994, and additional sampling will be conducted in Minnesota and in North Dakota. Field treatments out in 1995. Follow-up sampling over the next several years. Sampling will be done in ND and OK in 1997.

INTERPRETATIONS

64. PROJECT: Risk Assessment for Soil Interpretations
OBJECTIVE(S): Apply the fuzzy set approach to develop risk assessment methodology fbr soil interpretations.
SCIENTIST(S): Dewayne Mays, Istan Bogardi, UNL.
STATUS: Ongoing.

65. 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 Siilair, 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.

66. PROJECT: Relationship Between Soils snd Incidence of Human Cancers.

OBJECTIVE(S): (1) Compare the cancer data from cancer registries in two states to determine what level of comparability exists between them; (2) To do the same with GIS 'parameters chosen for Pennsylvania and North Carolina; (3) Examine relationships between soils and rocks and cancers present; (4) Working with the Appalacbiau Leadership Initiative on Cancer Program at NCI to test the feasibiity of extending results to the entire Appalachian region.
SCIENTIST(S): Lead Scientist G. Petersen, The Pennsylvania State University, along with cooperators from Penn State, Pennsylvania Department of Health, National Cancer Institute, Markey Caucer Center in Kentucky, University of South Carolina, and North Carolina State university.
STATUS: **Project will start in January 1995. Graduate student hired at PSU. Project will be for** two years.

67. A field approach to **interpretation** of **Andisols**
Nettleton, **S.H. Brownfield,** E.C. **Benham,** R Burt, **S.L.** Baird, and **H.R.** Sllair
Preliminary study has shown that field texture descriptions and estimates of O.C. contents of Andisols may be used to estimate both 1500kPa water and clay contents of the Andisol samples. This paper summarizes the physical and chemical data of Andisols by these classes using models developed in study No.1 so that interpretation of Andisols may be more accurately made in the field.

68. **A field approach to interpretation of the engineering properties of Andisols**
Nettleton and **E.C. Benham**
Preliminary study has shown that the field texture descriptions and estimates of O.C. contents of Andisols may be used to estimate both 1500kPa water and clay contents of the samples. This paper summarizes the engineering data of Andisols by these classes using models developed in study No.1 so that interpretation of Andisols may be more accurately made in the field.

69. **Data Validation/Population**
OBJECTIVE@): **Ensure** the **development, testing,** and **implementation** of algorithm8 for use **in** the population and/or validation of**soil properties.** In most **cases** the **algorithms will** be **computerized for use in NASIS.**
SCIENTIST(S): NSSC **Data Validation/Population** Team
STATUS: This is a long term **project;** however, the **first implementation** of **computerized algorithms** will be **10/95.** work is **ongoing.**

70. Soil fabric-based interpretation of some compact-disk national soil characterization data
Nettleton, B.R. Brasher, E.C. Benham, and S.L. Baird
Herein we summarize the physical and mineralogical data for the plasmic fabrics and the coarse/fine constituent patterns and relate the classes to each other and to the soil moisture regimes.

71. PROJECT: National Soil **Productivity** Index
OBJECTIVE The "Soil Rating for Plant Growth". Evaluate **inherent** soil properties for **potential** biomass **production. Rank** soils nationwide **independent** of economics **and crop management.**
SCIENTIST(S): Joyce **M. Scheyer** (R&D), Ray **Sinclair** (Applications), **NSSC; NRCS** Agronomists, Universities; **ARS**

STATUS: Research and development completed in FY94; NTC and NCSS technical review in FY95; Implementation in FY96.

72. PROJECT: Revision of "K" factor for RUSLE Implementation
OBJECTIVE(S): Develop tables for insertion into FOTG with RUSLE adjusted "K" factors for paper implementation of RUSLE.
SCIENTIST(S): Ray Sinclair, NSSC; NRCS Agronomists and Soil Scientists
STATUS: Completion by March 1995.

73. PROJECT: Regional Agronomy Soil Interpretations
OBJECTIVE(S): Develop ecosystem-based Rating Guides, Interpretive groups, and preliminary field procedures for agronomy, pasture, and agroforestry based on soil properties.
SCIENTIST(S): Joyce M. Scheyer, NSSC; NRCS Agronomists and Foresters; Universities, ARS.
STATUS: Strategic Project Plan completed FY95; Work plan and regional work sessions implemented FY96-FY97; Incorporation into NASIS FY98.

74. PROJECT: Regional Forest Soil Interpretations
OBJECTIVE(S): To identify and develop new Forest Soil Interpretations on an ecological basis by working with regional foresters and the Forest Service. Utilize new interpretations for FOTG and incorporate into NASIS.
SCIENTIST(S): Ron Bauer, Bob Nielsen, NSSC; Forest Service Foresters and Soil Scientists; regional foresters.
STATUS: Completion in FY98.

75. PROJECT: Regional Rangeland Soil Interpretations
OBJECTIVE(S): To identify and develop new Rangeland Soil Interpretations on an ecosystem basis by working with National and Regional Range Conservationists. Incorporate these new interpretations in NASIS (example: Seeding Suitability).
SCIENTIST(S): Carol Franks, Ron Bauer, Bob Grossman, Bob Nielsen, NSSC; Ken Harward, IRM-D; Arnold Mendenhall Pat Shaver Keith Wadman, NHQ.
STATUS: Completion in FY98.

76. PROJECT: T Factor Criteria Revision
OBJECTIVE(S): To develop nationally consistent "T" factor criteria automatically generated by soil property database elements. Use properties in the existing database to do.
SCIENTIST(S): Ray Sinclair, NSSC; Lewis Daniels, Colorado S.O.; Arlene Tugel, Soil Quality Institute; Daryl Lund, Portland, OR; Earl Blakley, SNTC; Michael Whited, Wetlands Institute.
STATUS: Criteria completed 1994; Presently undergoing testing, review and revision. To be fully implemented by March 199s.

FACILITATING ACTIVITIES

77. 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 I Goddard Space Flight Center, Greenbelt, Maryland 20771.

Status: Tbis 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.

78. PROJECT: Laboratory Characterization Projects
OBJECTIVE(S): Maintain assistance to states for soil characterization; support soil survey research; soil quality. Note: Several dozen projects per year involve pedological and analytical research, frequently to solve a question related to quality in soil surveys, and frequently in cooperation with other cooperating institutions..
SCIENTIST(S): Analytical Management Team and associated resource soil scientists.
STATUS: Ongoing work will be interrupted in 1995 by renovations to improve air-handling system.

79. PROJECT: Maintenance of National Soil Survey Handbook and Soil Survey Manual
OBJECTIVE(S): Keep these two NCSS standards and guides up to date.
SCIENTIST(S): Gary Muckel and others.
STATUS: Active work on changes to the NSSH; no activity on SSM.

80. PROJECT: MLRA Revision And Ecoregion Development (LRU and STATSGO).
OBJECTIVE(S): Where or what are the geographic extents of Land Resources Regions (LRR) and Major Land Resources Areas (MLRA'S) for the United States. Develop 1:250,000 LRU and STATSGO coverage for the United States.
SCIENTIST(S): S. W. Waltman, NSSC, Lead Scientist, USFS, BLM, EPA.

81. PROJECT: National Soil Geographic Data Base (NATSGO) Development
OBJECTIVE(S): Where or what is the geographic extent of soils and what are their properties for the United States? Develop a 1:1,000,000 and 1:5,000,000 scale digital soil geographic data bases for the United States (NATSGO) to provide soils input to global change models and other users.
SCIENTIST(~): S. W. Waltman, NSSC, Lead Scientist.

82. PROJECT: Application of Point Data to Map Unit Components
OBJECTIVE(S): Develop and test procedures for choosing representative pedons for map unit components and using such pedon data in a map unit data base.
SCIENTIST(S): R. Grossman

83. PROJECT: Advertising Data Availability Electronically
OBJECTIVE(S): Develop MOSAIC home pages that provide information on what soil data are availableandhowtoorderaudobtainit.
SCIENTIST(S): Jon Vrana, Sharon Waltman, Fred Minzenmayer, NCG, ISU Computer Center. IRMD Fort Collins.
STATUS: Initial home pages developed Work is on going.

84. **PROJECT:** CD ROM's of Soil **Survey** Data
OBJECTIVE(S): Develop **CDROM's** of **STATSGO,** National Soil **Characterization** Data **Base (NSCDB),** Map Unit **Interpretations** Record (MUIR) Data, **and Official** Series Descriptions **(OSEDS)** and **make** them available **to** the public.
SCIENTIST(S): Sharon **Waltman, Fred Minzenmayer,** Jon **Vrana,** Ellis **Benham, Steven** Baird, NSSC and NCG staff.
STATUS: **STATSGO,** NSCDB, and MUIR **completed.**

85. PROJECT: NASIS - Reports Generator Team
OBJECTIVE(S): Automated soil survey report and manuscript tables and FOTG Section II tables and criteria generation within NASIS by creating report functions that derive inputs from the NASIS soil and layer attribute data. This will provide local, regional, state, and private users with the ability to generate soil survey reports that reflect current knowledge and soil attribute data.
SCIENTIST(S): Jon Vrana, NSSC; NASIS Reports Generator Team
STATUS: DRS complete; OPD/TRS?/Prototype being developed.

86. PROJECT: NASIS Field Data Collection
OBJECTIVE(S): Using automated systems and state of the art technology, develop soil data collection technology that improves soil data collection efficiencies and insures soil data quality. For use by NRCS soil scientists, natural resource specialists, and other public and private soil data collection specialists.
SCIENTIST(S): E. Benham, NSSC; G. Teachman, IRMD; et al.
STATUS: Completion in FY96.

87. PROJECT: Soil Data Base Updates of Classification and Site Locations
OBJECTIVE(S): (1) To georeference and update the classification of all pedons in the NSSC data base (United States and Internationally collected pedons); (2) to ensure all of the classifications are updated and correct for all pedons in the data base; and (3) to enter pedon descriptions where they are not currently stored in the data base.
SCIENTIST(S): T. Reinsch, R. Engel, NSSC, NRCS, Lincoln, NE
STATUS: Work has been going on for the last 4 years, about 50% of the pedons have been checked for classification and georeferences. Activities will be focused on the states with the lowest percentage of completed files. One or two WAEs will be hired to help enter SCS-Form 8s, pedon descriptions, and to determine locations of the pedons.

Introduction of Topia - Topics Introduced During a Round of Individual Commentaries by Invited Participants.

Each invited participant took a turn introducing and discussing topics. Notes were made (previous page) and *later distributed Then the following list was constructed by going around the room for contributions until all participants were satisfied that the important topics were listed Some invited participants worried that the list might be biased towards things that were not mentioned in review of NSSC activities; the idea being that those important things not currently receiving attention should receive special note in this meeting. Further deliberations will be requited to bear that out,*

Finally, the topics were grouped, and the groups were prioritized by multi-vote [illegible] to apply to one or more topics.

1.

'2.

3.

4.

5. Deriving landscape scale interpretations using spatial data/GIS.

6. Deep investigations unsaturated zone.

7.

8.

17. Quantification/understanding of the

24. Develop protocols for measuring soil parameters that would indicate changes over time to get at sustainability (Montreal protocols) Forest/Range.

in Southeast.

33. Improve recommendations for nutrient loading rates for environmental concerns.

34. Mechanisms for integrating NCSS to accomplish all this work.

35. Relationships between pedologic properties and climatic regimes related to plant community dynamics.

36. Include line segment methods into national manuals.

37. Replacement protocol for water desorption curves from soil characterization data.

38. Soil genesis related to dense till and fragipans.

Prioritization - Groupings of topics **(bulleted)** considered during **multi-voting.**

Topics were grouped and bulleted groupings voted on to prioritize., Topics retain numbers from list of previous poge. Where there is only one topic per grouping, the topic is numbered ond bulleted.

- Field Soil Water **Regimes/Land**

  4. **How to visualize water flows through the landscape (flow nets).**

  14. Biological **influences on water movement and organic matter.**

  2.5. **Genesis of Spodosol w/n low Coastal Plain in Southeast.**

  38 **Soil genesis related to dense till and fragipans.**

- 2. **Quantification of Rooting Zones (what constitutes** a rooting **zone?).**

- **3. Particle** Sii Criteria (pore space by **WRD) Engineering Community.**

- **Scaling** Data - **GIS**

  5. **Deriving landscape scale interpretations using spatial data/GIS.**

  20. **How to take point data and relate to spatial in GIS.**

- 7. **Interpretation** of **Soil** Properties for **Air Quality.**

- Integrated Look at **Land/Landscape (research** plot, **ecological unit, small** watershed approach)

  8. ~~Integrated look at land (landscape)~~

  Develop a general policy to thoroughly characterize our research sites (reliable extrapolation).

  Relationships between pedologic properties and climatic regimes related to plant community dynamics.

- Reliability?
  12. **Improve data base completeness** and integrity
  29. Development of **means** of reporting **uncertainty and conveying the information** to **users.**

- Biological Processes **in Soils**
  16. **Quantification** of biologiallly active **organic matter peds in soils over broad ecological regions.**
  13. **Biological influences on water movement and organic matter.**
  18. **Anaerobic microorganisms in soils - redox.**
  23. Relationship of soil **properties** to **noxious** weeds **(knapweed/spurge)** areas of **Rick/control.**

- 17. **Quantification/understanding** of tile **interface** of **spodic and andic properties (using oxalate extractable silica criteria).**

- **19. Relationship between potential yields** and **climate and predictability.**

- 21. Long term irrigation **impacts** on **hydric soil** LD.

- 23. **Relationship** of **soil properties** to **noxious** weeds **(knapweed/spurge) areas** of **Rick/control.**

- 31. **Improve criteria** for SMR **characterization (Hargreaves** method?).

- **32. HIV/HIM in soils of Midwest.**

- **Morphology and the Environment?**
  33. **Improve recommendations for nutrient loading rates for environmental concerns.**
  1. **Effects of macropores and ped surfaces on water and chemical transport and absorption/desorption kenetics.**
  22. **Prediction of Ksat from field morphology.**

- **34. Mechanisms for integrating NCSS to accomplish all this work.**

- 36. **Include line** segment **methods** into **national manuals.**

- 37. **Replacement protocol** for **water desorption curves from soil characterization data.**

Prioritization - Listing of the Top Six Vote-Getters Among the Groupings, and Why They Are Important. Listed in *Order,* Based On Number of Votes.

Note that number 5 priority, Quantitative Paleo vs. Modern Properties and Processes in Soil Systems, was created after the groupings, previous page. It did not take topics that are shown under the other priority groupings..

Criteria for prioritization: It's a soil survey issue.
It's an emerging issue.
It's a key internal agency need (did we view 'agency' as NCSS agencies?).

1. Field Soil Water Regimes/Land

Why: Education/understanding - Transfer our information to users. - Explain.

Consequences (Impact on)

- land use
- genesis
- productivity
- environmental quality
- soil behavior
- Reactant, solvent, conveyor
- explains soil geography.
- helps build a bridge to land managers/administrators
- the Chief's say do it.
- it simulates a natural model
- able to measure kinetics
- permits application of process models

2. Integrated look at land/landscape (research plot, ecological unit, small watershed) approach.

Why:
- A cost effective means to develop a systems approach to landscape interpretations.
- Improves ability to extrapolate information.
- Gathers a set of hard data for modelers.
- Provides spokes to Integrate Researchers.
- To help define the concepts!
- Identify early warning system for land degradation.
- Identify appropriate management technology (appropriate health care) preventive medicine.

3. Soil Health/Quality

Why:
- High public visibility
- Undergirding for all ecosystem
- Because the quality of human health/society depends on soil health.
- Allows us to predict stress - response functions
- Basis for land carrying capacity

4. Biological Processes in Soils

why : - **They determine aeration oxidation state**
of the system
[illegible]

6. Scaling Data - GIS

- **Improve the accuracy of soil survey.**
- **To understand how to manage the system (Interpretations).**
- **To improve the body of our scientific knowledge. (basic research).**
- **Better predict soil stratographic patterns.**
- **To improve soil taxonomy.**
- **Improve inferences we make between morphology and (sporadic , episodal) processes (pedotransfer).**
- **Enhance our cooperation with other (earth) scientists.**

ofhealthofsoiltion

APPENDIX C

DEPARTMENT OF AGRICULTURE

Natural Resources Conservation Service

RFP #126-FW-NRCS-97

Soil Survey Division Research Program

AUTHORITY: Pub. L. 74-46, 16 U.S.C. 590(a-f), Pub. L. 89-560

AGENCY: Natural Resources Conservation Service, USDA

ACTION: Announcement of availability of funds for Request for Proposal.

SUMMARY: The Natural Resources Conservation Service (NRCS), Soil Survey Division through Congressional authority, has provided soil related research primarily through the National Soil Survey Laboratory (NSSL), and the National Cooperative Soil Survey (NCSS), in Lincoln, Nebraska. The Soil Survey Division has focused its research [redacted] [illegible] for Soil Taxonomy.

The Soil Survey Laboratories, in concert with University collaborators, led in the development of laboratory procedures for physical, chemical, and mineralogical methods in support of the NCSS. Historically, geomorphic projects constituted prominent research activities.

The Soil Survey Division has funds for selected proposals and will utilize these funds specifically for research and development within its budget.

DATES: The solicitation release date is June 10, 1997. Request for Proposal must be received on or before July 10, 1997. Proposals received after July 10, 1997, will not be considered for funding.

ADDRESSES: Proposals must be submitted to the following address: USDA, Natural Resources Conservation Service, National Business Management Center, FWFC, Bldg. 23, 501 Felix St., P.O. Box 6567, Ft.Worth, TX 76115-0567. The telephone number is (817)334-5461; Internet: jlowe9ftw.nrcs. usda.gov. Hand-delivered proposal, including those submitted through an express mail or a courier service, must be submitted to the following address: USDA, Natural Resources Conservation Service, National Business Management Center, FWFC, Bldg 23, 501 Felix St., Ft. Worth, TX 76115. The telephone number is: (817)334-5461.

FOR FURTHER INFORMATION CONTACT: John Kimble, U.S. Department of Agriculture, National Soil Survey Center, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, NE 68508-3866; telephone (402)437-5376; jkimble@nssc. nrcs. usda. gov.

SUPPLEMENTARY INFORMATION: Notice is hereby given that under the authority for Soil Survey, awards ranging from $10,000 to $50,000 will be awarded for support of any one proposal, regardless of the amount requested. The total amount of funds available for proposals is $300,000.

Eligibility and Limitations on Use of Funds

Under this program, subject to the availability of funds, the Secretary may award proposal to land-grant colleges and universities, State agricultural experiment stations, colleges, universities, private entities, and to Federal laboratories having a demonstrable capacity in soil research. Proposal received from scientists at non-United States organizations or institutions will not be considered for support.

This request for proposal is subject to the provision found in 7 CFR part 3019, the Uniform Administrative Requirement for Grants and Agreements with Institutions of Higher Education, Hospitals, and other Non-profit Organizations, which sets forth procedures to be followed when submitting grant proposals, rules governing the evaluation of proposals, processes regarding the awarding of grants, and regulations relating to the post-award administration of grant projects. In addition, other Federal statutes and regulations, such as 7 CFR 3051, the Audits of Institutions of Higher Education and Other Nonprofit Institutions, and OMB Circular A-110 and A-21, apply to this program.

Specific Areas of Research To Be Supported in Fiscal Year 1997.

A research framework has been developed to advance the fundamental goals of understanding and portraying (T.E.C.) the pedosphere, to develop and quantify soil interpretations, and to provide efficient technology transfer relevant for the NRCS and its cooperators. Methods development is important within this framework. In the past, much of the laboratory's focus was on development and improvement of laboratory methods. These efforts need to be continued. Also, additional needs are to focus more [redacted] methods development (laboratory and field) and information delivery techniques are extremely important.

This framework includes the following integrative elements:

1. Soil-Water and Temperature

2. Geomorphic Modeling

3. Soil Quality/Soil Health

4. Soil Biological Processes in Soils and Carbon Cycling

5. Soil Genesis and Taxonomy

6. Spatial Variability & Scaling.

Critical Research Issues

Research is needed in the following general focus areas:

1. **Utilization of the NRCS Soil database.** The NRCS has an excellent and extensive database consisting of measured soil physical, chemical, and mineralogical properties from soils throughout the world. The database is an under utilized tool that has significant potential for use in improving soil quality, increasing agricultural production, and providing information to our customers. Development of new uses for the soils data is encouraged.

2. **New and developing issues in agriculture.** Site specific management (production [redacted]ation and critical area management) and soil quality are current examples of new areas holding promise of improving agricultural production while maintaining or proving soil conditions.

3. **Global Climate Change**. Studies in this area include understanding future effects on agriculture and forestry of climate change, whether natural or human caused. Priority [redacted] moisture and temperature over time, and contributions of agriculture and forestry to the mitigation of greenhouse gas emission and to project the capability to adapt to these

changes. Studies related to developing data on soil properties that can be used by others in Global Climate research are also of interest.

4. **Use-dependent and temporal soil properties.** Studies in these areas may be closely related to other research activities such as site specific management or to development of long-term soil climate indices through analyses of continuously-monitored properties such as soil water status and soil temperature.

5. **Relationship of the pedosphere to other "spheres."** The relationship of the pedosphere to the atmosphere, geosphere, hydrosphere and biosphere should be investigated in a globally integrated manner. Included in this area is the development of models linking the soil environment to global models of the earth's interactions.

6. **Paleo-environment.** Studies of paleo-environmental parameters, as proxy models, can be used to predict climatic effects. This is an extremely important area in this era of global climate changes.

7. **Scaling data.** Included in this area are the needs to aggregate data from different sources and different scales and to develop means for dealing with geographically variable data.

8. **Ecosystem management.** Studies should be oriented to integrated units such as watersheds rather than individual farm fields, political areas such as counties, individual soil map units or point-location. The concept of soil landscape should be developed and refined.

How to Obtain Application Materials

Copies of this solicitation, and the Administrative revisions for this program (7 CFR and

3019) may be obtained by writing to the address or calling the telephone number which follows: USDA, National Business Management Center, Acquisition Management, Attn: Mr. James Lowe, P.O. Box 6567, 501 Felix Street, Ft. Worth, TX 76115-0567, (817)334-5461. Persons with disabilities who require alternative means of communication for proposal information (Braile, large print, audiotapes, etc.) should contact the USDA office of Communications at (202)720-2791.

These materials may also be requested via internet by sending a message with your name, mailing address (not e-mail) and phone number, to jlowe@ftw.nrcs.usda.gov. The material will be mailed to you as quickly as possible.

Preparation and submission of Proposals

Proposals submitted in response to this announcement for research opportunities must be submitted in accordance with the following guidelines.

Proposals shall be less than 10 pages in length. They must contain target dates and [redacted] statement of problem (s), a brief literature review, benefits of the proposed research to NCSS, science and society, proposed outreach program, and existing facilities/equipment. When the project is to be carried out in a cooperative nature with the NRCS, with a NCSS partner, or with another entity, the responsibilities of each partner must be described.

A two page curriculum vita for each researcher (s) needs to be included with the proposal. A description of the qualifications of the scientist (s) (including degrees, publications, related grants, and past work). Failure to provide full and complete [redacted] may reduce the possibility of receiving an award.

Proposal Review

Proposal will be reviewed by NRCS and outside reviewers to ensure that they are within the areas outlined under critical issues and within established procedures of the NRCS. Strong consideration will be given to proposals that have the potential for enhancing the use of the existing data and information presently available at the NSSC.

In accordance with Federal statutes and regulation and USDA, NRCS policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the Department of Agriculture. Entities or individuals will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities support by this award of assistance.

Roy R. Twidt

Director, National Business Management Center

Committee Report
on

Natural Resources Surveys

to the

National Cooperative Soil Survey Conference

Baton Rouge, LA
June 15-20, 1997

Charges:

1. Define the scope of a Natural Resources Survey and why a Natural Resources Survey is needed.

A natural resources survey is an all encompassing collection of information, **descriptions, and maps of the distribution, condition *and* functions of all natural resource components in a physiographic or geographic area. It should extend beyond political, ownership, and land management boundaries to the natural boundaries of the resources. The natural resource survey might be better described as an assessment process, and not a single product. The survey may consist of a review and correlation of available resource data and information. It could include, but certainly not be limited to the following:**

1) climatic information such as precipitation, temperatures, growing seasons, air quality parameters,
2) geomorphic information such as landscapes, landforms, topography, aspect,
3) geologic information such as parent rock types, structural formations, geologic setting, and sediment sources,
4) hydrologic information such as surface and ground waters, drainage status, base and peak flows, and water quality,
5) vegetative information such as plant species (macro and micro), communities, associations, and habitat types,
6) animal information such as species (macro and micro), communities, native or introduced, endangered, balance,
7) soils information including types, distribution, suitability, limitations, and potentials,
8) human parameters such as population, demographics, lifestyle, economics,
9) other components specific to user needs or geographic area.

One of the main advantages of a complete Natural Resources Survey is it would provide a means of 'one-stop shopping' for natural resources information. This service is being asked for by users of the data. The information would be put into a clearinghouse and available from a single source. Responsibility maintenance and update of each data layer would be with the authors/developers of that layer. Maintenance and update could be accomplished without changing the other layers, and duplication of effort could be reduced. This would also give the governmental agencies and public institutions a chance to tell one story about resource characteristics and conditions.

Previous inventories and surveys relied upon defined mapping units being delineated upon a map and all the components, conditions, and aspects of all the resources related through the description of the map unit. The link to data on all resources was through the soil map symbol in the case of soil survey. The document is hardcopy and lends itself to only manual analysis. Utilization of Geographic Information Systems (GIS) can provide its own linking of resource data. Each resource survey becomes a separate layer in the GIS system and is related back to other resources through positional data, usually the UTM coordinate. In this manner, each resource component can be delineated based upon its own natural bodies, breaks, gradients, or continuum. The GIS system can bring any or all of the layers together for viewing or digital analysis.

The skills needed to perform the inventory tasks do no reside in a single discipline specialist, and probably not within a single agency or institution. The survey must be designed and conducted to meet the discipline specialists needs, yet be integrated from the site level to the regional level. The task to complete the various tasks should reside with those who are available and those who can do it the best. Leadership in the effort should be from partnerships, such as the National Cooperative Soil Survey. These partnerships will facilitate the largest draw on skills needed and the proven capability to produce surveys of natural resources.

2. Establish where NCSS currently is in the Natural Resources Survey approach.

The National Cooperative Soil Survey and its members are currently making efforts to produce a more complete natural resource survey in many areas. A National interagency Technical Team from USFS, NRCS, EPA, BLM and USGS has been formed to develop a common spatial framework of ecological units. The US Forest Service has been conducting surveys to develop management units for ecological units within the forests. The realignment of the NRCS Soil Survey Program along Major Land Resource Area boundaries is designed to remove the political boundary issues, provide greater consistency (uniformity) within physiographic resource areas, and to allow for focus of human skills. The NRCS National Resources Inventory is designed to collect new natural resource information and associate it with soils data for analysis and trending. New partners in natural resource management such as the DoD-Army and National Parks Service have joined the NCSS. Watershed and river basin studies are being conducted using interagency specialists. Data collected can be assimilated into NASIS. Many new interagency agreements, MOUs, liaison positions, have been developed to share information and procedures to bring resource inventories/surveys into better alignment. The formation of institutes and inter-agency/inter-institution teams have come together to address natural resource inventory and monitoring problems. NRCS has designated four states to test the Natural Resource Survey concept.

3. Provide an explanation of how Natural Resources Surveys would differ from a Soil Survey so that the concept can be better understood.

The natural resources survey differs from other inventories or soil surveys in the number of components being surveyed and the groupings of the various resources. Soil surveys utilize natural soil bodies or interpretative conditions as the delimiter of the map delineations (map units). The other resources in the area are described in terms of the soil bodies for which they can be associated or correlated. Rangeland surveys similarly delineate areas of similar grazeable plant communities and then describe the associated soils, topography, etc. In each of these cases, the delimiter or criteria for delineation is a single resource component and other components are split along boundaries which may or may not be relevant to the other resource. The GIS-based natural resources survey would allow for independent display and analysis of one to several natural resources at a time. Additional resource data and information could be added at any time. Traditional soil surveys have had a designed in bias for based upon land use. The natural resource survey could be designed so land use could be a layer, and not a criteria used in map unit design.

4. Develop several procedural alternatives for conducting this a Natural Resources Survey.

Traditional data capture methods that are currently being applied to the various resources surveys can probably be used, but a little bit of coordination and agreement upon scale, data definition and the like needs to be made. In essence, a template(s) would be developed and followed by all participants. This template(s) would be populated with data relevant to each resource. Common mapping base and data capture conventions, and data dictionary would be followed by all contributors.

The skills needed to perform the inventory tasks do no reside in a single discipline specialist, and probably not within a single agency or institution. The survey must be designed and conducted to meet the discipline specialists needs, yet be integrated from the site level to the regional level. The task to complete the various tasks should reside with those who are available and those who can do it the best. Leadership in the effort should be from partnerships, such as the National Cooperative Soil Survey. These partnerships will facilitate the largest draw on skills needed and the proven capability to produce surveys of natural resources.

In most cases, the natural resources survey would be a cooperative team effort of collaborating natural resource specialist. Each would develop or acquire and data layer for which they have the most expertise. A team would need to consist of experts for the natural resource parameters to be surveyed or correlated. One of the first questions to be asked is "Why? and "What is needed? A clear vision of the information product and its users must be considered. In very few cases would no information exist about several of the natural resources in a given area. It is very important that the information and data be on the natural resource distribution, attributes, and conditions, and not interpretations of these characteristics. The existing surveys, inventories and assessments would need evaluated and classified for placement in a hierarchical system from the very general to the very specific. By doing such, the information which was not as detailed as needed could be identiied for further work, data at the correct detail could be correlated, and data too detailed for the desired intensity could be aggregated. The hierarchical classification could point out the data voids where field investigations are needed. At that time, the team could decide upon an agreed area of extent, scale of mapping, a common data dictionary, and information format and presentation It should also be decided who would collect or correlate which resource elements. This could prevent duplication or conflicting work which could be considered to overlap into multiple resource components. For example, intermittent water areas which sometimes function as soil and sometimes water

The following is a list of some of the steps of how the natural resources survey process might be done.

Ask Who? What? and Why?" A clear vision is needed.

Develop an hierarchical template or framework for existing data classification.
Collect *and* assess existing data for quality, applicability, accuracy and scale.
Place data and information into the hierarchical classification.
Assess the compatibility of the information to the "Who?, What? and Why?".
Identii and list data voids.
Prioritize data needed.
Develop a plan to fill the voids with data and information to meet the needs.
Utilize interdisciplinary/interagency teams for data collection and analysis.
Process the information into a commonly used GIS system.

Recommendations

It is recommended that efforts of the NCSS partners to develop and test the natural resource survey concept be continued. Standards, guidelines and procedures should be outlined and reviewed. An analysis of past and ongoing state, agency or institution natural resource survey efforts should be conducted.

(No recommendation was made to continue this committee. Multiple interagency teams of NCSS partners are already evaluating the requirements and needs to conduct more comprehensive *and* compatible natural resource surveys.)

COMMITTEE #5

FUTURE OF SOIL SURVEY

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

June 16-20, 1997

COMMITTEE REPORT

Committee **Members:**

Stan Anderson
Craig Ditzler
Sam Indorante
Chris Kendrick
Kevin Martin
Nathan McCaleb
Fred Miller
Sharon Waltman
Sid Davis
Paul Finnell
Russ Kelsea
Cameron Loerch, Chair
Dean Martin
Bob McCleese
Randy Southard

CHARGE # I: EVALUATE METHODS OF DATA COLLECTION AND ANALYSIS TECHNIQUES IN LIGHT OF FUTURE EXPECTATIONS AND NEEDS.

CHARGE #2. WHAT IS NEEDED FROM SOIL SURVEY PRODUCTS IN REGARDS TO CONTENT, FORMAT AND DELIVERY THAT WILL MEET THE FUTURE NEEDS OF OUR PARTNERS, CUSTOMERS, AND STAKEHOLDERS.

CHARGE #3: WHAT TYPES OF SYSTEMS OR TOOLS ARE NEEDED FOR PROVIDING TECHNICAL SERVICE OR ASSISTANCE TO OUR CUSTOMERS?

CHARGE #1: EVALUATE METHODS OF DATA COLLECTION AND ANALYSIS TECHNIQUES IN LIGHT OF FUTURE EXPECTATIONS AND NEEDS.

The comments pertaining to this charge created a wide spectrum of ideas on data collection and analysis. A **synopsis of the** comments is *that* field soil scientists and researchers need the ability to collect point data, georeference *the* location, view digital imagery, digitize map unit boundaries, and write qualitative field notes during the course of daily field operations.

The data to be captured revolve around soil properties (*i.e.* descriptions, soil quality features, temporal properties, *etc.),* location, ***map unit*** boundaries, and map unit notes. The data to be analyzed deals with defensible statistics on map unit composition and ***soil property*** ranges. Remote sensing technologies need *to* be pursued and developed ***as*** an aid ***in*** making surveys.

Software ***is*** available that allows ***collection of data and analysis of data.*** The soffware: *PEDON, NASIS, ARCVIEW,* and *GPS* are available for data ***collection*** and analysis. These ***programs are functional as designed.*** *but* need *to* be designed *to* run ***on a*** field data recorder.

- PEDON ***is a software*** fool ***used for data*** collection of point data. Through Standard Query Language (SQL) and ***Intelligent Query (IQ), PEDON has the*** ability fo analyze data collected as point and transect information. ***The software is flexible in*** allowing ***new user*** defined data elements *to* be added as *the* need arises. The alarming fact is that many field scientists ***do not have access to*** this fool and are not benifiting from ifs usage.

- *NASIS* ***is*** a software fool used for managing map unit data. ***This software allows for management of a survey area by*** maintaining legends, map units, correlation notes, and component *properties* and inferprefafions. *NASIS* also allows for data analysis and interpretation development ***using*** ranges and representative ***values of soil properties.***

- *ARCView* ***is a software fool used for*** spatial *data* analysis and limited digitizing. *This* one tool can provide limited digitizing, view of spatial imagery, location of ***collected*** point dafa, and potential location of map *unit* ***transects. It can test*** legends and interpretations *across* political boundaries.

- GPS [global positioning system) is a ***software fool*** used for site location. This ***fool has fhe*** potential to aid ***in the location of*** *site data as* relofed *to* geospatial distribution. This will assist in *data* analysis.

The fools to record soil survey activities are available, but they need to be ***merged info "one fool". The future*** of "data collection and analysis techniques" refiew on the *ability* to merge these ***"fools"*** info one operating *platform* on a single field ***data recorder.***

Evaluate methods of *data collection* and analysis techniques in light of future expectations and needs. *(cont'd)*

Recommendations:

Short Term *(1* ***year*** time *frame)*

1. ***Commit to providing all field scientists and*** researchers access to ***PEDON for*** data recording.
   - *Reprioritize NASIS* ***development to focus on field /eve/ functions.***
   - ***Move*** PEDON info the *NASIS data* structure.
   - Develop a *dos* ***version of PEDON.***

2. ***Reemphasize fhe need for thorough documentation of poinf data and map*** unit conceptual development. including an assessment of *the* level of ***confidence about the data, and storage of this documentation in digital*** format.

Long *Term (2-4* year *period)*

3. ***Develop a pen*** based *data* logger *(Hammerhead like) that* will enable *all software packages to function* on fhe some *platform* ond in a ***field*** environment.
   - *allocate* funds *fo* develop pen fechnofogy *($10,000 -$30,000)*
   - once developed, provide fo *all* ***soil survey project offices.***
     - -Number of *acfive* soil surveys: about 300
     - -Cost of technology per ***survey:*** $6,000
     - -Estimated cost $1.8 million

4. Provide thorough training on the ***use of*** the *hardware* and software in order *to* maintain the *"tools".*

5. Commitment of funding *to* the MLRA Project Office operations.

Once provided, the *publication* process ***con*** then be streamlined. The field soil ***scientist*** will ***hove*** the ability to collect ond *analyze* the *data,* develop mop unit *data* and reports. *create* the map and forward the information to the *correlator.* The correlotor con then move this informofion info the publication process, whether ***if is*** forpublicafion of the quad, the *county* or *the* MLRA.

CHARGE #2. WHAT IS NEEDED FROM SOIL SURVEY PRODUCTS IN REGARDS JO CONTENT, FORMAT AND DELIVERY THAT WILL MEET THE FUTURE NEED; OF OUR PARTNERS, CUSTOMERS, ANG STAKEHOLDERS.

ISSUES RELATED JO: CONTENT

- Partners, customers, and stakeholders should be continually surveyed for their specific needs concerning soil survey information.

- Current published soil survey reports contain information that could be provided by other sources. such as History or General Nature of the County.

- Many of our partners and clients desire access to traditional published soil survey information rapidly and in a digital format.

- Emphasis (including time, money, and other resources) should be to produce soil survey information that is scientifically sound, that is geospatially correct, and can be used in making accurate interpretations.

- Future soil surveys should be adaptable so that future scientific discoveries can be integrated in order to meet the needs of customers and users.

ISSUES RELATED TO:FORMAT

- Soil survey information should delivered in a digital format. Current/y, too much emphasis is being placed on producing a "Book". Efforts should be concentrated on getting soils information available.

- Geospafial databases should be created that compliment the digital soils maps.. Soil characterization data is one example of data that could be used to 'enhance' the usability of the information.

- Formats need to be flexible in order to deal with specific, local needs,

- Soil information needs a professional "National Geographic" level of presentation. Consult "National Geographic" to help design a profotype and in setting standards for remaining 3,000 surveys for digital presenfafion.

ISSUES RELATED JO: DELIVERY

. Commercially distributed (off-the shelf) software should be utilized to ensure a common language. (ie. Pagemaker)

. All media technologies [such as CD ROM, Internet, etc.) should be considered for delivery of soil information.

. Digital soil maps should be 'clickable' fo obtain attribute information as well as /inks to other data where appropriate.

. An easy, inexpensive method should be developed to produce hard copy soil survey information for those customers who desire that media.

RECOMMENDATIONS: (short-term]

1. ***Set up and maintain an ongoing customer survey to determine appropriate*** content, Format, and Delivery needs.
   - Contact NRCS *Social* Sciences *Institute* for assistance.
   - Include all NCSS cooperators in ***survey.***
   - ***Be sure to include*** the National Society of Professional Consulting Soil Scientists os they depend on soils information for earning a living.

2. Provide easy INTERNET access to the traditional published product with exception of modem interpretative ***fables*** from current data base sources.

   - ***Build*** Internet *(WWW)* interface much the some way *that* CD-ROM encyclopedias ore used presently. The interface should be graphical and allow the ***user*** *to* easily "click" through views of *the data* as follows:
     geo-political view -- notion to state to county ***to*** township *or* ***quad***
     natural division view -- ecoregion to *mlra* to *STATSGO* to SSURGO to PEDON

   - ***Convert*** existing ***collections*** of soil ***surveys*** to hove ***mops scanned and*** hypertext or ***"pdf"*** narrative and update with current interpretative tables.

   - Index hypertext or ***"pdf" soil survey*** products to WWW Home Page or CD-ROM or both by state and add color photographs of landscapes and soil profiles.

   This option offers no onalysis, only access *to* the information and ***mops only serve as*** *a* point of reference.

   Dotes: J-2 ***year*** timeframe
   Estimated Costs: *$10-20,000 to* ***build interface, $_____ per survey to get data*** info digital format.

3. Develop a system for creating publication ***qualify fables using*** *a* ***software*** *that* ***is compatible*** with electronic publishing.
   - Develop ***application*** in Pogemaker to create table suitable for publication and also ***is*** linked to rest of manuscript.
     Dotes: October J 997
     cost: *$25,000*

RECOMMENDATIONS AND DIRECTIONS FOR FUTURE *CONSIDERATION*

In 5 years:

Soil information should hove *Internet* accessible basic GIS capability for digital SSURGO mops *with NASIS* interpretive function and also *with legacy* digital soil survey mops. Minimum levels would be ***ftp access*** for notional collection of SSURGO spatial *and* attribute data bundled in a variety of formats via *WWW* and on CD-ROM or other appropriate media for the *time*. Simple, easily accessible ftp sites thot ore logical ond provide some pm-processed *data,* with acknowledgment of known limitations should be considered o bore minimum. CD-ROM and hard copy ore *still* offered *to* client.

RECOMMENDATIONS AND DIRECTIONS FOR FUTURE CONSIDERATION

In IO years:

Soil information should have easy, user friendly interface on-line through the Internet or WWW *(if* these ***ore*** still *the* terms in *use)* in the fox-payers living room via the "N-Browser". ***Such access is widely available of this time*** and ***the*** function ***the soil Survey site is*** advanced problems solving *(GIS)* analysis available ***for the*** entire country *with* SSURGO quality *data.* User enters *site* graphically and conducts ***query*** by asking o question. Either user *site* or o provided remote site is conducting *the* necessary calculation and consulting appropriate user provided data, probably housed in o *state* or local *data store* and managed by on NCSS partner and considering NCSS *algorithms* appropriate *to the* task. SSURGO *data* ore revised *and* maintained by quadrangle and *attribute* data ***ore*** correlated for a *variety* of *area* types in *NASIS*. SSURGO dofo are always up to *date* ***via*** notional dofo librarian and on historical log is available for *past* consult. *Up-to-*dote, local, *state,* and notional legislation affecting fox payer is fully acknowledged ond presented in the analysis ***scenario.*** CD-ROM and hardcopy still offered to client.

CHARGE #3: WHAT TYPES OF SYSTEMS OR TOOLS ARE NEEDED FOR PROVIDING TECHNICAL SERVICE OR ASSISTANCE TO OUR CUSTOMERS?

The key element or primary *expert* ***system is the soil*** *scientist with* field skills, communication skills, and also *a* proficiency in computers, geospafial databases, and GIS. Soil scientists should be teachers and *interpreters* of soil information. We should *recruit* and develop soil scientists with GIS skiffs and *GIS* specialists with skills in studying the natural ***world.***

1) Data Gathering

- Data should be gathered to increase the understanding of soil-landscapes.
- All *data* gathering should be toward building a geospafial *data* base, ***thus*** *the* ***use*** and development of *GeoPositioning* Systems *(GPS)* and ***Geographic*** Information Systems *(GIS)* ***are*** critical.
- Remote sensing technologies (e.g. satellite imagery) should be fully utilized.

Marketing Strategies for Soil Survey

Report of the soil survey marketing committee to the National Soil Survey Conference 6/17/97

Current marketing situation for soil survey

In the United States 3280 unique soil survey areas exist.
About 2400 have a hard bound up to date soil survey publication.
Another 200 are in process of publication.
Of the 2400, one third are digitized in some fashion but not certified.
65 soil surveys meet SSURGO certification standards for digitizing.

Most soil survey area boundaries correspond with county lines. The soil lines and map unit symbols for most surveys apply only within the soil survey publication area.

Potential users are consulted for the design of survey to meet the dominant needs within the survey area. These needs are stated in the Memorandum of Understanding. Many soil surveys predate current users and uses. The needs within a given survey area may have changed with time. Policy exists for evaluating soil surveys, but the policy does not require a set frequency or trigger mechanism. NASIS includes data quality parameters but evaluations of survey design and content for current use and needs are not maintained except with soil survey evaluations. These evaluations are maintained in state offices when completed.

The primary method for initial distribution of the published soil survey is a public information meeting where the new survey is explained. This is often the only training provided to field offices. Subsequent distribution is handled by the field office on a person to person basis. Ongoing and innovative training for field personnel and users of the soil survey is sporadic across tbe country.

Field offices commonly use loose soil survey maps and a list of assigned values for each map unit symbol for conservation program work. Field office staff often do not understand the basis for the values.

An objective of soil survey is a seamless survey across county and state boundaries. National programs that use soil information for highly erodible land and conservation reserve program determinations generate the need for consistency across county and state boundaries.

The desired condition of soil survey data generally has not been explored with other users. Users ask for quick electronic access to soil survey data and usually want a seamless condition within their area of interest.

Development of the National Soil Information System for managing tabular data and digitizing efforts on controlled map bases are in progress. Spatial and tabular data exchange standards require cartographic controlled bases and common data elements so that other resource data may be layered with soil data for analysis and interpretation.

Requests for soil data that is digital and tabular have increased. These products have proven to be more flexible for updating and provide for various formats for reports and electronic means of delivery. Targeting user groups and marketing with training are possible. The hardcopy of a soil survey is now only one medimn. CD-ROM disks, internet, and access to databases are planned. Information explaining "what is the information", "how to use it", or "what scientific base supports it" are weak

Soil survey information is not integrated with other resource information in databases at the present time. The information is included within field office technical guides but thls document has the same criticism.

A major role of the State Soil Scientists of NRCS is marketing soil survey information in their state. Emphasis on marketing varies greatly from state to state

No one has national responsibility for marketing soil surveys or for developing and following through on a soil survey marketing program.

Reorganization of the NRCS over the last two years established soil scientist positions in many different divisions

Marketing Strategies for Soil Survey

Objective - Make soil and natural resource data of the highest possible quality generally available to the public in a manner that ensures its appropriate use.

I Customers and their needs

A. Develop a process that continually assesses customer needs sad ensures that soil survey products meet those needs

- **Gather additional information on the needs of customers**
  - **Develop a database of customers and assign individuals to address their needs**
  - **Meet with customers and diis their needs**
- **Evaluate satisfaction with current products**
  - **Include a customer satisfaction response card with each soil survey product**
  - **Focus groups, phone interviews, or surveys are options**
- **Encourage state. soil survey planning (or user) conferences to develop processes to evaluate soil survey needs**

B. Nationally identify emerging groups. Target a few of their key members.

- **Private consultants**
- **Certified Crop advisors**
- **Precision farming**
- **Alternative agriculture**
- **Sustainable agriculture**
- **Environmental groups**
- **Realtors**
- **WEB users**
- **Geographic information system users groups**
- **Urban customers**
- **Science teachers**
- **Employees within agencies of NCSS that contact land managers**

II Product development - Internal consistency and scientific base of soil information

A. Continue development of the Nations1 Soils Information System

- Provide for quality **control** through validation **and** checks **within** the system
- Provide national guidance and **training for** data **entries**
- Connect **generalized** data with data such as lab data, soil descriptions, and field measurements

Et. **Update and improve the quality of STATSGO**

C. Work toward a seamless soil survey

- **Join surveys** during recompilation for digitizing the country
- **Join surveys during MLRA** projects

D. Create a process for the development end maintenance of standards for soil survey that includes public and private sector input

- **Involve the National Society of Consulting Soil Scientists (NSCSS) in establishing soil mapping standards**
- Include **data collected** by **Professional Registered Soil** Scientists
- **Maintain Federal geographic data exchange standards**

E. Partner with the private sector in the development of the soil survey and related produets.

F. **Consistently identify NCSS products** to **source and quality**

- **All cooperative soil survey and NRCS products should be rated for quality and utility.**
- **Provide for a certified label or logo such as SSURGO Certified or Meets NCSS Standards**

G. Expand formats for delivery of soil information

- **Digitize soil survey maps across the US**
- **Establish a centralized database for storage and delivery of digital and tabular data**
- **Provide access to digital and tabular data at the field office including hardware, software, and training**
- **Provide** for publication of soil surveys **in** bound **or** loose reports, CD **ROMS, or on the WEB downloaded from a common database**
- **Provide for reports tailored specifically for different user groups**

H. Make sure products meet user needs

- **Work with** customers before, during, **and after** product development
- Develop **specific** products for **well defined user** groups **including** those cited.
- Each product **should have** a **well-defined development,** market&g, end **training** component
- Include situation analysis, **purpose, goals, strategy,** audience, messages, success measurements, timetable, budget, **and an** action schedule.

III Visibility, accessibility, and delivery of soil information

A. Expand the visibility of how to obtain soil information

- **Prepare a** fact sheet **and** brochures explaining the soil survey and how to get **the information**
- **Establish** a **1-800-GET-SOILS** phone **number** to retrieve **the fact** sheet **and** brochure, **status** map, **and** directories
  - Publicize the l-800 number on posters. TV, magazines, **and through** equipment and chemical **companies.**
  - Target **national** Realtors **associations,** city **and** county **government** associations, **environmental organizations,** chemical dealers **associations, and** major farm equipment companies.
- Include the fact **sheet and** brochures **on** a soil survey WEB site. Add a map showing where soil information is available, in **what formats, and directions on** how to access **the** information. Include a **directory** of state soil scientists **and other agency** contacts.
- Incorporate soil **survey** end its use into **the classroom** of K-12.
  - Develop **teaching** products for teachers
- **Utilize the** soil **survey centennial** to initiate a soil information public awareness **campaign**
  - Develop end distribute a CD-ROM of **state** soils for teachers **and** others
  - Develop brochures, **book** marks, **and other** materiel **with** the I-800 number **and** promote **the centennial**
- Develop information educating **the public** on **the** availability of soil information

B. Market soil information to target audiences

- Develop a marketing plan for each soil survey and each soil survey product in conjunction with the field office involved.
- Utilize the Cooperative **Extension, soil survey cooperators, and public affairs specialist of the primary agency..**

C. Improve the accessibility of soil information

- Provide other organizations and the private sector **with the capability to market soil information**
- **Provide maps on the WEB of areas with soil surveys . Include a list of contacts for further assistance**
- **Provide soil survey laboratory end cooperator lab data on the internet**
- **Provide soil information in common user friendly formats and languages**
- **Package soil information and ways of using it with other resource information**
- **Build** capability of field staffs and users to access and provide soils data on demand for any size land area

D. Expand the accessibility of soil information to meet agency goals

- **Incorporate NASIS soil information into field office technical guides with the capability to manipulate the data into special reports and interpretations at the field level**

E. Provide follow-up support to soils products

- Provide training support to users of soil survey information
- Provide a network for technical soil services to respond to customer needs and feedback

F. **Consider privacy issues throughout the information gathering and dissemination process**

G. Create an information delivery function within NRCS

- **Develop, market, and provide training for soil information products**

IV Organizational structure and training to deliver soil services and support

A. Emphasize technical soil services and the marketing role of state soil scientists

- **Train state soil scientists in marketing**

B. Relieve state offices of production aspects of soil survey to allow marketing and technical services for users to occur

- **Folly implement MLRA office roles**

C. Establish or maintain soil scientist positions in other NRCS divisions bat retain in the network of technology

- **Ecological sciences**
- **Wetlands Institute**
- **Soil Quality Institute**
- Watersheds **Institute**
- Resource Inventory Division
- National Resource Inventory Institute
- Conservation **Program** Divisions

D. Establish liaisons from the National Soil Survey Center to various Divisions and Institutes

- **Maintain a critical mass of technical expertise at the NSSC to technically support the soil scientists providing daily support to other division and institutes and external organizations**

E. Train **for tbe**

REPORT FOR TASK FORCE ON NCSS STANDING COMMITTEES AND OTHER COMMITTEES ASSOCIATED WITH NCSS ACT-S AND THEIR MEMBERSHIP

NATIONAL COOPERATIVE SOIL **SURVEY** STEERING **COMMITTEE**

The Steering committee shall asist in the planning and management of the Conference. It shall formulate policy and procedures for the **Conference.** It shall determine subjects to be discussed and committees to be formed. It shall select committee chairs and obtain their approval and that of their agency for participation. It **shall** assign charges to the committee chairs, recommend committee mambers, determine individuals form the U.S. or other countries with **soil** science or related professional interest to be invited to **particiipate,** determine the place and date of the Conference, organize the program and select presiding chairs for the sessions, and assemble in joint session at least once during each Conference to conduct business of the **Conference.**

Chair:
Horace Smith
NRCS
P.O. Box 2890
Washington, **D.C.**
20013
phone: **202-720-7848**

Ken Scheffe
NRCS
6200 Jefferson, NE
Room 305
Albuquerque, NM
87109-3734
(505)761-4433

Dr. John Sencendiver
Div. of Plant Science
Agricultural Science
Building
WV University
Morgantown WV
26506
(304)293-4817

William Volk
U.S. Department of
Interior, BLM
Montana State Office
P.O. Box 36800
Billings, Montana
20090-6090
(406) 255-2926

NATIONAL, COOPERATIVE SOIL SURVEY STANDARDS STANDING COMMITTEE

This committee is charged with defining what standards are for NCSS, and for receiving recommendations from other committees and being the clearinghouse for issues dealing with standards. The committee can establish subcommittees to deal with particular standards, develop methodology for distributing standards, and make recommendations to the Steering Committee on disposition of issues raised.

Chair:
John Kimble
NRCS
National Soil Survey Center
Federal Building, Rm. 152
100 Centennial Mall North
Lincoln, NE 68508-3866
phone: 402-437-5376

Gretta Boley
U.S. Forest Service
201 14th Street, WS& A 3S0
Washington, D.C. 20250
phone: 202-205-1468

Mickey D. Ransom
Department of Agronomy
Throckmorton Hall
Kansas State University
Manhattan KS 66506-5501
phone: 913-532-7203

David G. Hopkins (Alternate)
Department of Soil Science
North Dakota State Univ.
State University Station
Fargo, ND 58105
phone: 701-237-7861

Tom Ammons
Dept. of Plant & Soil Sci.
University of TN
Knoxville, TN 37901
phone: 6 15-974-7997

Ed. J. Ciolkosz
Department of Agronomy
The Pennsylvania State Univ.
University Park, PA 16802
phone: 814-865-1530

Delvin S. Fanning (Alternate)
Department of Agronomy
University of MD
College Park, MD 20742
phone: 301-405-1342

Janis L. Boettinger
Dept. of Plants, Soils, & Biometerology
utab state univ.
Logan UT 843224820
phone: 801-797-4026

Scott Davis
State

NCSS RESEARCH AGENDA STANDING **COMMITTEE**

Committee is to establish a formal mechanism within the NCSS to: 1. Identify, document, prioritize, and address the critical research and development issues within the NCSS; 2. Identify opportunities for partnering on priority research needs; 3. Identify opportunities for funding priority research needs; 4. Increase the visibility and credibility on NCSS; and 5. Ensure the technical excellence of the NCSS.

Co-Chairs:

Larry Wilding
Soil & Crop Sci. Dept.
Texas A & M Univ.
College Station, TX
77843
phone: 409-845-3041

John Kimble
NRCS
NSSC
Federal Bldg. Rm. 152
100 Centennial Mall
North
Lincoln,
NE 68508-3866
phone: 402-437-5376

Members:

Curtis Monger
Dept. of Agronomy
Box 3Q
New Mexico State
University
Las Cruces, NM 88003
phone: 505-646-3406

Allan E. Tiarks
2500 Shreveport Hwy.
Southern Forest
Experiment Sta.
Pineville, LA 71360

Peter Veneman
12A Stockbridge Hall
univ. of MA
Amherst, MAO1003
phone: 413-545-2243

Robert Powers
U.S.

NATIONAL TECHNICAL COMMITTEE FOR HYDRIC SOILS

The National Technical Committee for Hydric Soils (NTCHS) has the responsibility to publish a National List of Hydric Soils. NTCHS also determines the definition and criteria for hydric soils.

Chain
P. Michael Whited
NRCS Wetland Institute
East Campus - UNL
Lincoln, NE 68583-0822
phone: 402-437-5178, ext. 37

Del Fanning
Dept. of Agronomy
University of Maryland
College Park, MD 20742
phone: 301-405-1344

Stephen Faulkner
Wetland Biogeochemistry Inst.
Louisiana State Univ.
Baton Rough, LA 70803-7511
phone: 504-388-8792

J. Herb Huddleston
Crop & Soil Science Dept.
Ag. Life Sciences Bldg., Room 3017
Oregon State Univ.
Corvalis, OR 9733 1-7306
phone: 541-737-5713

Wade Hurt
NRCS
P.O. Box 110290
2 Madbury Rd.
University of FL
Gainesville, FL 3261 1-0290
phone: 352-392-1951

W. Blake Parker
P.O. Box 1779
Verona, MS 38879
phone: 601-566-9967

Neil Peterson
NRCS
3244 Elder St., Room 124
Boise, ID 83705
phone: 208-378-5728

Chein-Lu Pi
Ag. & Forestry Exp. Station
Palmer Research Center
533 East Fireweed
Palmer, AK 99645
phone: 907-746-9454

Russell Pringle
NRCS Wetland Inst.
Louisiana State Univ.
104 Sturgis Hall
Baton Rouge, LA 70803
phone: 504-388-1337

Porter B. Reed, Jr.
USDI, Fish & Wildlife . Service
NWI, 9720 Exec. Center Dr.
Suite 101, Monroe Bldg.
St. Petersburg, FL 33702
phone: 8 13-570-5425

Jimmie Richardson
Depart of Soil Science
North Dakota State univ.
State University Station
Fargo, ND 58105
phone: 701-231-7851

David Smith
U.S. Forest Service
Watershed and Air Mgt. Staff
P.O. Box 96090
Washington, D.C. 20090-6090
phone: 202-205-1096

William Sipple
Envt. Protection Agency
4502F, 401 M St. S.W.
Washington, D.C. 20460
phone: 202-260-8000

R. Wayne Skaggs
NC state univ.
Dept. of Bio. & Ag. Eng.
College of Ag. & Life Sciences.
Box 7625
Raleigh, NC 27695-7625
phone: 919-515-6739

Russell M. Theriot
U.S.A.C.E.
Waterways Experiment Station
3909 Halls Ferry Rd.
Vicksburg, MS 39180-6199
phone: 601-634-3664

William Volk
Bureau of Land Management
Montana State Office
P.O. Box 36800
Billings, MT 59107
phone: 406-255-2926

FGDC SOILS SUBCOMMITTEE

This committee is charged with developing the spatial data standards for **developing**, archiving and sharing the digital soil information of the nation.

Chair:
Jii R. Fortner
NRCS
100 Centennial Mall North, Rm 152
Lincoln, NE 68508-3866
phone: 402-437-5755

Glen Bessinger
Bureau of Land Management
2850 Youngfield Street
Lakewood, CO 80214-7076
phone: 303-239-3761

Al Amen
Bureau of Laud Management
Service Center/Denver Fed. Ctr.
P.O. Box 25046
Denver, CO 80225
phone: 303-236-0154

David Smith
U.S. Forest Service
201 14th Street, WS& A 3so
Washington, D.C. 20250
phone: 202-205-1270

Gretta Boley
U.S. Forest Service
201 14th Street, WS& A 3so
Washington, D.C. 20250
phone: 202-205-1468

Dr. Scott Boyce
Branch of Research & Technical Stds.(5101-L)
195 1 Constitution Ave., N.W.
Washington, D.C. 20240
phone: 202-343-3839

Gary Colllins
U.S.E.P.A.
26 W. Martin Luther King Dr. (MD-525)
Cincinnati, OH 45628-1525
phone: 513-569-7174

Linda Kirkland
U.S.E.P.A.
401 M St, S.W. Mail Code 8205
Washington, D.C. 20460
phone: 203-260-5775

Francis H. Deter, Jr.
National Capital Planning Commission
801 Pennsylvania Ave., N.W. Suite 301
Washington, D.C. 20576
phone: 202-724-0195

Dr. Elisa Levine
NASA
GSGC Code 923
Greenbelt, MD 20771
phone: 301-286-5100

William McMahon
DOD - Defense Mapping Agency
8613 Lee Highway
Fairfax, VA 22031-2137
phone: 703-428-68 18

John Pallister
U.S.G.S. 12201 Sunrise Valley Dr.
Reston, VA 20192
phone: 703-648-6960

Frank R. Perchaiski
TVA - Maps and Survey Dept.
HB 2A, 1101 Market Street
Chattanooga, TN 37402-2801
phone: 615-751-5422

Porter Reed
National Wetlands Inventory
9720 Executive Center Drive, Suite 101
St. Petersburg, FL 33702
phone: 813-893-3148

John Short
NBS - Center for Urban Ecology
4598 MacArthur Blvd.
Washington, D.C. 20007
phone: 202-625-5363

FGDC SOILS WORKGROUP

This group is charged with maintenance of the spatial data standards for the digital soil information of the nation.

Chair:

Jim R. **Fortner**
NRCS
100 C1 óà ø0À2ali North, Rm. 1 2.

NCSS ADVISORY GROUP TO NRCS SOIL SURVEY DIVISON

(CURRENTLY BEING FORMULATED)

NRCS SOIL TAXONOMY COMMITTEE

These committees **review** and comment on proposed **amendments** to **Soil** Taxonomy

South:

Larry B. Ward
NRCS
Room 504 **Federal** Bldg.
700 West Capitol Ave.
Little Rock, AR 72201
phone: 501-324-5410

David **Pettry**
Plant **&** Soil Sci. **Dept.**
P.O. Box 9555
Mississippi State Univ.
Mississippi State, MS
39762
phone: 601-325-2459

Kenneth E. **Murphy**
NRCS
Suite 1321, Fed. Bldg.
100 West Capitol St.
Jackson, MS 39269
phone: 601-965-4341

Bill Smith
Agron. **&** Soils Dept.
Clemson University
Clemson, SC 29634
phone: 803-656-35 11

Tom Hallmark
Soil **&** Crop Sciences
Texas A **&** M Univ.
College **Station, TX**
77843
phone: 409-845-3041

Steve Lawrence
NRCS
355 East Hancock Ave.
Fed. Bldg., Box 13
Athens, GA
30601-2769
phone: 706-546-2077

A.D. **Karanthanasis**
Dept. of Agronomy
Univ. of **Kentucky**
Lexington, KY 40546
phone: 606-257-73 10

Bill Craddock
NRCS
771 Corporate Dr. **#110**
Lexington, KY
40503-5479
phone: 606-224-7369

Northeast:

Margie Faber
NRCS
627 **River** St.
Windsor, CT
06095-3003
phone: 860-688-4099

Christine **Evans**
Dept. of Natrl. Res.
univ. of NH
215 James Hall
Durham, NH 03824
phone: 603-862-1020

Harvey **Luce**
Dept. of **Plant** Sci.
Univ. of CT
Storrs, CT 0[illegible]
phone: **20[illegible]-2924**

Shawn Finn
NRCS
1370 Hamilton Street
Somerset, NJ 08873
phone: 908-246-2358

John Galbraith
Dept. of Soil, Crop, **&**
Atmosphere **Sciences**
Cornell University
Ithaca, NY 03824
phone: 607-255-1716

Alex **Topalanchik**
NRCS
75 High street
Room 301
Morgantown, WV
26505
phone: 304-291-4152

Midwest:

Nathan **McCaleb**
NRCS
Federal Bldg. Rm. 152
100 Centennial Mall N.
Lincoln, NE 68508
phone: **402-437-4113**

Robert **McLeese**
NRCS
1902 Fox Drive
Champaign, IL 61820
phone: 217-398-5286

Travis **Neely**

WELCOME TO LOUISIANA!

Guidebook for the Field Trip

prepared by

W. H. Hudnall, L. M. West and J. J. Daigle

Agronomy Department
Louisiana Agricultural Experiment Station
Louisiana State University Agricultural Center

and

United States Department of Agricultural -
National Resources Conservation Service

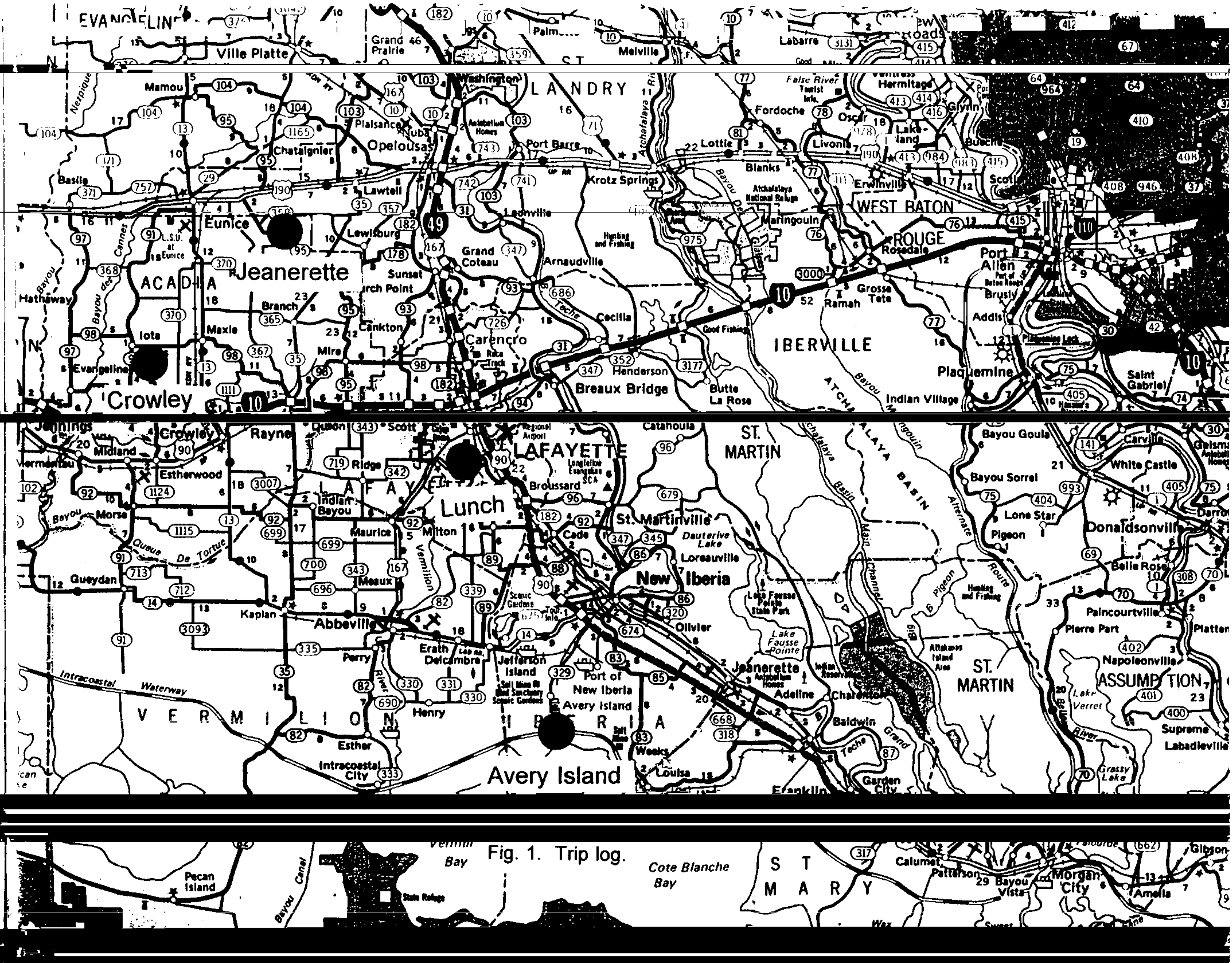


Fig. 1. Trip log.

LAGNIAPPE

Welcome to Louisiana, the edible state. No matter where you travel in Louisiana, from the pine covered hills in the north to the shady bayous down south

ORIENTATION **AND SPACE RELATIONS**

Louisiana orientation with respect to local features and distant location, it's physical and cultural setting are compared with other parts of the United States and the World. Louisiana has a position on the earth's surface that is easy to remember. New Orleans, the state's largest city, is located 90" West and 30° North. Ninety degrees West means that New Orleans is a quarter the way around the world from the meridian of 0° at Greenwich, England near London. Translated into time differences, Louisiana is six hours earlier than Greenwich. If it is noon at Greenwich, it is 6:00 a.m. Central time in New Orleans.

Due North on the 90th meridian from New Orleans are Memphis and St. Louis. This line passes west of Chicago, east of Duluth across Lake Superior, along the western side of Hudson Bay and on through the Arctic Islands. South of New Orleans, the due South course of the 90th meridian is surprising to most people. It cuts across the Gulf to Yucatan in Mexico, then across Guatemala into the open Pacific and through the Galapagos Islands that lie about 700 miles West of the mainland of South America. New Orleans has an advantage over rnost other major United States ports in shorter distance to Central America and the West Coast of South America.

At latitude of 30" North, New Orleans lies one-third of the way between the Equator and the North Pole. If we compare our latitude with that of other places, we can see how far south Louisiana is. In the Continental United States, only Florida and Texas extend farther South. If we follow the 30th parallel westward across North America, we see that it runs through Houston, Austin, the Big Bend of Texas and across Northern Mexico into the Pacific almost 200 miles South of the southern boundary of California. Eastward the 30th parallel cuts across Northern Florida into the Atlantic south of Jacksonville. Across Africa
it lies everywhere south of the Mediterranean Sea and runs tjer Tc

temperature ranges between the humid subtropics of 64.4°F and 32°F. There is a period in which plant growth is inhibited but it does not produce severe freezing and frozen grounds. Our winters are open, which means they are marked by periods of relatively warm temperatures in contrast to the closed or severe winters of the northern parts of the United States. Of all the states of the southeast United States grouped as humid tropical, Louisiana alone meets the qualifications perfectly. Figure 2 gives the average growing season. The growing season is defined as the number of days between the last killing frost in Spring and the first killing frost in Autumn. Figure 3 is the average annual precipitation for the State. individual years may vary quite markedly from the averages shown.

Louisiana is one of the nation's largest producers of sugar-cane, early Spring strawberries, sweet potatoes and cane syrup. Other important crops are rice, cotton, corn, potatoes, soybeans, citrus, truck crops, tobacco, pecans, and aquaculture. The state ranks high in lumber production with Kraft paper mills using large quantities of slash pine. The number of beef cattle is approximately 600,000. Louisiana also has an important dairy industry. In 1993 there were 678 dairy farms in the state. Only 2 % of our population are directly involved in agriculture on 34 % of Louisiana's land that is used to provide livelihood for more than 17,800 farm family workers assisted by 13,000 hired workers producing Louisiana farm products. Rice constitutes 8% of total farm products valued in the state and places Louisiana third in the nation in production of rice. In addition, Louisiana's agricultural output is composed of soybeans, 14%; cattle and calves, 12%; cotton, 13%; dairy products, 9%; sugarcane, 11%; broilers, 10%, and all other agricultural products, 23%. These products are valued at more than $3.8 billion annually.

Louisiana's approximately 4,200 manufacturing units employ approximately 164,000 wage and salary workers whose annual earnings are $6.3 billion. The state annually produces nearly $63 billion worth of products including petroleum, chemicals, plastic, clothing, wood products, industrial alcohol, wall board, cement, condiments, seafood, glass and drugs.

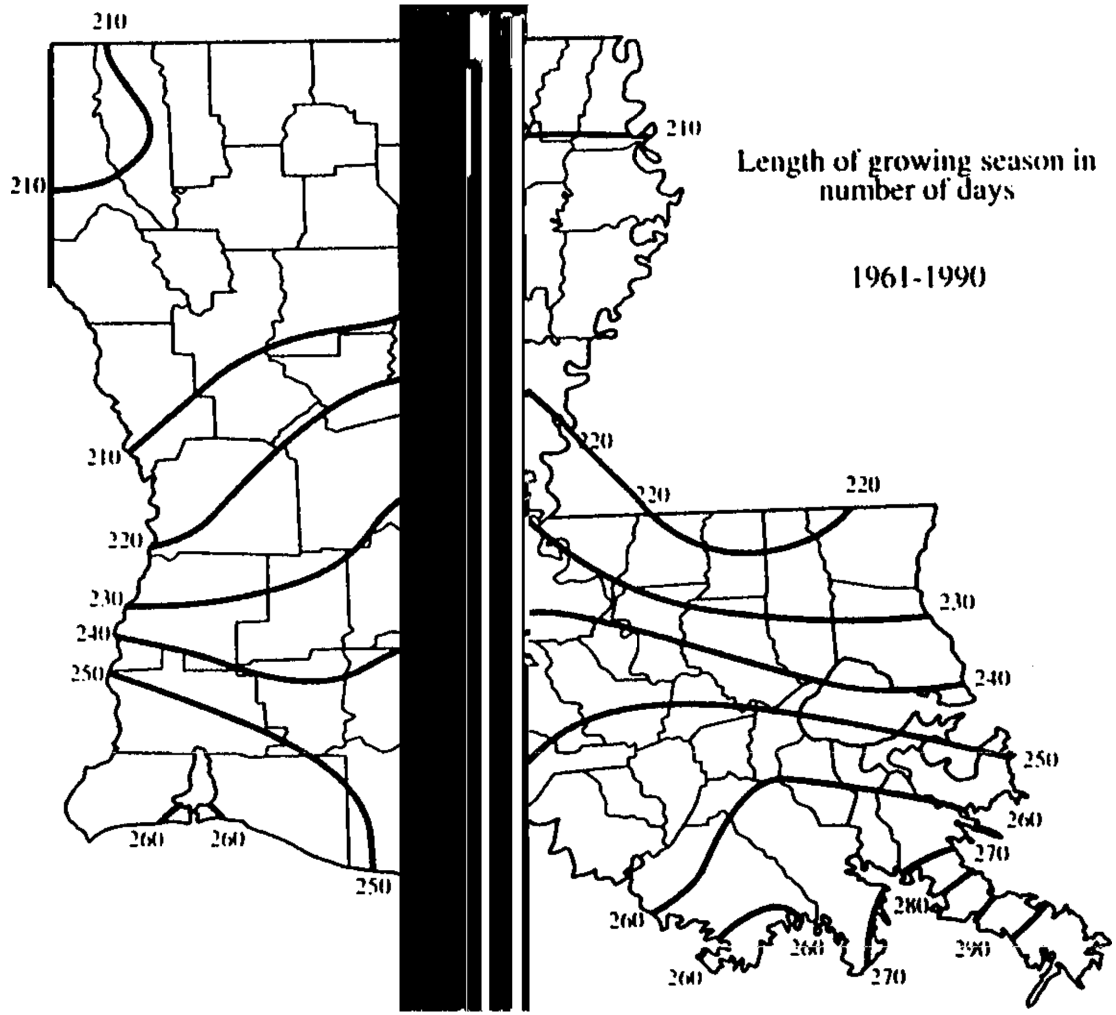
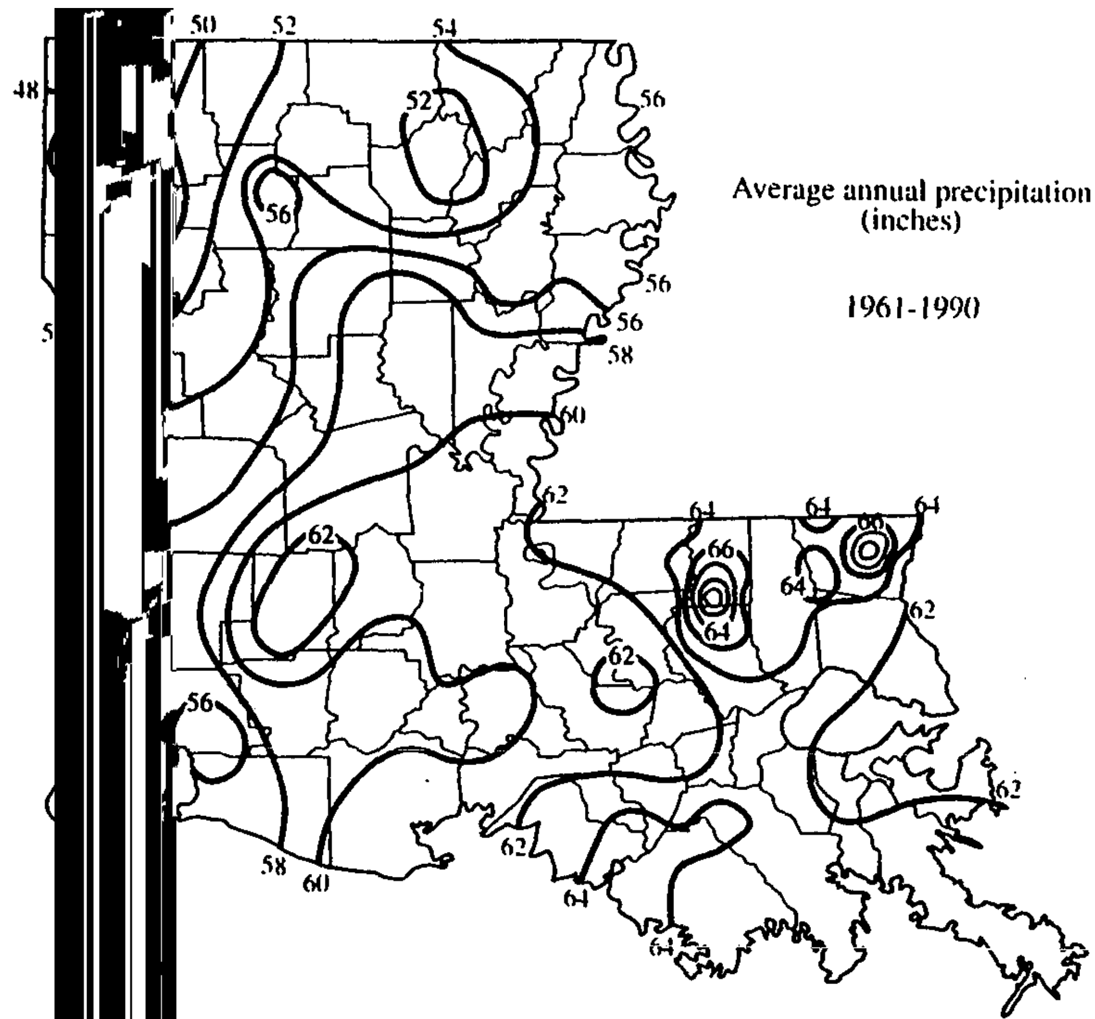

Length of growing season in
number of days
1961-1990
210
210
210
210
220
220
220
220
230
230
240
240
250
250
250
260
260
260
260
260
260
270
270
280
290

Fig. 2.



Cl[illegible]a provided by Louisiana Office of State Climatology. John M. Grymes III, State Climatologist.

Fig. 3.

FIELD TRIP OBJECTIVES

There are three objectives. The first 2 are technical and the 3rd is a combination of technical and cultural. Both soils at the first two stops are seasonally wet soils. They have presented some debate (sometimes heated) es to their hydric status and correct taxonomic classification.

1. To observe a soil that is not on the Hydric Soils list, but should be according to some. The Jeanerette silt loam soil is classified as fine-silty, mixed, hyperthermic Typic Argiaquolls. We will see a pedon in an agriculture setting. Nearly all of this soil is in improved pasture or agronomic crops. The soil under virgin conditions does not exhibit hydric condition necessary for it to be a hydric soil. During the spring before flooding, soils planted to rice the previously year usually do exhibit morphological features required for hydric soils.

2. The Crowley silt loam soil is not on the Hydric Soils list either. It is classified as fine, montmoriilonite, hyperthermic Typic Albaqualfs. Most of this soil is either in pasture, rice or soybeans.

3. We will visit Avery Island, a loess-covered salt dome. Avery Island is the home of the world renowned Tabasco pepper sauce. The formation of the salt domes is rather unique. We will observe a soil formed in the loess and you will have an opportunity to see the underlying geology fro a sand pit. We will tour the Tabasco farm, processing plant and store and hope that you get a little Louisiana flavor while on the island.

INTRODUCTION

HYDRIC SOILS

Field indicators of hydric soils should be used as a guide to identify and delineate hydric soils in the field. " Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Federal Register, July 13, 1994). Some key word that one has to interpretate are: formed under, conditions, saturation, long enough, growing season, anaerobic conditions in the upper part. Some of these term are defined, but other do not have universally accepted definitions. For example: when is a soil saturated, how long is long enough, what defines the growing season and when is a soil considered anaerobic? Soils that are on the extreme end of wetness do not present major problems. However seasonal wet soils and soils with Mollic epipedons and red soils are difficult to determine their hydric status even using the hydric indicators.

AQUIC CONDITIONS/AQUIC MOISTURE REGIME

The definition and criteria of the aquic soil moisture regime was revised by the International Committee on Soils with Aquic Moisture Regimes (ICOMAQ). This committee was in charge of the revisions of the keys and proposal for the aquic soil moisture regime that affects all orders of Soil Taxonomy. Professor, Dr. Johan Bouma, Head of the Department of Soils and Geology of the Wageningen Agricultural University, the Netherlands was committee chairman. The committee members included all interested scientists that corresponded through circular letters. This method of intercommunication was introduced by Frank Moormann in 1975 (Moorman, 1985). These letters contained the discussion and proposal of changes in the definitions and classification that have been received since the last circular by those scientist who responded.

The problems to be solved by the committee were many. They were related to the definition and inferences of the aquic moisture regime. They were also related to what can be effectively observed and measured by the field soil scientist. As a consequence of being asked to provide data and an investigative technique to solve some of these questions, a research project was established in Louisiana and Texas to study the aquic conditions in soils that are identified according to three diagnostic features, saturation, reduction and redoximorphic features. The objectives of this research were:

1. Define the depth, duration and periodicity of saturation, and reduction

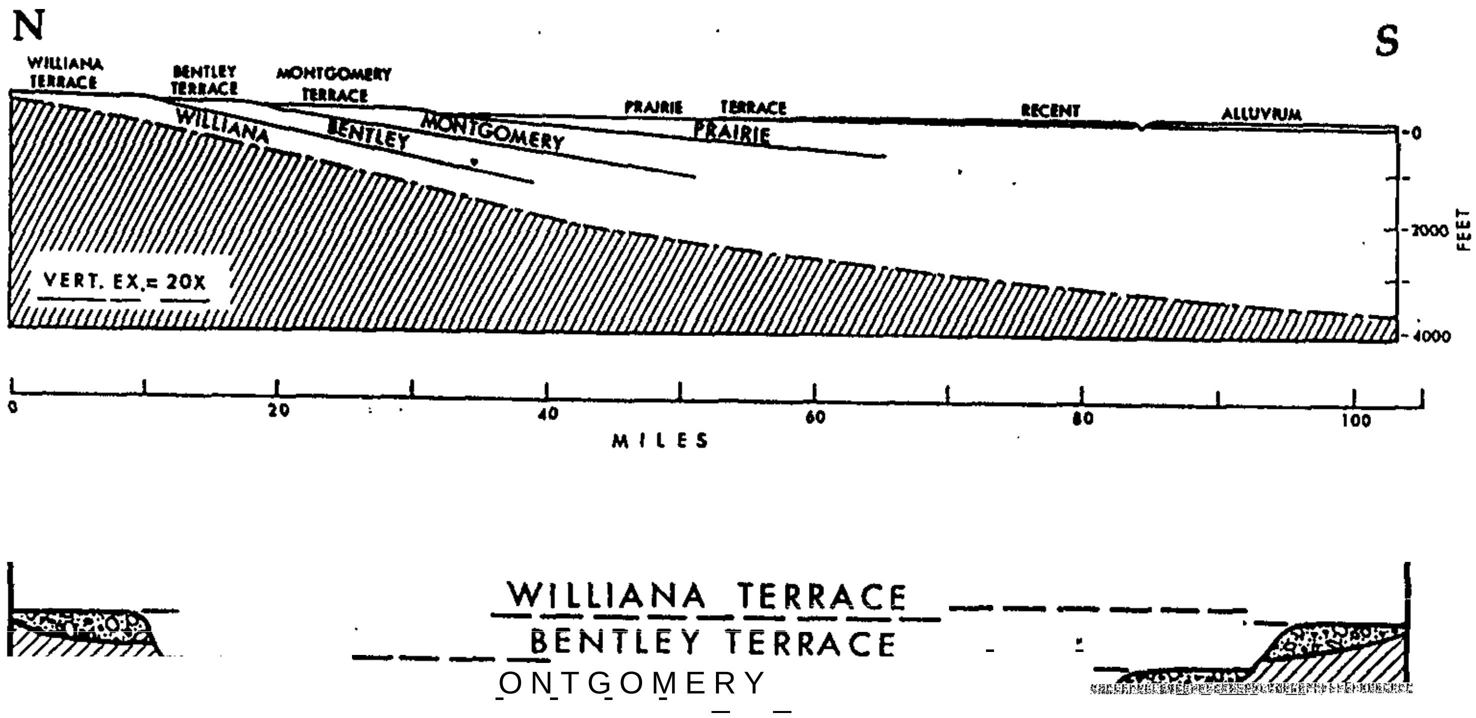


Fig. 4. Pleistocene Terrace Relationships.

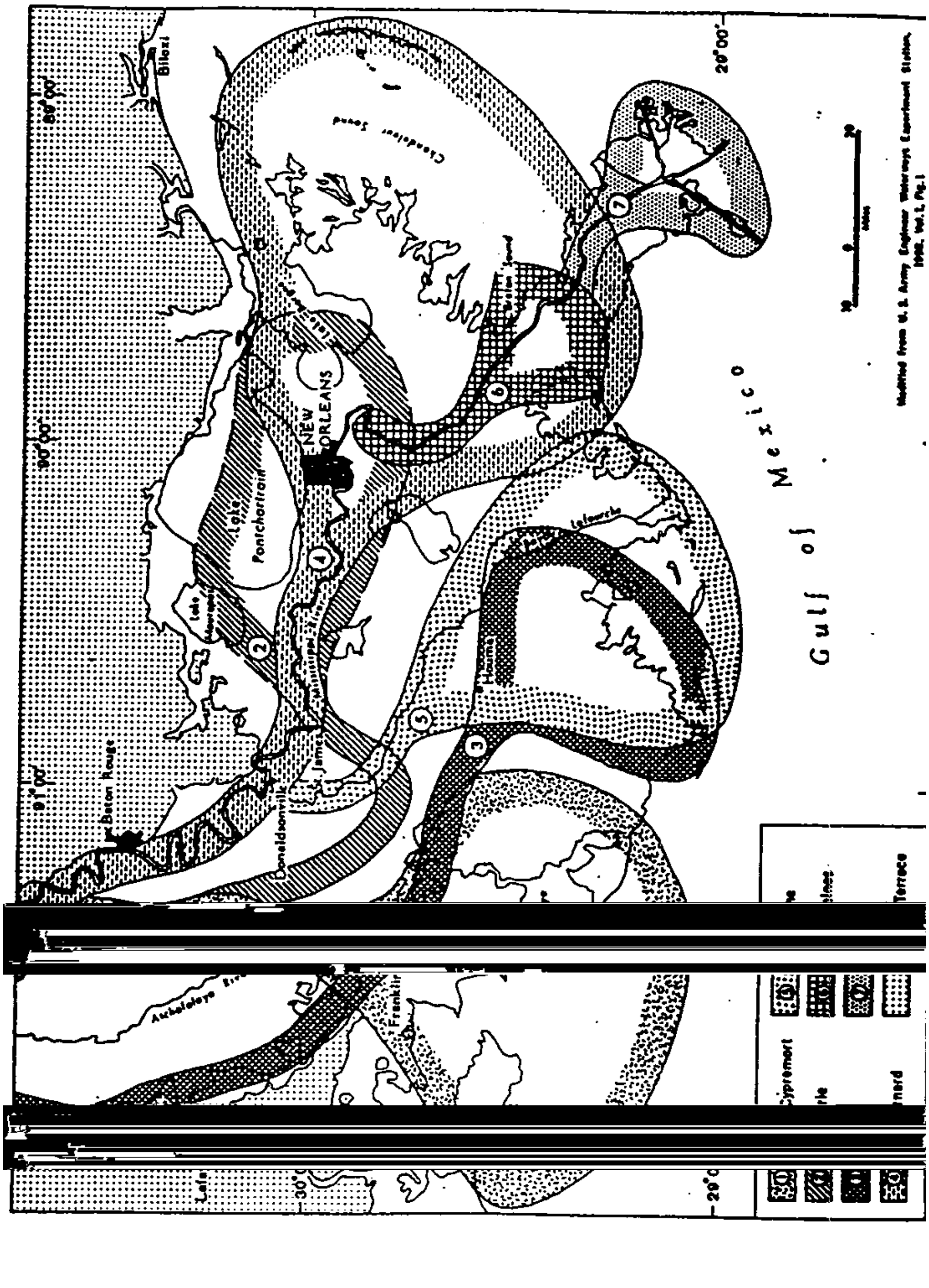


Fig. 5. Mississippi River Delta Systems.

48") that limited a 30' x 30' square plot next to the place where the pit was

Depth. Table. The water table depths were measured with piezometers and unlined boreholes. The piezometers were built from 3/4" PVC pipe. The PVC pipes were cut into 4 different lengths (0.5, 0.75, 1.25, 2.25 m) to be installed at depths of 0.25, 0.50, 1.00 and 2.00 m. A special set of pipes were cut for each one of those sites with a claypan at a depth different from the ones mentioned. Those piezometers placed in flooded sites were constructed with an extra length of 0.25 m. Eight horizontal slits were cut at one end of the PVC pipe and a piece of geofabric was glued to it covering the slits and closing the end of the pipe. The other end of the piezometer was covered with a PVC cap with a small hole in its center.

Triplicate piezometers were installed at the depths mentioned above. An auger hole to the desired depth was made in order to place each piezometer. The bottom of the hole was filled with sand and the piezometer end with the silts was embedded in it, followed by a bentonite plug, a layer of soil and another bentonite plug at the surface.

Reduction. The reduction was characterized by measuring the redox potentials directly with Pt electrodes (Figure 7) and indirectly by testing in the field for the presence of reduced iron with dyes. Redox potentials were measured with permanently installed Pt electrodes.. The Pt electrodes were tested in the lab in a pH-buffered, quinhydrone solution in order to know if they were giving good readings, Any electrode differing more than 10 mV from the proper value at a given temperature was discarded.

Electrodes were installed in the field in Louisiana at 50 and 100 cm depth in triplicate. For permanent installations, a hole half the depth desired was made with a probe and a sharpened metal rod was used to make the hole thinner and deeper to about 2 cm less than the desired depth of the exposed platinum tip of the electrode. Following this, a 1/4" diameter tube was placed over the lead of the electrode until the end of the tube fit tightly against the junction of the lead, the heat shrinking tubing and the top end of the glass tubing. This tube allowed the electrode to be pushed 2 cm deeper into the undisturbed soil material (beyond the depth reached by the sharpened metal rod). Dry bentonite clay was poured into the hole and packed around the lead until the hole was completely filled in order to seal the system against the flow of water or diffusion or air from soil surface to the electrode, which might lead to erroneous readings.

Redox potentials were taken in the field with a portable voltmeter and a saturated calomel electrode inserted into a salt bridge (Figure 7). The salt bridge

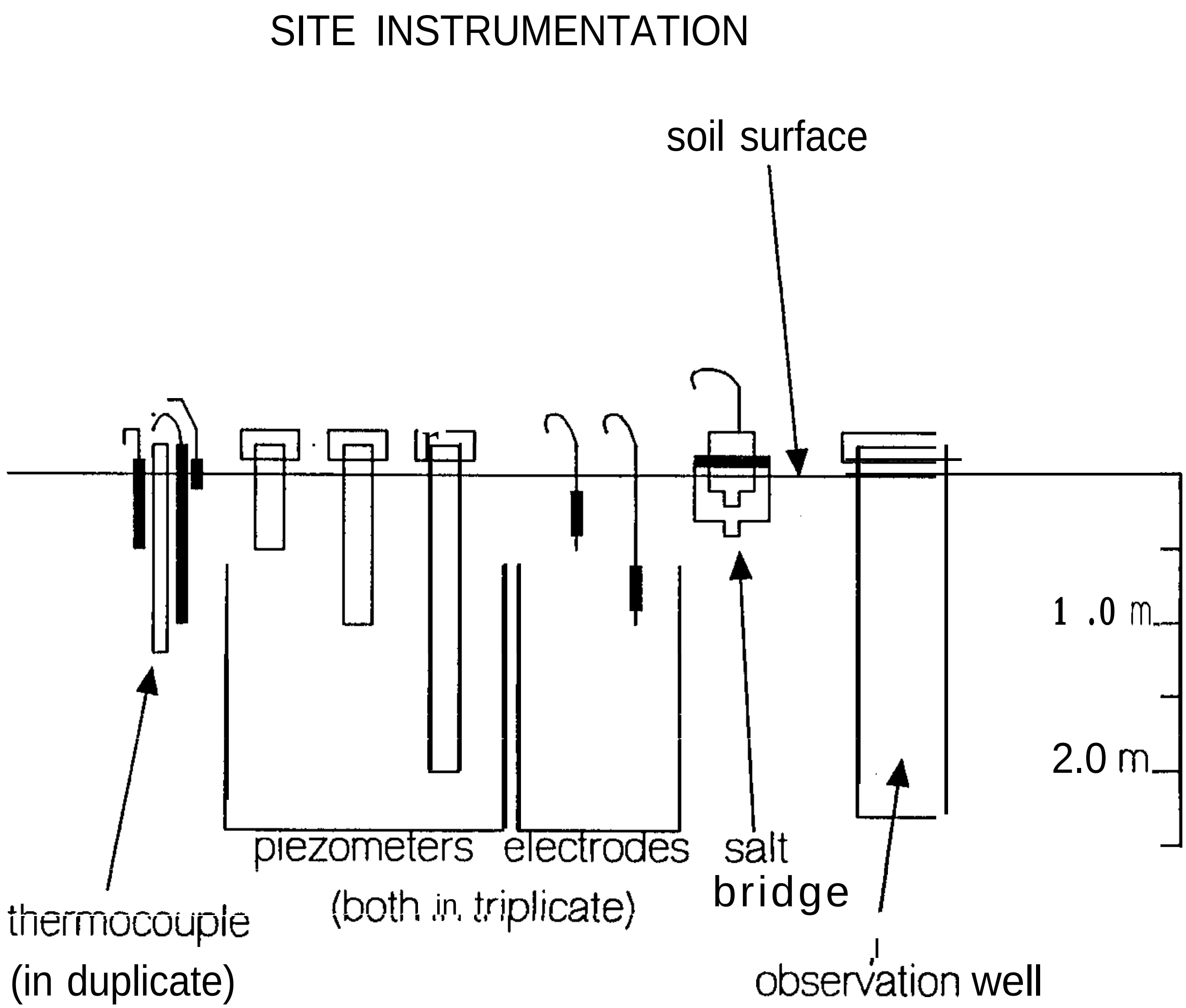


Fig. 6. Layout at each Instrument Site.

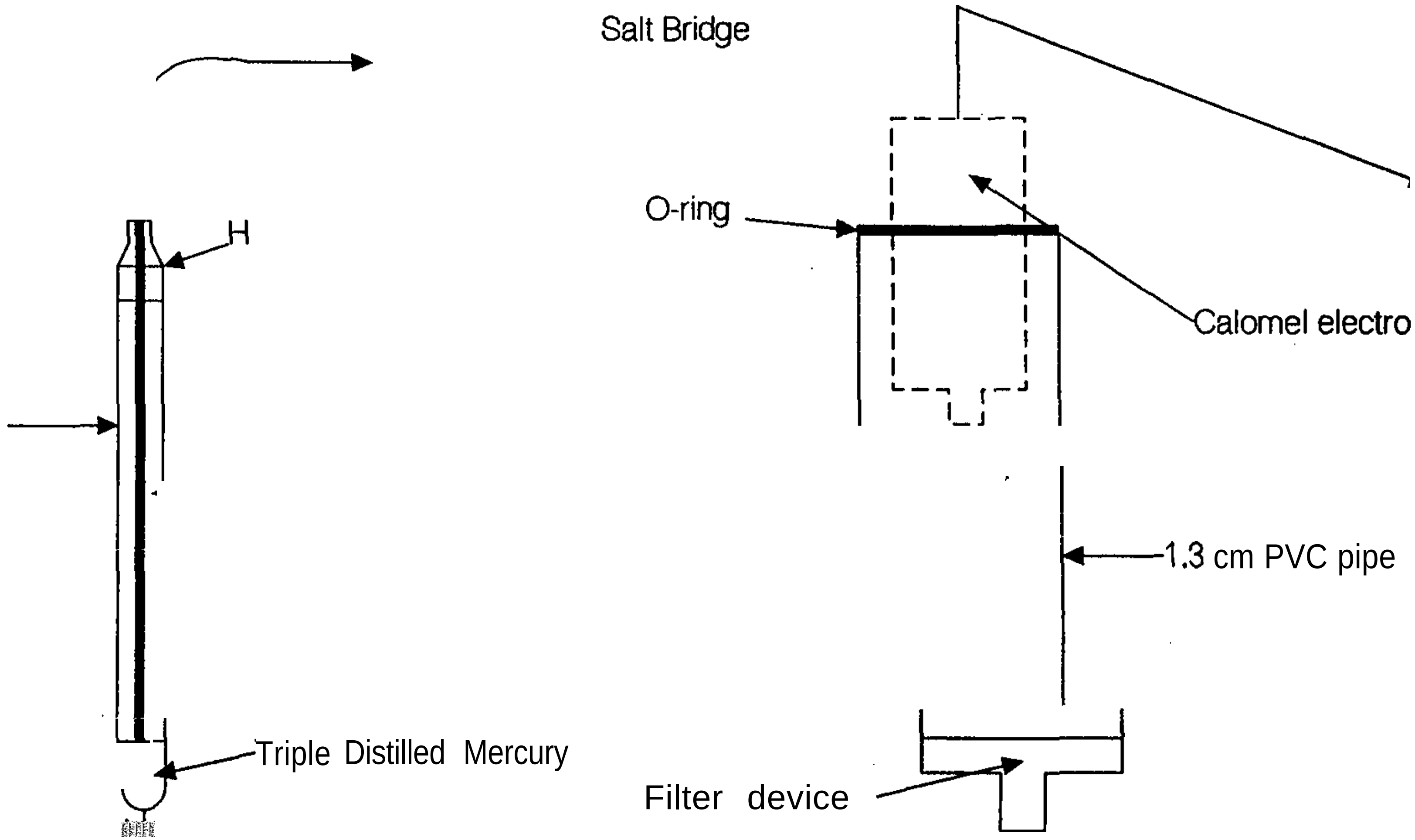


Fig. 7. Platinum Electrode and Salt Bridge with Reference Electrode used to Measure Redox Potential.

was placed into wet or moistened soil at the soil surface. The readings were taken after several minutes when the reading drift decreased so that an equilibrated value could be recorded. The meter values from the soil were adjusted by adding +244 mV to the readings in order to base redox potentials on the standard hydrogen reference electrode.

Temoerature. Thermocouples were constructed from 1.3 cm PVC pipe and copper-constantan wire (Figure 8). Thermocouples were installed at depths of 50 and 100 cm in duplicate.

Data **Recording**

GodfryL.

Vertisols.

ponded,or

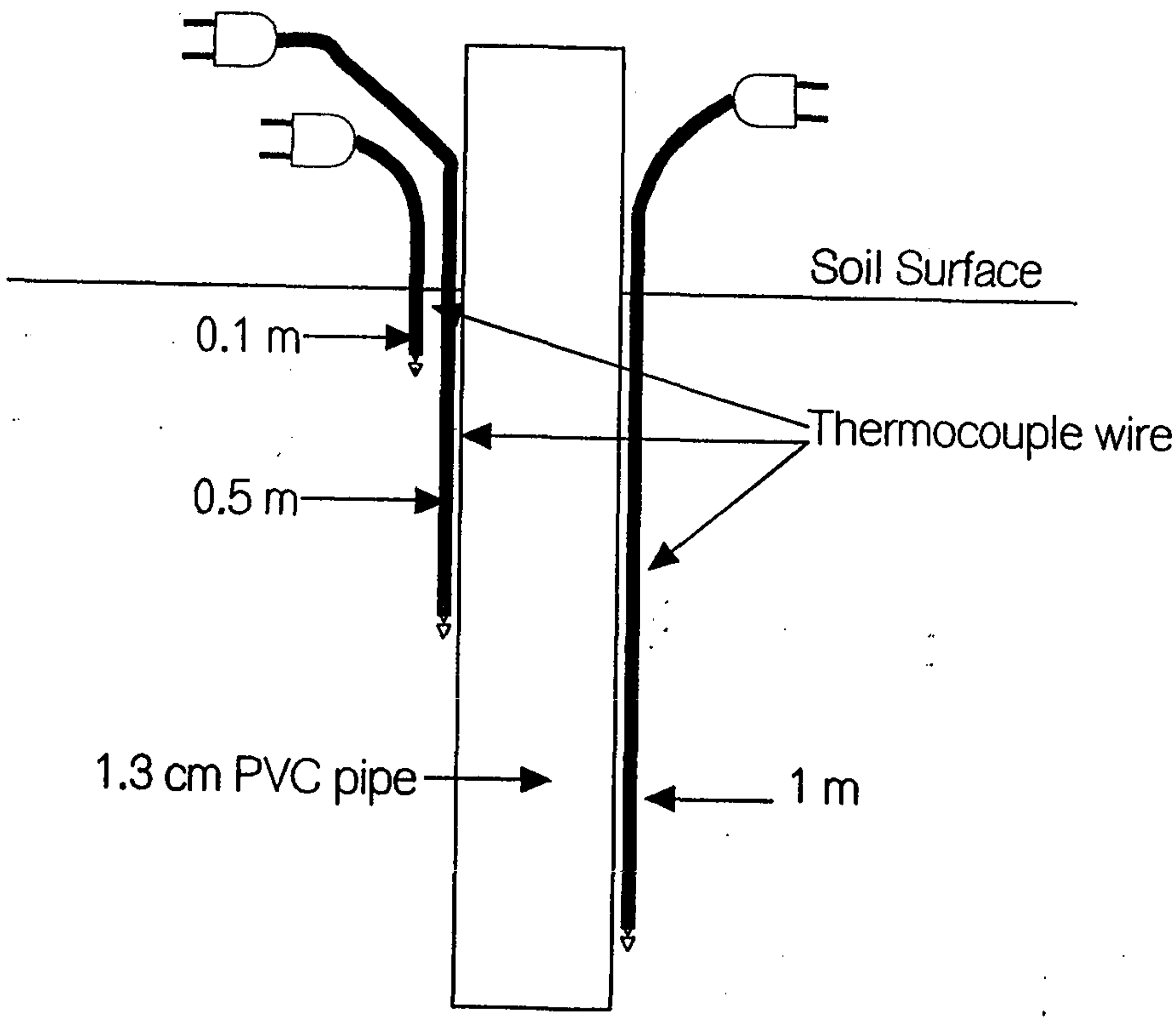


Fig. 8. Schematic of Thermocouple Installed to Measure Soil Temperature.

4. Freezing of tensiometer during winter months.
The tensiometer gauges are water-filled when they are working properly. They are subject to freezing during the winter and the ballast expand or burst. In order to use the gauge, each one must be calibrated. This is unpractical. Automatic recording tensiometer and piezometers are desirable, but are expensive. The use of a swage-lok and the tensiometer (Soil Measurement System Tucson, AZ) adapted with a chromatographic system alleviates this problem. The readings are more accurate and both positive and negative tensions can be measured.

5. Crawfish and fire ant activity along piezometers and tensiometer.
Crawfish are common in most of the soils under investigation. They may burrow along side of the piezometer or tensiometer. This may be corrected by relocating the piezometers and tensiometer. More than triplicate sets may be needed to obtain reliable data.
Fire ants may be a problem with shallow tensiometer. The ceramic cup provides a source of moisture and the nest may be built around the tensiometer. The 25 cm depth tensiometer are the most likely to be infested. Once a nest is built, the ants must be killed and the tensiometer moved because of the tunnel network created by the fire ant.

6. Spatial variability on a close interval basis of a few meters or less. Soil spatial variability is inherent. Some soils are likely to be more variable than others. Vertisols that exhibit strong gilgai relief are the most problematic. Additional instrumentation alleviates some of the problems, but extreme data ranges and interpretation of data is still difficult.

7. Long lag times in oxygen diffusion through slowly permeable soils,
The rate of oxygen diffusion is so slow that its measurement and the use of such data seem impracticle as a way to measure oxygen depletion.

8. Amount of reduction indicated by dyes.
Childs (1981) evaluated the use of $\propto - \propto$ dipyridyl in 10% acetic acid as proposed by Hoffer (1945). Childs concluded that the low pH may cause erroneous reading. He suggests that $\propto - \propto$ dipyridyl dissolved in 1 N NH_4OAc is preferred. In Louisiana, we have obtained much more agreeable results with the Pt electrodes when the NH_4OAc solution is used. The $\alpha - \alpha$ dipyridyl in 10% acetic acid overestimated iron reduction.

9. The pH dependency of iron reduction,
This is not a new problem, but probably the most critical because iron reduction is used as a portion of the aquic condition definition. Work by Ponnamperuma (1972) Turner and Patrick (1968), Collins and Buol (1970 a, b), Bohn (1971), Gotoh and Patrick (1974), and Patrick (1980) have developed redox equilibria and stability diagrams on the relationship between pH and Eh and iron reduction. In soils that are acid and continuously flooded this may not be an important problem. However soils that have neutral and higher pH, extremely low Eh values must be reached before iron is reduced. At pH 8, iron does not reduce regardless of how low the Eh may become (Collings and Buol 1970a). There are many aquic soils throughout the world that have $pH > 8$. Using the present criteria, these soils would be excluded from the aquic condition.

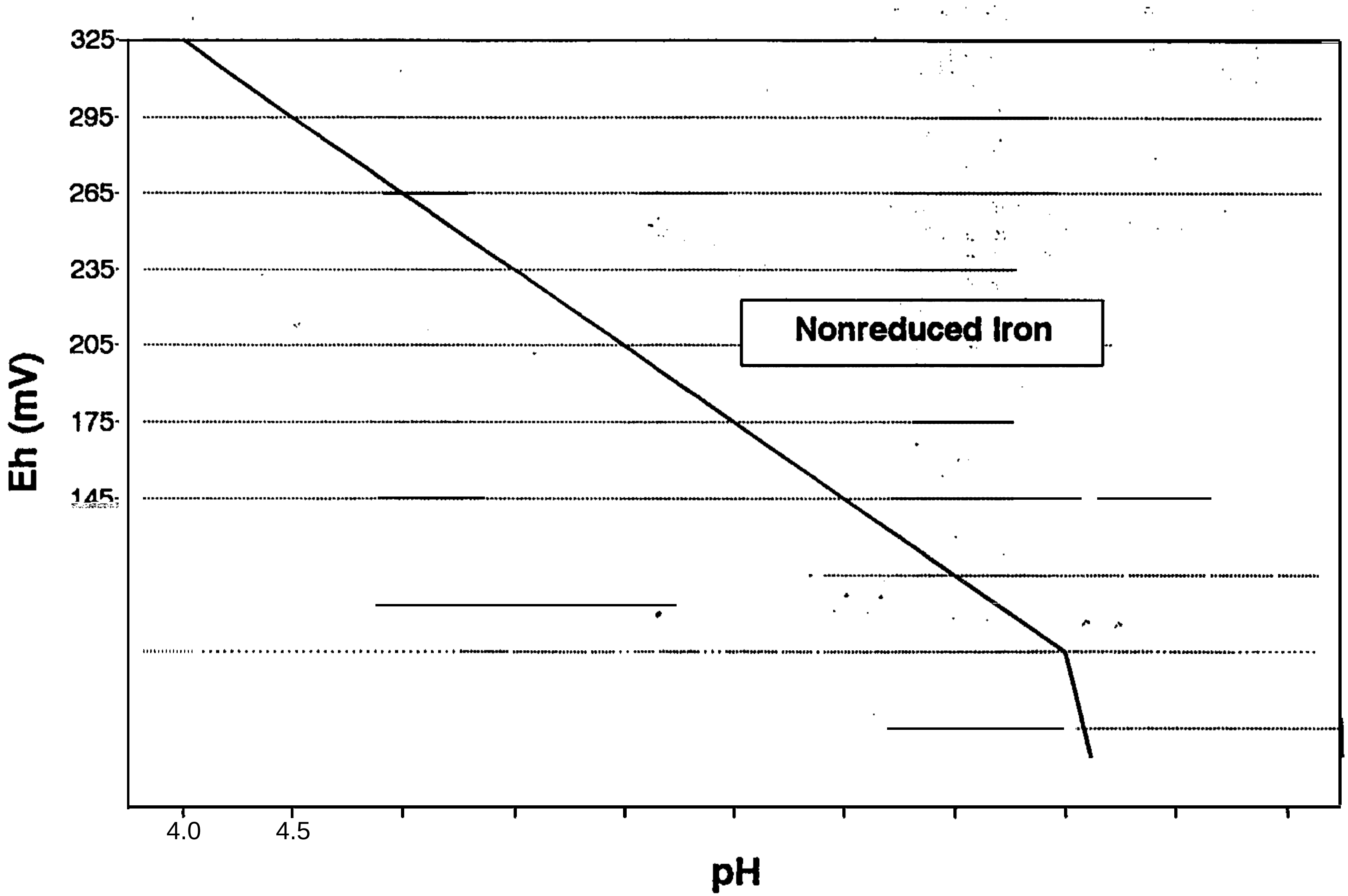
Figure 9 shows the relationship between pH, Eh and iron reduction. Any soil that has an Eh, pH above the line would not exhibit iron reduction. One can determine that an acid soil at pH 4 would exhibit iron reduction at an Eh of ≈ 320 mV while a soil at pH 8.0 would require an Eh of < 90 mV to exhibit iron reduction, or a difference of 230 mV.

The redoximorphic features are waived for red soils, but there are soils that have a pH > 8 that are not red and will not meet the reduction and redoximorphic feature required for the aquic condition. Bouma (1990) has adequately stated that we do not yet have a technique to measure anaerobic, oxygen depleted, conditions.

IO. Measuring aquic condition criteria in loamy and sandy soils.

The majority of the control section of the soils under investigation are fine-silty or finer. The problems associated with loamy and coarser soils have not been investigated. These kinds of soils along the Atlantic seaboard and other parts of the world will present additional problems and questions.

The problems associated with tensiometer and piezometers are not new. Hvorslev (1951) discussed most of these. We just have not yet devised ways to overcome many of Mother Nature laws and creatures like crawfish and fire ants. We see that the problems associated with gathering and interpreting data needed to support the aquic condition criteria as the most challenging.


Eh (mV)
325
295
265
235
205
175
145
Nonreduced Iron
4.0
4.5
pH

Acadia Parish

Agriculture:

There are 420.000 acres in Acadia Parish. Approximately 320.000 acres are in cropland that include: soybeans, 140,000 ac, '26 bu/ac; rice 77,000 ac, 27 barrels/ac (162 lbs/barrel); wheat, 15,000 ac, 34 bu/ac; corn, 4,000 ac, 100 bu/ac; and oats, 1,500 ac, **48 bu/ac.** In 1989 there were 25,000 acres of government set-a-side. There are 71,000 acres of woodlands, mostly along streams. There are 26,507 ac in urban areas in the four major towns, Crowiey, parish seat, Rayne, Church Point and Iota. There are 6,350 ac in pasture land. The pastures are used for beef cattle, sheep and goats.

SOILS

JEANERETTE SILT LOAM

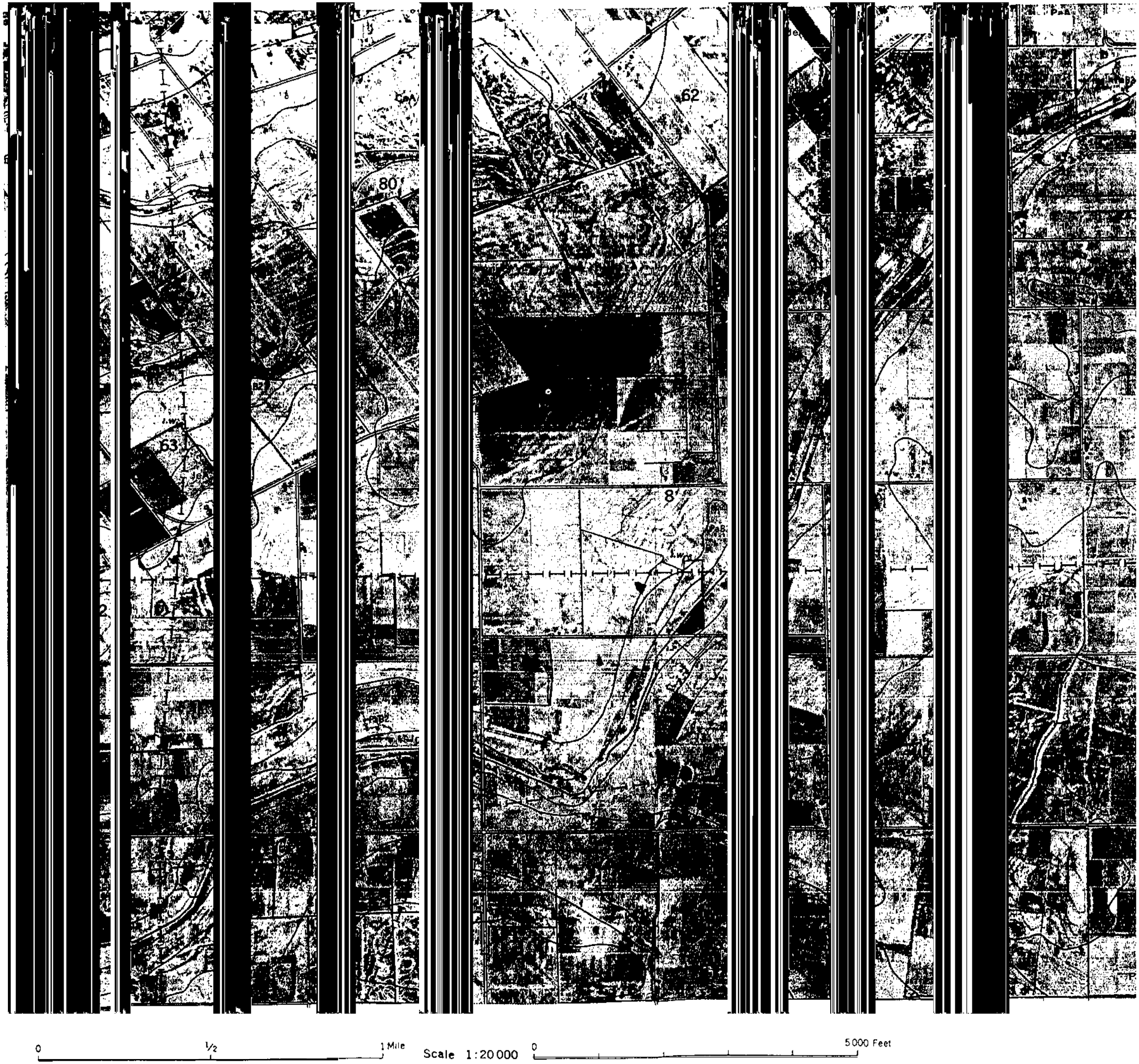


Fig. 10. Soils Map Showing Location of the Jeanerette Site.

This soil is well suited to pasture. Few limitations affect this use. The main suitable pasture plants are common bermudagrass, improved bermudagrass, bahiagrass, ryegrass, small grain, white clover, and vetch. Excess surface water can be removed by shallow field ditches and vegetated outlets. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition.

This soil is well suited to woodland. Most areas, however, are used as cropland and are not likely to be used for commercial wood production. The native vegetation was tall prairie grasses. If the soil is used for timber production, the wetness can limit the use of equipment and cause moderate seedling mortality. Also, the surface layer is subject to compaction and competition from understory plants can be severe.

The capability subclass is llw. The woodland ordination symbol is 4W.

Soils Data:

Profile Description:

TAXONOMIC CLASS: Fine-silty, mixed, superactive, hyperthermic Typic Argiaquolls

TYPICAL PEDON: Jeanerette silt loam, on a broad flat, in a cultivated field at an elevation of 50 feet, (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 cm; very dark grayish brown (10YR 3/2) silt loam; grayish brown (10YR 5/2), dry; weak fine granular structure; very friable; many very fine and fine roots; slightly acid; clear smooth boundary. (IO to 25 cm thick)

Btgl--18 to 38 cm; very dark gray (10YR 3/1) silt loam; gray (10YR 5/1), dry; moderate medium subangular blocky structure; friable; many fine and very fine roots; 10 percent krotovinas; many distinct clay films on faces of peds; few medium, moderately cemented iron-manganese concretions throughout; slightly alkaline; clear wavy boundary.

Btg2--38 to 60 cm; very dark gray (10YR 3/1) silty clay loam; gray (10YR 5/1), dry; moderate medium subangular blocky structure; firm; few fine and very fine roots; 10 percent krotovinas; many distinct clay films on faces of peds; few medium, moderately cemented iron-manganese concretions throughout; slightly alkaline; clear wavy boundary. (Combined thickness of the Btg horizon ranges from 15 to 50 cm).

Btkgl--60 to 132 cm; gray (10YR 5/1) paragravelly silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine and very fine roots; 10 percent krotovinas; many distinct dark gray (10YR 4/1) clay films moderately cemented iron-manganese concretions throughout; many fine prominent yellowish brown

S93LA-001-015 ** P R I M A R Y C H A R A C T E R I Z A T I O N D A T A **
(ACADIA PARISH, LOUISIANA)

PRINT DATE 12/06/9

SAMPLED AS : JEANERETTE ; FINE-SILTY, MIXED, HYPERTHERMIC TYPIC ARGIAQUOLL
REVISED TO : ;

SSL - PROJECT 94P 31, (CP94LA085) ACADIA PARISH
- PEDON 94P 175, SAMPLES 94P1051- 1859
- GENERAL METHODS 1B1A, 2A1, 2B

UNITED STATES DEPARTMENT OF AGRICULTUR
NATURAL RESOURCES CONSERVATION SERVICE
NATIONAL SOIL SURVEY CENTER
SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SAMPLE NO.	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
				(- - -TOTAL	---	-)(-	-CLAY-	-)(-	-SILT-	-)(-	---	-SAND--	-	- -)	(-COARSE	FRACTIONS(MM)-)				(>2MM
				CLAY	SILT	SAND	FINE	CO3	FINE	COARSE	VF	F-	M	C-	VC	- - - -	WEIGHT	- - - -		WT
SAMPLE	DEPTH	HORIZON		LT	.002	.05	LT	LT	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	PCT D
NO.	(CM)			.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1						
								PCT	OF	<2MM (3A1) - - -										
												1.3	0.1	0.2						
						5.7						1.0	0.3	0.3						
						5.5						0.7	0.2							

	-1-	-2-	-9-
			0.49
	0.56	0.069	0.45
	0.30	0.052	0.47
	0.24	0.055	0.45
	0.13	0.047	0.47
	0.09		0.47
	0.06		0.49
	0.05		0.46
			0.47

PRIMARY CHARACTERIZATION DATA

S93LA-001-015 PRINT DATE 12/06/
SAMPLED AS : JEANERETTE ; FINE-SILTY, MIXED,HYPERTHERMIC TYPIC ARGIAQUOLL
USDA-NRCS-NSSC-SOIL SURVEY LABORATORY; PEDON 94P 175, SAMPLE 94P 1051- 1059

DEPTH (CM)	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20
	(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.		(- - - -PH - - -	
	CA	MG	NA	K	SUM	ITY	AL	SUM	NH4-	BASES	SAT	SUM	NH4	CACO3	OHMS		MMHOS		CACL2	H2O
	5B5a	5B5a	5B5a	5B5a	BASES			CATS	OAC	+ AL			OAC	<2MM	/CM		/CM		.01M	
	6N2e	6O2d	6P2b	6Q2b		6H5a	6G9b	5A3a	5A8b	5A3b	5G1	5C3	5C1	6E1g	8E1		8I		8C1f	8C1
	<- - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - - -PCT - - -									
	9.9	3.2	1.8	TR	14.9	3.0		17.9	14.6			83	100						5.7	
	13.5	4.3	0.6	--	18.4	1.0		19.4	19.0			95	97						6.9	7.
	17.3	5.8	0.8	0.2	24.1	1.5		25.6	24.6			94	98							7.
		6.4	0.9	0.2		0.9							100						7.7	8.
	19.5	5.8	0.7	0.3	26.3	1.5													7.6	8.
	15.0	5.8	0.6	TR	21.4	1.7													7.0	7.
	13.9	5.7	0.5	0.2	20.3	1.4						94							6.9	7.
	12.5	5.7	0.4	0.2	18.8	1.4						93								

** PRIMARY CHARACTERIZATION OATA **

```
S93LA-001-015                                                                                    PRINT DATE 12/06/
SAMPLED AS    : JEANERETTE           ; FINE-SILTY, NIXED, HYPERTHERMIC TYPIC ARGIAQUOLL
USDA-NRCS-NSSC-SOIL SURVEY LABORATORY ; PEDON 94P 175, SANPLE 94P1051-1059

               -1--  -2--  -3--  -4--  -5-q'         -6--  -7--  -8--  -9--  -10-  -11-  -12-  -13-  -14-  -15-  -16-  -17-  -18-  -19-  -20

--------- ---------------------------------------------------------------------------------------------------------------------------------
               < - - - - - - - - - - - - - - - - - - - - - - CLAY       MINERALOGY (<.002mm) - - - - - - - - - - - - - - - - - - - - - - -
               FRACT < - - - - - X-RAY - - - - - -->< - - - THERMAL - - - -->< - - - - - - -      ELEMENTAL      - - - - - - - ->< - -> EGME INT
SAMPLE           ION <                              >< - DTA - -->< -   TGA   - -> SIO2 AL203 Fe203 MgO   CaO   K20   Na20 <    > RETN PRE
                     < -   - - -  7A2I - - - - - -->< - 7A6 - >< - 7A4b - >< - - _ _ _ _ _ _ _ _ 7C3 - - - - - - - - - - ><   > 7D2   TI
NUMBER         <- · >< - I - - peak size - - - - -->< - - - Percent - - - >< - - - - - - - - - Percent - - - - - - - - - >< - -><mg/g>< -

94P1051        TCLV   MT 3  KK  2  MI  1  RN  1  QZ  1
94P1052        TCLV  MT  3  KK  3  NY  2  MI 2 QZ 1
94P1058        T C L V  MT 3  K K 2  MI  1 MM  1 QZ  1

--------- ---------------------------------------------------------------------------------------------------------------------------------
               < - - - - - - - - - - - - - - - - - - - - - SAND - SILT MINERALOGY (2.0-0.002mm) - - - - - - - - - - - - - - - - - - - - - - -
               FRACT < - - - - - - X-RAY - - -->< - - - THERMAL - - - -->< - - - - - - - - OPTICAL - - - - - _ - - -><                  > INT
SAMPLE           ION <                        >< -  DTA  - -->< -  TGA  - ->TOT RE< - - - - - GRAIN   COUNT   - - - - - -><                  > PRE
                     <  - - - - 7A2i - - - - >< - 7A3b - >< - 7A4b - >< - - - - - - - - - 7B1a -



--------- ---------------------------------------------------------------------------------------------------------------------------------
```

•⊠⊠ P R I M A R Y C H A R A C T E R I Z A T I O N 0 A T A ***

S93LA-001-015 (ACADIA PARISH, LOUISIANA)

PRINT DATE 12/06/

SAMPLED AS : JEANERETTE ; FINE-SILTY, MIXED, HYPERTHERMIC TYPIC ARGIAQUOLL

UNITED STATES DEPARTMENT OF AGRICULTU
NATURAL RESOURCES CONSERVATION SERVIC
NATIONAL SOIL SURVEY CENTER
SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508-3866

SSL - PROJECT 94P 37. (CP94LA085) ACADIA PARISH
- PEOOW 94P 175, SAMPLES 94P 1051-1059
- GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZ NO	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20
		ACID OXALATE EXTRACTION				PHOSPHOUS		KCL	TOTAL	(- -WATER CONTENT- -)				(---- WATER DISPERSIBLE ----)						MIN	AGG
		OPT DEN	FE	SI	AL	RET	CIT- ACID	MN	C	0.06 BAR	1- BAR	2- BAR	15 BAR	<- - PIPETTE --> CLAY	SILT	SAND	<- HYDROMETER -> CLAY	SILT	SAND	SOIL CONT	STA <5
		B J	6C9a	6V2	6612	6S4	6S5	603	6A2d	4B1c	4B1a	4Bla	4B2b	<- - - 3A1c	- - ->		<- - - SML	- - ->		8F1	4GI
		<- P C T o f < 2 m m ->					<- P P M														
94P1051	1											13.9									
94P1052	2																				
94P1053	3											19.8									
94P1054	4											20.3									
94P1055	5											20.8									
94P1056	6											20.9									
94P1057	7											20.9									
												20.2									
94P1059	9											20.3									

29

S93LA-001-015

SUPPLENENTARV CHARACTERIZATION DATA • a*
(ACADIA PARISH, LOUISIANA)

PRINT DATE 12/06/

SAMPLED AS : JEANERETTE ; FINE-SILTV, MIXED, HYPERTHERMIC TYPIC ARGIAQUOLL
REVISED TO : ;

SSL - PROJECT 94P 37, (CP94LA085) ACADIA PARISH
- PEDON 94P 175, SANPLES 94P1051-1059
- GENERAL METHODS (ENGINEERING FRACTIONS ARE CALCULATED FRON USDA FRACTION SIZES)

UNITED STATES DEPARTNENT OF AGRICULTU
NATURAL RESOURCES CONSERVATION SERVIC
NATIONAL SOIL SURVEY CENTER
SOIL SURVEY LABORATORY
LINCOLN. NEBRASKA 68508-3866

SAMPLE NO.	DEPTH (In.)	HORIZON	ENGINEERING 3 (INCHES) 1	2	3/2 3	1 4	3/4 5	3/8 6	5 (NUMBER) 7	10 8	40 9	200 10	PSDA SIEVE 20 (MICRONS) 11	5 12	2 13	USDA 1. (MILLIMETER) 14	.5 15	.25 16	.10 17	DIAMETERS(mm) AT PERCENTILE .05 / 60 18	50 19	10 20	21	ATTERBERG LL (PCT) 22	PI 23	GRADAT UNI-FNTV C" 24
94P1051S	0- 7	Ap	100	100	100	100	100	100	100	100	100	96	64	35	16	100	100	100	98	92	0.02	0.010	0.001	32		19.4
94P1052S	7- 15	Btg1	100	100	100	100	100	100	100	100	99	97	70	42	24	100	99	99	98	94	0.01	0.007	0.001	39	15	23.7
94P1053S	15- 29	Btg2	100	100	100	100	100	100	100	100	100	97	71	47	31	100	100	99	99	94	0.01	0.006	--			25.3
94P1054S	24- 35	Btkgl	100	99	98	96	95	82	69	67	66	65	48	33	23	67	66	66	65	63	0.04	0.023	0.001			75.5
94P1055S	35- 51	Btkg2	100	99	99	98	97	96	95	95	94	92	68	46	31	95	94	94	93	90	0.01	0.007	--			28.7
94P1056S	51- 63	Btg1	100	100	100	100	100	100	100	100	99	96	71	47	31	99	99	99	98	94	0.01	0.006	--			25.9
94P1057S	63- 76	Btg2	100	100	100	100	100	100	100	100	99	96	70	46	31	100	99	99	98	94	0.01	0.006	--			26.6
94P1058S	76- BB	Btg3	100	100	100	100	100	100	100	100	99	96	68	45	30	100	99	99	98	93	0.01	0.007	--	41	25	28.3
94P1059S	BB- 98	et95	100	100	100	100	100	100	100	100	99	95	66	45	31	100	99	99	98	91	0.01	0.007	--			31.5

DEPTH (In.)	GHT FRACTIONS) SOIL (mm) 75 -2	75 -20	20 -5	5 -2	<2 (of WHOLE SOIL)	<75 mm FRACTION 75 -20	20 -5	5 -2	<2 (PCT OF <75 mm)	(WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL: SOIL SURVEY 1/3 BAR	OVEN -DRY	ENGINEERING MOIST	SATUR -ATED	<2 mm FRACTION: SOIL SURVEY 1/3 BAR	15 BAR	ENGINEERING OVEN	VOID RATIO AT 1/3
														1.34			0
												1.90		1.53			0
												1.88		1.52			0
												2.07		1.55			0
												1.96		1.58			0
												1.94		1.58			0
63- 76	--	--	--									2.00		1.64			0
76- 88	--	--	--											1.66	1.74		0
88- 98	--	--	--														

*** SUPPLEMENTARY CHARACTERIZATION DATA ***

S93LA-001-015 PRINT DATE 12/06/
SAMPLED AS : JEANERETTE ; FINE-SILTY, MIXED, HYPERTHERMIC TYPIC ARGIAQUOLL
USDA-NRCS-NSSC-SOIL SURVEY LABORATORY ; PEGGN 94P 115, SANPLE 94P1051- 1859

(V G L U N E F R A C T I O N S)(C/)(R A T I 0 S to C L A V)(LINEAR EXTENSIBILITY)(WR
----WHGLE SGIL (ı) at 1/3 BAR ;---(/N) -

DEPTH (In.)	PORES D	RAT	FINE				
0- 7	8			2.2	1.7	2.2	0
1- 15	4			4.6	2.8	4.6	0
15- 24	8			5.6	2.6	5.6	0
24- 35	5			4.8	2.5	6.3	0
35- 51	9			5.1	2.3	5.2	0
51- 63	9			5.4	2.3	5.4	0
63-76-	9			4.1	1.4	4.1	0
76 88	9			4.2	1.6	4.2	0
88- 98	7						

DEPTH (In.)
0- 7
7- 15
15- 24
24- 35
35- 51
51- 63
63- 76
76- 88
88- 98

0-18
0-40

31

Saturation and Rainfall - The piezometer data (Figure 11) show a perched water table above 25 cm during the winter and spring of each year, especially during 1997. practice, rice-soybeans vs rice-crawfish-rice. The Jeanerette soil does oxygenate to 2 m and then resaturate from the top down under soybean management. But the soil remain wet, saturated and reduced under rice-crawfish management. This is evident from the figure. The field was in soybeans in 1994 and 1996, but in rice in 1995.The figure depict this management in that water is staring in the field during the summer of 1995. This soils exhibits Episaturation.

Reduction - The presence of ferrous Fe has been confirmed at this Jeanerette site using $\propto$-$\propto$ dipyridyl. The redox data are presented in Figure 12 These data are similar to the saturation data in that when the soil is saturated the redox potential decreases. During periods of short saturation duration (1996) the upper 25 cm had a lower redox potential than the 50 and 100 cm depth, but the potential was below the threshold of Fe reduction. When the soil was saturated for long duration (summer 1995 and winter 1997), the soil was reduced with respect to Fe at both depths, Prior to rice harvested, the soil was drained and the upper 50 cm was oxidized. The soil became saturated from winter rains and the soil reduced, but not to the level it was during rice flooding. As the soil dried in the spring, the upper 50 cm begin to oxidize. The soil remained saturated at 100 cm and slowly dried and a maxima redox potential was recorded during late summer. When the rains began, the upper 50 cm saturated and there was rapid reduction because of the abundant supply of carbon and the redox potential dropped below 0 mv. The subsoil became saturated, but the potentials did not reach the low that had been recorded during rice production.

Redoximorohic Features - No redoximorphic features were described for the upper 38 cm. This description was obtained when the field and been in pasture for 2 to 3 years. We described 7.5 YR 5/6 pore linings in the upper 10 cm during the spring after rice harvest. There are few, medium, moderately cemented Fe-Mn concretions in the Btg horizon. This horizon is slightly alkaline. The Fe and Mn are going into solution and are precipitated in the Btg horizon because of the increase in pH.

Aquic Condition Criteria:

The Jeanerette soil data support aquic conditions. Saturation, reduction and redoximorphic features occurred within the upper 50 cm to below 2 m. The soil had an unsaturated zone between 1 and 2 m, which meets the criteria for Epiaquic saturation. The soil was saturated in the upper 50 cm while dry between 50 cm and 2 meters. Under natural conditions (prairie) if drainage is not provided, it is believed that the soil will be saturated and reduced for a sufficient length of time to meet the aquic conditions. The combined data support the criteria for Epiaquic saturation.

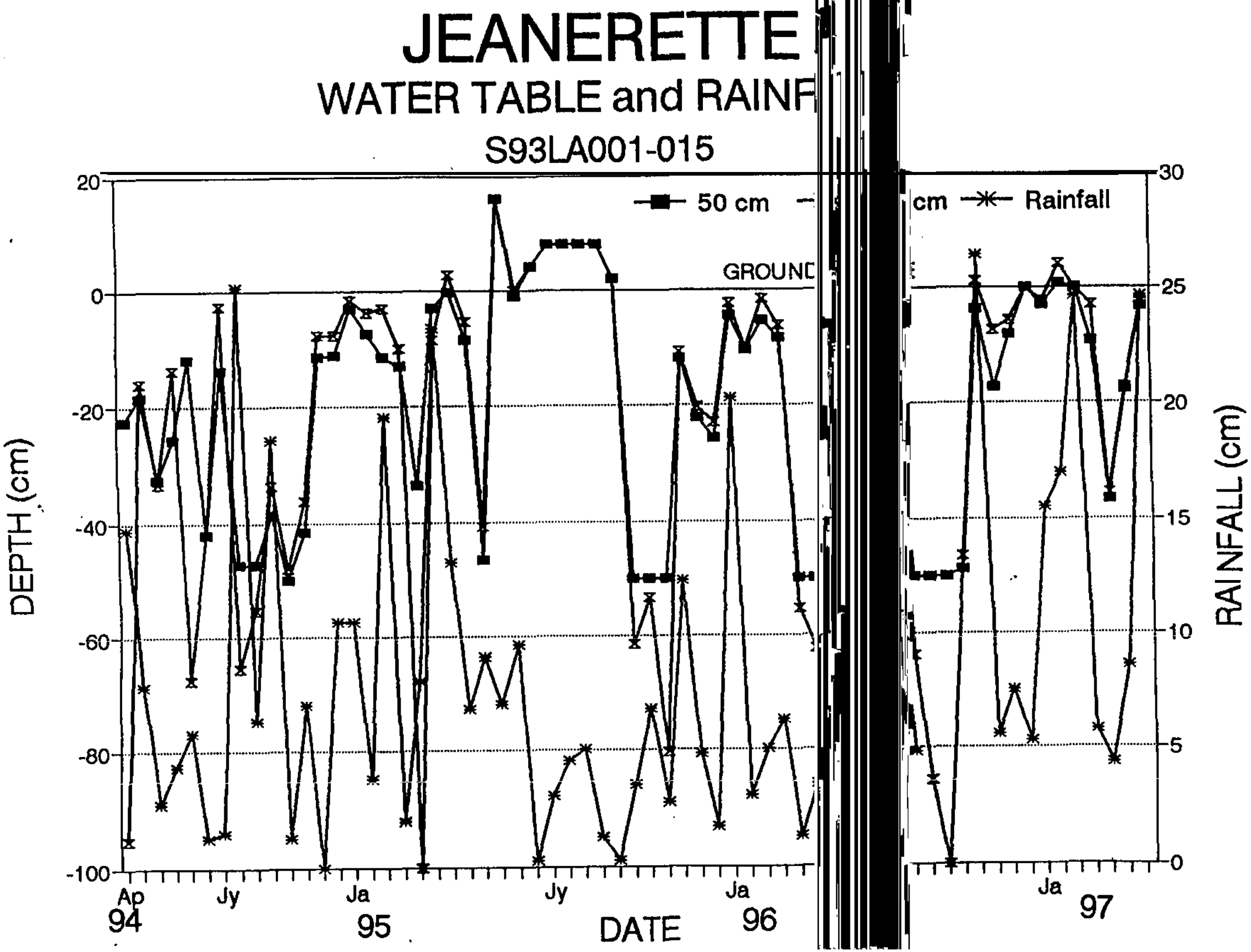


Fig. 11. Water Table and Rainfall Data for the Jeanetette soil, April 1994 through May 1997.

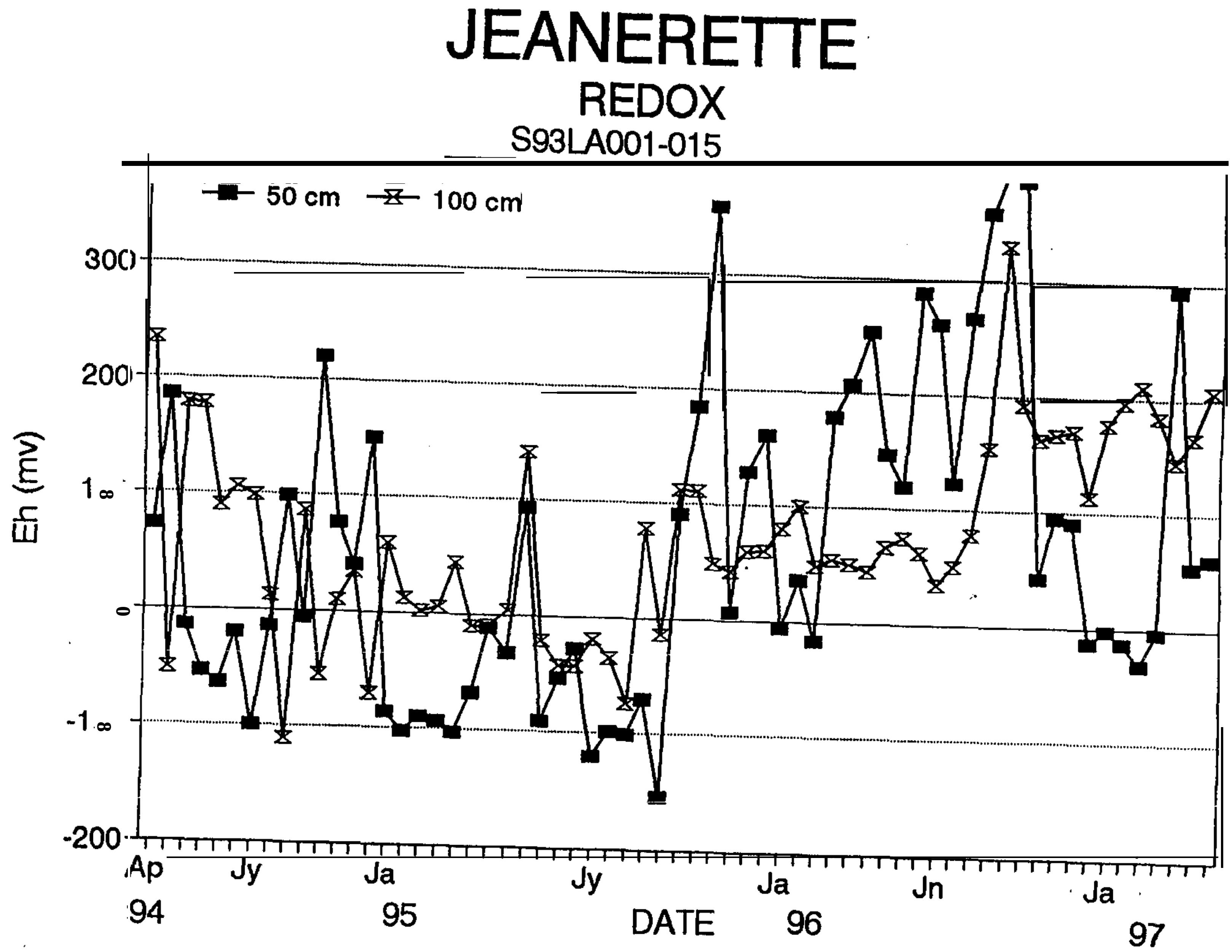


Fig. 12. Redox Potentials at 50 and 100 cm for Jeanerette Soil, April 1994 through May 1997.

Soil Temperature:

The soil temperature at 50 and 100 cm is presented in Fig. 13. Note that the soil temperature is never lower than 5 °C, which is considered biological zero. This soil's microbial activity may be **slower** in the winter, but the potential for reduction occurs all year.

Hydric Indicators:

This soil is in LRR T. Based upon the profile description taken in 1994, this soil does not have any of the indicators to be classified as a hydric soil. This soil does not meet F5. Thick Dark Surface.

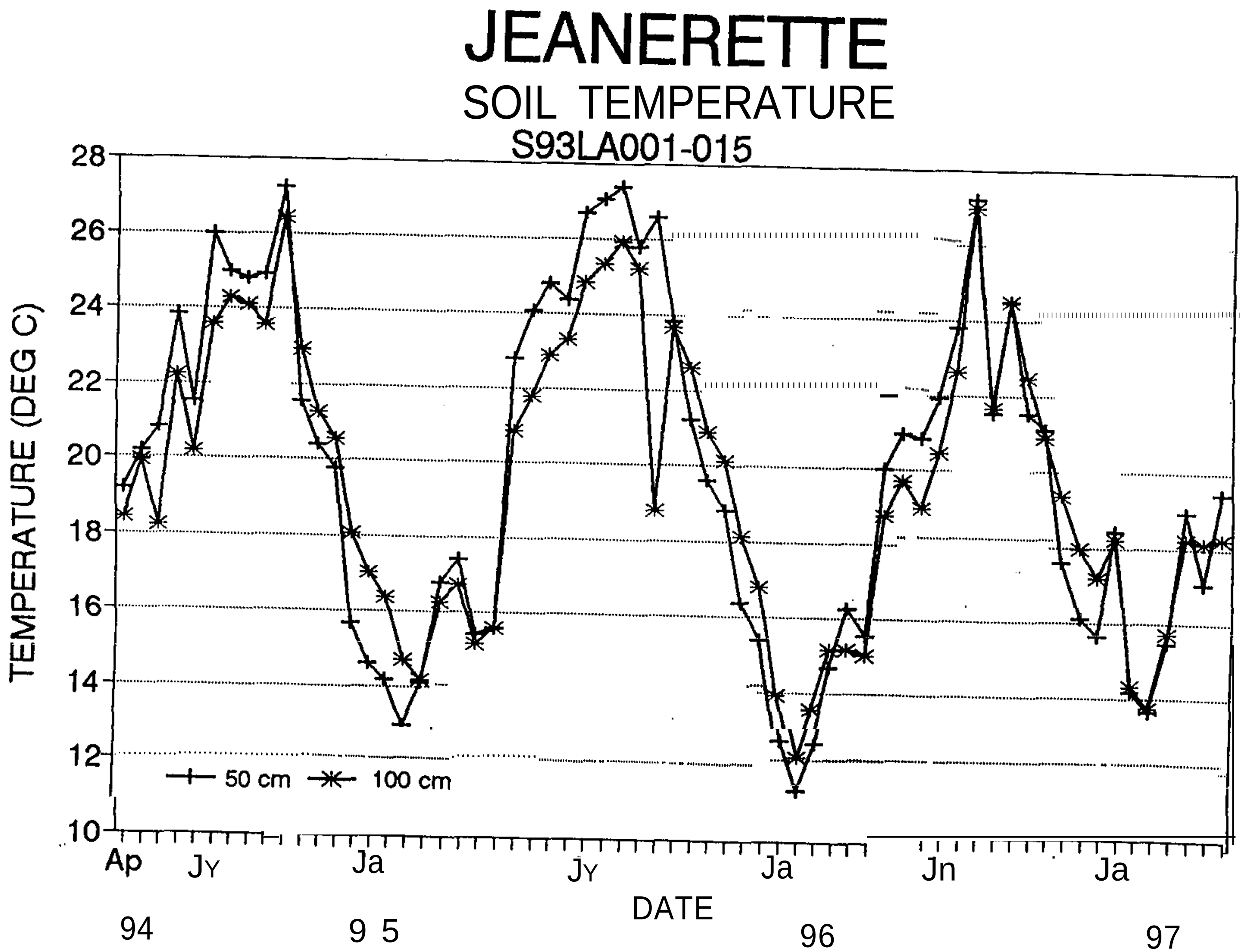


Fig. 13. Soil Temperatures at 50 and 100 cm for the Jeanerette soil, April 1994 through May 1997

CROWLEY SILT LOAM

Geographic Setting:

Crowley soils are on nearly level to level Pleistocene terraces on slightly convex slopes. Slope gradients range from 0 to 3 percent. Circular mounds of about 50 to 75 feet in diameter and 15 to 30 inches high were common but most of these **have been leveled.** The parent material is primarily alluvial sediments of Pleistocene age. At the type location mean annual temperature is 68 degrees F., and average annual rainfall about 59 inches.

Soil Characteristics:

CrA-Crowley silt loam, 0 to 1 percent slopes (aerial photograph). The Crowley soils are level and somewhat poorly drained. They are on broad convex ridges on terraces on the Gulf Coast Prairies. Areas are irregular in shape and range from 20 to 2,500 acres. The landscape consists of broad convex ridges thet contain small convex mounds or mound areas that have been smoothed. The mounds are circular and range from 50 to 150 feet in diameter and 1 to 3 feet in height before being leveled. Most mounds have been leveled. (Fig. 14.)

The Crowley soil has a surface layer of grayish brown silt loam about 15 cm thick. The next layer is gray, mottled silt loam about 13 cm thick. The subsoil between depths of about 28 cm to 49 cm is dark gray, mottled silty clay. The subsoil to a depth of about 273 cm is light brownish gray, mottled silty clay loam to silty clay.

Use and Management:

The Crowley soil has medium fertility and moderately high levels of exchangeable aluminum that are potentially toxic to crops. Water and air move

Fig. 14. Soils Map Showing the Location of the Crowley Site.

grazing during wet periods help keep the pasture and soil in good condition. Fertilizer and lime are needed for optimum growth of grasses and legumes.

The soils of this map unit are moderately well suited to woodland. Wetness severely limits the use of equipment and causes slight to moderate seedling mortality. Conventional methods of harvesting timber are suitable, but the soil may be compacted if it is wet and heavy equipment is used. This can be overcome by using specialized equipment during wet seasons or by logging during the drier seasons. Competition from understory plants is severe. Reforestation after harvest must be carefully managed to reduce competition from undesirable understory plants, Suitable trees to plant are loblolly pine, slash pine, water oak, and green ash.

The soils in this map unit are in capability subclass IIIw. The woodland ordination symbol is 11W for the Crowley soil.

Soils Data:

Profile Description:

TAXONOMIC CLASS: Fine, Smectitic, hyperthermic Typic Albaqualfs.

TYPICAL PEDON: Crowley silt loam on a broad, nearly level area in cropland at an elevation of 32 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 18 cm; dark grayish brown (10YR 4/2) silt loam; weak fine granular structure; friable; many very fine and fine and few coarse roots; few fine rounded black and brownish iron-manganese concretions; common fine yellowish brown (10YR 5/6) and yellowish red (5YR 5/6) oxidation stains around root channels; moderately acid; clear wavy boundary. (8 to 33 cm thick)

Eg--18 to 36 cm; light brownish gray (10YR 6/2) silt loam; weak fine subangular blocky structure; friable; many very fine and fine roots; few very fine and fine discontinuous tubular pores; few fine and medium rounded black and brownish iron-manganese concretions; common fine dark brown (7.5YR 4/4) oxidation stains around root channels; moderately acid; abrupt wavy boundary. (10 to 35 cm thick)

Btgl--36 to 64 cm; grayish brown (10YR 5/2) silty clay; moderate medium subangular blocky structure; firm; common very fine and fine roots; common very fine and fine discontinuous tubular pores; many continuous distinct clay films on surfaces of peds; few fine rounded black and brownish iron-manganese concretions; many medium prominent red (2.5YR 4/6) masses of iron accumulation; many dark gray (10YR 4/1) ped coatings; moderately acid; clear wavy boundary.

Btg2--64 to 84 cm; grayish brown (2.5Y 5/2) silty clay; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; common very fine and fine roots; many very fine discontinuous tubular pores; many continuous distinct clay films on surfaces of peds; many fine, medium, and coarse rounded black and brownish iron-manganese concretions; many fine and medium prominent red (2.5YR 4/6) and common medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; many dark gray

Bckssg--175 to 216 cm; light brownish gray (2.5Y 6/2) silty clay; many coarse prominent reddish brown (5YR 5/4) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common very fine random dis-continuous tubular pores; many distinct slickensides greater than 10 cm. long that are at angles of 20 to 60 degrees; common medium irregular black manganese accumulations; many medium and coarse prominent **yellowish brown** (10YR 5/6) masses of iron accumulation; common coarse calcium carbonate concretions; moderately alkaline.

Chemical, Physical and Mineralouic Data

This soil was sampled as a CROWLEY SIL
This soil was sampled in ACADIA Parish
This soil's identification number is S95LA001056- 4
The CROWLEY SIL is classified as a
Typic Albaqualf, fine, montmorillonitic, thermic

Selected physical properties of a CROWLEY SIL soil sampled in ACADIA Parish, Louisiana.

HORIZON	DEPTH	SAND	SILT	CLAY	VCS	CS	MS	FS	VFS	SAND > VFS	VFS + SILT	TEXTURAL CLASS
	(cm)	(---------------pct less than 2 mm---------------)										
Ap	0- 18	22.3	59.1	16.6	0.6	1.7	0.9	4.0	16.1	1.2	14.2	sil
E	18- 36	21.0	52.8	26.2	3.2	3.3	1.2	5.9	7.4	13.6	60.2	sil
Btg1	36- 64	10.6	40.6	48.6	0.3	0.2	0.0	2.2	7.9	2.7	48.5	sic
Btg2	64- 84	10.9	45.5	43.6	0.2	0.3	0.1	2.4	7.9	3.0	53.4	sic
Btg3	84-102	16.4	46.4	35.2	0.2	0.2	0.1	3.4	12.5	3.9	60.9	sicl
Btg4	102-127	22.6	48.9	26.3	0.4	0.2	0.1	4.6	17.5	5.3	66.4	Cl
Btgss	127-145	23.3	45.7	31.0	0.2	0.1	0.0	4.3	18.7	4.6	64.4	Cl
BCgss	145-175	22.4	41.1	36.6	0.1	0.0	0.0	4.5	17.8	4.6	58.9	Cl
BCkgss	175-206	17.9	47.3	34.8	0.0	0.1	0.1	3.1	14.6	3.3	61.9	sicl
2Ckssg	206-229	10.0	50.2	39.8	0.0	0.0	0.0	1.6	8.4	1.6	58.6	sicl
2Ckss	229-244	8.9	49.2	41.9	0.0	0.0	0.0	1.3	7.6	1.3	56.8	sic

Selected physical and chemical properties of a CROWLEY SIL soil sampled in ACADIA Parish, Louisiana.

HORIZON	DEPTH	Moist. Ret. (1/3b)	Moist. Ret. (15b)	WRD	BULK DENSITY A.D.	BULK DENSITY O.D.	BULK DENSITY F.M.	COLE	O.C.	N	C/N
	(cm)			(%)	(-----g/cc		----)		(%)	(%)	
Ap	0- 18	27.8	6.3	21.5	1.48	1.51	1.45	0.010	1.60	-	-
E	18- 36	27.1	8.8	18.3	1.68	1.76	1.64	0.020	0.60	-	-
Btgl	36- 64	36.1	17.5	18.6	1.65	1.74	1.55	0.040	0.84	-	-
Btg2	64- 84	33.8	17.5	16.3	1.85	1.91	1.67	0.040	0.39	-	-
Btg3	84-102	30.1	15.9	14.2	1.89	1.95	1.76	0.040	0.22	-	-
Btg4	102-127	27.0	13.4	13.6	1.83	1.93	1.74	0.040	0.07	-	-
Btgss	127-145	27.1	13.3	13.8	1.93	1.98	1.82	0.030	0.03	-	-
BCgss	145-175	31.1	16.1	15.0	1.93	1.99	1.78	0.040	0.05	-	-
BCkgss	175-206	31.7	15.7	16.0	1.92	1.99	1.80	0.040	0.07	-	-
2Ckssg	206-229	35.7	17.5	18.2	1.83	1.92	1.71	0.040	0.02	-	-
2Ckss	229-244	36.5	18.3	18.2	0.00	0.00	0.00	0.000	0.19	-	-

Selected chemical characteristics of a CROWLEY SIL soil sampled in ACADIA Parish, Louisiana.

HORIZON	DEPTH	pH	pH	pH	Ca	Mg	K	Na	Ex. Acid.
	(cm)	(H2O)	(KCl)	(CaCl2)	(----cmole(p+)/kg----)				
AP	0- 18	5.1	4.6	5.2	3.8	0.8	0.3	0.1	6.0
E	18- 36	5.3	4.3	5.0	4.1	1.3	0.2	0.1	5.4
Btgl	36- 64	5.3	4.3	5.0	9.2	5.9	0.3	0.4	8.4
Btg2	64- 84	6.0	4.8	5.1	10.7	7.0	0.3	0.5	5.4
Btg3	84-102	6.4	5.2	5.6	10.5	6.8	0.2	0.6	3.6
Btg4	102-127	6.3	5.8	6.0	9.0	5.6	0.1	0.7	1.8
Btgss	127-145	7.2	5.9	6.4	9.0	5.4	0.1	0.7	2.4
BCgss	145-175	7.3	6.1	6.6	13.5	7.7	0.2	1.0	3.0
BCkgss	175-206	7.5	6.1	6.8	13.7	7.6	0.3	0.9	1.8
2Ckssg	206-229	7.3	6.2	6.9	18.7	10.1	0.3	1.0	3.6
2Ckss	229-244	7.2	6.0	6.8	20.6	11.0	0.4	1.0	4.0

Selected chemical characteristics of a CROWLEY SIL soil sampled in ACADIA Parish, Louisiana.

HORIZON	DEPTH	CEC		BASE SAT.		Fe	Al	H	PHOSPORUS	
	(cm)	(NH4OAc)	(sum)	(NH4OAc)	(sum)	(%)	(cmole(p+)/kg)		Bray 1	Bray 2
		(cmole(p+)/kg)		(-----pct----)					(----ppm----)	
AP	0- 18	6.5	11.0	76.9	45.5	0.2	0.0	0.6	117	117
E	18- 36	7.5	11.1	76.0	51.4	0.3	0.0	0.6		10
Btgl	36- 64	18.5	24.2	85.4	65.3	0.4	0.0	0.8		9
Btg2	64- 84	19.8	23.9	93.4	77.4	0.4	0.0	0.4		12
Btg3	84-102	20.0	21.7	so.5	83.4	0.3	0.0	0.4		10
Btg4	102-127	15.3	19.2	100.7	89.6	0.4	0.C	0.2		10
Btgss	127-145	16.0	17.6	95.0	86.4	0.3	0.0	0.2		11
BCgss	145-175	19.3	25.4	116.1	88.2	0.3	0.0	0.2		13
BCkgss	175-206	23.0	24.3	97.8	92.6	0.2	0.0	0.2		10
2Ckssg	206-229	27.8	33.7	108.3	89.3	0.2	0.0	0.2		13
2Ckss	229-244	30.0	37.0	110.0	89.2	0.1	0.0	0.2		30

Note:

1. Values of less than 0.05 are reported as 0.0.

*** PRIMARY CHARACTERIZATION DATA ***

S88LA-001-001 — PRINT DATE 02/27/9
SAMPLED AS : CROWLEY ;FINE, MONTMORILLONITIC, THERMIC TYPIC ALBAQUALF
NATIONAL SOIL SURVEY LABORATORY ;PEDON 89P 45, SAMPLE 89P507- 521

	-1-	-2- to -7-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18- to -19-	-20-
	CLAY MINERALOGY (<.002mm)										
SAMPLE NUMBER	FRACTION	X-RAY 7A2i peak size	SIO2	AL2O3	Fe2O3	MgO	CaO	K2O	Na2O	EGME RETW 7D2 mg/g	INTERPRETATION
			ELEMENTAL 7C3 Percent								
89P 509	TCLY	MT 3 KK J MM 3 MI 2		24.8	6.9			1.3			MONT
89P 510	TCLY	MT 4 KK 3 MI 2 QZ 1 MM 1		24.8	7.1			1.3			MONT
89P 510	TCLY	CL 1									
89P 516	TCLY	MT 3 KK 3 MI 3 MM 1 CL 1		20.0	8.6			2.5			MONT
89P 516	TCLY	QZ 1									
89P 520	TCLY	MT 4 MI 2 KK 2 CA 1 QZ 1		IB.B	7.4			2.8			WONT
89P 520	TCLY	MM 1 CL 1									
89P 521	TCLY	MT 4 W I 3 KK 3 MM 1 CA 1		21.8	1.6			2.5			MONT
89P 521	TCLY	QZ 1									

Column headings as printed: THERMAL: DTA 7A3b Percent (-7- to -9-); TGA 7A4b (-10-).

FRACTION INTERPRETATION:

TCLY Total Clay, <0.002mm

MINERAL IWTERPRETATIOW:

MT montmorill · MI mica · KK kaolinite · CA calcite · QZ quartz · MM ● ont-mica
CL chlorite

RELATIVE PEAK SIZE: 5 Very Large 4 Large 3 Medium 2 Small 1 Very Small 6 No Peaks

INTERPRETATION (BY HORIZON):

PEDON WI NERALOGY
BASED ON SAND/SILT:
BASED ON CLAY: MONTMORILLONITIC
FAMILY MINERALOGY: MONTMORILLONITIC
COMMENTS:

Saturation and Rainfall -

CROWLEY
WATER TABLE and RAINFALL
S95LA-001-004

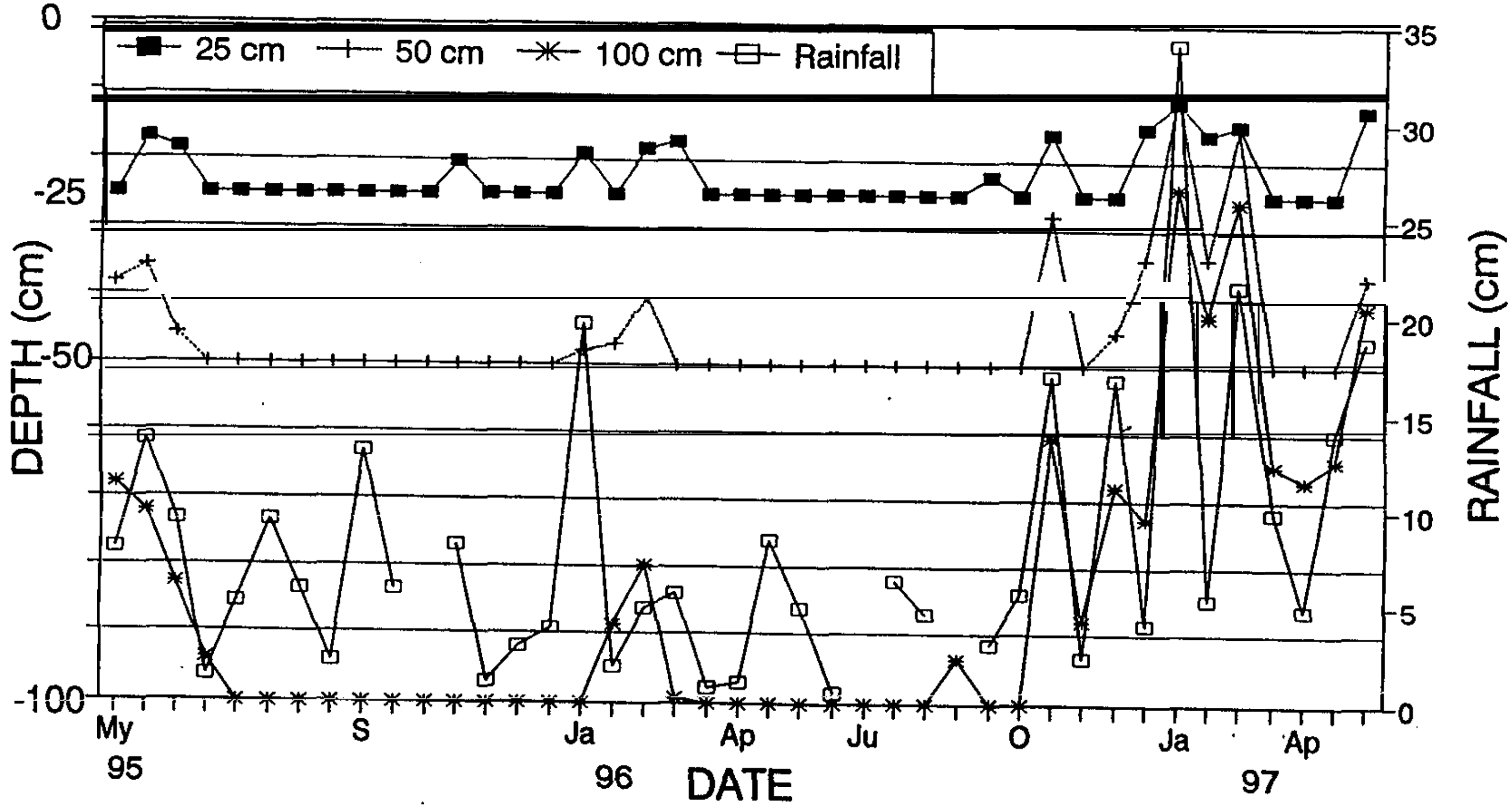


Fig 5. Water Table and Rainfall Data for the Crowley Soil, May 1995 through May 1997.

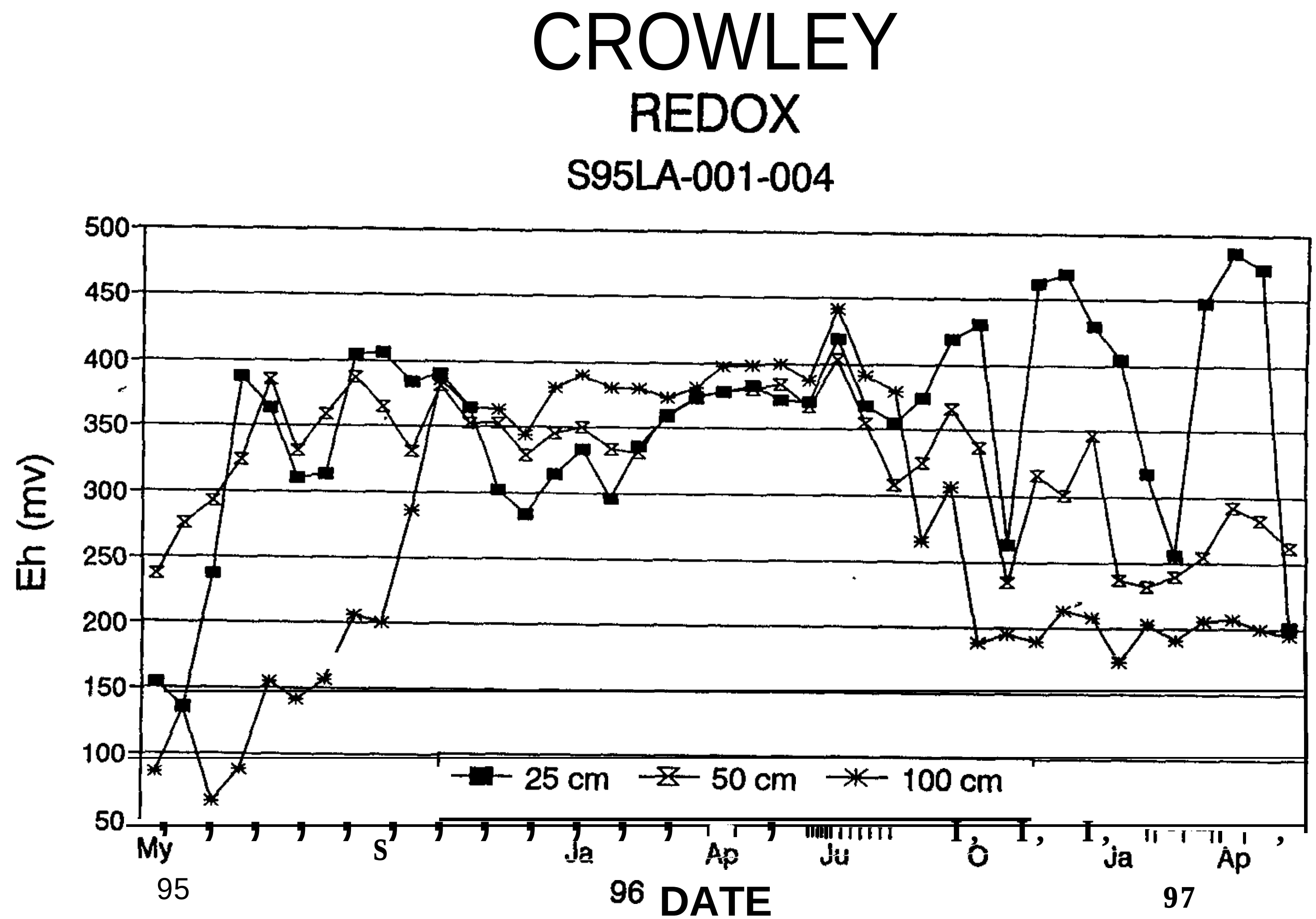


Fig. 16. Redox Potentials at 50 and 100 cm for the Crowley Soil, May 1995 through May 1997.

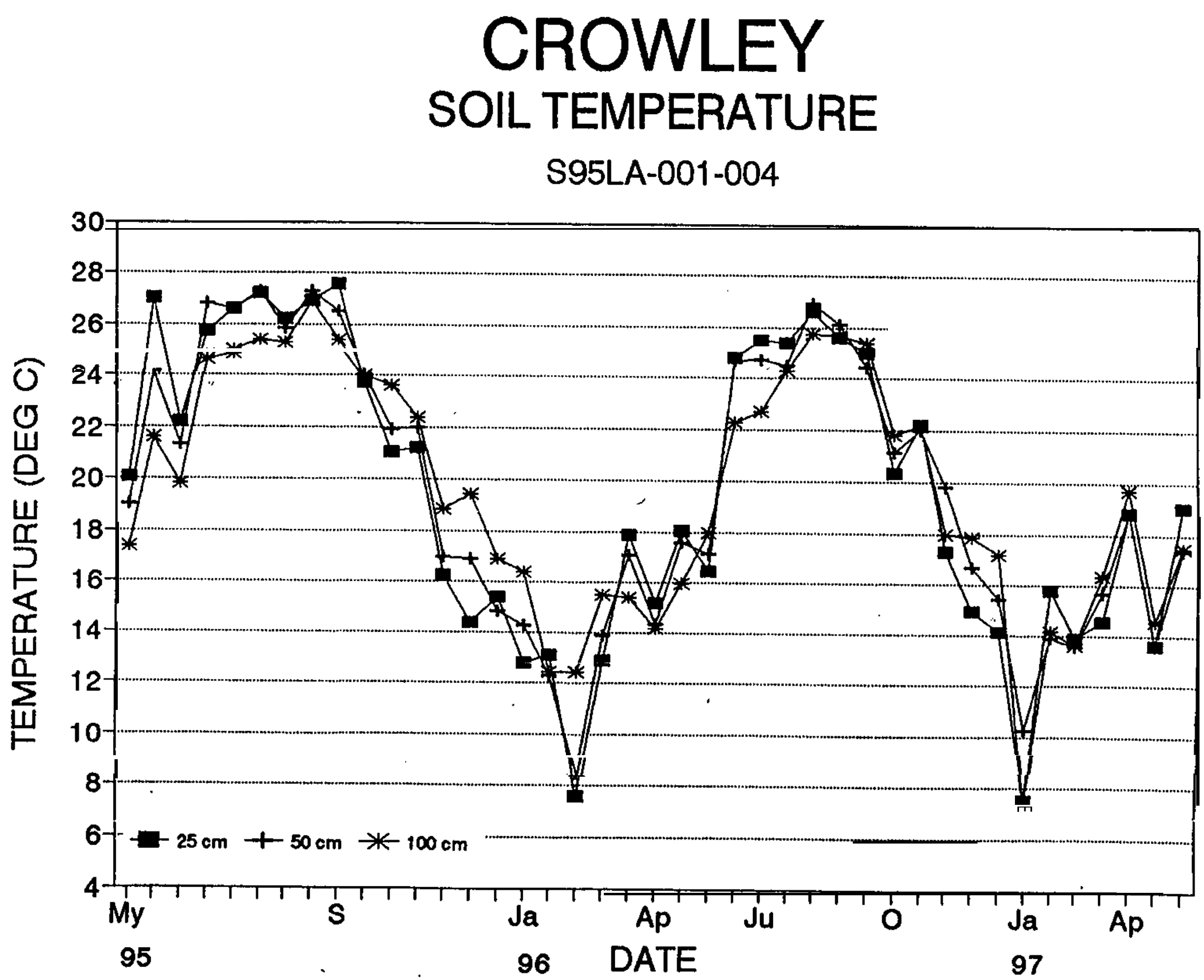


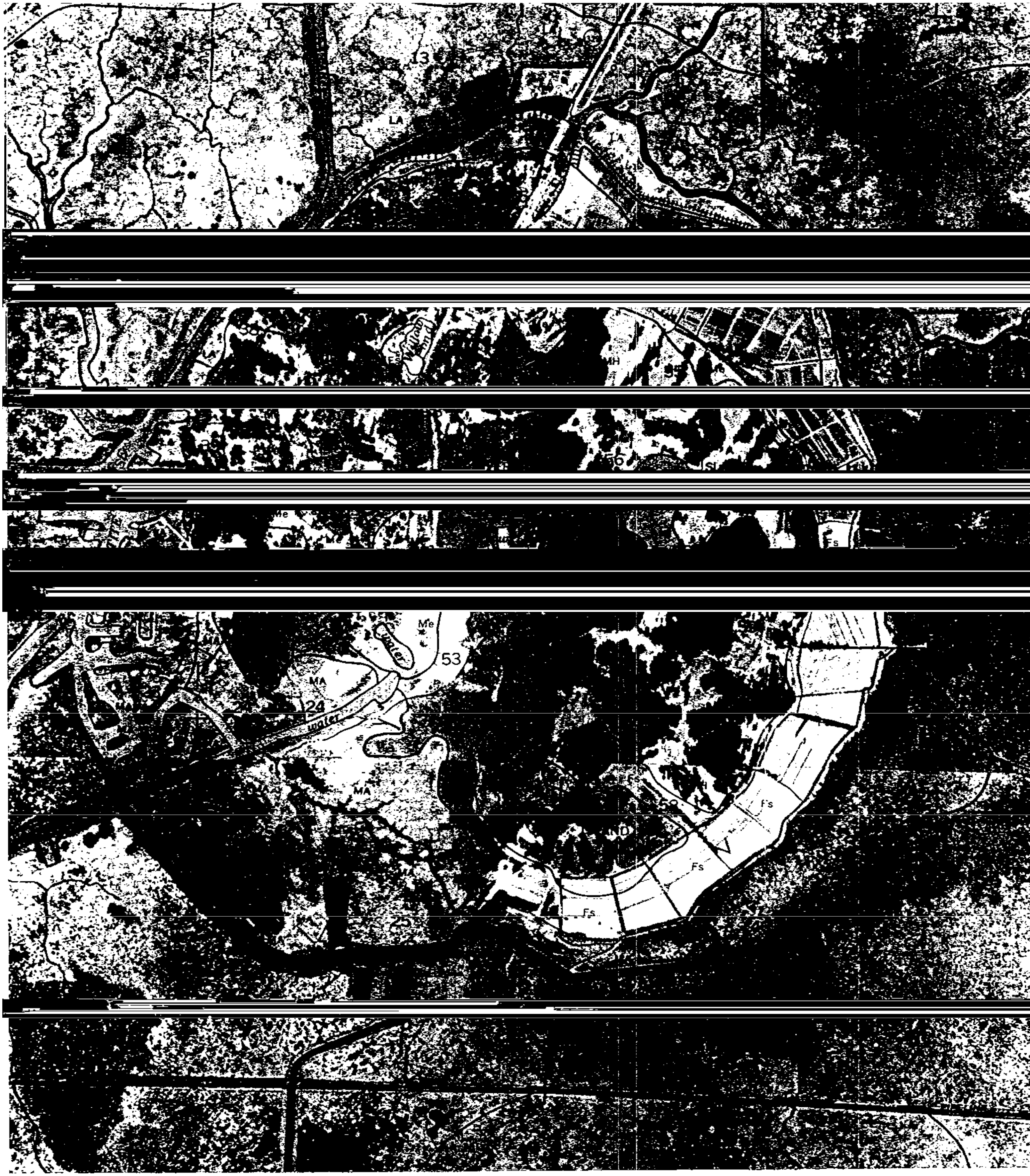
Fig. 17. Soil Temperature at 50 and 100 cm for the Crowley Soil, May 1995 through May 1997.

Hvdric Indicators:

This soil is in LRR T. The data support the Hydric indicator F3. Depleted Matrix. This soil has been kept of the Hydric Soils of Louisiana by being described as somewhat poorly drained., but do not have a frequently occurring water table less than 0.5 feet from the surface for 14 consecutive days during the growing season. We contend that the soil is poorly drained and probably meets 2.b.(2) of the Hydric Soils Criteria.

LUNCH

AVERY ISLAND



lg.
eri
ve

Particle Size Analysis

Location: Avery Island
Date: 2-May-97

Sample	Depth (cm)	%clay	%silt	%sand	Sand: vcs	Sand: cs	Sand: ms	Sand: fs	Sand: vfs	Class
Avery Island	0-8	25.6%	84.9%	9.5%	0.0%	1.2%	3.6%	4.0%	0.7%	SiL
Avery Island	a25	20.5%	74.1%	5.4%	0.0%	0.8%	1.9%	2.2%	0.5%	SiL
Avery Island	25-34	20.4%	68.5%	11.1%	0.3%	1.4%	4.0%	4.4%	1.0%	SiL
Avery Island	34-45	20.7%	73.4%	5.0%	0.0%	0.9%	2.3%	2.3%	0.4%	SiL
Avery Island	45-80	20.6%	74.3%	5.1%	0.1%	0.8%	1.0%	2.1%	0.3%	SiL
Avery Island	80-110	20.6%	75.8%	3.6%	0.0%	0.3%	1.4%	1.6%	0.3%	SiL
Avery Island	110-150	20.5%	77.2%	2.3%	0.0%	0.1%	1.0%	0.7%	0.5%	SiL
Avery Island	150-170	20.4%	70.2%	1.4%	0.0%	0.1%	0.5%	0.6%	0.2%	SiL
Avery Island	170-190	20.5%	78.4%	1.1%	0.0%	0.1%	0.3%	0.4%	0.3%	SiL
Avery Island	190-225	25.6%	73.3%	1.1%	0.0%	0.0%	0.2%	0.6%	0.3%	SiL
Avery Island	225255	28.0%	70.8%	1.2%	0.0%	0.1%	0.2%	0.5%	0.4%	SiCL

SOIL FERTILITY PROFILE

Location: Avery Island
Date: 2-May-97

Sample	Depth (cm)	pH water	P ppm	Exchangeable Cations: Ca	Mg	K	Na	Al	H	Extr.Acid. BaCl2-TEA	C.E.C. (sum)	% Base Sat.	%Na Sat.	% Al Sat.	Ca/Mg
Avery Island	0-8	4.8	55	4.53	3.31	0.37	0.18	3.60	0.00	13.06	21.45	30.1%	2.1%	30.0%	1.37
Avery Island	a25	4.7	61	1.55	2.84	0.23	0.15	6.20	0.00	9.79	14.58	32.8%	3.2%	56.5%	0.54
Avery Island	2534	4.7	40	1.65	2.15	0.21	0.18	3.90	0.30	8.53	10.70	30.0%	3.9%	46.6%	0.77
Avery Island	3445	4.7	50	3.26	3.21	0.32	0.24	6.00	0.20	10.61	17.63	30.8%	3.4%	45.4%	1.01
Avery Island	45-80	4.0	65	3.32	3.08	0.37	0.32	6.40	0.00	10.61	17.60	40.0%	4.6%	47.5%	1.08
Avery Island	80110	5.0	102	346	3.37	0.37	0.40	5.20	0.00	8.16	15.75	48.2%	5.3%	40.7%	1.03
Avery Island	110-150	5.0	110	5.00	4.36	0.30	0.52	3.60	0.00	7.34	17.60	58.3%	5.6%	26.0%	1.15
Avery Island	150-170	5.1	131	5.73	4.33	0.39	0.53	2.80	0.00	4.90	15.07	00.1%	4.9%	20.3%	1.32
Avery Island	170-190	5.2	182	7.29	4.80	0.44	0.61	1.40	0.40	4.90	17.07	72.7%	4.6%	0.4%	1.51
Avery Island	190-225	5.4	230	7.27	4.31	0.37	0.58	1.10	0.30	4.08	16.60	75.4%	4.6%	7.0%	1.68
Avery Island	225-255	5.6	250	7.10	4.02	0.33	0.58	0.40	0.60	2.45	14.47	83.1%	4.8%	3.1%	1.77

References

Bohn, H. L. 1971. Redox potential. Soil Sci. 112:39-45.

Bouma, J. 1990. Circular Letter No., 10. ICOMAQ. Wageningen Agricultural Univ. Unpublished. Wageningen, The Netherlands.

Childs, C. W. 1981. Field test for ferrous iron and ferric-organic complexes (on exchange sites or in water-soluble forms) in soils. Aust. J. Soil Res. 19:175-180.

Collins, J. F. and S. W. Buol. 1970a. Effect of fluctuations in the Eh-pH environment of iron/or manganese equilibria. Soil Sci. 110:118-123.

Collins, J. F. and S. W. Buol. 1970b. Patterns of iron and manganese precipitation under specified Eh-pH conditions. Soil Sci. 110:157-162.

Faulkner, S. P., W. H. Patrick, Jr., and R. P. Gambrell. 1989. Field techniques for measuring wetland soil parameters. Soil Sci. Soc. Am. J. 53:883-890.

Gotoh, S., and W. H. Patrick, Jr. 1974. Transformation of iron in a waterlogged soil as influenced by redox potential and pH. Soil Sci. Soc. Am. Proc. 38:66-71.

Hoffer, G. N. 1945. Fertilized corn plants require well-ventilated soils Better Crops 29(1):6-8.

Hvorslev, M. J. 1951. Time lag and soil permeability in ground water observation. Bulletin 36 50 pp. U.S. Army Corps of Engineers Waterways Experiment Station. Vicksburg, MS.

Marthalar, H. P., W. Vogelsanger, F. Richard, and P. J. Wierenga. 1983. A pressure transducer for field tensiometer. Soil Sci. Soc. Am. J. 47:624-627.

Moorman, F. R. 1985. Excerpts from the Circular Letters of the International Committee on Low Activity Clays (ICOMLAC). Technical Monograph No. 8. Soil Management Support Services - Agency for International Development, Washington, D.C.

Nyhan, J. W. and B. J. Drennan. 1990. Tensiometer data acquisition system for hydrologic studies requiring high temporal resolution. Soil Sci. Soc. Am. J.

Patrick, W. H., Jr. 1980. The role of inorganic redox systems in controlling reduction in paddy soils. p. 107-117. In Symposium on paddy soils Proc. Institute of Soils Science, Academia Sinica. Nanjing, China.

Patrick, W. H., Jr., and I. C. Mahapatra. 1968. Transformation and availability to rice of nitrogen and phosphorus in waterlogged soils. Adv. Agron. 20:323-359.

Ponnamperuna, F. N. 1972. The chemistry of submerges soils. Adv. Agron. 24:29-96.

Turner, F. T., and W. H. Patrick, Jr. 1968. Chemical changes in waterlogged soils as a result of oxygen depletion. p. 53-56. In Trans. Int. Congr. Soil Sci., 9th, 1968. Adelaide, Australia.

NATIONAL COOPERATIVE SOIL SURVEY

Soil Survey Conference Proceedings

San Diego, California
July 10-14, 1995

Library
Copy

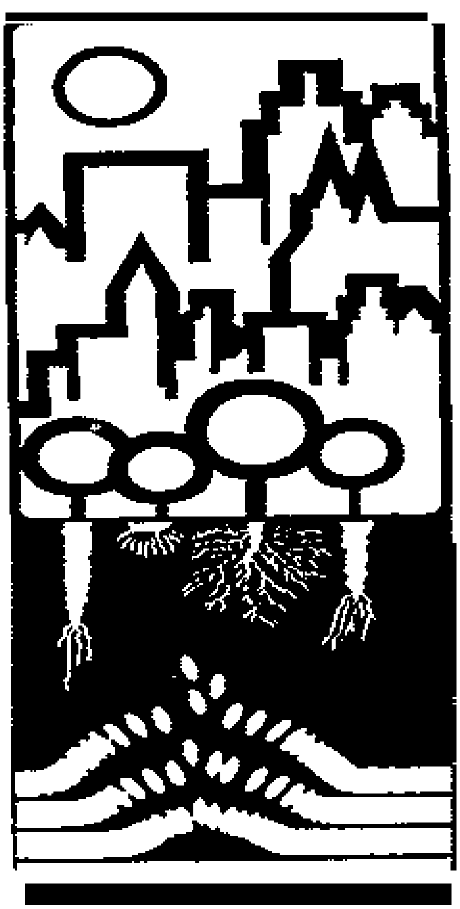
PROCEEDINGS OF THE NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

San Diego, California
July 10-14, 1995

TABLE OF CONTENTS

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

San Diego, California
July 10-14, 1995



United States Department of Agriculture
Natural Resources Conservation Service

5:00 PM - 7:00 PM **Registration**

AM Chairoerson - Tommie Parham

8:00 AM - 9:00 AM	**Registration**
9:oo Ah4 - 9:15 AM	Welcome Gene Andreuccetti West Regional Conservationist USDA-NRCS Sacramento, California
9:15 AM - 10:00 AM	*NRCS Reorganization and Reinvention of Soil Survey Activities* Dr. Richard Arnold Director, Soils Division Washington, D.C.
lo:oo AM - 10:30 Ah4	**Break**
10:30 AM - 11:00 AM	*California Landscapes* Dt. Hershel R Read State Conservationist, California USDA-NRCS
11:00 AM - 11:10 AM	*North East Agricultural Experiment Station Report* Dr. Marty Rabenhorst Department of Agronomy University of Maryland
11:10 AM - 11:20 AM	*BLM - Soil Survey Activities* William Volk BLM State Soil Scientist Billings, Montana

11:20 AM - 12:00 PM — *Soil Taxonomy Standing Committee Report*
Bob Ahrens
Lead Scientist,
Soil Taxonomy
National Soil Survey Center
USDA- NRCS

12:00 PM - 1:00 PM — Lunch

PM Chair person -Jim Ware

1:00 PM - 2:00 PM — *Report on the National Research Council* Committee on the *Characterization of Wetlands*
Dr. Carole Johnston
Natural Resources Research Institute
university of Minnesota

2:00 PM - 2:10 PM — *West Agricultural Experiment Station Report*

2:10 PM - 2:20 PM — *USFS - Soil Survey Activities*
Gretta Boley
Watershed and Air Management
Washington, D.C.

2:20 PM - 2:30 PM — North *Central Agricultural Experiment Station Report*
Dr. Doug Malo
Plant Science Department
South Dakota State University

2:30 PM - 3:00 PM — Break

3:00 PM - 4:30 PM — *Panel Discussion on Disturbed Soils*
Dr. Tom Ammons - Panel Leader

6:00 PM - 8:00 PM — Mai Tai Mixer Monday evening for all to get together

Tuesday - July 11

AM Chairperson - William Volk

8:00 AM - 10:00 AM — *Hydric Soil Issues Seminar*
Dr. Martin Rabenhorst - Chairman

9:30 AM - 10:00 AM — Break

10:00 AM - 12:00 PM — *Hydric Soil Issues Seminar* - Cont.

12:00 PM - 2:00 PM — Luncheon
Doug Helms - Chairing-
Discussion on 100 year anniversary for soil survey.

2:00 PM - 3:00 PM — Committee 1
NCSS and USDA Reorganization
Chair: Thomas E. Calhoun
committee 2
Soil Quality
Co-Chair:
Maurice Mausbach
Co-Chair: Bob Meurisse
Committee 3
Hydric Soil
Chair: Martin Rabenhorst
Committee 4
Eroded Soils
Chair: Tom Fenton

[redacted]

[redacted]

AM Chair person - Mary Collins

1:50 PM **- 2:00 PM** | ***BIA Soil Survey Activities***
Charlie Dillahunty
Wind **River** Reservation
Ft. **Washakie,** WY

2:00 PM **- 2:30** PM | NCSS Standards ***Standing Committee Report***
Dr. Steve Holzhey
USDA **- NRCS**
National Soil **Survey Center**

2:30 PM **- 3:00** PM | ***National Data Infrastructure***

Report - Committee 3
Hydric Soil
Chair: Martin Rabenhorst

Hanalei Hotel
North San Diego
California

United States Department of Agriculture

Natural Resources Conservation Service

P.O. Box 2890
Washington, D.C.
20013

Subject: National Cooperative Soil Survey Conference Steering Committee Minutes   Date: 8/8/95

To: Stewing Team Members (see listing)   File Code: 430-14

The Steering Committee for the National Cooperative Soil Survey Conference met at the conclusion of the Conference on 7/14/95, in accordance with the By-laws. The meeting was called to order by Dr. Arnold at *11:00* AM, and a quorum was present. Items to be discussed were the committee reports and recommendations, and the location of the next conference.

The first order of business was to take action on committee reports and recommendations.

1. **Committee 4, Eroded Soils Chair - Dr. T.E. Fenton**
   A. No specific recommendations for action were presented to the Steering Committee.
   B. **It was** moved and seconded that the Committee report as submitted be accepted. Motion passed.
   C. **It** was moved **and** seconded that the committee be continued.
   Discussion included :
   Why? Because a broader approach to the issue of eroded soils needs to be established.
   The Committee charges need to be reviewed and broadened.
   Some of the alternatives discussed in the report need to be tested.
   Alternatives from this report should be forwarded to the regional conferences for their deliberation.
   If the issue of eroded soils is given to the International Committee on Anthropogenic Soils, will there be a need for this committee to continue?
   The steering Committee could recommend that the concepts discussed in this report be incorporated into the charges to the International Committee on Anthropogenic Soils. The Steering Committee needs to look into providing new charges to this committee for the future. It is appropriate to accept this report and to recommend continuing this committee. **Motion carried.**

2. Committee 3, Hydric Soils Chair - Dr. Martin Rabenhorst

A. Recommendation 1 - Policies and mandates set forth by the 198.5 Food security Act (FSA), the 1990 Food, Agriculture. Conservation and Trade Act (FACTA), and the Wetland Protection portion of the Clean Water Act (CWA - Sec 404) forced the development of hydric soils definitions, hydric soils criteria, and hydric soil lists within a relatively short period of time. Because of similar exigencies, the Field Indicators of Hydric Soils in the United States were also developed and implemented rapidly.

Thus, while we do understand that the Field Indicators are soil morphological features related to iron reduction and organic matter accumulation and thus generally indicative of wet soil conditions, the National Cooperative Soil Survey Conference should acknowledge that:

a. due to the rapid development of the Field Indicators, they have not been correlated with objective and measurable soil properties (a technical standard) which would more fully explain the definition of Hydric Soils. and

b. that in spite of the release of the Field Indicators, the degree of wetness or anaerobiosis reflected by these Indicators is not well understood (especially some of those which are related to organic matter features such as stripped matrix. 70% ofvisible grains masked with organic material, and soil colors of 3/1 or darker, as opposed to colors of 3/2 or 3/3).

Committee action:

The Committee would prefer that the recommendation emphasize what is known, not what is not known The Steering Committee recommends therefore to have Committee 3 - Hydric Soils restate the recommendation in a more positive manner. The Steering Committee will then send it to the National Technical Committee on Hydric Soils along with the concerns listed. For example, the statement could be worded along these lines:

Field Indicators, are soil morphological features related lo iron reduction and organic matter accumulation and thus generally indicative of wet soil conditions. Due to their rapid development, continuing the documentation on their correlation with measurable soil properties is recommended.

B. Recommendation 2 - A Technical Standard for hydric soils should be developed to clarify the definition of Hydric Soils and to provide an objective and measurable way to evaluate when the definition of hydric soils has been met. The Technical Standard should focus on 1) the height, duration, and seasonal occurrence of the free water surface within the upper 30cm of the soil, and 2) chemical parameters indicative of anaerobic conditions such as the level of dissolved oxygen or iron reduction.

Committee action:

The Steering Committee agrees that technical standards are needed, and it supports the concept and development of technical standards. The **Steering** Committee **requests, however, that the word "objective" be removed from the committee's recommendation** number 2 statement "...Hydric Soils and to provide an objective and measurable way to evaluate when....". The Steering committee feels this statement could be misinterpreted as implying that what has been done to date is not objective. With that modification, the Steering Committee will forward this recommendation on to the National Technical Committee on I-Iydric Soils Committee for their consideration.

C. Recommendation 3 - It is clear that the Field Indicators will continue to be used before a technical standard can be developed and approved. Therefore, the National Cooperative Soil Survey Conference should encourage inclusion of a caveat in the introduction to the Field Indicators of Hydric Soils in the United States (perhaps similar to #1) which identifies the extend of our scientific knowledge regarding the Field Indicators.

Committee action:

The **Steering Committee recommends therefore**

The Steering committee recommends that Committee 3 restate the recommendation in a more positive manner similar to what is recommended for their recommendation number 1. The Steering Committee will encourage the inclusion of a positively worded statement to this effect in the introduction to the Field Indicators. Such a statement should encourage developing documentation to further support Field Indicators.

D. Recommendation 4 - The Technical Standard should be developed by a joint group comprised of the Technical Issues Subcommittee of the NTCHS and the pedological research (AES) community.

Committee **action:**

Review current membership of the Technical Issues Subcommittee to insure researchers from the Agricultural Experiment Stations arc included.

Current membership on the Technical Issues Subcommittee includes:

Dr. Del Fanning	University of Maryland
Dr. Jim Richardson	North Dakota State University
Dr. Herb Huddleston	Oregon State University
Dr. Chen Lu Ping	University of Alaska
Dr. Steve Faulkner	Louisiana State University
Dr. Wayne Skagg	North Carolina State University

This should constitute a good representation of the pedological research community.

No **further action needed**.

E. **Recommendation 5 - Research** should continue to be focused on identifying the relationships between soil morphological **properties and** the types of soil conditions to be included in the Technical Standard (the height, duration, and seasonal occurrence of the free water surface within the soil, and chemical parameters indicative of anaerobic conditions such as the level of dissolved **oxygen or iron reduction).**

Committee action:
Recommendation accepted It will be forwarded to the NTCHS.

F. Recommendation 6 **-** The Field Indicators should provide a focal point for research activities, so that their significance may be fully understood and interpreted.

Committee action:
The steering Committee accepts this recommendation pending removal of the word "fully" from the statement "*...so that their significance may be fully understood and interpreted.*" **The concern** here, again, is possible misinterpretation of the word "fully" as meaning a total lack of understanding.

3. **Committee 1 - NCSS and USDA** Reorganization **Chair - Thomas E. Calhoun**

A. Recommendation 1 **-** Propose to the NRCS that the name of the Soil Survey *program* be changed to The Soil Resources Cooperative Program If the agency elects to change the name of the program, then develop a proposal to change the name of the National Cooperative Soil Survey Program

Committee action:
The Steering Committee **tabled this recommendation** because **the Program** is named by legislative action, and would require legislative action not agency action to change it.

B. Recommendation 2 **-** A lead soil scientist from each of the 6 regions of NRCS serve as liaison to the NCSS Conference.

Committee action:
Recommendation accepted, and it will be forwarded to the 6 NRCS Regional Conservationists for their consideration.

C. Recommendation 3 **-** Establish a National Cooperative Soil Research Agenda Standing Committee.

Committee action:
Recommendation **accepted. Dennis Lytle moved, rod it was seconded** that the intent of the draft charges (attached) be reviewed by the Committee and that suggestions be submitted to Dennis by 8-15-95. Suggestions for a committee Chair should also be submitted by that date. **Motion carried.** It was also **moved rnd seronded that** this Research Agenda topic be discussed at each of the Regional Conferences. *Discussion centered around the fact*

that the Regional conferences set their own agendas, and the National Conference cm only suggest agenda items for their consideration. The motion was amended to state that the National Conference recommends that this Research Agenda topic be included on the agendas of the Regional Conferences. **Motion carried.**

D. Recommendation 4 - Initiate and develop a soil educational activity that incorporates all agencies and members to accommodate the various kinds of land. This activity should be designed to provide a colorful and structural approach to promoting the interest and desire to sustain the productivity of the soil resource, Audiences including youth groups, schools, land users both public and private need to be accommodated. State of the art techniques, including involving National Educational Groups should be used. This needs to be a continuing activity to accommodate arising needs and to utilize the latest visual and educational approaches.

Committee action:

A Task Force is to be established to address the awareness and educational needs of the soil survey program. This issue will also be **recommended to the Regional Conferences for consideration on their agendas. Regional Conferences will be asked to canvas their membership for ideas on appropriate tasks and for potential membership.**

E. Recommendation 5 - Propose an Ad-Hoc Committee be established on Global Climate Change activities. This Committee will report at the next Regional and National Conferences so that the membership will have a better understanding of the kinds of projects being carried out.

Committee action:

Global Climate change activities will be included in the charges for the Research Agenda Standing Committee.

F. Recommendation 6 - the Steering Committee include 6 NRCS representatives in addition to the Director of the Soils Division instead of the 7 representatives it currently has. The 6 representatives will include representatives of the National Headquarters, National Soil Survey Center, and Regional soil staffs as determined by the Director, Soils Division NRCS.

Committee action:

The motion was **presented** and it was seconded. The **Motion** carried.

G. Recommendation 7 - A member of the private sector be added to the Steering Committee as designated by the National Society of Consulting Soil Scientists

Committee action:

Motion was made and seconded. *Discussion centered on who might* **he** *designated by the Society.* With concurrence of Pierre Bordenave, the **motion was amended to: The President Elect of the National Society of Consulting Soil Scientists be added to the Steering Committee to represent the private sector. hlotion carried.**

H. Recommendation 8 - Recommend to the Regional Conferences that they formally invite the 1890 Land Grant Institutions to their Conferences, and determine the status of Memoranda of Understanding on soil survey with these schools. Where there are no MOUs determine if the schools want to be cooperators with NCSS and participate in the National Conference.

Committee action

Recommendation accepted. NRCS NHQ Soil Staff will review the status of MOUs. This recommendation will also be given to the Standing Committee on Research Agenda, and will be provided to the NRCS Soil Quality Institute.

4. **Committee 2 - Soil Qualify Co-Choirs Dr. hlnruice Mausbach and Dr.** Bob Meurisse

No specific recommendations were presented to the conference for action.
The following proposal was submitted on Soil resilience: It is proposed that a Committee on Soil resilience be established with at least 3 representatives from each region and with the following charges.

1. To evaluate and elaborate on the concept of soil resilience and develop an operational definition.
2. To identify the potential areas of application as a tool in the assessment of soil degradation and soil quality.
3. To assess the relevance and possible application of the concept in CRP, WRP, and other such programs.

Steering Committee accepts the report as presented. The committee also recommends that this committee be continued with revised charges for the next National Conference. Charges will include the suggestions on a committee for soil resilience.

5. **Recommendations from the Panel on Site Specific Soil Survey.**

A. Establish a NCSS representative on the National Society of Consulting Soil Scientists (NSCSS) High Resolution Soil Survey Committee. The NCSS representative will be selected from the membership of the NCSS Standards Committee, or a nonmember of their choice.

Committee action:

The Committee recommends the Chair of the Standards Standing Committee or his representative be a member of the NSCSS High Resolution Soil Survey Committee.

B. Establish a NSCSS representative on the NCSS Standards Committee. The NSCSS representative will be selected from the membership of the NSCSS High Resolution Soil Survey Committee, or a **nonmember** selected by the Board of directors.

Committee action:
Since committee membership is the option of the respective committee chair, the Steering Committee will forward this recommendation to the Chair of the Standards Standing committee for his consideration.

6. **The** Agronomy Department and the Louisiana Agricultural Experiment Station of the Louisiana State University Agricultural Center in cooperation with the Louisiana NRCS have invited the 1997 National Cooperative Soil Survey Conference to meet in Louisiana.

Committee action:
The steering Committee accepted the invitation,

THOMAS E. CALHOUN
Program Manager
Soils Division

ADDENDUM TO STEERING COMMITTEE MINUTES 12/27/95

1. All proposed changes to the By-Laws were approved. Acopy of the revised By-Laws are attached.

2. A revised set of recommendations from the Hydric Soils Committee were received, and the revisions have been incorporated into the report for the Proceedings.

3. The Division Director has determined that the 6 NRCS representatives on the NCSS Steering Committee, in addition to the Director himself, shall be:

One representative from the National Soil Survey Center

One representative from the Soils Division, NRCS, National Headquarters staff

Four NRCS State Soil Scientists, one from each of the Host States for the next Regional Conferences as determined by each of the Regional Conferences.

BY LAWS
NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Article I. Name

The name of the Conference shall be the National Cooperative Soil Survey (NCSS) Conference.

Article II. Objectives

The objective of the Conference is to contribute to the general human welfare by promoting the use of soil resource information and by developing recommendations for courses of action, including national policies and procedures, related to soil surveys and soil resource information.

Article III. Membership and Participants

A. Permanent chairman of the Conference is Director of Soils. NRCS.

B. Permanent membership of the Conference shall consist of

1. Members of the Steering Committee.

2. Additionally, two State members appointed by each of the four regional conferences, and six NRCS lead soil scientists as members representing each of the six NRCS Regions.

3. Individuals designated by the Federal Agencies listed in Appendix A.

C. Participants of the Conference shall consist of

1. Permanent members, and

2. Individuals invited by the Steering Committee

Article IV. Regional Conference

Section 1.
Regional Conferences are organized in the northeast, north-central, southern, and western regions of the United States.

Section 2.
Regional Conferences determine their own membership requirements, officers, and number and kind of meetings.

Section 3.
Each Regional Conference adopts its own purpose, policies, and procedures, provided these are consistent with the bylaws and objectives of the NCSS Conference.

Section 4.
Each Regional Conference shall publish proceedings of regional meetings

Article V. Executive Services

The National Headquarters Soils Staff of the Natural Resources Conservation Service (NRCS) shall provide the Conference with executive services. The Soils staff NRCS, shall:

- Carry out administrative duties assigned by the Steering Committee.

- Distribute draft committee reports to participants.

- Issue announcements and invitations.

-Prepare and distribute the program

- Make arrangements for lodging, food, meeting rooms, and local transportation for official functions.

- Provide a recorder

- Assemble and distribute the proceedings.

- Provide publicity.

- Maintain the Conference mailing list

- Maintain a record of all Conference proceedings; proceedings of Regional Conference meetings; and a copy of each Regional Conference's purpose. policies, and procedures.

Article VI. Steering Committee

Section 1.
The Conference shall have a Steering Committee. The Steering Committee shall assist in the planning and management of the Conference. The Steering Committee shall consist Of

- The NRCS Director, Soils; permanent chair.

- The U.S. Forest Service Soil Survey Leader.

- The Bureau of Land Management Senior Soil Scientist,

- Four Agriculture Experiment Station Soil Survey Leaders, one from each respective Regional Conference. This normally is the State representative that was chair or vice chair of the previous Regional Conference.

- Six NRCS Soil Survey Staff Leaders, to include representatives of the National Headquarters. National Soil Survey Center, and Regional Soil Staffs as determned by the Director, NRCS Soils Division

- The President Elect of the National Society of Consulting Soil Scientists, representing the private sector.

Section 2.
The Steering Committee shall select a vice chair for a 2 year term The chair is responsible for all work of the Steering Committee. The vice chair acts for the chair in the chair's absence or disability or as assigned.

Section 3.
The Steering Committee shall formulate policy and procedure for the Conference,

Section 4.
The Steering Committee shall plan, organize, and manage the Conference. The Steering Committee shall:

- Determine subjects to be discussed

- Determine committees to be formed.

- Select committee chairs and obtain their approval and that of their agency for participation.

- Assign charges to the committee chairs

- Recommend committee members to committee chairs

- Determine individuals from the United States or other countries with soil science or related professional interest to be invited to participate.

- Determine the place and date of the Conference

- Organize the program and select presiding chairs for the sessions.

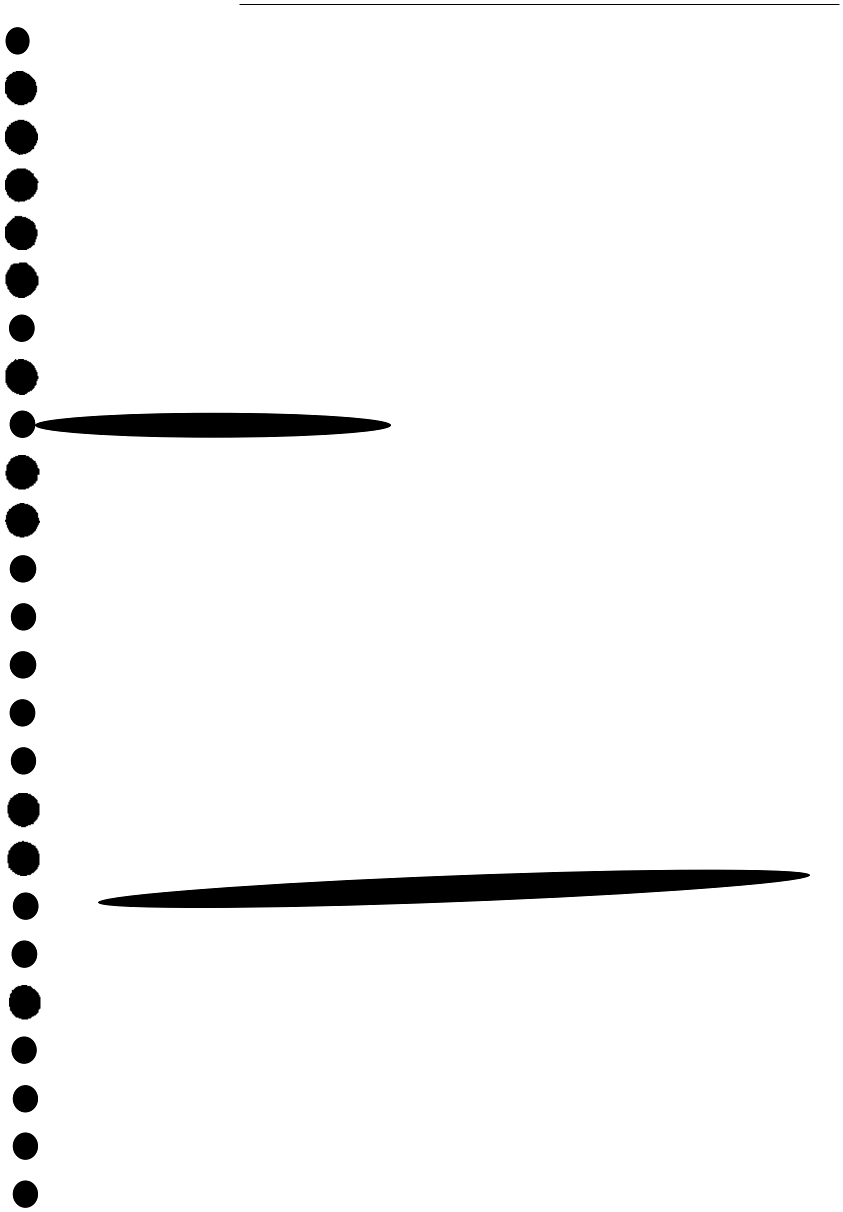
- Assemble in joint session at least once during each Conference to conduct business of the Conference.

Section 5.
Steering Committee work will normally be done by correspondence and telephone communication.

Section 6.
Fifty percent of the Steering Committee shall constitute a quorum for the transaction of business. Items shall be passed by a majority of members present or corresponding. The chair does not vote except in the case of ties.

Article VII. Meetings

Section 1.
A meeting of the Conference normally shall be held every 2 years in odd numbered years for the presentation and discussion of committee reports; exchange of ideas; and transaction of business. It shall consist of committee sessions and general sessions. Opportunity shall be provided for discussion of items members may wish to have brought before the Conference.



Article IX. Amendments

The bylaws may be amended by ballot with a majority vote of the permanent members. An amendment shall, unless otherwise provided therein be effective immediately upon adoption and shall remain in effect until changed.

APPENDIX A

FEDERAL AGENCIES HAVING MOU'S WITH NRCS in the NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Agricultural Stabilization and Conservation Service, U.S.D.A

Bureau of Indian Affairs, U.S.D.I.

Bureau of Land Management, U.S.D.I.

Bureau of Reclamation. U.S.D.I

Economics and Statistics Service, U.S.D.A.

U.S. Environmental Protection Agency

Federal Crop Insurance Corporation, U.S.D.A.

Forest Service. U.S.D.A.

National Bureau of Standards. U.S.D.C

National Oceanic and Atmospheric Administration, U.S.D.C

National Park Service, U.S.D.I.

Office of Territorial Affairs, U.S.D.I.

Extension Service. U.S.D.A

Cooperative State Research Service, U.S.D.A.

Tennessee Valley Authority (quasi Federal)

U.S. Fish and wildlife Service, U.S.D.I.

U.S. Food and Drug Administration, U.S.D.H.H.S

U.S. Geological survey, U.S.D.I.

U.S. Army Corps of Engineers, U.S.D.O.D

Defense Mapping Agency, U.S.D.O.D.

PARTICIPANTS IN THE 1995 NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE
SAN DIEGO, CALIFORNIA

Dr. Andres Aguilar
Universidad Autonoma Chapingo
P.O. Box 45
56230 Chapingo
Mexico

Dr. Bob Ahrens
Soil Scientist
National Soil Survey Center
USDA - SCS
Federal Building, Rm 345
100 Centennial Mall North
Lincoln NE 68508-3866
(402)437-5659
FAX (402)437-5336

Terry Aho
Soil Scientist
USDA-NRCS
W. 3 16 Boone Avenue
Suite 450
Spokane. WA 99201-2348
(509) 353-2339
FAX (509) 353-2354

Russell Almaraz
Soil Scientist
USDA-NRCS
P.O. Box 2890
Washington

Dr. Tom Ammons
Associate Professor Soil Genesis
Department of Plant and Soil Sciences
College of Agriculture
University of Tennessee
Knoxville TN 37901
(615)974-8804
FAX (615)974-4744

Gene Andreuccetti
Regional Conservationist, West
USDA-NRCS
650 Capitol Mall, Rm 6072
Sacramento, CA 9581.5
(916) 498-5284
FAX (916) 498.5326

Dr. Richard W. Arnold
Director, Soil Survey
USDA - NRCS
P.O. Box 2890
Washington, D.C. 20013
(202)720-1821
FAX (202)720-4593

Wayne Bachman
Soil Scientist
USDA-NRCS
200 4th Street S.W.

Pierre Bordenave
National Society of Consulting Soil Scientists
C/O InterMountain Resources
111 Cedar Suite #8
P.O. Box 1724
Sandpoint, Idaho 83864
(208) 263-9391
FAX (208) 263-7013

Dr. RR). Bryant
Associate Professor of Soil Genesis end Classification
Department of Soil, Crop, and Atmospheric Sciences
Cornell University
Ithaca NY 14853
(607)255-1716
FAX(607)255-2644

Thomas Calhoun
Assistant Director, Soil Survey
NKCS
P.O. Box 2890
Washington, D.C. 20013
(202)720-1824
FAX (202)720-4593

Steve Carpenter
Slate Soil Scientist
USDA - SCS
75 High Street
Morgantown WV 26505
(304)291-4484
FAX (304)291-4628

Kim Chang
Soil Scientist
USDA-NRCS
2121-C 2nd Street
Suite 102
Davis, CA. 95616-5475
(916) 757-8270

Dr. Mary Collins
Professor of Soi Genesis and Classification
Department of Soil Science
College of Agriculture
University of Florida
Gainesville, Florida 32611
Phone (904) 392-1951
FAX (904) 392-3902

Richard Coote
Program Leader
Agriculture Canada
Research Branch
Center for Land and Biologic Resources Research
Ottowa, Ontario K1A-OC6
(613)995-5011
FAX (613)995-7283

Jim Culver
National Soil Survey Center
USDA - SCS
Federal Building. Rm 345
100 Centennial Mall North
Lincoln NE 68508-3866
(402)437-5353
FAX (402)437-5336

Jerry Daigle
State Soil Scientist
NKCS
3737 Government Street
Alexandira, LA 71302
(3 18) 473-7787
FAX (215)499-3979

Bill Dollarhide
Soil Scientist
USDA-NRCS
5301 Longley Lane
Reno, NV 89511
(702)784-5875
FAX (702)784-5939

Mike Domaratz
Committee Secretariat
Federal Geographic Data Committee
USGS
590 National Center
Reston, VA 22092

Dr. Hari Eswaran
National Leader, World Soil Resources
NHQ Soil Survey Division
USDA - SCS
P.O. Box 2890
Washington, D.C. 200

Dr. Chris Evans
Associate Professor of Pedology
Natural Resources Department
College of Life Sciences and Agriculture
University of New Hampshire
Durham NH 03824
(603)862-1020

Dr. Tom Fenton
Professor of Soil Morphology and Genesis
Department of Agronomy
Iowa State University
Ames IA 50011
(515)294-6148

Dr. Klaus Flach
USDA-NRCS retired
4104 El Macero Dr.
Davis, CA 95616

Jim Fortner
Soil Scientist
USDA-NRCS
National Soil Survey Center
USDA - SCS
Federal Building. Rm 345
100 Centennial Mall North
Lincoln NE 68508-3866
(402)437-5353
FAX (402)437-5336

Jerry Freeouf
U.S. Forest Service
740 Simms St.
P.O. Box 25127
Lakewood, CO 80225
(303) 275-5095

Talbert Gerald
State Soil Scientist
NRCS
Federal Building. Box 13
355 East Hancock Ave.
Ahtens, GA 30601
(706) 546-2278

Joe Gibson
U.S. Army Corps of Engineers
(703) 355-2675
FAX (703) 355-3176

Chuck Gordon
Soil Scientist
USDA-NRCS
10 East Babcock Street
Bozeman, MT 59715-4704
(406) 587-6818
FAX (406) 587-6761

Rob Griffith
USDA-Forest Service
630 Sansome St.
San Francisco, CA 94111
(415) 705-2876

Kenneth Harward
NASIS Project Manager
NRCS
Information Technology Center
2625 Redwing Rd., Suite 110
Ft. Collins, CO 80526
(970) 282-1457
FAX (970) 282-1955

Dennis Heil
State Soil Scientist
NRCS
220 E. Rosser Ave.
Bismark. ND 58502-1458
(701) 250.4435
FAX (701) 250-4118

Douglas Helms
National Historian
NRCS
P.O. Box 2890
Washington, D.C 20013
(202) 720-3766
FAX (202) 720-6473

Dr. C. Steve Holzhey
USDA - SCS
Federal Building. Rm 345
100 Centennial Mall North
Lincoln NE 68508-3866
(402)437-5353

Sam Indorante
Area Soil Scientist
NRCS
25 B Center Plaza Dr.
Belleville, IL 62220
(618) 234-1484

Dr. Carol Johnson
Natural Resources Research Institute
University of Minnesota
5013 Miller Trunk Highway
Duluth, MN 55811
(2 IX) 720-4269

Paul Johnson
U.S. Forest Service
Deputy Forest Supervisor
Angeles NF
701 N. Santa Anita Ave.
Arcadia, CA 91006
(818) 574-1613
FAX (8 18)574-5233

David Jones
State Soil Scientist
USDA - SCS
100 West Capitol Street
Jackson MS 39269
(601)965-5193
FAX (601)965-5178

Dr. Ellis Knox
National Soil Survey Center
USDA - SCS
Federal Building. Rm 345
100 Centennial Mall North
Lincoln NE 68508-3866
(402)437-5353
FAX (402)437-5336

Kip Kolesinskas
State Soil Scientist
USDA - SCS
16 Professional Park Road
Storrs CT 0626X-1299
(203)487-4047
FAX (203)487-4054

Dr. Alan Kosse
Soil Scientist
Bureau of Indian Affairs
Navajo Area Office
Land Inventory and Classification Section
P.O. Box 1060
Gallup. NM X7305
(505) 863-8487
FAX (SOS) x63-8245

Karl Langlois
Soil Scientist
Biological Conservation Sciences Staff
P.O. Box 2890
Washington. D.C. 200 13
(202) 720-1858
FAX (202)

Dr. Doug Malo
Department of Plant Sceinces
South Dakota State University
Box 2140
Building NPBL. 247C
Brookings, SD 57007

Dr. Maurice Mausbach
USDA - SCS
P.O. Box 2890
Washington. D.C. 20013
(202)720-1812
FAX (202)720-4593

Dr. Dwayne Mays
National Soil Survey Center
USDA - SCS
Federal Building. Rm 345
100 Centennial Mall North
Lincoln NE 6850X-3866
(402)437-5353
FAX (402)437-5336

Nathan McCaleb
Soil Scientist
Ecological Sciences and Planning Staff
Midwest NTC
USDA - SCS
Federal Building. Rm 345
100 Centennial Mall North
Lincoln NE 6850X-3866
(402)437-5315
FAX (402)437-5381

Mark S. McClain
National Society of Consulting Soil Scientists
Soil Horizons Inc.
1300 Drawbridge lane
Lafayette, IN 47905-7814
1-800- 28%Soil
(317)449-1665
FAX (317)449-4313

Lynn Mood)
NRCS
2121-C 2nd Street
Suite 102
Davis. CA 95616-5475
(916) 757-8270

Gary Muckel
Soil Scientist
USDA-NRCS
FAX (817)334-5290
National Soil Survey Center
Lincoln. NB

Dr. Ken Olson
Associate Professor of Soil Pedology
Agronomy Department
W-203 Turner Hall
1102 South Goodwin
Urbana IL 61801
(217)333-3420

Kenneth Oster
NRCS
2121-C 2nd Street
Suite 102
Davis, CA 95616-5475
(916) 757-8270

Tommie Parham
NRCS
National Cartographic Center
Federal Center
Building 23, room 60
Felix and Hemphill Street,
P.O. Box 6.567
Ft. Worth TX 761 16
(817)334-5224
FAX (817)334-5290
(202)690-0138

Larry Pointer
Program Coordinator
National Park Service
U.S. Dept. of Interior
1201 Oakridge Rd., suite 250
Ft. Collins. CO 80525
(970) 225-3539
FAX (970) 225-9965

Debby Prevost
Soil Scientist
NRCS
5 17 Gold Avenue, SW
RM 3301
Albuquerque, NM X7102
(SOS) 766-3277

Alan Price
Soil Scientist
USDA-NRCS
655 Parfet Street
Lakewood, CO 80215-5517
(303) 236-2910
FAX (303) 236.2986

Russ Pringle
Soil Scientist
USDA-NRCS
Rm. 401 Sturgis Hall
Louisiana Stale University
Baton Rouge, LA 70803
(504) 388-1337
FAX (504) 388-1403

Dr. Marty Rabenhorst
Associate Professor of Soil Pedology
Department of Agronomy
College of Agriculture
University of Maryland
College Park MD 20742
(301)405-1306

Pedro Ramos
Soil Scientist
USDA - Forest Service
Watershed and Air Management
20114th st. SW
3rd floor south
P.O.Box 9609
Washington, D.C. 20090-6090
(202)205-1270
FAX (202)205-1096

Paul Reich
Geographer
USDA - NKCS
P.O. Box 2890
Washington. D.C. 20013
(202) 690-0037
FAX (202)720-4593

Dr. Pierre Robert
Department of Soil Science
College of Agriculture
University of Minnesota
St Paul, MN 55108
(612) 625-9734

Bill Roth
Soil Scientist
NHQ. Soil Survey Division
USDA - SCS
P.O. Box 2890
Washington, D.C. 20013
(202)720-1809
FAX (202)720-4593

Walt Russell
Soil Scientist
USDA - Forest Service
Watershed and Air Management
20114th St. SW
3rd floor south
P.O.Box 9609
Washington, D.C. 20090-6090
(202)205-1270
FAX (202)205-1096

Jerome Scharr
Soil Scientist
USDA-NRCS
200 4th Street S.W.
Huron, SD 57350-2475
(605) 353-1810
FAX (605)353-1742

Benjamin Smallwood
Biological Conservation Sciences Staff
P.O. Box 2890
Washington, D.C. 20013
(202) 720-2587
FAX (202) 720-2646

Dave Smith
Regional Soil Scientist
NRCS
West Regional Office
650 Capitol Mall, Rm. 6072
Sacramento, CA 958 IS
(916) 498-5284
FAX (916) 498-5326

Dr. Randy Southard
Land. Air. and Water Resorces
College of Agriculture
University of California
Davis. CA 95616
(916) 752-3607

Susan Southard
Soil Scientist
USDA-NRCS
2121-C 2nd Street
Suite 102
Davis, CA 95616-5475
(916) 757-8270

Ron Taylor
State Soil

THE NATIONAL COOPERATIVE SOIL SURVEY: WHERE ARE WE TODAY?

by: Richard W. Arnold
Director, Soils Division
NRCS Washington, D.C

Slide Number

I. The mission of the National Cooperative Soil Survey is to assist mankind in understanding and wisely using soil resources for a sustainable and desirable quality of life.

2. A prosperous forestry industry manages forests responsibly and with a conservation ethic.

3. High quality range doesn't just happen - it requires careful attention and a proper attitude.

4. Dryland farming in the Great Plains has always been risky. however appropriate conservation practices are available.

5. The U.S. has a lot of prime agricultural land where soil resources are capable of high levels of production.

6. The richness of biological diversity and its protection contributes to the well-being of our citizens.

7. There is a wealth of beauty and majesty in our wilderness areas, national parks, and other areas ofgeologic and biologic significance.

8. Cities must expand as our citizenry grows. Rational environmental decisions can be made during the process of growth.

9. Yes, we are interested and committed to "America the Beautiful". A critical performance indicator of our success can be the beauty of the landscape. It is a measure of man's love for the land and his diligence in caring for its resources.

10. Two of the ways we attempt to accomplish our mission are these:
(1) by maintaining a strong scientific basis for determining relationships important to decision makers,
and
(2) by providing scientific expertise for identifying, classifying, mapping and interpreting soils.

11. We have learned to look for those relationships where thresholds have been exceeded. Understanding limitations to use and management is critical.

12. Observing patterns that are linked to soils gives rise to hypotheses about those relationships. Interpreting relationships correctly is fundamental to predicting resource behavior.

13. Relationships experienced in one place may be transferable to other locations Validating and calibrating our interpretations is an ongoing task.

14. Our scientific expertise of interest for many others is associated with our knowledge of soils. The complexities imbedded in our concept of a soil are truly astounding.

15. The history of a soil involves the accumulation of earthy materials at a specific location and the biogeochemical processes that have, and are, transforming those materials into a soil.

16. Temporal processes give rise to temporal results. But we also know that temporal processes are conditioned and markedly influenced by the longer term historical geographical characteristics of soils.

17. You look; you see. You touch; you feel. You draw on a mental database full of possibilities. It is your special expertise at work. It is based on good science.

18. Concepts, properties, measurements. Obtaining the data needed to understand is a process that slowly leads us into new ideas about soil behavior - such as use dependent temporal soil features.

19. Our knowledge, our understanding , and our predictions are all based *on* relationships, If A, then B; if X, then Y. Functional relationships are never exact. There is always a degree of uncertainty; a level of probability associated with our statements. But it is science-based, and it is good.

20. Two other aspects are necessary for us to accomplish our mission:
(a) making our information readily available to users,
(b) and helping people use the information.
Simple. Effective. Meaningful.

21. *We* have made maps and legends and published reports detailing the soils of the United States.

22. We have stood in the rain to explain what we see and know, and how we interpret the soils in their landscapes.

23. Helping people understand soils has been our business for a long time, and we've done it in many ways.

24. We have provided information on limitations, on suitability, and estimated the responses for many uses and alternative ways of management.

25. About ten years ago the work of soil survey started to take on a different color. It was a change that affected the future course of events. The government decided to tie part of its agricultural programs to the preservation and conservation of soil resources.

26. Plowing up, and planting marginal lands to commodity crops was discouraged by the Sodbuster provisions ofthc Food Security Act of 1965.

27. Natural catastrophes went on a rampage from time to time, setting in motion environmental and conservational conflicts about the appropriate restitution of the land

28. A fresh look at the importance of wetlands was based on the ecological functions provided by the many different kinds of wetlands throughout America.

29. We were still faced with excessive rates of erosion in many parts of the U.S. which decreased productivity and degraded the environment.

30. Cross-compliance meant that you could remain eligible for USDA benefits if you developed and implemented an acceptable conservation plan. Although voluntary, it got the attention of a lot of people.

31. Conservation tillage and improved residue management began to sweep the country. Erosion rates on cropland have dramatically been reduced by the farmers using these practices.

32. Vernal pool wetlands are recognized as valuable contributors to ecosystem diversity. Today it is possible to consider reconstructing wetlands to provide continuity of ecosystem harmony and function.

33. Plant community succession that follows disturbances, whether natural or man-made, receives additional attention when using holistic approaches to planning and managing the environment.

34. New tools, new databases, integrated information We are beginning to see old patterns in new ways. Ecological subsystems and Major Land Resource Areas have more in common than they do differences.

35. Regardless of the agency or institution we work for and represent, there is reasonable consensus that we can assist customers and users strive for a sustainable quality of life when we emphasize: watersheds, resource interactions. and environmental harmony.

36. The U. S. has an abundance of fascinating landscapes. Unique, specific. fragile, important. Even as we learn how resources interact there is the constant concern of establishing an acceptable level of sustainability.

37. The harshness of some areas requires special understanding to achieve a balance and harmony of external and internal controls of the processes that maintain proper functional relationships.

38. "Humanized watersheds" as units of the environment make more and more sense as society adjusts to the ever changing conditions in a finite world. Hartnony can not exist without complementary interactions among the resources - soils, water, air, plants, animals, and humans.

39. Here are two aspects of "humanized landscapes" - one rural and one urban. The educational opportunities to enhance comprehension of soil resources and man's dependence upon those resources have, perhaps, never been better than in 1995.

40. A humble beginning. The source of a story. The object of our discipline. The basic building block of the Pedoshpere. Our mission: to help people understand soils. Simple isn't it? To help people understand soils.

41. New York City has requested assistance in obtaining more soil information. Land fills, bulldozed and reshaped parks, construction sites and densely packed residential suburbs have landscape evolutions that also must be deciphered and understood if we are to help.

42. Duripans can be, and have been, ripped. From undisturbed Durixeralfs to highly disturbed Xerarents - the transformations are dramatic. Man is a factor of soil formation requiring serious consideration. So many attitudes and so much thinking to change.

43. This false color infra-red view of iron chlorosis in grain sorghum on Vertisols in the Texas Gulf Coast Prairies reminds us that an important role of ours is to detect repeatable patterns and develop functional relationships that provide useful predictions of soil behavior. Science has a million scales of observation.

44. Harmony, satisfaction, resilience, tranquillity. Humankind is always intrusive, however, it does not have to be abusive. The better we understand the pressures on the land, the better we understand the cause-and- effect relationships. and the better we are able to modify our responses to mitigate those pressures.

45. We are a gee-referenced globe. Land tenure without adequate cadastre leads to disagreements. Precision farming must be accurate to be economical. Computer

46. Global climate change and the Conservation Reserve Program have both helped focus attention on environment features that change on a decadal scale. We now consider different time intervals during which soil properties form, are modified, or remain relatively stable. A change of thought processes - towards use dependency and soil quality indicators.

47. There are some soil resources so fragile that they need the help of laws to ensure that they can perform meaningful functions in ecosystems. It is the concern of many partners, rather than any one of us working in isolation.

48. Soil survey products will be provided in almost as many formats as there are possible ways to do so. Internet self help, CDs of many former and current products, interactive kiosks, and one-on-one, face to face dialogs. Just as automotive highways have foundations in soils, why shouldn't the information highway have important contacts with the pedosphere?

49. We want resources used wisely. Those decisions need to be backed by appropriate experience and research on soil related behavior and responses. We believe that sound management plans greatly assist the process.

SO. Conservation is for forests. for range, for cropland. Conservation is for all ecosystems and all watersheds. Why is a land ethic so important?

51. Because all life requires water. For most things, the better the water, the better the life. Conservation and a good land ethic produce good water.

52. Helping people understand soils. Having people help others. Helping each other. Partnering makes a big difference. We can, each day in some way, make each others job a little easier.

53. In a system of voluntary approaches nothing can, or will, change unless there is social acceptance. Conservation, a land ethic, and resource stewardship in America rely on our recognition of, and positive involvement with the cultural aspects, the economic impacts, and the available technology associated with each situation. Not easy - but very worthwhile for the NCSS.

54. The NCSS has always been noted for its ability to pull together when the chips were down. Our willingness to work together for a common good is our strength. It is the envy of many of our associates. We are proud of who we are, and what we can achieve. If we, once again. pull together we can reinforce, promote, and help others.

55. We can help others understand. We can help others accept. We can be a force that confirms conservation to be an ethic - a way of life - a fundamental belief of the National Cooperative Soil Survey.

56. Happy, joyful, laughing. loving. He displays unfettered trust. He believes. He is not afraid. Wise decisions for a sustainable and desirable quality of life. What a noble mission we have undertaken

57. Our togetherness this week is so vitally important to keep us doing the right things and ensure that we can do those things right. Thank You.

1995 NCSS CONFERENCE, SAN DIEGO. CA. JULY IO. 1995

"California **Landscapes" (presented by D. Smith)**

California -- "America's most diverse, most populous and most economically, culturally, and politically potent state with superpower-like impact that reaches around the globe" (D. Walters, The New California, 1992).

BIOPHYSICAL LANDSCAPE

Land Area -- 158.706 sq mi. (101 million acres)

- third largest state in U.S. (AK & TX larger)
- 85% is forest, range, or wildland
- 46% federal land including 18 National Forests, 17 National Parks, etc., and large areas of land managed by BLM, BIA, DOD
- 58 counties (S.F. smallest in nation, San Bernardino largest)
- 1000 miles of coastline
- 16 Major Land Resource Areas (MLRAs)

Elevation -- ranges from 14.494' at Mt. Whitney to -282' in Death Valley

Climate --

- average annual ppt. ranges from 120 inches on north coast to less than 2 inches in Colorado Desert
- up to 100 inches average annual snowpack in Sierra Nevada Mountains

Soil Climates --

- udic/isomesic on north coast with fog drop and up to 120" ppt in places (redwood forests)
- xeric/thermic in Central Valley and hills under grassland or grass-oak savanna
- xeric/mesic in mountains under conifer or mixed hardwood-conifer forests or shrub formations
- xeric/frigid & cryic under alpine communities in mountains at higher elevations
- aridic/thermic & hyperthermic in Mojave Desert

Soil -- about 2,000 soil series and more than 12,000 soil map units

- Alfisols, Inceptisols, Mollisols, Vertisols, Andisols

Plate Tectonics -- major influence on geology, geomorphology, earthquakes, etc

HUMAN LANDSCAPE

Human History -- Coastline first explored by the Spaniard Cabrillo in 1546. Not settled until two centuries later by Spanish Missionaries. There were 300.000 *Native* Americans in the state when settled Portola and Father Junipero Serra founded the first mission at San Diego in 1764. California was under provincial rule of Mexico until 1846 when it was deeded to the U.S. by Mexico as part of the settlement following the Mexican-American War (started due to boundary dispute between Texas and Mexico).

Population (as of 1993) -- 31,552,000

- more than any other state in the nation
- grew from less than 2 million in 1910 to 16 million in 1960
- doubled to more than 22 million from 1960 to 1980
- growing by some 800,000 persons per year (whereas the nation grew by 10% in the 1980s, California grew by 25%)
- projected to reach near 40 million by 2010
- California elects 11% of the entire U.S. Congress (52 Representatives, 2 Senators)

Ethnicity --

- about 25% Hispanic. 9% Asian. 8% Black, 58% Anglo and other
- Hispanic and Asian segments of population growing fastest with combined total projected to he about 50% of the overall population by the year 2000

Demographics --

- about 70% of the people live on 11% of the land area
- 15 million people in S. California on about 6% of the land area
- 6 million people in S.F. Bay area Counties on about 5% of the land area
- N. California (above Sacramento) includes about 30% of the land area of the state with only I million people (3% of total)
- less than 2% of the population involved in agricultural production
- half of the population growth in 1980s stemmed from immigration; the state's Hispanic population grew by 55% and Asian population grew' by 75% during that decade (the other 40% of growth came from birthrate and 10% from elsewhere in U.S.)

Economics --

- largest state economy in the nation (gross state product of more than $550 billion)
- 6th largest economy in the World when compared to counties
- post-industrial hybrid economy that rests on multiple bases -- defense production, aerospace. electronics & computers, agriculture, tourism, entertainment, energy, construction, chemicals & plastics, printing, furniture, timber, etc.
- media" home sale price was $80,000 in 1985, $200,000 in 1992, and $175,000 in 1995
- top farm state in nation (about $20 billion ag economy) followed by Texas ($13 billion), Iowa ($10 billion), Nebraska, Illinois, etc.
- $10.7 billion in 1993 exports of agricultural products, fish, and timber (12% of nation's total)

Agriculture --

- contains 8 of the top IO ag producing counties in the nation (Fresno County alone ranks higher in agricultural production than 24 states)
- California's soils and climate permit over 250 crops to be grown
- 8 million acres irrigated cropland
- grows 55% of the nation's fruits, nuts & vegetables"" 3% of the nation's farmland
- leads nation in production of 75 crops (top 10 = milk/dairy, grapes, cattle/beef, nursery, cotton, almonds, flowers, lettuce, hay, strawberries)
- crops grown exclusively in California include almonds. artichokes. dates, figs, kiwifruit, olives, pistachios, prunes, walnuts, raisins

National Cooperative Soil Survey Conference
San Diego, California

Northeast Agricultural Experiment Stations Report

M. C. Rabenhorst
July 10, 1995

Disturbed Soils - There has been growing interest in highly human influenced soils, even to the point that there is a now an international committee on anthropogenic soils (ICOMANTH). You **have** probably also already noticed that there is a panel discussion scheduled for later this afternoon on Disturbed Soils, and which is being chaired by Dr. Tom Ammons. Soil scientists in the NE region have been actively involved in this area for the last couple of decades. Earlier and ongoing work has been done in WV on reclaimed mine soils and in Maryland on anthropogenic soils associated with earthmoving areas in more populated areas (The Mall in Washington DC, soils formed in Dredged Materials.) More recently there has been addition work and interest by Chris Evans at UNH and by Ray Bryant at Cornell, both of whom I believe will be part of the panel discussion later today. I would just like to draw your attention to the report of a working committee (#2) of the NE regional Soil Survey Conference last year which addressed this topic, and you may be interested in obtaining copies of that report (contact Chris Evans, committee chair).

Soil Science Institute - The 1995 Soil Science Institute was held in the NE region at Cornell University last winter. There were 34 participants from USDA and in addition there were 3 guests from the People's Republic of China.

State of the NCSS - Some questions have been raised concerning the quality or level of communication between the NRCS and the cooperators within the National Cooperative Soil Survey with respect to the present/ongoing reorganization of the NRCS. Concern has been raised about why the cooperators were not included in discussions nor solicited for input during the process. (There may in fact be some good reasons for this.) There is, however, the perception, at least by some, that the National Cooperative Soil Survey is becoming less cohesive and more fragmented. With relation to the NRCS reorganization, and the new regional and LRR structure in the NRCS, some are wondering what will become of the regional soil survey conferences. I believe that Tommy Calhoun is chairing a working committee of this conference which has been addressing a number of these questions, and we should look forward to hearing their report later in the week.

NE Soil Map and Bulletin - A decision **has** been made to rewrite and publish both the map and bulletin. One subcommittee is working on the map which will be published on a single sheet at a scale of approximately 1:1.6M. The composited STATSGO maps served as a starting point but they are being revised in order to develop a readable map at that scale. Once the map is completed, then the bulletin subcommittee will assign authors for the various chapters.

Northeast Agricultural Experiment Stations Report

1995 NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

JULY 10-14, 1995

AGENCY REPORT

WILLIAM VOLK

NATIONAL SOILS PROGRAM LEAD

BUREAU Of LAND MANAGEMENT

BILLINGS, MONTANA

The BLM is quite pleased to be here as a participant in the National Cooperative Soil Survey (NCSS) and I am most pleased to be here as the Bureau,s representative. BLM is and has been involved in the inventory of western forest and rangelands resources for many years. The BLM looks forward to maintaining this involvement and particularly in the use of natural resource data by electronic methods.

Restructuring of the Bureau of Land Management.

The Bureau, like other agencies, is currently in the midst of reorganization, downsizing and reduction of staff, as vell as trying to modernize for a technological future. Teams and team leaders are being developed to address and implement the many issue6 BLM ancounters. Retirements, buyouts, as Vell as adjusting to reduced budget6 constantly changes team membership slowing progress.

Interagency cooperative efforts for sbil surveys.

The BLM *currently* has about 42 soil scientists. Approximately 40 percent are located in Oregon; with one each *for* Alaska, Colorado, and Utah. California, Idaho, New Mexico, Nevada, Montana and Wyoming share the rest. Soil scientists are filling vital roles at the National Training Center in Phoenix and the Service Center in Denver. The number of soil scientists, like other disciplines, ha6 *been* going down. Some have gone into management or changed to other duties such a6 the Hazardous Materials program.
Current progressive soil survey activities in the Bureau are primarily in the states of Oregon, Nevada and Idaho. Activities vary from cooperative efforts to contracts vith NRCS for updates *of* existing surveys. Currently, negotiations are

NATIONAL WORK PLANNING CONFERENCE

Robert J. Ahrens
Lead Scientist, Soil Taxonomy
July, 1995

Introduotion

I appreciate the opportunity to attend the National Soil Survey Work Planning Conference. In this presentation I am going to give you a brief update on Soil Taxonomy. If you have any questions I will try to answer them, and if you have any suggestions how we can better work together to improve Soil Taxonomy, I would appreciate receiving them.

Soil classification Staff

During and after reorganization of the NRCS, Bob Engel and myself will continue working on improving and revising Soil Taxonomy.

Soil Taxonomy

The 6th edition of *The Keys to Soil Taxonomy* was published in 1994. This edition contains numerous changes as a result of the work of the International Committee on Aridisols (ICOMID). Important changes recommended by this committee include expanding the number of suborders from 2 (Argids and Orthids) to 7 (Cryids, Salids, Durids, Gypsids, Argids, Calcids, and Cambids).

The International Committee on Families (ICOMFAM) has submitted the final report. Some of the proposed changes that will appear in the next amendment to *Soil Taxonomy* include:

Cation Exchange Activity Classes based on CEC-7/clay ratios
- Superactive--equal to or greater than 0.60
- Active--0.40 to 0.60
- Semiactive--0.24 to 0.40
- Subactive--<0.24

"Mineralogy" Classes for modifiers that replace names of particle-size classes:

Amorphic--A sum of eight times the Si (percent by wt. extracted by acid oxalate) plus two times the Fe (percent by weight extracted by acid oxalate) plus two times the Fe (percent by weight extracted by acid oxalate) of 5 or more and eight times the Si is more than two times the Fe.

Ferrihydritic--A sum of eight times the Si (percent by weight) extracted by acid oxalate) plus two times the Fe (percent by weight extracted by acid oxalate) of 5 or more.

Glassy--Thirty percent or more (by grain count) volcanic glass in the 0.02 to 2.0 mm fraction.

Mixed--Soils that have modifiers that replace names of particle-size classes and do not meet the requirements of any of the above classes.

New Mineralogy Classes
Ferritic
Magtic (Serpentinitic)
Isotic
Parasesquic
Paramicaceous

Made "Keys" to various classes

International Committees

We currently have three active international committees. The International Committee on Soil Moisture and Temperature Regimes (ICOMMOTR) was originally established in 1981 as the International Committee on Soil Moisture Regimes *in* the Tropics. In 1989 the focus of the committee was broadened to include temperature and not limit the committee's efforts to the tropics. Ron Paetzold is directing this committee and three circular letters have been issued to date. We hope to issue another circular letter by the end of the summer.

The International Committee on the Classification of Anthropogenic Soils (ICONANTH) was recently established to define appropriate classes in *Soil Taxonomy* for soils that have their major properties derived from human activities. Soils that need to be considered include: deep plowed or ripped soils in which diagnostic horizons have been destroyed, eroded Mollisols, strip-mined land, paddy soils, etc. Ray Bryant is chairing this committee and the initial circular letter needs to be prepared and circulated.

The International Committee on Permafrost-Affected Soils (ICOMPAS) is chaired by Jim Bockheim. To date three circular letters have been prepared. It appears from comments received so far that the committee will recommend a new soil order, the Gelisols. The fundamental problem that still remains to be solved is should the new order encompass all soils with permafrost or only those with cryoturbation.

Updating **Boil Taxonomy**

During 1996 and 1997 a concerted effort will be made to update Soil Taxonomy: A ***System of*** Soil ***Classification for the Making and Interpreting of Soil Surveys.*** The goal is to complete the 2nd edition in time for the International Congress of Soil Science in 1998.

The following questionnaire was developed to help us **in the preparation** of **the** new edition. I **would appreciate it if you took the time to respond to this questionnaire and return it to me before the conclusion of this conference.**

What additional chapters or sections would you like to have included in the new edition?

Do you recommend anything in the present edition be deleted or improved for the new edition?

What format do you recommend for the publication of the 2nd edition?

Plans are underway to publish a 2nd edition of Soil Taxonomy: A *System of Soil* Classification *for the* Making *and Interpreting of Soil Surveys* (Soil Survey Staff, 1975). We are soliciting your suggestions and comments.

What additional chapters or sections would you like to have included in the new edition?

Do you recommend anything in the present edition be deleted or improved for the *new* edition?

What format do you recommend for the publication of the 2nd edition?

Are you willing to help with this endeavor? If so in what way?

Other comments or suggestions

1995 Western Agricultural Experiment Station Report

Submitted by:
Paul McDaniel
Soil Science Division
University of Idaho
Moscow, ID 83844-2339
pmcdaniel@uidaho.edu

INTRODUCTION

The Western Agricultural Experiment Stations (WAES) are currently experiencing the same decline in resources that has affected other NCSS participants, Nevertheless, representatives from the WAES continue to play an active role in the NCSS through teaching, research, and extension activities. We have attempted to provide an overview of these efforts in the following section. Much of the work reflects our current research efforts and this is simply because most of the WAES representatives to the NCSS have a university appointment that is predominantly research-oriented.

NCSS-RELATED ACTIVITIES

Information Delivery

Colorado Agricultural Experiment Station (Dr. Gene Kelly). A cooperative agreement between Colorado State Univ. and the NRCS has been established to expedite the delivery of digital soil survey data. CSU is providing technical support to assist in the verification and digitizing of soil survey data.

Wyoming Agricultural Experiment Station (Dr. Larry Munn). A statewide soils map in digital format (ARCINFO) is being developed. The map is being compiled at the family level of Soil Taxonomy and is based on hard rock geology, a statewide surficial geology map recently completed by the Wyoming Geological Survey by photo interpretation and STATSGO.

Idaho Agricultural Experiment Station (Dr. Paul McDaniel). A loess distribution map of southeastern Idaho has been completed. The map is based on STATSGO, used in conjunction with surficial geology maps and field verification.

New *Mexico Agricultural Experiment Station* (Dr. Curtis Monger). A video entitled *" The evolution of the Rio Grande Valley and soils in southern New Mexico"* is being produced. In another cooperative project, areas in southern New Mexico where aquifers are most vulnerable to pesticide contamination are being located. This project requires extensive use of NRCS soil survey maps.

Soil Interpretations

Oregon *Agricultural Experiment Station* (Dr. Herb Huddleston). Ongoing research includes participation in the wet soils monitoring program. Sites being monitored include Mollisols/Alfisols of the Willamette Valley and Andisols of central Oregon. A new study has been initiated to monitor hydrological and chemical parameters in saline soils of eastern Oregon. Both of these studies will provide much-needed information on relating redoximorphic features to hydrological/chemical regimes in some of the "problem soils"-Andisols and salt-affected soils in which expression of redoximorphic features is often very weak or lacking despite prolonged wetness.

Utah *Agricultural Experiment Station* (Dr. Janis Boettinger). Current research is investigating susceptibility of gypsiferous Entisols of southwestern Utah to concentrated flow erosion. Goals are to determine the mechanisms responsible for concentrated flow erosion and test the effectiveness of polyacrylamide on reducing erosion. The use of ground-penetrating radar and electromagnetic induction in determining soil depth over petrocalcic horizons and basalt is being investigated. A separate project is examining the genesis and seasonal dynamics of saline and wet soils in eastern Utah. This project will provide data needed for consistent identification of these hydric soils.

California *Agricultural Experiment Station-Riverside* (Dr. Bob Graham). Major research includes properties, genesis, and rote of weathered granitic bedrock in ecosystems and environmental quality. Saturated and unsaturated hydraulic conductivity, morphologic and micromorphologic features, and mineral weathering trends in soil-weathered bedrock sequences have been determined. A 2-year monitoring program of chaparral use of weathered granitic bedrock in the southern Sierra Nevada has been completed. A study of water flow and virus transport through weathered bedrock has been initiated. Information from these studies can be used to improve soil survey interpretations in areas where soils are underlain by weathered bedrock.

Idaho Agricultural Experiment Station (Dr. Paul McDaniel). Current research is examining at the role of hydraulically restrictive subsurface horizons on landscape hydrological processes. We are measuring the response of perched water tables to climatic fluxes and quantifying the amount of seasonal precipitation that is contained in the soil as perched water. A related study is demonstrating that rapid, lateral transport of solutes via perched water tables occurs in sloping landscapes of the eastern Palouse region. Perched water tables interpretations for an ongoing NRCS-funded survey of the Clearwater County Area are being developed through a cooperative monitoring program between the Univ. of Idaho and the NRCS.

California Agricultural Experiment Station-Davis (Dr. Randy Southard). Research on PM-l 0 is focusing on soil properties and crop management influences on fugitive dust generation. A future objective is to develop “dust potential” maps based on research results and the soil survey data base.

Washington Agricultural Experiment Station (Dr. Alan Busacca). Cooperative research has been initiated to monitor fugitive dust in central and eastern Washington.

Soil Mapping

Colorado Agricultural Experiment Station (Dr. Gene Kelly). Technical assistance and research to support a soil survey of Rocky Mountain National Park is being provided. This work includes remote sensing support, field assistance, and research focusing on soil moisture relationships, forest productivity, and age determinations of glacial deposits.

New *Mexico Agricultural Experiment Station* (Dr. Curtis Monger). Current work includes detailed mapping of the Jornada Long-Term Ecological Research (LTER) Site. Studies on how geomorphic units can be used to locate archaeological sites are also being conducted at the Fort Bliss military base.

Soil Genesis/Characterization

University of Hawaii (Dr. Ike Ikawa). The Univ. of Hawaii has provided laboratory characterization for 15 pedons in support of the recently completed soil survey of the island of Kahoolawe.

Idaho Agricultural Experiment Station (Dr. Paul McDaniel). Limited laboratory support has been provided for an ongoing soil survey in the Clearwater County area. Support includes analyses needed to verify andic properties and providing reagents required for field test kits.

Utah Agricultural Experiment Station (Dr. Janis Boettinger). Research is being conducted on the genesis and mineralogy of soils formed in Pleistocene-aged quartzite glacial deposits, north slope of the Uinta Mountains, Utah-Wyoming in cooperation with the US Forest Service and NCRS cooperative soil survey.

New Mexico *Agricultural Experiment Station* (Dr. Curtis Monger). Arid and semiarid landscape evolution is being investigated using soil genesis and stable isotopes. This research is being conducted in the Chihuahuan Desert of New Mexico and Mexico, and in MLRA 77.

California Agricultural Experiment Station-Riverside (Dr. Bob Graham). Using a biosequence of native chaparral species planted in soils of large lysimeters -50 years ago, we are quantifying the effects of different chaparral plant species on soils properties and processes. This information is relevant to soil survey in that it clarifies the effects of certain plant species on soil development trends and demonstrates the rapidity with which morphologic features can form.

Global Change

Washington Agricultural Experiment Station (Dr. Alan Busacca). A current project involves research on paleosols and the paleoclimatic interpretations of the Palouse loess. This work is being done cooperatively with Dr. Gene Kelly of Colorado State University.

Colorado Agricultural Experiment Station (Dr. Gene Kelly). Cooperative research includes assessment of atmosphere-ecosystem interactions (trace gas and hydrological research) and paleoclimate research in the short grass steppe.

A separate project is looking at the biogeochemical response of soils to elevated CO, of Biosphere 2.

California Agricultural Experiment Station-Davis (Dr. Randy Southard). Current research is monitoring soil water regimes in the SW Sacramento Valley. The intent is to compare, in the current xeric-thermic regime, depth-to-leaching calculations based on long-term average climate data with actual field measurements and then to develop a daily water balance model that allows leaching predictions that can incorporate wetter-than-average years and impacts of individual major storms. We hope to refine the model enough to allow forward- (global warming?) and backward-looking (cooler Pleistocene?) estimations of leaching and weathering potential.

SUMMARY

While there is relatively little direct involvement by the WAES in soil mapping aspects of the NCSS. there is a great deal of work being done in the area of soil interpretations. It is expected that this trend will continue as researchers find it increasingly necessary to demonstrate the relevance of projects for which they seek funding.

Funding for much of the WAES research described in this report is comes from “non-traditional” sources. These sources include the Environmental Protection Agency, National Science Foundation, National Aviation and Space Administration, and US Dept. of Agriculture-National Research Initiative Competitive Grants Program to name a few. The significance of this is that it underscores the need for WAES researchers and other NCSS cooperators to attempt to align some of our research and soil survey goals. The fact that we are all involved in the NCSS is a clear indication that we share many of the same interests related to soil science. The challenge is therefore to continue to find common goals that can be best achieved through our cooperative efforts.

A final note-Dr. Ike lkawa of the University of Hawaii has retired effective July 1, *1995.* He has been a long-time participant in the WAES activities and wishes to extend his *Aloha* to the Western Regional Soil Survey group.

NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS

ECOMAP, USDA Forest Service, Washington, D.C.

October 29, 1993

PREFACE

The National Hierarchical Framework of Ecological Units was developed to provide a scientific basis for Ecosystem Management in the Forest Service. Use of the Framework will improve consistency in developing and sharing resource data and information at multiple geographic scales and across administrative and jurisdictional boundaries. Maps of these units provide a fundamental layer of Information that can be added to with other resource layers for complete analysis. Implementation of the Framework will help Integrate the principles of Ecosystem Management Into national, regional and forest planning and assessment efforts. The required use of consistent terminology, common maps and standard data will Improve communications internally and with our publics and partners. This Hierarchical Framework is a synthesis of Weld and scientific knowledge and has taken a year to develop. Active participation in its development came from all regions, several research stations and with input from several federal and state agencies and universities.

Effective Immediately we will begin using the Framework on the National Forests and Grasslands. It will be updated within the next year when the

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. 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, physbgraphy, 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 to 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 information 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, landform, 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 information resolution. These applications are summarized bebw. The hierarchical framework is largely a Forest Service effort, although there has been involvement by the U.S. 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 goats 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 dewbped for Ecoregion and Subregion scales covering all U.S. lands.

National hlrrarchy of **ecological** units.

PLANNING AND ANALYSIS SCALE	ECOLOGICAL UNITS	PURPOSE, OBJECTIVES, AND GENERAL USE	GENERAL SIZE RANGE
Ecoregion Global	Domain	Broad applicability for modeling and sampling. Strategic planning and assessment International planning.	1,000,000's to 10,000's of square miles
Continental	Division		
Regional	Province		
Subregion	Section	Strategic, multi-forest, statewide and multi-agency analysis and assessment.	1,000's to 10's of square miles.
	Subsection		
Landscape	Landtype Association	Forest or area-wide planning, and watershed analysis.	1,000's to 1 00's of acres.
Land Unit	Landtype	Project and management area planning and analysis.	100's to less than 10 acres.
	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 diiribution and Interaction 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 tand classifications, describes the hierarchical framework for ecological unit design, examines underlying principles, and shows how the framework can be used in resource planning and management The basic objective of the hierarchical framework is to provide a systematic method for classifying and mapping areas of the Earth based on associations of ecological factors at different geographic scales. The framework is needed to improve our efforts in national, regional. and forest level planning; to achieve consistency in ecosystem management across National Forests and regions; to advance our understanding of the nature and distribution of ecosystems; and to facilitate interagency data sharing and planning. Furthermore, the framework will help us evaluate the inherent capabilities of land and water resources and the effects of management on them

Ecological units delimit areas of different biological and physical potentials. Ecological unk maps can be coupled with inventorias of existing vegetation, air quality, aquatic systems, wildlife, and human elements to characterize complexes of life and environment, or ecosystems. This information on ecosystems can be combined wkh our knowledge of various prcocesses to facilitate a more ecological approach to resource planning, management. and research.

Note that ecological classification and mapping systems are devised by humans to meet human needs and values. Ecosystems and their various components often change gradually, forming oontlnua on the Earth's surface which cross administrative and political boundarfes. Based on their understanding of ecological systems, humans decide on ecosystem boundaries by using physical, biological, and social considerations.

We recognize

[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.

at regional scales Include those of Driscoll et al. (1984), Gallant et al. (1989), and Omemik (1967) in the United States and those of Wiken (1966) and the Ecoregions Working Group (1969) in Canada Concepts have also been presented for ecological classification at subregional to local scales in the United States (Barnes et al. 1982), Canada (Jones et al. 1963, Hills 1952), and Germany (Barnes 1984).

But no single system has the structure and flexibility necessary for developing ecological units at continental to focal scales. Each of these systems have strong points that contribute to the strength of the national hierarchy. The concepts and terminology of the nationaf 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 identify land and water areas at different levels of resolution that have similar capabilities and potentials for management. Ecological Units are designed to exhibit similar patterns in: (1) Potential natural communities, (2) soils, (3) hydrologic function, (4) landform and topography, (5) liihobgy, (6) climate, (7) air quality and (6) 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 hierarchica! level.

It follows, then, that ecological map units are differentiated and designed by muftiple components Including climate, physbgraphy. geology, soils, water, and potential natural communities (FSM 2066, FSH 2696.11). These components may be analyzed Individually and then combined, or muftiple factors/components may be simultaneously evaluated to classify ecological types which are then used In ecological unlt design (FSH 2090.1 I). 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 identify unks 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).

Ecological unit inventories are generally designed and conducted in cooperation with the Soil Conservation Service, Agricultural Experiment Stations of Land Grant Universities,

environments where summers are short In contrast, the climate of the Humid Tropical Domain is influenced by equatorial air masses and there is no winter season.
Domains

the

characteristics of aquatic habitats (Platts 1979, 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. 1982, Jordan 1982, Spies and Barnes 1966); and these factors change at different spatial and temporal scales Ecological systems therefore exist at many spatial scales, from the global ecosphere down to regions of microbial activity.

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 climatic regions, physiography or landforms modii macroclimate (Rowe 1984. Smalley 1986, Bailey 1987), and affect the movement of organisms, the flow and orientation of watersheds, and the frequency and spatial pattern of disturbance by fire and wind (Swanson et al. 1988). Within climatic - physkgraphk regions, water, plants, animals, soils, and topography interact to form ecosystems at Land Unit scales (Pregitzer and Barnes 1964). The challenge of ecosystem classification and mapping is to distinguish natural associations of ecological factors at different spatial scales, and to define ecological types and map ecological units that reflect these different levels of organization.

While the association of multiple biotic and abktk factors is all important in defining ecosystems, all

SPATIAL AND **TEMPORAL VARIABILITY** The structure and function of ecosystems change through space and time. Consequently, we need to address both spatial and temporal sources of variability while evaluating, classifying, mapping, or managing ecosystems (Delcourt et al. 1983, Forman and Godron 1986). At a Land Unit scale, for example, the fertility of particular locations changes through space because of differences in soil properties or hydrology, and at Ecoregion scales, conditions vary from colder to warmer because of changes in macroclimate. These relatively stable conditions favor certain assemblag-as of plants and animals while excluding others because of biotic tolerances, and processes such as competition. These environmental conditions are classified as ecological types and mapped as ecological units.

Within ecological units, ecosystems may support vegetation that is young, mature. or old, and they may be composed of communities that are early, mid-. or fate successional. These relatively dynamic conditions also benefit certain plant and animal species and assemblages. Condiiions that vary temporally are classified and mapped as existing vegetation, wildlife, water quality, and so forth

These examples illustrate that ecological units do not contain all the information needed to classify, map and manage ecosystems. Ecological units address the spatial distributions of relatively stable associations of ecological factors that affect ecosystems. When combined with Information on existing conditions, the National Hierarchy of Ecological Units provides a means of addressing spatial and temporal variations that affect the structure and function of ecosystems. Adding our knowledge of processes to this information will enable us to better evolve into ecosystem management.

USE OF ECOLOGICAL UNITS

Ecological units provide basic information for natural resource planning and management. Ecological unit maps may be used for activities such as delineating ecosystems, assessing resources, conducting environmental analyses, establishing desired future conditions, and managing and monitoring natural resources

ECOSYSTEM MAPPING To map ecosystems, or places where life and environment interact we need to combine two types of maps: maps of existing conditions that change readily through time, and maps of potential condiiions that are relatively stable.

High resolution Information obtained for fine scale ecological units can be aggregated for some types of broader scale resource assessments. Resource production capability, for example, can be estimated based on potentials measured for landtype phases, and estimates can be aggregated to assess ranger district, national forest, regional, and national capabilities.

ENVIRONMENTAL ANALYSES Ecological units provide a means of analyzing tha feasibility and effects of management alternatives. To dii the effects of management on ecosystems. we often need to examine condkons and processes occurring above and below the level under consideration (Rowe 1980). For example, the effects of timber harvesting are manifest not only at a land unit scale, but also at micro-site and landscape scales. Although the direct effects of management are assessed at the land unit scale, indirect and cumulative effects take place at different points in space or time, often at higher spatial scales. Ecological units defined at different hierarchical levels will be useful in conducting multi-scaled analyses for managing ecosystems and documenting environmental effects (Jensen et al. 1991).

WATERSHED ANALYSIS The national hierarchy provides a bask for evaluating the linkages between terrestrial and aquatic systems. Because of the interdependence of geographical components, aquatic systems are linked or integrated with surrounding terrestrial systems through the processes of runoff, sedimentation, and mlgratkn of biotk and chemical elements. Furthermore, the context of water bodies affects their ecological significance. A lake embedded within a landscape oontalning few lakes, 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 (Frissell et at. 1986). Overlays of hierarchical watershed boundaries on ecological mapping units are useful for most watershed analysis efforts In this case, the watershed becomes the analysis area whkh is both superposed by and composed of a number of ecological units whkh 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 condiilons expected if goals and objectives are met Ecological units will be useful in establishing goats 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 dii not occur naturally. Moreover, natural processes like disturbance or hydrologk 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 specks) if we consider the effects of projects at several scales of analysis. Ecological units will be useful in delineating land units at relevant analysis scales for planning DFC's (Brenner and Jordan 1 991).

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 health to meet conservation, restoration, and human needs. Information on current productivity can be compared to potentials determined for Landtype Phases, and areas producing fess than their potential can be identified (Host et al. 1988). Furthermore, kng 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 information on the condition of ecosystems at 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 monitoring. Representative ecological units can be sampled and information can then be extended to analogous 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 monltoring. The Forest Service is developing a National Vibilii Monitoring Strategy that addresses protection of air quality standards as mandated by the Clean Air Act, along with other concerns (USDA Forest Service 1999). Key to thls plan is stratification of the United States at the subregion level of the national hierarchy into 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 tha San Bernardino Mountains of southern California will require establishment of sampling networks in smaller ecological units at landscape or tower levels.

CONTEMPORARY AND EMERGING ISSUES

The National Hierarchical Framework of Ecological Unlts is based on natural associations of ecological factors. These associations will be useful In

LITERATURE CITED

Albert DA; Denton S.R.; Barnes, B.V. 1986. Regional landscape ecosystems of Michigan. School of Natural Resources, University of Michigan, Ann Arbor. 32 p.

Allen, T.F.H.: Starr, T.B. 1962 Hierarchy: perspectives for ecological complexity. Chicago: The University of Chicago Press. 310 p.

Allen, T.F.H.: Hoekstra, T.W. 1992 Toward A Unified Ecology. New York: Columbia University Press. 364 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. 1960. Descriptions of the ecoregions of the United States Washington DC: U.S. Department of Agriculture, Forest Service. Miscellaneous Publication 1391. 77 p.

Bailey,R.G.; Zoltai,S.C.; Wiken, E.B. 1985. Ecologicat Regionalization In Canada and the Unked States. Geoforum 16 (3):265-275.

Bailey, R.G. 1997. 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. Department 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 States. Washington DC: U.S. Department of Commerce. NOAA U.S. Government Printing Office. 113 p.

Barnes. B.V.; Pregitzer KS; Spies, T.A; Spooner, V.H. 1962. Ecological forest site classification. Journal of Forestry 80:493-498.

Barnes, B.V. 1964. Forest ecosystem classification and mapping In Baden-Wuerttemberg.

Frissell, C.A.; W.J. **Liss,** W.J.; Warren, C.E.; **Hurley, M.C. 1986.** A hlerarchicai framework for stream habitat **classification: viewing** streams **in** a watershed **context. Environment**al Management 10: **199-214.**

Gallant, AL:

tal 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

Trewartha, 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. Biicience 37:IIQ127.

U.S. Department of Agriculture. 1981. Land resource regions end major land resource areas

Table 1. **National** hierarchy of **ecological** untts.

PLANNING AND ANALYSIS SCALE	ECOLOGICAL UNITS	PURPOSE, OBJECTIVES, AND GENERAL USE
Ecoregion Global	Domain	Broad applicability for modeling and sampling. Strategic planning and assessment. International planning.
Continental	Division	
Regional	Province	
Subregion	Section	Strategic, multi-forest, statewide and multi-agency analysis and assessment.
	Subsection	
Landscape	Landtype Association	Forest or area-wide planning, and watershed analysis.
Land Unit	Landtype	Project and management *area* planning and analysis.
	Landtype Phase	
Hierarchy can be expanded by user to smaller geographical areas and more detailed ecological units if needed.		*Very detailed project planning*

Table 2. **Principal map unit design criteria of ecological units.**

ECOLOGICAL UNIT	PRINCIPAL MAP UNIT DESIGN CRITERIA[1]
Domain	• Broad climatic zones or groups (e.g., dry, humid, tropical).
Division	• Regional climatic types (Koppen 1931, Trewartha 1968). • Vegetational affinities (e.g., prairie or forest). • Sdlorder.
Province	• Dominant potential natural vegetation (Kuchler 1964). • Highlands or mountains with complex vertical climate-vegetation-soil zonation.
Section	• Geomorphic province, geologic age, stratigaphy, lithology. • Regional climatic data • Phases of soil orders, suborders or great groups. • Potential natural vegetation • Potential natural communities (PNC) (FSH 2090).
Subsection	. Geomorphic process, surficial geology, lithology. • Phases of soil orders, suborders or great groups. • Subregional climatic data • PNC-formation or series.
Landtype Association	• Geomorphic process, geologic formation, surficial geology, and elevation. • Phases of soil subgroups, families, or series. • Local climate. • PNC-series, subseries, plant associations.
Landtype	• Landform and topography (elevation. aspect slope gradient and position). • Phases of soil subgroups, families, or series. • Rock type, geomorphic process. • PNC-plant associations.
Landtype Phase	• Phases of soil families or series. • Landform and slope position. • PNC–plant associations or phases.

[1] It should be noted that the criteria listed are broad categories of environmental and landscape components. The actual classes of components chosen for designing map units depend on the objectives for the map.

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 • qurre miles
Division	1:30,000,000 to 1:7,500,000	100,000's of square miles
Province	1:15,000,000 to 1:5,000,000	10,000's of square miles
Section	1:7,500,000 to 1:3,500,000	1,000's of square miles
Subsection	1:3,500,000 to 1:250,000	10's to bw 1 ,000's of square miles
Landtype Association	1:250,000 to 1:60,000	100's to 1,000's ot • troa
Landtype	1:60,000 to 1:24,000	10's to 100's of acres
Landtype Phase	1:24,000 or larger	cl 00 • croa

APPENDIX 1: CONTRIBUTORS

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.

RANDY MOORE, Soil Scientist, Watershed end Air Staff. Wash. DC.

GORDON STUART, Hydrologist, Cooperative Forestry Staff. S&PF, Wash., DC.

GREGORY A RUARK, Ecosystem Research. Forest Environment Research, Wash., DC.

CHRIS TOPIK, Botanist Wildlife and Fisheries Staff, Washington, DC.

GREG SUPER, Planning Coordinator, Recreation, Cultural Resources end Wilderness Management Staff, Washington, DC.

RICHARD G.CLINE, Soil Scientist, Fores: Environment Research, Wash., DC.

LEE COLLETT, Transportation Planner, Engineering staff, Washington, 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 WHEELER, Regional Ecologist, Region 2, Denver, CO.

JIM MAXWELL, Regional Hydrologist, Region 2, Denver, CO.

BARRY JOHNSTON, Plant Ecologist, Region 2, Delta, co.

WAYNE A ROBBIE, Regional Soil Scientist, Region 3, Albuquerque, NM.

MIKE LINDEN, Regional Geologist, Region 3, Albuquerque, NM.

THOMAS M. COLLINS, Regional Soil Scientist, Region 4, Ogden, UT.

CUNT WILLIAMS, Ecologist, Region 4, Ogden, UT.

EARL ALEXANDER, RETIRED. Soil Scientist, Region 4. Ogden, UT.

JOHN CHATOIAN, Regional Geologist, Region 5, San Francisco, CA

DAVID V. DIAZ, Regional

TERRY **BROCK, Regional** Soil Scientist, Region 10. Juneau, AK

GREG **NOWACKI, Regional** Ecologist, Region 10, Juneau, AK

REVIEWERS AND **COMMENTERS** ON MIS PAPER:

USDA **Forest Service**

WILLIAM M. BRISTOW, II, Director, **Information** Systems and Technology. Washington, DC.

ROBERT **M. WILLIAMSON,** Director, Range Management. Washington, DC.

JOAN **M. COMANOR,** Director, Land Management Planning, Washington, DC.

JIM **CAPLAN,** Director, Public Affairs **Office,** Washington, DC.

DAVE **UNGER,** Acting Chief, Washington, DC.

GERALD (Skip) **COGHLAN,** Deputy Director, Engineering Staff, Washington. DC.

H. **GYDE** LUND, Forest Inventory, **Economics,** end **Recreation** Research, Wash., DC.
28
ROY DROEGE, Forester, Lands Staff, Washington, DC.

DONNAV. LAMB, Air Program Manager, Watershed amd Air **Management.** Washington, DC.

RICHARD W. FISHER, Air Specialist, Watershed and **Air** Management. Washington, DC.

KENDRICK GREER, Systems **Analyst, Land** Maw agement Planning, 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.

DENVER BURNS, Station Director, Rocky Mountain Station, Ft Collins, CO.

KENNETH HOLTJE. Ecosystems Team, **Eastern** Region. Milwaukee. WI

ADRIAN HAUGHT (for) Director of **RPA,** Washing. ton, 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, Rii **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 **Northwest Station, Portland,** OR

EDWARD WHITMORE, Director, Forest Menagement **Pacific** Southwest Region, Ban Francisco, CA

KEITH EVANS, Acting Station **Director.**

DAVID V. SANDBERG, Pacific Northwest Station, Corvallis, OR.

LOUISE M. TRITTON, Research Forester, North. eastern Statbn. Burlington, VT.

The Nature Conservancy:

DENNIS GROSSMAN, Lead Ecologist, The Nature Conservancy, Washington, DC

PATRICK S. SOURGERON, Landscape Ecologist, The Nature Conservancy, Denver, CO.

DAVID M. HIX, Assistant Professor and Principal Investigator, School d Natural Resources, The Ohb State University, Columbus. OH.

GEORGE E. HOST, Research Associate, Center for Water end the Environment, University d Minnesota, Duluth, MN.

KURT S. PREGITZER, Professor of Forest Ecology, Michigan State University, East Lansing, MI.

APPENDIX 2: GLOSSARY

Terminology in this paper deals mainly with ecological classification and ecosystem manage ment. Some of these terms are relatively new for Forest Service personnel, who are becoming more Invoked in ecosystem management. and their intended meaning may be unclear. This glossary has been compiled from many sources to provide 8 brief reference of ecological terms for persons who inventory, manage, study, conserve. and plan the use of land, water, and air resources. The purpose of this glossary is to standardize definitions of ecological terminology to improve communication within the Forest Service and with other agencies. Thii glossary is preliminary and definitions are being refined by the Forest Service Ecosystem Management Interdisciplinary Team.

AQUATIC ECOSYSTEM - The stream channel, fake or estuary bed, water, biotic communities and the habitat feature-s that occur therein.

BIOLOGICAL DIVERSITY -The variety of fife and its processes, including the variety in genes, species, ecosystems, and the ecological processes that connect everything in ecosystems (adapted from Keystone Policy Dialogue).

CARTOGRAPHIC FEATURE FILE - A data file containing the digital representation of all features, except contours, from a Primary Base Series map. Features are represented as line strings and points in ground coordinates with attribute information attached.

DESIRED FUTURE CONDITION: A portrayal of the land or resource conditions which are expected to result if goals and objectives are fully achieved (draft 36 CFR 219).

ECOLOGICAL LAND CLASSIFICATION AND MAPPING - A hierarchical, multi-factor approach to categorizing and delineating. at different levels of resolution, areas of land having similar capabilities and potentials for management. These areas d land are characterized by unique comblnatiom of the physical environment. biological communities and human dimension.

ECOLOGICAL PROCESSES - The actions or events that link organisms and their environment, such as predation, mutualism, successional develop ment, nutrient cycling. carbon sequestration primary productivity, and decay (from Webster's dictionary adapted to ecology)

ECOLOGICAL TYPE - A category of land having a unique combination of 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 2060)

ECOLOGICAL UNIT - A mapped landscape unit designed to meet management objectives, comprised of one or more ecological types. (FSM 2060)

ECOSYSTEM - A complete interacting system of organisms and their environment (FSM 2060)

ECOSYSTEM MANAGEMENT - The use of an ecological approach to achieve the multiple use management of national forests and grasslands by blending the needs of people and envvironmental values in such a way that national forests and grasslands represent diverse, healthy, productive, and sustainable ecosystems.

LANDFORM -Any physical, recognizable form or feature of the earth's surface, having a characteristk shape and produced by natural causes. (Glossary of Selected Geomorphk and Geologic Terms by Hawley and Parsons, 1980)

LANDSCAPE - A heterogeneous land area composed of a cluster of interacting ecosystems that is repeated In a similar form throughout; and can be viewed at one time from one place. (adapted from Forman and Godron, and Webster).

LANDSCAPE ECOLOGY - A study of the principles concerning structure, function and change of landscapes, and the use of these principles in the formulation and solving of problems. (adapted from Forman, R.T.T.: Godron, M. 1986. Landscape Ecology. New York: Wiley and Sons.)

PLANT ASSOCIATION - A potential natural plant community of definite floristic composition and uniform appearance. (FSM 2060)

PLANT COMMUNITY - A group of one or more populations of plants In a common spatial arrange ment. (FSM 2060)

POTENTIAL NATURAL COMMUNITY - The biotic community that would be established if all successional sequences of its ecosystem were completed without additional human-caused disturbance under present environmental conditions. Grazing by native fauna, natural disturbances, such 89 drought, floods, wildfire, insects, and dii. are inherent in the development of potential natural communities whkh may include naturalized nonnative species.

POTENTIAL NATURAL VEGETATION - The vegetatkn that would exist today if man were removed from the scene and if the plant succession after his removal were telescoped into a single moment. The time compression eliminates the effects of future climatic fluctuations, while the effects of man's earlier activities are permitted to stand. (National Atlas of the United States, Rev 1995)

PRIMARY BASE SERIES - A topographk map series that includes culture, drainage, landnet, ownership, and contours and is prepared on a stable base film. me map series is used to produce Forest Service cartographic products used in managing National Forest System lands. Similar maps are available for other lands.

REGIONALIZATION - A mapping procedure in whkh a set of criteria are used to subdivide the earth's surface into smaller, more homogeneous units that display spatial patterns related to ecosvstem structure, composition. and function.

RIPARIAN AREA - Geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems.

RIPARIAN ECOSYSTEM - A transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetatkn communities that require free or unbound water.

SCALE - The degree of resolution at which ecological processes, structures, and changes across space and time are observed and measured.

SUBNIVAL - A mountainous environment below the snow zone in which frost action is an important ecological process.

NORTH CENTRAL AGRICULTURAL EXPERIMENT STATIONS REPORT
NCR-3 SOIL SURVEY COMMITTEE

D.D. Malo, South Dakota State University

I. COMMITTEE OBJECTIVES.

A. Coordinate and plan experiment station research in support of the goals of the National Cooperative Soil Survey.

B. Identify specific soil and land-use research needs that will benefit from a regional or subregional approach that can either build upon existing initiatives in individual states or address a timely emerging need.

C. Coordinate official NCR representation on national NCSS and Soil Taxonomy committees and relay/evaluate national recommendations and initiatives to pertinent groups throughout the region.

II. COMMITTEES OF THE 1994 WESTERN/MIDWESTERN REGIONAL COOPERATIVE SOIL SURVEY CONFERENCE.

A. Committee 1 - The role ot NCSS in site specific soil surveys.

0. Committee 2 - Drastically disturbed soils.

	IL	IN	IA	KS	MI	MN	MO	NE	ND	OH	SD	WI
No. Counties	102	92	99	105	83	87	104	93	53	88	66	72
Published	72	90	85	105	69	53	71	86	38	77	68	60
In Press (Update)	30	2	14	0	8	18	21	7	14	3	11	4
In Progress (Update)	3	5	4	4	10	13	15	8	6	7	4	19
Waiting	0	5	2	3	6	3	7	0	0	13	2	0

3. Committee felt it did not understand the relationships between environmental factors and soil properties well enough to write a definition that would separat ɜ hydric and non hydric soils in all cases.
4. Goal - short, straightforward definition that could be understood by scientists in many disciplines related to wetlands.
5. Users of this definition must be well trained in principles of pedology.

D. Definition - A hydric soil must meet landscape and profile requirements.

V. NEW SOIL MAP FOR THE NORTH CENTRAL REGION.

New soil map for the North Central Region is nearing completion. Legend reviews, digitization, and publication are all that remains.

VI. RESEARCH ACTIVITIES RELATED TO THE COOPERATIVE SOIL SURVEY.

A. Illinois - Ken Olson.
1. Soil productivity and soil erosion relationships.
2. Evaluation of conservation tillage systems for the restoration of productivity of previously eroded soils.
3. Crop yield prediction by soil including soil productivity index ratings.
4. Quantification of erosion and sedimentation rate studies.
5. Provide research data to assist field soil scientists in mapping eroded phases of Alfisols and Mollisols.

B. Indiana - Don Franzmeier.
1. Monitoring water table depth, reduction and water movement in several toposequences. This is part of the NRCS global change initiative.
2. Compaction and cementation in C horizons of soils formed in glacial till.
3. Standards for construction of house foundations, especially in swelling soils, and standards for surface and subsurface drainage around foundations.
4. Detection and quantification of the amount of residue cover on fields using remote sensing (AVIRIS) data.
5. Relating map units of the STATSGO maps to the SOTER map project, and international soil and terrain map based largely on landforms.

C. Iowa - Tom Fenton.
1. Erosion-Productivity project including soil quality.
2. Use of ground conductivity meters in soil survey.
3. Stratigraphic relationships under loess-covered benches in Lucas County (with NRCS).
4. Savanna Terraces soil project (with NRCS).

5. Landscape evolution on the Des Moines Lobe.
6. Hydric soil characteristics in Iowa.
7. Water table studies of selected soils (with NRCS).
8. Soil sampling project in southeast Iowa (with National Soil Survey Laboratory).
9. Developing improved procedures for updating soil surveys in Crawford and Woodbury Counties (with ISU Statistical Laboratory).
10. Use of soil survey data in precision farming and yield mapping.

D. Kansas - Mickey Ransom.

1. Clay translocation and carbonate accumulation in the 16-26 inch rainfall zone of western Kansas.
2. Distribution and properties of clay minerals in Kansas soils with emphasis on applications to soil fertility.
3. Soil genesis and geomorphology on the Konza Prairie (Bluestem Hills), a long term ecological research project site of the NSF.
4. Parent material stratigraphy and genesis of soils developed in eolian materials in the Southern High Plains.

J. Development of a GIS (including Landsat TM data) that includes soils information, land use, soil suitability for crop land, and water resources for Finney County.

E. Michigan - Del Mokma.

1. Impact of accelerated erosion on soil properties and productivity.
2. Soil absorption of septic tank effluent and sand filter effluent.
3. Impact of cultivation on spodic horizon properties.
4. Development of methods and guidelines for local wetland protection end related land use planning.

F. Minnesota - Pierre Robert.

1. Describing soil and crop variability on a sand plain landscape with surface collected data.
2. Alternative individual sewage treatment systems development and demonstration for areas with seasonally high watertables.
3. Wet soil monitoring.
4. Soil-terrain monitoring.
5. Soil variability related to turfgrass maintenance.
6. Understanding and prediction of carbon dynamics in forested ecosystems of the Lake States.
7. Soil-landscape evolution in southeastern Minnesota.
8. Movement and storage of mercury in the terrestrial landscape.
9. Catenary relations in an ancient landscape in the low desert of southwestern Utah.
10. Methodology for prediction and quantification of soil property variability using GIS technologies.
11. Modeling the effect of erosion on crop yields.
12. Mapping soil water content with electromagnetic induction probe.

13. Soil Survey Information System/SOIL 7 GIS.
14. World-wide web-based teaching module on the catena concept.

G. Missouri - Randy Miles.

1. Eagle Bluff Constructed Wetlands- pre-inundation baseline data, spatial variability, and soil chemistry.
2. Soil acidity, aluminum, and mineralogy study of strongly acid south Missouri soils.
3. Soils and on-site small flows water research and development of Missouri Small Flows Wastewater Center.
4. Evaluation and restoration of flood damaged land.
5. Soil spatial variability study on Missouri River bottom soils.
6. Use of GIS to produce usable slope class maps.
7. Study of soil spatial variability in loess mantled till plain in mid-Missouri relative to hillslope positions.
8. Ecological land type study (Missouri Ozark Forest Ecosystem Project).

H. Nebraska - Mark Kuzila.

1. Geo-statistical study of the variation in map units of soils in the Mollisol order.
2. Relationship of spectral reflectance to turbidity generated by erosion of common soil types.
3. The effect of climate and landuse on soil organic matter in the Sand Hills of Nebraska.
4. Pesticide mobility in six benchmark terrace soils.
5. Use of video camera to determine in situ soil color.
6. The effect of "forest" vs prairie on the morphology of a loess soil in eastern Nebraska.
7. Testing a soil moisture model with data collected from the Ashland Plateau in North Carolina.

I. North Dakota - Dave Hopkins.

1. Digitizing of soils and landuse data for Golden Valley and Stutsman Counties.
2. Site-specific management and soil variability study in the Red River Valley of North Dakota.
3. Soil hydrology and wet soil monitoring.

J. Ohio - Neil Smeck.

1. Glacial till fractures and their impact on hydrologyfespecially around land fill sites) in northern Ohio.
2. Properties of loess on uplands are being compared to loess properties in footslopes in glacial margin areas.
3. Mineralogy of loess deposits is being examined.

4. Networks of polygonal patterned ground are being studied in western Ohio. Soil properties vary systematically across the periglacial features.
5. Study of Illinoian-age terraces and soil genesis in southern Ohio.
6. Electronic storage of soil pcdon data available at the Ohio Soil Characterization Lab at Ohio State University (with NRCS).

K. South Dakota - Doug Malo.

1. Developing soil productivity rating systems for inclusion in soil surveys starting with Clay, Brookings and Minnehaha Counties (with NRC'S).
2. Precision farming (site specific) farming project with NRCS and ARS was started in 1995 to examine crop management (including chemical inputs) and soil differences on a watershed basis.
3. Use of ground electromagnetic technologies for soil survey uses is being tested on three 160 acre fields. Both EM31 and EM38 meters are being evaluated against soil properties on a 100 foot grid basis.
4. Evaluation of the impact of long term irrigation on soil properties (possible map unit separation) in Spink County (with NRCS).
5. Parent material stratigraphy and soil genesis in eolian materials along the Big Sioux River in Brookings County.
6. Development of a classification key for SD soils.
7. Data base development of basic soils information for the major series found in SD was initiated (jointly funded by NRCS and SDAES).

L. Wisconsin - Kevin McSweeney.

1. Soil landscape modeling SE Driftless Region (NSF).
2. Soil landscape modeling SW Driftless Region (Hatch).
3. Tree-throw affected soil landscapes NE Wisconsin (McIntyre Stennis, UW Ag. and Nat. Res. Consortium).
4. Fate and transport of ag. chemicals in sandy soils (many funding sources).
5. Chronosequence studies on raised marine terraces, Oregon (NSF).
6. Genesis and classification of permafrost affected soils (NSF).
7. Land evaluation for sustainable land management in the tropics, Costa Rica, Honduras, and Zimbabwe (USAID, McKnight Foundation).

Proposed Definition of Hydric Soils in the North Central Region

NCR-3 Committee, June 13, 1995

Hydric soils have distinctive landscape and profile (pedon) characteristics. The definition below, based on those characteristics, applies to most soils in the North Central Region, Soil properties, however, are affected by many environmental factors and because these relationships are not completely understood, it is not possible to write a definition that will separate hydric from non-hydric soils in all cases. For example, some hydric soils developed from very red parent material and some hydric Spodosols are not correctly identified by the rules below. In these special cases where the proposed rules do not apply, hydric soils must be identified by relating them to nearby soils. For example, a soil formed from very red parent material in a depression that lacks certain gray colors would be called hydric if nearby soils formed from similar, but less red, parent material in depressions qualify as hydric. The field investigator must use his/her profession judgment in applying the rules. A hydric **soil must meet landscape and profile requirements.**

Landscape characteristics and requirements

Hydric soils are in landscape positions that are likely to receive water from other soils or do not shed water because they are very flat and have subsurface layers of low hydraulic conductivity. An area larger than the hydric soil is needed to evaluate landscape shape and position. Hydric soils must be in one of the following landscape positions:

1. Concave areas (depressions). An area is considered to be concave if its entire surface is concave or it has a complex concave-convex topography in which the concave part dominates, as in a generally flat landscape with numerous tree throws.
2. Flat landscapes such as lake plains and terraces; usually the soil has subsurface layers with low hydraulic conductivity.
3. Lower backslope and footslope positions that receive water by subsurface flow (seep areas).
4. Flood plains.

Profile characteristics and requirements

The mineral matter of most soils is grayish. the color of silicate clay. The main pigmenting materials that give subsoil its colors are iron oxides, which tend to make it brownish or reddish; and manganese oxides, which tends to be in small black concentrations. When the soil is waterlogged and becomes reduced, Fe and Mn oxides dissolve, and the grayish color of the clay appears. But many sandy soils do not become as gray as finer-textured soils. To identify hydric soils, first identify a hydric diagnostic zone, and then examine the zone to determine if it meets the requirements.

1. In soils with a dark (value ≤3, chroma ≤3) surface layer >25 cm thick the hydric diagnostic zone is the 20 cm layer immediately below the dark layer; for other soils the zone is 25 to 45 cm deep.
2. The hydric diagnostic zone must meet one or more of these conditions:

Dominant color of matrix			Redox concentrations*
Hue	Value	Chroma	(chroma specified)
Soils in which the diagnostic zone is not sandy			
5GY, 5G, 5BG, 5B	any	≤2	no requirement
2.5Y, 5Y	any	≤1	no requirement
	≥5	>1 and ≤2	no requirement
	4	>1 and ≤2	required, chroma ≥4
1 OYR	any	≤1	no requirement
	any	>1 and ≤2	required, chroma ≥4
7.5YR or redder	any	≤1	required, chroma ≥4
Soils in which the diagnostic zone is sandy (coarser than loamy fine sand)			
Any	any	≤3	required, chroma ≥5

• Redox concentrations include high chroma mottles (chroma specified), Fe coats, Fe concentrations, Mn coats, and Mn concentrations.

PANEL DISCUSSION ON DISTURBED SOILS

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE
JULY 10-14, 1995

Panel Members: Tom Ammons (chairman), Ray Bryant, Sam Indorante, and Alan Kosse.

The following are the charges discussed at the conference.

Charge I. Overview: This charge was to focus on the current literature on minesoil properties that could relate to a disturbed soil classification system.

Much of this literature has been covered in a chapter titled Minesoil Genesis and Classification by J.C. Sencindiver and J.T. Ammons in the reissue of Reclamation of Drastically Disturbed Soils sponsored by SSSA and ASSMR.

The renewed interest in disturbed soil classification has grown from activities in the regional Work planning Conferences as follows: Southern Regional WPC-1988; Southern Regional WPC-1990; South-Northeast WPC-1992; National WPC-1993; and Southern WPC-1994.

A definition of drastically disturbed soils and some common properties of minesoils have been thoroughly discussed in these proceedings.

Charge II. Characterize Disturbance: The discussion under this charge was to separate paddy soils and eroded soils from the drastically disturbed soils resulting from deep earth excavation techniques. Several points were made regarding man-made geomorphic units and some of the basic philosophy regarding soil genesis. Many of the subjects have been thoroughly discussed in the regional work planning conferences. One suggestion was clear, we should develop a proposal under the guidelines of Soil Taxonomy. Once this is complete, many of the suggestions will be incorporated into the proposal during the review process.

Charges II and IV. Better linkage between U.S. and Others and activities of the International Disturbed Soil Committee: Ray Bryant presented Circular Letter no.1 of the International Committee on Anthropogenic Soils (ICOMANTH). Many of the topics covered in this circular were carried over into all aspects of the panel discussion. Circular Letter no.1 is attached to this report.

R.W. Fitzpatrick and I.D. Hollingsworth introduced the Australian minesoil classification scheme (overview presented by J.T. Ammons). The title of the paper is" Towards a New Classification of Minesoils in Australia Based on Proposed Amendments to Soil Taxonomy". The authors are with the Division of Soils, CSIRO and the report is attached with the permission of the authors.

Summary: All future activities related to disturbed soils resulting in drastic alterations by human activities or alterations caused by long term agricultural use will be directed toward the International Committee on Anthropogenic Soils (ICOMANTH).

The Soil that We Classify

The pedon and polypedon are defined in Chapter 1 of Soil Taxonomy, and all soil scientists have a working understanding of these concepts. The polypedon is the landscape unit to be classified and the pedon is the unit of sampling that supposedly is representative of the range of characteristics within the polypedon. Natural breaks in the landscape are the more desirable limits of the polypedon as we strive for a system that is most useful for soil survey, but class limits of soil series (including higher class limits, such as family particle size classes, which are also limits for series in a categorical system) may also determine a boundary of a polypedon. In spite of diligent efforts to tailor Soil Taxonomy to fit naturally occurring soil landscapes, we frequently encounter landscapes that cannot be mapped as simple consociations. The dominant characteristic of some anthropogenic soils may well be their variability. Can the concepts of pedons and polypedons be directly applied to anthropogenic soils or should we revisit the definitions in Soil Taxonomy to determine their applicability?

Case example:

Urban fill may or may not be extremely variable in terms of the nature and arrangement of materials. In some cases, layers of materials such as bricks, concrete and rebar, asphalt, coal ash, etc. may be very predictable and mappable. It is conceivable that we may wish to establish series with very limited ranges in characteristics. But we are also certain to find areas of urban fill which are characteristically unpredictable. Must we treat these as complexes, or might higher classes be established specifically for these soils where the nature and arrangement of materials are virtually unpredictable? Such classes might then be further differentiated on the basis of other important properties such as wetness, presence or absence of certain types of materials, etc.

Questions:

- How do we deal with the variability of anthropogenic soils in our classification scheme? Is variability in and of itself a highly significant characteristic that can be used as criteria for a class?
- What is our unit of classification? Are we concerned in all cases with the mappability of our classes where accommodating variability is of major concern, or will the system also be used on a site-by-site basis where specificity of information is most desirable?

The 2 Meter Rule

In some cases, the reason for wanting to differentiate among anthropogenic soils derives more from the nature of the substratum that it does from the nature of the material in the "soil zone", and we commonly have knowledge of the substratum that would allow classification based on the nature of those deeper materials. In recent years there has been a move to expand our lower depth of mapping (and classification?) of naturally occurring soils and geological deposits in response to the acknowledged need for more information. Our best chance for success in classifying to lower depths would seem to be in anthropogenic soils where we have historical knowledge of the nature of the substratum. Can we really form desired groupings of soils without taking into consideration the nature of the substratum?

Case example:

An unregulated landfill on Staten Island, New York has a thin cap of "soil" cover over urban garbage. Over most of the landfill, one can readily observe urban waste within the 2 meter zone. The major limitations to use and management are the evolution of methane gas and settling as a result of waste decomposition. The long range plan for use of the landfill is as a city park. In one area, an additional 2 meters or more thickness of clean fill has been added and a billfold was constructed. Assuming that we had classes designed to differentiate between landfills containing garbage and soils forming in clean fill (i.e. - fill derived from soil or geologic material not containing trash and which may be suitable for home construction), how would we handle this case?

Questions:

- To what depth do we classify anthropogenic soils when the main reason for differentiating soils may be the nature of the substratum?
- How would we implement different rules for classifying anthropogenic soils to greater depths without affecting additional changes in Soil Taxonomy?

<u>Man as a Soil-forming Factor and Appropriate Categorical Level(s)</u>

Some discussions about anthropogenic soils treat man as a natural part of the ecosystem and man's activities as soil forming processes. However, most of man's activities are destructive with respect to the ordering of horizon's, i.e. - soil is disturbed and horizonation is set back to (or near) time zero. In many cases the "parent material" is not earthy material that could be observed in landscapes not disturbed by anthropogenic activity (landfills with garbage near the surface, urban fills containing construction debris, etc.). In one sense, the anthropogenic activity is constructive in that the "parent materials" could not derive from natural processes other than anthropogenic. That being the case, are anthropogenic processes such as these equivalent to the geological deposition of parent materials or are they processes of soil formation in which man's activities are the dominant factor of soil formation or both? In any case, the logic of Soil Taxonomy is that the dominant factors (and processes) of soil formation that explain the existing gross morphology are recognized at the highest levels of Soil Taxonomy. In the cases of Andisols and Vertisols, it is parent material that is the dominant factor explaining the gross morphology. There is much debate about whether or not we can adequately classify anthropogenic soils by modifying the existing soil orders or whether a new soil order is needed. The answer would seemingly need to be consistent with the existing logic of Soil Taxonomy, but also allow for an adequate degree of flexibility for showing differences and relationships among anthropogenic soils.

Questions:

- How do various kinds of anthropogenic activities relate in an analogous way to non-anthropogenic geological and pedological processes and what are the resultant implications for selecting the categorical levels to be used in classification?
- How many of the 6 categorical levels in Soil Taxonomy are needed to show relationships and differences among anthropogenic soils?
- What characteristics of anthropogenic soils are of greater or lesser significance than others?

Knowledge of Genesis vs. Morphology-based Criteria

At the higher categories in Soil Taxonomy, classes arc formed to group soils in order to reflect their genesis. Our theories of genesis govern the groupings and reflect our current state of knowledge about soils and the factors and processes of formation. Since our state of knowledge is never complete, we guard against biasing our classification by requiring that criteria for classification be based on morphological characteristics that can be observed or measured by laboratory or field techniques. In foilowing the strict rules for classifying soils according to their morphology, we frequently discover that some soils make odd bedfellows. That may lead us to conclude that our current concepts of genesis may be flawed. Hence, Soil Taxonomy becomes a valuable research tool to assist us in improving our knowledge of soils and their genesis. It would not be so if we allowed our current bias with respect to mode of genesis to enter into the classification process. Grouping soils according to theories of genesis at the higher categories and using morphology-based criteria are fundamental principles that guided the construct of Soil Taxonomy.

In the vast majority of cases of anthropogenic soils, the anthropogenic processes resulting in the present expression of morphology are a matter of historical record. There may be absolutely no uncertainty with respect to the anthropogenic processes of development or modification which led to the current soil morphology. Why then should we constrain ourselves from using that knowledge to form groups of soils with similar genesis? What rationale would there be for ignoring historical record? This becomes especially relevant when there may be no reliable morphological indicators that can be consistently applied to identify the genetic processes. There are many soils for which this is the case.

Case example:

In China, there are soils that have formed by deposition of sediments as a result of long-term irrigation. The morphology (and in a sense the process of formation) of these soils is identical to that of a Fluvent. But these soils may occur on a terrace or upland position where their presence in clearly "not natural" (i.e. - anthropogenic). They do not conform to the ecology of the landscape. In natural landscapes, the presence of Entisols may be due to recent deposition by geologic processes indicating a geologically active environment, resistance of the parent material to weathering and soil development, etc., but they occur in predictable landscape positions. To the Chinese, this anthropogenic "Fluvent" is not the same as a naturally occurring Fluvent. Yet there are no morphological clues as to the difference.

Questions:

- Do we want to alter the principles of Soil Taxonomy to allow the use of historical knowledge as criteria for classifying anthropogenic soils?
- If not, what is our rationale for ignoring historical knowledge of anthropogenic processes?
- If so, how can this be accomplished with a minimum disruption of the rest of the system?

properties of Anthropogenic Soils with High Levels of Significance:

Any subdivisions of anthropogenic soils within Soil Taxonomy should be based on properties of greatest significance to their genesis in the higher categories and on properties of greatest significance to use and management in the lower categories. Most current and evolving systems differentiate on the basis of the nature of the "parent material" as one of the properties of highest significance. But what other properties of anthropogenic soils are highly significant? An aquic moisture regime (and its modifications, i.e. -- aeric, epi, endo, etc.) is a highly significant property to both genesis and use and management in existing soil orders, but how important is it in anthropogenic soils? How should anoxic conditions due to methane gas be treated? How important is bulk density (and/or porosity)? For all of these properties and others, are there morphological properties that can be used to consistently and reliably identify the condition, and can they be used in mapping?

Questions:

- What are the properties of anthropogenic soils that are of greatest significance to genesis and use and management?
- What are the morphological characteristics that identify these conditions, and can they be consistently identified in the field during mapping?

Constructive vs. Destructive Anthropogenic Processes

It is relatively easy to envision classes of anthropogenic soils forming in anthropogenic parent materials. Criteria can be based at least in part on morphology. But how do we address anthropogenic processes that result in the removal of soil material? By some of the logic above, what is not there due to the activities of man may be as important (at least conceptually) as what is put there by the activities of man. A borrow pit formed by the removal of gravel or caliche is as readily identified as a landfill and is as much "out of place" in the ecology of the landscape. If we allow the use of historical knowledge, it would not be difficult to construct classes for these situations. But the difficulty may lie in determining how much soil must be lost before we begin to recognize the effects of anthropogenic processes. A recent DRAFT of a revised definition of a buried soil is appended. Classification of antbropogenic soils **may begin** when the thickness of a surface mantle of new material (of antbropogenic origin) effectively buries the underlying soil. But how much soil must be lost before the rules of classifying anthropogenic soils are invoked? It has been proposed that this committee address the issue of eroded Mollisols. Is accelerated erosion an intergrade to soils where removal was affected by other anthropogenic processes? If so, how do we treat it within the context of Soil Taxonomy?

Questions:

- Do we treat the loss of soil by anthropogenic processes similarly to the way we treat the accumulation of soil materials by anthropogenic processes?
- If so, how do we define the degree of anthropogenic modification based on what is not there?

Intergrades to Other Classes

The previous discussion touched on the issue of defining intergrades between anthropogenic soils and other classes. There are other situations in which anthropogenic processes affect changes in classification within Sol! Taxonomy. How do we address the agricultural liming of an Ultisol to the point that it classifies as an Alfisol? What about the Mollisol that no longer meets the color requirements of a Mollic epipedon due to the incorporation of carbonates by deep plowing? I believe we are expected to address soils in California that are drastically disturbed by "deep" plowing. How deep is deep? Are salinization and desalinization, due to irrigation, anthropogenic processes that should be addressed by this committee? The point here is that Soil Taxonomy was designed so that "normal agricultural practices" would not change the classification of a soil. But "normal agricultural practices" of the day have changed, and they do in fact cause changes in taxonomic classification. By expressly recognizing anthropogenic processes in Soil Taxonomy, we will be forced

Closing Statement

ITEM: ____________________

TECHNICAL REPORT 19/1994

TOWARDS A NEW CLASSIFICATION OF MINESOILS IN AUSTRALIA BASED ON PROPOSED AMENDMENTS TO SOIL TAXONOMY

R.W. Fitzpatrick and I.D. Hollingswotth

CSIRO DIVISION OF SOILS **TECHNICAL REPORT 19/1994**

NOT FOR PUBLICATION
The material contained herein has not been refereed. It may be quoted as a personal communication following written consent of the authors.

TOWARDS A NEW CLASSIFICATION OF MINESOILS IN AUSTRALIA BASED ON PROPOSED AMENDMENTS TO SOIL TAXONOMY

RW. Fitzpatrick and I. D. **Hollingsworth***

*CSIRO, Division of Soils, Private Bag No. 2, Glen Osmond, South Australia. 5064

Summary

We have described and **recognised** a wide range of distinct types **of minesoils** forming on waste-rock dumps and tailings dams in Australia This is likely to be in **response** to the wide range io **age (i.e.** ranging fmm days to up to twenty years) and rates of weathering (i.e. **different** rock types occurring in **a** wide range of **climates** such as **tropical,** arid to **mediterranean)** in Australia **This** information, together with recent amendments to Soil Taxonomy **(e.g.** Smith and Sobek, 1978; Fanning **and Faming,** 1993) **has been used** to develop preliminary proposals to modify **both** Soil Taxonomy and the New **Classification** System for Australian Soils (3rd approximation).

Minesoils generally have high contents of weathered rock **fragments** (ranging fmm 10 to **>30%),** a **thin** friable vesicular surface **crust** (5 to 10 mm), very weakly developed A and B horizons (100 mm thick and usually at depths fmm **50** to 500 mm) **with** silty sandy clay loam to silty light clay **textures**

(Soil Survey Staff, 1992) together with amendments (e.g. Smith and Sobek, 1978; Fanning and Fanning, 1993) does provide a framework for classifying and interpreting the management problems associated with such complex soils/materials.

It is scientifically of great interest that minesoils form so rapidly, for soil scientists traditionally deal with soil materials and profiles that are the integrated products of landscape processes over immense and usually unknown periods of geological time (Fanning and Fanning. 1997). These affects of the wide range of climates in Australia (e.g. tropical to Mediterranean) and the exposure of readily weatherable rocks to the subaerial environment are important factors. It is of practical importance to be able to identify and classify specific types of minesoils in order to help develop consistent rehabilitation strategies.

During investigations over the past seven years we have characterized and recognised several distinct types of sails that have formed on minespoils in the relatively small time span since they were constructed (ranging from present to up to 20 years). A wide variety of minesoils developed from rocks in various stages of physical and chemical breakdown have been described and sampled along hydro toposequences (i.e. from the drier upper to wetter lower surfaces) of minespoils at several mines in The Northern Territory, Queensland, South Australia and Norfolk Island (e.g. Fizpatrick and Milnes 1988, Fizpatrick et al 1988, Fizpatrick 1991, 1993, Fizpatrick and Hollingsworth 1994. Milnes et al. 1988; 1992. The minesoils have been compared with natural soils in undisturbed parts of mines from many viewpoints in order to identify the processes and rates of soil formation. In addition, representative natural soils occurring adjacent to the minespoils have been described, characterized and classified according to Soil Taxonomy. These soils contain mineral assemblages that are in equilibrium with the natural landscape and the local weathering environment, and have been compared with the morphological, physical, chemical and mineral assemblages present in samples collected from minespoils. However, we have investigated minesoils at a limited number of mines in Australia. Our objective is to continue projects that will build on these findings and expand the study of minesoils in more localities across Australia. Discussions have been held with the aim of more systematically collecting and collating data on minesoils (Spolents) and broadening the base to support the suggested modifications.

As a result of intensive field and laboratory work being conducted at specific mines in Australia the need for improvements and modifications to Soil Taxonomy have become obvious to several soil scientists. The objectives of this report are to provide suggestions for upating the classification of minesoils (Spolents) in:

(i) Soil Taxonomy (Soil Survey Staff, 1992) based on amendments primarily by Smith and Sobek (1978) and Fanning and Fanning (1987) and,

(ii) A classification system for Australian Soils (3rd approximation) (Isbell, 1993) based on the information developed in (i).

This report proposes some changes to the 1992 Keys *to* Soil Taxonomy (Soil Survey Staff, 1992) in order to provide more suitable categories for minesoils in Australia. We propose to send a copy of this report together with more detailed supporting documents to the Soil Taxonomy headquarters at USDA in Lincoln. Nebraska, for their consideration and further input. These modified keys should then be tested further and modified on the basis of such input As well, the information gained from new proposals to modify Soil Taxonomy to Australian minesoils has also enabled preliminary suggestions to further improve and develop the new Australian Soil Classification System (Isbell, 1993). These preliminary proposals will be made available to “The Australian Collaborative Land Evaluation Program” (ACLEP). It is also anticipated that some of this information will be used to develop a new technical soil classification system for use by minesite rehabilitation officers.

Results

Suggestions for upating the classification of minesoils (Spolents) in Soil Taxonomy (Soil Survey Staff, 1992) based on: (i) amendments largely by Smith and Sobek (1978) and Fanning and Fanning, (1987) and (ii) profile descriptions of minesoils made in Australia.

Outline of scheme to classify the new classes:

Order: ENTISOLS

Suborders: AQUENTS — SPOLENTS GARBENTS etc.

SUBORDER
AQUENTS

GREAT GROUP
Spolaquents

SUBGROUPS of Spolaquents:
Sulfic Spolaquents
Salic Spolaquents
Scdic Lithic Spolaquents
Aeric Spolaquents
Typic Spolaquents

SUBORDER
SPOLENTS

GREAT GROUPS
Ustispolents
Xerispolents
Udispolents
Torrispolents

SUBGROUPS of Ustispolents:
Sulfic Ustispolents
Salic Ustispolents
Sodic Lithic Ustispolents
Sodic Leptic Ustispolents
Sodic Vertic Ustispolents
Sodic Argic Ustispolents
Argic Ustispolents
Sodic Fluventic Ustispolents
Flwentic Ustispolents
Psammentic Ustispolents
Aquic Ustispolents
Kandic Ustispolents
Aeric Ustispolents
UstispolentsTypic Ustispolents

SUBGROUPS of Torrispolents:
Sulfic Torrispolents
Sodic Lithic Torrispolents
Sodic Leptic Torrispolents
Scdic Argic Torrispolents
Argic Torrispolents
Sodic Flwentic Torrispolents
Fluventic Torrispolents
Aquic Torrispolents
Kandic Torrispolents
Typic Torrispolents

SUBGROUPS of Xerispolents:
Sulfic Xerispolents
Sodic Lithic Xerispolents
Sodic Leptic Xerispolents
Sodic Argic Xerispolents
Argic Xerispolents
Sodic Flwentic Xerispolents
Flwentic Xerispolents
Aquic Xerispolents
Kandic Xerispolents
Typic

Defintions of new classes:

KEY 13 SUBORDER:
AQUENTS

KEY TO GREAT GROUP

Insert before KAA on page 234 of Soil Survey Staff (1992).
Aquents that have in one or more layers within 100 cm from the mineral surface, 10 percent or more (by volume) fragments of diagnostic spolic material are arranged in any discernible order. Definition of "spolic materials" is similar to "properties of Spolents" defined by Smith and Sobek (1978). This definition could be abbreviated and simplified.

Spolaqueots

KEY TO SUBGROUPS
Spolaquents which have, within 100 cm of the mineral soil surface, one or more of the following:

- sulfuric horizon, or
- have all characteristics of a sulfuric horizon, except that it has a pH value of between 3.5 and 4.0 *or*
- sulfidic materials.

Sulfic Spolaquents

Other Spolaquents that have, in one or more layers within 100 cm of the mineral soil surface. a salic horizon.

Salic Spolaquents

other Spolaquents that have,

- an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10.
- a lithic or paralithic contact within SO cm of the mineral soil surface.

Sodic Lithic Spolaqueots

Other Spolaquents that have a chroma of 3 or more in 40 percent or more of the matrix of one or more horizons between 15 and 20 cm from the mineral soil surface.

Aeric Spolaquents

Other Spolaquents

Typic Spolaquents

KEY TO SUBORDER
Entosols that have in one or more layers within 100 cm from the mineral surface, 10 percent or more (by volume) fragments of diagnostic spolic material are arranged in any discernible order. Definion of "spolic materials" is similar to "properties of Spolents" defined by Smith and Sobek (1978). This definition could be abbreviated and simplified.

Spolents

KEY TO GREAT GROUPS

Spolents that have a Ustic moisture regime

Ustispolents

Other Spolents that have a xeric moisture regime

Xerispolents

Other Spolents that have a udic moisture regime

Udispolents

Other Spolents that have an aridic moisture regime

Torrispolents

KEY TO SUBGROUPS of Ustispolents identified in the Bow" Basin, Queensland by Fizpatrick and Hollingsworth (1994).

Ustispolents which have. within 100 cm of the mineral soil surface. *one* or more of the following:

- sulfuric horizon. or
- have all characteristics of a sulfuric horizon, except that it has a pH value of between 3.5 and 4.0 or
- sulfidic materials.

Sulfic Ustispolents

Other Ustispolents that have, in one or more layers within 100 cm of the mineral soil surface. a salic horizon.

Salic Ustispoleots

Other Ustispolents that have.

- a" exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10.
- a **lithic or paralithic contact within SO cm of the mineral soil surface.**

Sodic Lithic Ustispoleots

Other Ustispolents that have, in one or more layers within 50 cm of the mineral soil surface:

- a" exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10.
- a lithic or paralithic contact within 100 cm of the **mineral soil**

Other Ustispolents which have:

- an organic carbon content that decreases irregularly with increasing depth to 100cm or to a lithic or paralithic contact if shallower and a slope of less than 25 percent.

Fluventic Ustispoleots

Other Ustispolents that have a sandy particle size in all layers within 100 cm of the mineral soil surface

Psammentic Ustispolents

Other Ustispolents which have., in one or more layers within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artifificial drainage).

Aquic Ustispoleots

Other Ustispolents which have within 100 cm of the mineral soil surface the following:

- 50 percent or more of material with CEC of less than 24 [illegible]

Typic Ustispolents

Other Torrispolents which have in one or more layers within 100 cm of the mineral soil surface the following:

- have fragments of a" argillic horizon with base saturation (by sum of cations) of 35 percent or more.

Argic Torrispolents

Other Torrispolents which have in one or more layers within 100 cm of the mineral soil surface *both* of the following:

- a" exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of IO.
- an irregular decrease in organic carbon content to a depth of 100cm or to a lithic or paralithic contact if shallower and a slope of less than 25 percent.

Sodic Fluventic Torrispolents

Other Torrispolents which have:

- a" organic carbon content that decreases irregularly with increasing depth to 100cm or to a lithic or paralithic contact if shallower and a slope of less than 25 percent.

Fluventic Torrispolents

Other Torrispolents which have, in one or more layers within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artifificial drainage).

Aquic **Torrispolents**

Other Torrispolents which have within 100 cm of the mineral soil surface the following:

- 50 percent or more of material with CEC of less than 24 cmol(+) per kg clay (by NH4OAc pH7).

Kandic Torrispolents

Other Torrispolents

Typic Torrispolents

SUBGROUPS of Xerispolents (identified at the abandoned Brukunga Pyrite mine and other kaolinte mines in the Mount Lofty Ranges).

Xerispolents which have. within 100 cm of the mineral soil surface, one or *more* of the following:

- sulfuric

Other Xerispolents which have in one or more layers within 100 cm of the mineral soil surface the following:

- have fragments of an argillic horizon with base saturation (by sum of cations) of 35 percent or more.

Argic Xerispolents

Other Xerispolents which have in one or more layers within 100 cm of the mineral soil surface *both* of the following:

- an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10.
- an irregular decrease in organic carbon content to a depth of 100cm or to a lithic or paralithic contact if shallower and a slope of less than 25 percent.

Sodic Fluventic Xerispoleots

Other Xerispolents which have:

- an organic carbon content that decreases irregularly with increasing depth to 100cm or to a lithic or paralithic contact if **shallower** and a slope of less than 25 percent.

Fluventic Xerispolents

Other Xerispolents which have. in one or more layers within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Xerispoleots

Other Xerispolents which have within 100 cm of the mineral soil surface the following:

- 50 percent or more of material with CEC of less than 24 cmol(+) per kg clay (by NH4OAc pH7).

Kandic Xerispoleots

Other Xerispolents

Typic Xerispoleots

Suggestions for upating the classification of minesoils (Spolic, Anthromorphic Anthroposols) in the new Australian Soil Classification System (Isbell, 1993 with modification dated 17/5/94) based on both the suggested modifications made to Soil Taxonomy (see above) and the profile descriptions of minesoils in Australia.

Outline of scheme to classify the new classes:

SUBGROUPS of SPOLIC, ANTHROMORPHIC ANTHROPOSOLS:

- Soils with sulfuric materials, *or* that have all characteristics of a sulfuric horizon, except that it has a pH value of between 3.5 and 4.0 *or* has sulfidic materials within the upper 0.5 m of the profile. **Sulfic.**
- Soils which are highly saline (EC > 2 dSm^{-1}; 1:5 H_2O) within the upper 0.5 m of the profile often salt encrusted. **Salic.**
- Soils with an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10 and a lithic or paralithic contact within 0.5 m of the mineral soil surface. **Sodic** Lithie
- Soils with an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10 and a lithic or paralithic contact within 1 m of the mineral soil surface. **Sodic Leptic.**
- Soils with a lithic or paralithic contact within 1 m of the mineral soil surface. **Leptic.**
- Soils with an exchangeable sodium percentage-of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10 and fragments of material with slickensides or that have a linear extensibility of 6.0 cm. Sodic **Vertic.**
- Soils with an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of 10 and have fragments of argillaceous materials with base saturation (by sum of cations) of 35 percent or more. Sodic Argic (or Argillaceous).

- Soils with fragments of argillateous materials with base saturation (by sum of cations) of 35 percent or more. Argic (or Argillaceous).
- Soils in which sedimentary layering or buried soil materials are evident throughout the profile and has a" exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more years out of IO to a depth of 1 m or to a lithic or paralithic contact if shallower and has a slope of less than 25 percent. Sadie Stratic
- Soils in which sedimentary layering or buried soil materials are evident throughout the profile to a depth of 1 m or to a lithic or paralithic contact if shallower and has a slope of less than 25 percent. Stratic
- Soils that have a sandy particle size in all layers within 1 m of the mineral soil surface Arenic.
- Soils that have, in one or more layers within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage). Aquic.
- Soils that have, within 100 cm of the mineral soil surface 50 percent or more of material with CEC of less than 24 cmol(+) per kg clay (by NH4OAc pH7). Kandic.
- Soils that have. a chroma of 3 or more in 40 percent or more of the matrix of one or more horizons between IS and 20 cm from the mineral soil surface. Aeric.

REFERENCES

Fanning, D.S., and Fanning, M C (1989). Soil, morphology, genesis and classification. John Wiley & Sons. 395 p.

Fitzpatrick RW. (1986). Morphology, classification and genesis of “mine soils” on the waste-rock dumps. In: Rehabilitation of Waste-rock Dumps, Ranger No. 1 Mine, Northern Territory. Chapter 2, 26 p.

Fitzpatrick RW.. P.G. Self and S.G. McClure (1986). Nature and properties of red-brown iron-rich precipitates on retention pond 4. In: Milnes A.R. and Armstrong, A.B. (eds), Rehabilitation of waste-rock dumps, Ranger No. 1 mine, Jabiru, N. T. CSIRO Div. of Soils Project Report to Ranger Uranium Mines Pty Ltd., Chapter 3, 42p.

Fitzpatrick RW. and A.R Milnes (1988). Characteristics of soils forming on wasterock dumps in the Ranger Project area, Jabiru, N.T. Focus Report No. 6. Confidential Report to Ranger Uranium Mines Pty Ltd. 10p.

Fitzpatrick RW., P. Reddell, A.R. Milnes and T.A. Beech (1988). Description and classification of

Fitzpatrick, R.W., Hudnall, W.H., Self. P.G., and Naidu, R (1993) Origin and properties of inland and tidal saline acid sulfate soils in South Australia. Selected papers of the Ho Chi Mini; City Symposium on Acid Sulfate Soils (Eds D. L. Dent and M. E. F. van Mensvoort). International Institute for Land Reclamation and Development Publication 53, 71 - 80.

Fitzpatrick. RW., Cox, J.W., Fritsch, E., and Hollingsworth, I.D. (1994). A soil-diagnostic key to manage saline and waterlogged catchments in the Mt. Lofty Ranges, South Australia. *Soil Use and Management* (In Press).

Fitzpatrick, RW., Fritsch, E.. and Self, P.G.(1994c). Interpretation of soil features produced by ancient and modern processes in degraded landscapes: V Development of saline sulfidic features in non tidal seepage areas. *Geoderma*. (In Review).

Fitzpatrick, RW. and Hollingsworth, I.D. (1994). Description, classification and geneses of minesoils and natural soils. In Soil from Spoil Project: Measurement of rate of soil formation in spoil and rehabilitated spoil landforms at BHP Australia coal LTD mines, central Queensland: Blackwater, Gregory and Saraji collieries (In preperation).

Fitzpatrick, RW. (1994) Key soil morphological indicators to predict catchment problems and change :Notes for Doug Reuter (CSIRO unpublished internal report)..

Isbell, R.F. (1993) A classification system for Australian soils (Third Approximation). CSIRO Division of Soils Technical Report 2/1993..

McDonald, KC., Isbell, RF., Speight, J.G., Walker, J. &Hopkins, M.S. 1990. Australian soil and land survey field handbook. 2nd Edition, Inkata Press, Melbourne.

Milnes A.R., W.W. Emerson, B.G. Richards, RW. Fitzpatrick and A.B. Armstrong (1988). The long-term stability of waste-rock dumps in the Ranger project area, Northern Territory. Australia. Proceedings of Environmental Workshop - Darwin 1988 Vol. II, p.79-94. Australian Mining Industry Council, Dickson A.C.T.

Milnes A.R., RW. Fitzpatrick P.G. Self, A.W. Fordham and S.G. McClure (1992). Natural iron precipitates in a mine retention pond near Jabiru, Northern Territory, Australia. In "Biomineralization Processes of Iron and Manganese -Modern and Ancient Environments". (eds H.C.W. Skinner and RW. Fitzpatrick). Catena Supplement No. 21 p 23 q261.

AYDRIC SOILS ISSUES SEMINAR
NATIONAL SOIL SURVEY CONFERENCE, SAN DIEGO, CA
JULY 11, 1995

I. INTRODUCTION TO TIIE HYDRIC SOILS ISSUES SEMINAR

Martin C. Rabenhorst
Professor of Pedology
University of Maryland at College Park

Few issues have impacted pedology and soil survey during the last decade as has the issue of hydric soils. Hydric soils has made its way into our scientific and research agendas. They have become a significant component of program activities for soil scientists and conservationists within the NRCS, and have also become an important focal point for policy discussion.

Prior to the passage of the 1985 food security act, wet soils were largely neglected within the research arena and also during soil survey efforts. With the introduction of the Swamp-buster portion of the 1985 farm bii, wet soils were brought to the forefront. During the 1980's the National Technical Committee on Hydric Soils (NTCHS) became an active group contributing the understanding of wet soils. In 1993, the Soil Science Society of America was approved for Division S-10 (wetland soils) for provisional status, and in 1994 its permanent status as a division was finalized. Also, more recently the NRCS has approved the formation of a Wetlands Institute. These specific events serve to illustrate the significance and prominence of hydric soils in pedology today.

Developments withii the field of wet soils has been changing rapidly, especially from the regulatory standpoint. Therefore, the following seminar has been organized to provide a currant look at a number of pertinent issues related to hydric soils within an appropriate historical setting. The seminar has been organized according to the following schedule.

I. Welcome and Introduction

II. Hydric Soils: Where are we now, and how did we get here?

III. Status report from the National Technical Committee on Hydric Soils (NTCHS)

IV. Response/critique of the National Academy of Sciences report on wetlands

V. How are NRCS programs impacted by hydric soil determinations?

VI. What is/should be the role of pedologists in hydric soil determinations?

VII Instructional Strategies: University, Private Sector, Govt. Agencies

II. HYDRIC SOILS: WHERE ARE WE NOW, AND ROW DID WE GET HERE?[1]

- the land periodically supports predominantly hydrophytes,
- the substrate is predominantly undrained hydric soil,
- the substrate is non-soil and is saturated with water or is covered by water some time during the growing season of each year.

In cooperation with the effort that the FWS was beginning with the NWI, the Soil Conservation Service (SCS) agreed to develop the hydric soil definition (classification) and to provide a list of hydric soils for use in the NWI.

The work began on developing a class of hydric soils concurrent with the development of the Cowardin et al (1979) publication. The main objective of the hydric soil definition or classification was to define a class of soils that correlated closely with hydrophytic vegetation,

Rydric Soil Classification Process

Phase 11977-1980: The strategy for developing a list of hydric soils was to first define the concept and criteria for identifying hydric soils and then to conduct field studies to determine which soils best fit the initial definition of hydric soil. Some initial questions were (1) how long does it take hydric soils to form, and (2) how long does a soil have to be saturated to support growth of hydrophytes.

The initial working definition was:

> Hydric soils are soils with water at or near the surface for most of the growing season or the soil is saturated long enough to support plants that grow well in a wet environment.

Initially it was thought that all soils with aquic and peraquic moisture regimes would meet this definition. The definition of aquic moisture regime:

> " implies a reducing regime that is free of dissolved oxygen because the soil is saturated by' ground water or by water of the capillary fringe" (Soil Survey

Phase

in determining wetland as part of the Clean Water Act (Environmental Laboratory, 1987).

Feedback from the 1983 list and criteria for hydric soils suggested:

- that only poorly and very poorly drained soils be included on the list;
- there was an alarming inconsistency among state lists. and thus indicated the need for a standardized procedure to generate the list of hydric soils.

As a result of the need for a standardized procedure for generating the national list of hydric soils, the NTCHS concentrated on developing criteria that would use soil properties in the Soil Interpretations Record (SIR) for soil series to create a national list of hydric soils. The SIR is a national database that contains soil property records for all soil series recognized in the National Cooperative Soil Survey in the United States (Mausbach, et al., 1989).

The NTCHS used the aquic moisture regime of soil taxonomy as a general cut for saturated soils supplemented with water table, flooding and ponding data, and Land Capability Class and subclass. They arbitrarily created growing season periods based on soil temperature regimes (National Technical Committee for Hydric Soils, 1985).

This list generated many comments:

- capability classification could not be used because it was based on a hierarchy and the wetness factors may not be correctly reflected in the subclass notation;
- taxonomic criteria do not identity all hydric soils;
- a number of SIR's are missing drainage class information;
- there are a number of aquic soils that do not have water tables close to the surface;
- the definition and criteria do not match
- the flooding and ponding criterion includes well- and excessively well drained soils.

The NTCHS considered these comments and replaced the use of Land Capability Subclass with drainage class and water tables. The final definition and criteria were (National Technical Committee for Hydric Soils, 1985):

Definition - A hydric soil is a soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation.

The use of the phrase "in its undrained condition" has be misinterpreted by many to imply that a drained soil would not meet the definition of hydric soils. The phrase was included to tie the hydric soil definition to the keys in soil taxonomy that state "unless artificially drained." The phrase means that once a hydric soil always a hydric soil and that drainage of the soil would not change the classification.

Criteria -

1. All Histosols except Folists, or
2. Soils in Aquic Suborders, Aquic Subgroups, Albolls Suborder, Salorthids Great Group, or Pell Great Groups of Vertisols that are:
    a. somewhat poorly drained and have water table less than 0.5 ft from the

surface at some time during the growing season, or

b. poorly drained or very poorly drained and have either:

(1) water table at less than 1.0 ft from the surface at some time during the growing season if permeability is equal to or greater than 6.0 in/hr in all layers within 20 inches, or

(2) water table at less than 1.5 ft from the surface at some time during the growing season if permeability is less than 6.0 in/hr in any layer within 20 inches, or

3. Soils that are ponded during any part of the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

The use of drainage classes and water table depths appears inconsistent with the definition of drainage classes in that the highest water tables are associated with the somewhat poorly drained soils. Because the SIR database does not include duration of water tables, drainage class is used as a substitute for duration of the water table at a certain depth. Somewhat poorly drained soils are interpreted as having relatively short duration of water tables, thus the water table is placed at a depth of less then 0.5 ft. The use of permeability class relates to ease of drainage of excess water from the soil and, rightly or wrongly, relates to the capillary fringe above the free water table. One could argue that texture is better correlated to capillary fringe.

The first National List of Hydric Soils of the United States was published in 1985 (National Technical Committee for Hydric Soils, 1985).

<u>Phase 4 1985 - present</u>:

The passage of the Food Security Act of 1985 played a significant role in the use of hydric soil definition, criteria, and lists. It passed into law the definition of wetland as meeting three criteria: hydrophytic vegetation, hydric soils, and hydrology. Rules and regulations developed by the Department of Agriculture allowed the use of only two criteria; hydric soils and vegetation; in areas where hydrology had not been modified. These changes in the use of the hydric soil list, definition, and criteria placed increased pressure on the hydric soil definition and criteria in respect to length of time for a soil to become anaerobic. Increasingly groups were citing the hydric soils criteria as indicating 7 days of saturation, flooding, and ponding as the length of time for a soil to become anaerobic. The 1989 Federal Wetlands Manual (Federal Interagency Committee for Wetland Delineation, 1989) used verbatim the hydric soil hydrology criteria as the hydrology criteria for the manual. These same groups were misquoting the hydric soil criteria and stating that a water table could be as low as 1.5 A and still meet wetland hydrology (by convention water tables in the SIR are recorded by 0.5 ft increments thus the NTCHS could have easily used less than or equal to 1.0 ft. in place of less than 1.5 ft in the criteria). There were also some lingering issues of the criteria such as requiring ponded and flooded soils to have aquic moisture regimes, and sandy soils in the southeastern coastal plain.

Because of these developments, the NTCHS received comments criticizing the implied 7 days duration of saturation for anoxic condition to develop. They then reviewed recent literature and research on wet soils with respect to anaerobic conditions in the upper part of the soil as related to sandy soils, duration of wetness, and depth of wetness. Duration for saturation was added to the criteria in a 1987 revision (National Technical Committee for Hydric Soils, 1987). In 1990 they made a significant change to the criteria by increasing the period for saturation from 1 week to 2 weeks or more during the growing season based on recent research. This change did not affect the list of hydric soils since the Soil Interpretation Record distinguishes high water table on a basis of a few weeks.

The SCS and NTCHS also conducted field tests in the southeastern coastal plain and added a special criterion for sandy soils based in part on the potential capillary rise in these very sandy soils. This criterion requires the water table to be at the surface for these soils.

The present definition of hydric soils is (NTCHS, 1994):

> A hydric soil is a soil that is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. The following criteria reflect those soils that meet this definition.

Changes to the definition from 1985 include removing the phrase "in its undrained condition" and the reference to hydrophytic vegetation. The reference to hydrophytic vegetation was replaced with the phrase indicating presence of anaerobic conditions in the upper part. This change was made to make the definition independent of hydrophytic vegetation although hydric soils are still closely related to the presence of hydrophytes.

The criteria use the basic soil properties of water table depth, flooding, and ponding; the soil quality, permeability; and classes of soil taxonomy and drainage. The criteria are:

1. All Histosols except Folists, or
2. Soils in Aquic Suborders, great groups or subgroups, Albolls Suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
   a. Somewhat poorly drained with a water table equal to 0.0 foot (A) from the surface during the growing season, or
   b. poorly drained or very poorly drained and have either:
      (1) water table equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 in, or for other soils
      (2) water table at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 in/h in all layers within 20 in, or
      (3) water table at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or
3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

The criteria were never meant to be used in the field identification of hydric soils, but in the absence of field procedures for identifying hydric soils in the wetland delineation process, delineators were trying to apply the hydric soil criteria along with morphological descriptions of the soil in soil survey reports. In many cases these descriptions were not complete enough for the delineators to make consist wetland delineation calls. The NTCHS recently added a statement of meet the hydric soil defmition and criteria

Conclusions

The development of the hydric soil classification of soils has evolved over 15 years of study and testing of the definition and criteria. The objective was and still is to develop a list of soils that correlates with the presence of hydrophytic vegetation. The classification criteria use the aquic moisture regime of Soil Taxonomy as a first cut in identifying soils with anaerobic conditions, The soil properties and qualities of water table depth, flooding and ponding, soil texture, soil permeability, and drainage class are used to generate a list of hydric soils from the national Soil Interpretations Record database. The criteria are strictly utilitarian in that they are useful for generating a standardized list of soils. Field morphological properties that related to water table levels and zones of anaerobicity in soils should be used when identifying hydric soils in the field.

References

Cowardin, Lewis M., Virginia Carter, Francis C. Golet, and Edward T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States, Fish and Wildlife Service, U.S. Dept. of Interior, Washington, DC. 103 pp.

Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual, technical report &-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 100 pp plus appendices.

Federal Interagency Committee for Wetland Delineation. 1989. Federal manual for identifying and delineating jurisdictional wetlands. U.S. Army Corps of Engineers, US. Environmental Protection Agency, U.S. Fish and Wildlife Service, and USDA Soil Conservation Service, Washington, D.C. Cooperative technical publication. 76 pp. plus appendices,

Hurt, G. W. and W. E. Puckett Proposed hydric soil criteria and their field identification. In J. M. Kimble (ed.) Proc. 8th Inter. Soil Correl. Mtg (VIII ISCOM): Characterization, Classification, and Utilization of Wet Soils. USDA, Soil Conservation Service, National Soil Survey Center Lincoln, NE. p 148-151.

Mausbach, Maurice J., David L. Anderson, and Richard W. Arnold. 1989. Soil survey databases and their uses. Proceedings of the 1989 Summer Computer Simulation Conference.. July 24-27, 1989, Austin TX. Sponsored by the Soc. for Computer Simulation. Edited by Joe K. Clema. p659-664.

National Technical Committee for Hydric Soils. 1985. Hydric Soils of the United States. USDA Soil Conservation Service, Washington, DC.

National Technical Committee for Hydric Soils. 1987. Hydric Soils of the United States. USDA Soil Conservation Service, Washington, DC.

National Technical Committee for Hydric Soils. 1991. Hydric Soils of the United States. USDA Soil Conservation Service, Misc. Publ. 1491, Washington, DC.

Soil Survey Staff. 1975. Soil Taxonomy: A basic system of soil classification for making and interpreting soil survey. Agric. Handb. No. 436, US Govt. Printing Office, Washington, DC.

Watts, Frank C. and G. Wade Hurt. 1991. Determining depths to the seasonal high water table and hydric soils in Florida. Soil Survey Hor. 32: 117-121.

III. STATUS REPORT FROM THE NATIONAL TECHNICAL COMMITTEE ON HYDRIC SOILS (NTCHS)

P. Michael Whited
Natural Resources Conservation Service
Midwest National Technical Center
Lincoln, Nebraska

The National Technical Committee for Hydric Soils is an interagency, multidisciplinary committee. Organizations represented are: Natural Resources Conservation Service, U.S. Fish and Wildlife Service, Environmental Protection Agency, Army Corps of Engineers, Bureau of Land Management, U.S. Forest Service, universities, and private consultants. Our current membership consists of 20 individuals including 15 soil scientists, 3 biologists, 1 engineer and 1 ecologist

Background

The NTCHS has it's origins in the 1970's. The U.S. Fish and Wildlife Service was charged with the responsibility of conducting the National Wetlands Inventory (NWI). Much of the work was being done using remotely sensed information. They realized that published soil surveys could be an excellent source of ancillary data to aid in interpreting remotely sensed images. In 1977 W. Blake Parker (Soil Scientist with SCS) was assigned to work with the FWS. The objective was to define a class of soils closely associated with hydrophytic vegetation that would help to identify wetlands as described by Cowardin et al. (1979). These soil series would come to be known as "hydric soils". The Soil Conservation Service (now the Natural Resources Conservation Service) appointed an ad-hoc committee under the direction of Dr. Richard Guthrie to assist Blake Parker in this effort,

After several iterations of the concept and definition of hydric soils and a number of field studies to test these ideas, draft lists of hydric soil series were developed. It soon became clear, however, that some mechanism would be needed to ensure consistency from state-to-state and region-to-region in the identification of hydric soils. In an effort to provide this oversight, the NTCHS was formed. It was an ad-hoc, interagency committee charged to review and revise the definition of hydric soils and to develop criteria which could be used as a computer query of the Soil Interpretation Record (SIR) database. The purpose of this query was to generate a national list of hydric soil series. Inclusion of a soil on the list was baaed on the taxonomic placement of the soil, estimated soil properties (ie drainage class, permeability, particle-size class, and depth to water table), and phase criteria (ie flooding or ponding frequency and duration) listed for each soil series. The first national list of hydric soils was published in 1985 (National Technical Committee for Hydric Soils, 1985).

The 1985 Food Security Act and the NTCHS

In 1985 Congress passed the Food Security Act (FSA) which explicitly recognized hydric soils in the legislation. Under the "Swamp Buster" portion of the legislation, wetlands were defined as follows:

a) Have a predominance of hydric soils

b) Are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation.

c) Under normal circumstances do support a prevalence of such vegetation,

The act further stated that "the secretary of agriculture shall develop criteria for the identification of hydric soils and hydrophytic vegetation, and lists of such soils and vegetation."

In order to implement the FSA, the Secretary of Agriculture designated the Soil Conservation Service to provide lists of hydric soils and to "oversee the development and application of criteria to identify hydric soils in consultation with the National Technical Committee for Hydric Soils." In response to this formal recognition of the NTCHS by the Secretary of Agriculture, SCS distributed National Instruction 430-303, which lists 5 functions for the NTCHS. They are:

I) Develop and maintain the definition and criteria for hydric soils.

2) Consider and respond to comments and suggested changes in the hydric soil criteria and definition,

3) Periodically publish a national list of hydric soils of the United States.

4) Provide technical consultation on hydric soils to other technical groups.

5) Provide technical leadership in the formulation, evaluation, and application of criteria for hydric soils as related to soil, hydrology, and climatic data.

The work of the NTCHS has centered around developing and testing the hydric soil definition, development of criteria to be used as a computer query so that a consistent national list of hydric soils could be produced (National Technical Committee for Hydric Soils, 1985, 1987, 1991), and in reviewing changes to the national list The committee held numerous meetings, conducted several field investigations, and considered many comments in carrying out their work (Mausbach, 1994). During this period the NTCHS grew from a small ad-hoc committee to the present membership. The chairmanship has been passed from Richard Guthrie, to Keith Young, to Maury Mausbach, and in 1994, to Craig Ditzler, a soil scientist at the National Soil Survey Center.

Recent Changes

Two changes affecting both the definition and criteria for hydric soils were approved by the committee in 1994. The definition was modified to read:

"A hydric soil is a soil that *formed under conditions of* saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Change in italics.)

The intent of this change was to make it clear that hydric soils that are artificially drained are still considered hydric after being drained. This is particularly important when considering applications for wetland restoration. This change also implies (intentionally) that soils exhibiting morphology indicative of saturation and reduction, even though it is the result of artificial measures such as flood irrigation, are to be considered hydric. (Whether these soils are to be regulated as wetlands is a separate issue. Currently they are exempt as artificial wetlands). This change to the definition of a hydric soil was recorded in the July 13, 1994 Federal Register.

The criteria used to generate a list afhydric soils from the SIR database has been modified to more clearly reflect the intended depths for water tables. The depths listed as "less than" 1.5, 1.0, and 0.5 feet were changed to "less than or equal to" 1.0, 0.5, or 0 foot respectively. This is because the estimated depths to water tables are listed in 0.5 foot increments on the SIR. So when the criteria said for example "water table at less than 1.5 feet" the computer selected soils with water tables listed as less than or equal to 1.0 foot. This change to the criteria did not cause any soils to be added to or deleted from the list. The revised criteria was published in the February 23, 1995 Federal Register.

Future Activities

The NTCHS is currently cooperating in, or actively working toward, three objectives First, we are cooperating with an interagency group representing NRCS, COE, EPA, and FWS to develop a set of field indicators of hydtic soils. This is an effort to identify the morphological expression of oxidation/reduction processes in the soil which indicate that a soil meets the definition for a hydric soil. This is important because it provides the information needed to consistently identify hydric soils in the field (Smith, 1994).

A second effort involves a technical subcommittee of the NTCHS which is charged to suggest standard procedures for collecting field monitored data and specific threshold limits to be applied when determining whether a soil meets the definition for a hydric soil. For example, the definition refers to the "upper part" of the soil. We need to explicitly tell where to place. sensors in order to be in the upper part. What is meant by anaerobic? It is unreasonable to expect a literal absence of oxygen, but how low should it be for a soil to be considered anaerobic? If redox potential is, measured, what values indicate a sufficiently reducing environment to consider the soil hydric? How long should the values persist? Can we better define the growing season? By recommending a standard method for monitoring, and by establishing threshold values, it will help us to be more objective in evaluating the adequacy of the currently proposed field indicators, and in evaluating future proposals for additions to the list of indicators. It will also help in cases where soils are obviously wet, but morphological indicators are not present.

The third area that the NTCHS is pursuing is the use of the INTERNET for distributing information about hydric soils. In the near future we hope to be able to provide access to the current national list of hydric soils. Eventually we plan to provide options to obtain state and county lists. In addition, we will provide information about the NTCHS, information regarding the definition and criteria for hydric soils, glossary of terms, field indicators, and instructions for commenting on these items. In effect, this means updating Hydric Soils of the United States and distributing it electronically.

Summary and Conclusion

The NTCHS has played an important role over the last 20 years in the area of wetlands identification and protection. Early efforts to support the U.S. Fish and Wildlife Service in the National Wetlands Inventory resulted in the recognition of hydric soils as an important class of soils associated with wetlands. Recognition of the NTCHS as an authority by the federal agencies charged with implementing the Food Security and Clean Water Acts further increased the importance of the committee. The NTCHS has devoted considerable effort to developing and testing the hydric soil definition and the criteria used to generate lists of hydric soil series. The committee is cooperating with the interagency committee developing the field indicators for hydric soils. A subcommittee of the NTCHS is attempting to develop a hydric soil standard to be used in monitoring sites in the field and in evaluating the data. We are also exploring opportunities involving the use of the

IV. RESPONSE/CRITIQUE OF THE NATIONAL ACADEMY OF SCIENCES REPORT ON WETLANDS

Jerry J. Daigle
State Soil Scientist
Alexandria, Louisiana
USDA-NRCS

The National Research Council (NRC) Committee on the Characterization of Wetlands released its much anticipated report on May 9, 1995. The report, entitled Wetlands: Char- Boundaries, is a comprehensive document encompassing the total realm of topics that can be included under the general term of "Wetlands." The specific charge of the committee was to review and evaluate the consequences of alternative methods of wetland delineation and to summarize the scientific understanding of wetland functions, Specifically mentioned in the committee's charge are the issues of wetland definition, the structure and functioning of wetlands and regional differences among wetlands. The NRC committee did reach a broad consensus on the issues related to its charge. In its report the committee presents a reference definition of wetlands that sets the stage for, in its words, "a fresh look at existing regulatory definitions and for reconsideration of the confusion surrounding parameters, criteria, and indicators." In addition, the committee offers an overview of wetland functions as they relate to the protection of wetlands and provides many recommendations and conclusions related to criteria and indicators.

The committee recognized the potential differences between wetlands defined by scientifically baaed criteria and wetlands delineated using policy oriented definitions. They urged scientists to apply proven scientific techniques in dealing with wetland issues realizing that other, non-scientific, motivations may dictate the scope of the final delineation. They also urged that this identification and delineation of wetlands be kept separate from the functional analysis of wetlands.

Recommendations of the NRC committee include having all wetland regulatory functions consolidated under a single federal agency and the adoption of a single new manual to make identification and regulation of wetlands more consistent The committee reinforced the three factor approach for identifying wetlands but redefined the factors as "Water, Substrate, and Biota." Greater recognition of differences in wetlands from region to region and a need for regionalized studies of the relationships between hydric soils, hydrophytic vegetation and specific hydrologic thresholds associated with the development of wetlands was urged by the committee. As was establishment ofregional technical committees on hydric soils. At the same time, the use of a uniform process to develop national standards was strongly recommended.

The committee saw no justification to use special definitions or criteria to distinguish agricultural wetlands from similar wetlands outside the farming area They stated that the scientific basis for special permitting of wetlands in headwaters or isolated wetlands is weak and should be reviewed, Committee members deemed prevalence index or dominance estimate near 50 percent as not reliable indicators for assessment of vegetation in the absence of independent information on soils, hydrology, or both. They recommended that "FAC-neutral" type tests be thrown out and added weight on the other indicators be added. They also recommended that an array of simple but definitive indicators, based on vegetation, be constructed for use in the field as a means of conserving time, effort, and expense in vegetation analysis.

If riparian areas are to be protected, the committee recommended that it must be through legislation that recognizes their special attributes and not by defining them as wetlands.

Water was deemed by the committee to have special status because neither of the other two factors could develop in the absence of specific hydrologic conditions. Even though, it was pointed out that substrate and biota will typically provide the most easily obtained and reliable evidence of the presence of wetlands, except where hydrology has been altered. It was also recommended that, in the absence of alteration or ambivalent indications, it is scientifically defensible to infer information about one factor or another.

The committee went on to state that each of the three criteria (water, substrate, and biota) must be interpreted in terms of <u>indicators</u> that can be documented under field conditions. It was also emphasized that wetlands that lack hydric soils or hydrophytic vascular plants, although unusual, should not be excluded from regulation simply because they lack the most common indicators. The committee also emphasized the fact that specific hydrologic conditions are an absolute requirement for the formation and maintenance of wetlands, but are often hard to be directly assessed and should not he held as a strict requirement for identification and delineation of wetlands, The committee reinforced the thinking that hydrologic analysis, as a minimum, information on three related elements. Those three elements and the committee's recommended threshold values are duration of saturation and its relation to growing season (14 days), the critical depth of saturation (rooting zone of 30 cm), and the frequency of saturation (> 50% occurrence).

The current concept of growing season cannot be applied reliably according to the committee and the search for a more credible system for defining saturation thresholds was highly recommended.

Visual indicators of hydrologic events, such as drift lines and blackened leaves were also deemed by the committee to be not reliable.

The committee recommended the continued use of the <u>National List of Hydric Soils</u>. However, they urged that the primary data and procedures for identification of hydric soils and changes in the designation of hydric soils should be more thoroughly documented They also recommended the development of a wetlands fidelity system for use with hydric soils, more studies of soils that are difficult to classify in the field, and a greater emphasis placed on the development of field indicators for hydric soils.

The NRC committee stressed the need for a federal system for maintaining computerized records of wetlands delineations. This would be the basis for periodic nationwide reports. They also said it would not be possible to rely on broadly drawn categories to determine the usefulness or value of specific wetlands; for example, high, medium, and low value based on some general assessment of the purposes served by wetlands such as low value for wetlands less than 10 acres in size.

Continued and new studies in all areas were strongly urged by the committee Current unavailability of critical information demonstrates an urgent need for study of selected wetland characteristics for which lack of information hampers the identification of wetlands. More extensive study of plant species that have genetically distinctive populations having differing affinities for wetland conditions, and appropriate identification of the regions in which the different genetic types are present will enhance the usefulness of the Hydrophytic Plant List according to the committee.

V. HOW ARE NRCS PROGRAMS IMPACTED BY HYDRIC SOIL DETERMINATIONS?

Karl H. Langlois, Jr.
Natural Resources Conservation Service
Northeast National Technical Center
Chester, PA

Since the passage of the 1995 Food Security Act (FSA) the Natural Resources Conservation Service has been identifying wetlands and hydric soils on agricultural lands. The importance of wetlands and their extensive amount, has resulted in an identification program having a large impact on the workload of the agency. The impact has been felt in many disciplines but probably none as much as soil survey and biology.

This presentation addresses the definition of wetlands and the criteria, indicators, and procedures for identifying hydrology, hydrophytic vegetation, and hydric soils. Wetland determinations and delineations are needed for FSA and the Wetlands Reserve Program. The workload associated with hydric soils affects soils scientists at all level of the organization.

A soil scientist at the Northeast NTC spent 50 percent of his time developing hydric soil indicators and at the Midwest NTC over 50 percent of a soil scientists time was responding to wetland appeals, All NTC's spent time testing the hydric soil indicators and time providing training for wetland determinations and delineations. Some state office soil scientists handle appeals and provide help making wetland determinations and delineations. In the Field Offices District Conservationists are spending more time on-site identifying wetlands and Resource Soil Scientists involvedin wetlands identification spend 25100% of their time in the process,

The major impact of wetland determinations and delineations for the soil survey program is the need to divert soil scientists from soil survey production to technical soil services. This also impacts all levels of the organization.

If soil scientists did not have the wetland workload, we could develop and improve soil interpretations for conservation planning, develop new interpretations for NASIS, map more acres, and enter more pedon data. The work we do with hydric soils has provided some positive impacts such as gathering more and better data about wet soils.

VI. WHAT IS/SHOULD BE THE ROLE OF PEDOLOGISTS IN HYDRIC SOIL DETERMINATIONS?

Mary E. Collins
University of Florida
Gainesville, FL

Traditional Roles of Pedologists in Wetland Research

Research and educational programs in pedology traditionally focused on agricultural ecosystems (primarily emphasis on crop production to support the agricultural clientele) with a lesser emphasis on natural resource management (especially wetlands). Pedologists' work reflected only limited professional interest in wetlands. Soil scientists did not consider soils in wetlands and other ecosystems as a part of their domain, primarily due to a lack of awareness of the importance of these systems in the landscape. Soil scientists worked primarily within their own areas of expertise and had relatively little communication and/or collaboration with scientists in other disciplines.

Early soil classification systems placed major emphasis on upland soils and often ignored floodplain areas or other wetlands. Often the broad category of "wet areas" was used. At the time most of the soil surveys were made, wetland recognition and delineation were not issues.

The **primary** role of soil scientists in the National Cooperative Soil Survey Program (NCSSP) in the U.S. was to **identify, classify,** and map soils. Much of the work was done in the field through visual observation of soil morphological features such as soil color, texture and structure. The depth **to the seasonal high** water table (SHWT) generally was not measured or documented. Rather, the natural drainage class of each soil series was designated, and an estimate of the SHWT was made based primarily on soil colors and mottling characteristics. Usually, the soil series was assigned the same SHWT depth throughout the region or area in which the soil was mapped and correlated. In many states or regions, most of the soils in a particular drainage class were assigned the same SHWT depth.. More emphasis was placed on predicting yields of important crops and interpreting soils for agricultural, and some non-agricultural uses, rather than estimating the depth to or the duration of the seasonal high water table.

Current and Future Roles of Pedologists in Hydric Soil Determinations

The historical agricultural orientation of soil scientists resulted in a lack of interdisciplinary collaboration between wetland scientists and soil scientists. The wetland scientists (ecologists, biologists, botanists, zoologists) therefore pursued the wetland ecosystems with the assumption that soils play some undetermined secondary role in the systems function.

In recent years, interest in wetland delineation and hydric soil indicators has created a new environmentally-oriented role for soil scientists. Pedologists have made efforts to bridge the gap with other disciplines. Pedologists identified their role and took the lead in developing soils criteria for defining hydric soils and wetland boundaries. Pedologists now work on an interdisciplinary team of scientists that includes plant ecologists and hydrologists in developing definitions for wetlands. A group working on the hydric soils classification (National Technical Committee for Hydric Soils) includes 2 biologists, an ecologist and an agricultural engineer in addition to the pedologists. Soil scientists have made progress, however many deficiencies still exist in all programs involving wetland soils.

The role ofpedologists must be clearly defined, and pedologists must realize the importance of their input in an interdisciplinary approach and make a serious effort to work together with other disciplines on the hydric soils as well as the many wetland issues. The problems and issues of hydric soils and wetlands are too complex to be addressed by a single discipline.

Pedologists must lead the way in hydric soil characterization and delineation. This is not to say that pedologists should or must do all hydric soil determinations. Other disciplines will not allow this to happen. Rather pedologists must be leaders in developing hydric soil criteria, in research, and in training other disciplines in using the hydric soil criteria and/or indicators. Pedologists numbers are simply too small to do most or all the hydric soil determinations. Pedologists in the NRCS are too few in number and do not have the time to do all the hydric soil determinations, and the number of pedologists in the state, county and private sectors is even less.

To give some examples, in Florida, The Florida Association of Environmental Soil Scientists has about 65 members. These are soil scientists employed by federal and state governments as well as consultants, The Florida Association of Environmental Professionals (mostly biologists and botanists) has over 900 members. Nationally and internationally, in the Soil Science Society of America (SSSA) there are about 1200 individuals that list the pedology subdivision (S-S) as their first choice, In comparison, The Society of Wetland Scientists currently has about 3600 members.

Use of hydric soil indicatora in training of non-soil scientists

The development of hydric soil indicators has been valuable in some areas in the training of non-soil scientists, In Florida for example, The Florida Association of Environmental Soil Scientists conducted a one-day hydric soils workshop on the hydric soils indicators developed in Florida. Technical lectures were given by individuals with federal agencies, universities, and private consultants. Attendance at this workshop was limited to about 150 individuals, and would have been much larger if space had permitted The individuals receiving the training were not pedologists, but all have been and will be making hydric soils and wetland determinations. The participants nearly unanimously agreed that this training was the best that they had ever received. Was the training long enough? Certainly not. Several days to a week would have been better, but this involves more time from the individuals doing the training as well as the trainees. Should hydric soils training be given to non-soil scientists? That question is open to debate. The thing that is known though is that these non-soil scientists will continue to do the hydric soils and wetland determinations whether adequately trained or not. And isn't it better for pedologists to give the hydric soils training than non-pedologists? Does this type of training cheapen the pedology profession? Not if the trainees are made to realize and understand the very small amount that they know about soils, and particularly hydric soils. Sometimes as we learn the more we realize that we don't know. Most people working with computer programs have probably come to this realization a long time ago.

In addition to the annual hydric soils workshop that is conducted by the Florida Association of Environmental Soil Scientists, a "Hydric Soils Handbook" has been prepared by the members of the Association and is provided to all the participants in the workshop. The handbook contains papers that discuss such topics as the factors of soil formation, soil profile and horizon designations, and concepts and formation of hydric soils. Color pictures are included of some of the hydric soil indicators used in Florida.

To provide education and training in soils, particularly hydric soils, a multimedia computer program was developed in the Soil and Water Science Department at the University of Florida for use by the U.S. Army Corps of Engineers. The computer program called Hydric Soils Disc, is on a CD-ROM and trains the user on the properties associated with hydric soils and demonstrates the common hydric soil indicators. The program includes numerous audio and video files that enables the user to "see" the hydric soils and other morphological features.

Whether or not each state or region should develop hydric soil indicators is also open to much debate. The answer probably is that it depends on the state or region. The indicators appear to be very useful in Florida, but the state of Florida and its soils are unique in many ways. Certainly, before any area adopts hydric soil indicators, considerable research and testing of the indicators are needed.

Other Roles of Pedologists

Pedologists can and must play an active role in the research and decisions involving hydric soils criteria, indicators, and the delineation and characterization of wetlands. But there are other areas in which pedologists should be involved through interdisciplinary teams including: water quality in wetlands, wetland restoration and creation, wetland regulations and policies, and wetland biogeochemistry.

Moving toward the 21st century, it appears it is up to the pedologists to carve out a niche in the above areas of wetland sciences and to educate other disciplines concerning the overall importance of soils with respect to our overall understanding of wetlands. SSSA has established the S-10 Division on Wetland Soils, which provides a framework for pedologists to develop links not only within the sub-disciplines of soil science, but also with wetland scientists from other disciplines. The Society of Wetland Scientists with its large membership of predominately non-pedologists, is another group that may offer pedologists the opportunity to interact more with other disciplines.

To look at the possible roles of pedologists, we will discuss further the possible role and involvement of pedologists in hydric soil activities in three major areas:

Colleges and Universities
Federal and State Governments
Consultants

Pedologists **at Colleges and Universities**

1. Teach courses related to hydric soil identification and processes related to the formation of morphological features of hydric soils. As an example a number of courses related to hydric soils and wetland processes have been developed in the Soil and Water Science Department at the University of Florida.

2. Develop information to help students as well as practicing non-soil scientists and soil scientists

better see and understand hydric soils and factors of soil formation. Example: Hydric Soil Disc computer program and the Hydric Soil Handbook.

3. Make an effort to recruit students from other disciplines into soil science programs and develop interdisciplinary research programs.

4. Develop research activities related to better understanding the morphology of hydric soils and relationship to hydrophytic vegetation and wetland hydrology.

5. Publish research findings.

Possibly the most extensive research and publications recently completed by a pedologist at a university has been by Dr. Jimmie L. Richardson at the North Dakota State University. One of his recent publication is a chapter in Advances in Agronomy, Vol. 52, in 1994 entitled, "Wetland Soils of the Prairie Potholes", by J.L. Richardson, J.L. Arndt, and J. Freeland, pp 121-171. In this chapter, Dr. Richardson gives a background on the history of wetlands, basic hydrologic concepts and wetland classifications. He also discusses wetland soil properties, soil sequences and soils in the prairie potholes edges in the north-central region of the U.S. as well as southern Canada. It is significant that under the heading, "Conclusions and Future Work", Dr. Richardson lists **Interdisciplinary research into Wetland Systems as** the **Number** 1 priority.

6. Be a member and be involved in professional associations/societies that may have input into hydric soil activities.

7. Identify and keep pedologists informed of hydric soil educational activities.

Pedologists employed by Fedeml and State Governments

1. Keep pedologists at colleges and universities and private consultants informed and up-to-date on hydric soils issues.

2. Help with the development, securing of funding and carrying out of cooperative hydric soil field studies with researchers in Pedology at colleges and universities.

3. Provide input into state and national policy decisions and procedures related to hydric soil determinations.

4. Work with the National Technical Committee for Hydric Soils to refine the definitions and criteria for hydric soils.

5. Assist with the development of new/improved techniques to use in the identification and delineation of hydric soils.

6. Develop and test hydric soil indicators. Using Florida as an example, hydric soil indicators developed by the SCS have been adopted into law by the Florida State Legislature. In Florida, the SCS began working with the Florida Department of Environmental Protection (DEP) to develop the use of soils as a tool to use in the identification of wetlands in the state. The wetland indicators

listed in the 1987 Wetlands Delineation Manual of the U.S. Army Corps of Engineers were tested and found to be lacking in their usability as indicators of wetlands in Florida. For example, the "indicator" of a aquic moisture regime is actual criteria, and generally cannot be applied in the field because it cannot be determined by morphology alone.

7. Observe, study, and describe the morphology of hydric soils, and provide training to individuals within other governmental agencies involved in wetland determinations.

8. Provide input into Food Security Act wetland determinations.

9. Be a member and be involved in professional associations/societies that may have input into hydric soil activities.

Pedologists working as consultants

1. Do on-site hydric soil determinations.

2. Observe, study, and describe the morphology of hydric soils, and provide training to other consultants involved in wetland determinations.

3. Be a member and be involved in professional associations/societies that may have input into hydric soil activities.

The Role of Professional Societies and Associations

Professional societies and associations provide a network to link pedologists in all organizations together as well as providing a link to other disciplines. Some important professional societies/associations include:

State Professional Soil Scientists Associations
Soil Science Society of America/ASA
National Society of Consulting Soil Scientists
Soil and Water Conservation Society of America
Society of Wetland Scientists

Possible activities of professional societies and associations related to hydric soils:

1. Develop a stronger political voice in defining the criteria and methodology for hydric soil determinations.

2. Keep members informed and up-to-date on hydric soil activities. Examples:

a) Newsletter of the National Society of Consulting Soil Scientists has a section entitled, "Wetland and Hydric Soils News". **In this section are published any significant news related to hydric soils as well as the latest changes by the NRCS in hydric soils in the U.S.**

b) Wetlands Bulletin published by the Society of Wetland Scientists has a section on meetings, conferences and upcoming training related to hydric soils and wetlands. The Wetlands Bulletin also has a section listing employment opportunities related to wetlands.

3. Sponsor hydric soil conferences, workshops, and courses, Examples:

a) The Florida Association of Environmental Soil Scientists Annual Hydric Soils Workshop.

b) ASA/SSSA sponsored a Hydric Soils Symposium at the 1994 ASA meetings in Seattle and will be sponsoring a Hydric Soil Field Workshop at the 1995 ASA meetings in St. Louis.

4. Participate in national hydric soil committees.

5. Exchange information on hydric soils with other societies and other disciplines

Summary

Pedologists should lead the way in characterizing hydric soils and in determining and defining the criteria aod methodology for hydric soil determinations. Pedologists are too few in number to make all the hydric soil determinations. Rather, pedologists must understand and accept their role, whether they are employed by a governmental agency, university, or as a consultant. Pedologists must make the extra effort to work with other disciplines in the hydric soils determinations, but should never forget their education and training in the sciences and as a pedologist and maintain the highest standards possible when working with the other disciplines.

Acknowledgements

Information provided in this report concerning the traditional role of pedologists and future work of pedologists in wetland areas is from a manuscript by Reddy, K.R., W.F. DeBusk, and M.E. Collins. 1995. "Role of Soil Scientists in Wetland Research and Resource Management" (in press.) Thanks are also given to Ronald J. Kuehl, consulting soil scientist, for his work in collecting background information for this report regarding the role of pedologists in hydric soil determinations.

VII. INSTRUCTIONAL STRATEGIES: UNIVERSITY, PRIVATE SECTOR, GOVT. AGENCIES

J. C. Bell
Department of Soil, Water, and Climate
University of Minnesota
St. Paul, MN

The growth of wetland regulations over the past decade has created a large demand for both scientists and technicians who are capable of delineating the spatial extent of hydric soils for site-specific applications. In response to this demand, a wide variety of training courses have emerged nationwide originating from private industry, governmental agencies, and educational institutions. Nationally, the coordination, consistency, and quality of hydric soils training efforts has been quite variable. The development of effective instructional strategies requires a clear understanding of the characteristics of the audience While the characteristics of the audience is quite diverse, perhaps the most important characteristic is their background in terms of pedological education and experience. The main division that we can make with regard to student background is the pedologist vs. the non-pedologists. In an ideal world, pedologists would conduct all hydric soil delineations, however, a lack of qualified pedologists and economic realities dictate that non-pedologists will and are involved in hydric soil delineations. Consequently, separate instructional strategies are required for training pedologists (scientists) and non-pedologists (technicians). Pedologists will require advanced instruction on the pedological processes of hydromorphic soils, landscape- scale hydrology, wetland regulations, and how to interpret problem and disturbed soils. The role of the pedologist, ideally, would be to conduct delineations on problem soils, disturbed soils, complex sites, and to advise soil technicians. Instructional strategies for soil technicians must recognize their lack and pedological knowledge and experience. We cannot expect to train someone in the complexities of pedology through a series of training courses. Consequently, the role of the soil technician in hydric soil delineation must be carefully constrained; as is the relationship between technicians and professionals in other disciplines. The instructional goal for soil technicians is to train them to recognize soil morphological characteristics generally associated with prolonged periods of soil saturation and how these characteristics might change with landscape position. Training programs for soil technicians must address some basic concepts of pedology, soil profile description, landscape interpretation, specific soil morphological indicators and the proper use of soil surveys. Additionally, they need to be able recognize problem and disturbed soil and where to obtain assistance for these more difficult situations. Training for both pedologists and technicians should be viewed as a continuing process and follow up courses, once some field experience has been gained, is essential. In summary, different instructional strategies are required for pedologists and technicians, the domain of pedologists and technicians needs to be clearly defined, and coordination and certification public and private sector training efforts is needed.

National Cooperative Soil Survey Conference

Field Tour Wednesday July 12th, 1995

San Diego, California

TIME	ITEM
7:45 a.m.	Board Buses in Hanalei Hotel Parking Lot
8:00	Buses depart and travel 37 miles to Stop 1, east of Escondido, CA.
9:oo	STOP #1- Observe Fallbrook map unit and land use in area. Observe pedogenic weathering of tonalite.
1o:oo	Buses depart and retrace route to Miramar Naval Air Station.
10:45	STOP #2- View Redding map unit and discuss genesis, correlation, and interpretations of Durixeral fs on marine terraces. Vernal pool presentation by Miramar NAS staff.
11:45	Buses depart and travel 16 miles to Torrey Pines State Reserve.
12:15	LUNCH AND STOP #3. Picnic tables and rest rooms available.
1:15	Buses depart and travel 0.2 miles up hill (or you may walk). Observe Carlsbad duripans in road cuts. Visit with geologist docent with park at nature center.
2:30	Buses depart from Nature Center and travel 15 miles to Stop #4 south of Miramar NAS on beach ridge.
3:oo	STOP #4. Observe Chester-ton soil. Discuss genesis of concretions and beach ridge geology.
4:oo	Load buses. Depart for hotel.
4:30 p.m.	Arrive at hotel.

SOIL SURVEY ACTIVITIES IN CANADA - 1995

D.R. Coote
Centre for Land and Biological Resources Research
Agriculture and Agri-Food Canada
Ottawa, Canada

- Soil surveys started in Canada in 1914.
- Thev have been part of a Federal-Provincial cooperative program since 1945.
- They were directed by the National Soil Survey Committee, which became the Expert Committee on Soil Survey in the 1970's, with just an advisory role. This committee has now become an Internet Discussion Group.
- A sub-committee of the National Soil Survey Committee was responsible for developing and maintaining the Canadian System of Soil Classification.
- Maps and reports have been published jointly between the Federal and provincial soil survey programs.
- Provincial interest and involvement has been declining in recent years. While the Federal Government still has a soil survey unit in each of the 10 provinces, plus one in the Yukon Territory, only 5 provinces now maintain a soil survey team (Saskatchewan, Manitoba, Ontario, Quebec and Newfoundland).
- A seamless national soil map and database is complete at 1:1 million scale, together with associated products such as soil organic carbon content and ecological zonation.
- Detailed soil survey maps and databases are being digitized and input to the National Soil Database of the Canadian Soil Information System (CanSIS)

Tbe 1995 Federal Budget and "Program Review"

- Major impact on Department of Agriculture.
  - Downsizing (Federal deficit reduction)
  - De-centralization from Ottawa region
  - Departmental Directives:
    - Soil Survey and National Soil Database to continue
    - Soil research to focus on crop production

- Direct impacts on soil survey and soil research programs:

    - 16 of 80 positions lost (20%)
    - 11 soil survey units to report to 4 eastern and 4 western research centres
    - Salary and operating budgets to go to the 8 research centres
    - "National" programs now to be achieved b' "coordination"
    - Ottawa headquarters retains National Soil Database + small research staff (about 8 prof.) for coordination

New Directions

- Matching Investment Initiative (MII)

    - Provides for matching the cash and "in-kind" contribution of collaborators with Federal cash for use in our labs or for contracts.
    - Limited to "industry" collaborators - other government contributions cannot be matched.
    - Budgets are being cut, but funding can be replaced through the MII.
    - Future research will be influence by industry collaborators who are willing to suppor work with cash or in-kind.

Current Studies of Federal Soil Survey Program

Data Standards and Quality Control

Ensures the consistency of maps and legends, and data in soil files, for all soil mapping in Canada.

Federal•þ ,92 BI48 92 ñtorial Soil Inventory

Operates the 11 Land Resource Units (soil survey units) across Canada, and p ,9des coordination of soil inventory and interpretation activities among federal, p ,92 BI4, t92 ñtorial and p ivate sector collaborators. This study is the "umbrella" under which many activities such as MII, collaboration agreements with other federal or p ,92 BI4 departments, etc. are ca2 ñed out.

Improvement of the Canadian System of Soil Classification

Updates the soil taxonomy system used in Canada to keep it consistent with new knowledge and international developments, and publishes revised editions when required.

Canadian Soil Information System

Maintains an evolving computerized data handling and storage system that produces maps and tables of interpreted soil, landscape, climate, land use and crop productivity data to meet needs of scientists, regulators, producers and collaborators in government, university and private sectors.

Improvement of the Resouroe Database of Agricultural Areas

Upgrades and digitizes existing soil maps nd base maps, creates seamless coverages for use in Geographic Information Systems, and provides consistent digital databases for use in interpretive mapping and applications.

Boil Carbon and Pedological Processes

Advances knowledge of the distribution of soil properties, especially soil carbon, and relates these to human influences such as climate change (recent work has concentrated on Northern Canada).

Land Resource Data Applications

Develops applications of the databases in response to needs, such as the Land Suitability Rating System (which replaces the Canada Land Inventory - Soil Capability for Agriculture Classification).

Soil and Environmental Quality Analysis System

Interpret5 soil, climate and land use information to identify land at risk of deterioration by agricultural practices, and land which may contibute to environmental problems.

Soil Degradation

Develops, verifies and applies computer models to determine past and future rates of soil erosion, salination, organic matter loss and soil structure degradation.

Land use, land management, and soil condition assessment

Develops procedures for monitoring agricultural land use, land management and soil conditions using a combination of remote sensing technology and soil and land use databases.

Scientific Criteria for Sustainable Land Management

Develops criteria for sustainability analysis through adaptation and application of models of crop yield and soil moisture, and "expert system" technology, to address issue6 such a6 soil conservation and sustainable land management.

Agri-Environmental Indicators

Develops indicator6 forevaluating and monitoring the effect of agricultural production on the environment.

Boil Quality Monitoring Benchmark Sites

Follow6 change6 in soil properties and productivity in 23 (intensively monitored) typical cultivated field6 across Canada, and relate6 results to soil and crop management practices.

PANEL DISCUSSION ON SITE SPECIFIC SOIL SURVEY

INTRODUCTION

The roles, responsibilities, and relationships of traditional National Cooperative Soil Survey operations and private sector soil scientists and organizations (currently 42) has taken on increased importance. Our success in educating federal, state, and local governments to the value of soils information for natural resource protection and sustainable economic development has resulted in a myriad of laws and regulations that require soils information, and site specific surveys for implementation. This has resulted in a need to further define our public/private soil scientist's relationships, quantify and record site specific survey information, and examine methods to improve the sharing of information to improve society's landuse decisions.

A number of past NCSS committees and speakers have addressed private/public soil survey operations and site specific soil surveys. They include:

National NCSS meeting committee 1993
Joint Northeast/South Regional NCSS Committee 1992
Joint West/Midwest Regional NCSS Committee 1994
Northeast Regional NCSS Committee 1994

Copies of these regional committee reports are available, and form the basis for some of the panel members responses. The charges for this 1995 NCSS panel discussion are:

1. Report on what has been done on a regional basis.
2. What is the interface between private and public soil survey operations?
3. How do consultants document and report information for NCSS?
4. How does the private sector input data into NASIS?
5. What is the private sector's perspective on interpretations?
6. What kind of legends do private sector soil scientists use?

CONTRIBUTING PANEL MEMBERS ARE AS FOLLOWS:

Rip Kolesinskas (Chairperson)
State Soil Scientist
USDA, Natural Resources Conservation Service
16 Professional Park Road
Storrs, Connecticut 06268.1299
Phone (203) 487-4047 FAX (203) 487-4054

Dr. Del L. Mokma
Professor of Soil Classification and Genesis
Department of Crop and Soil Sciences
College of Agriculture and Natural Resources
Michigan State University
East Lansing, MI 48824
Phone (517) 355-0271 FAX (517) 355-5174

Dr. Jim Patterson
Research Agronomist
USDI, National Biological Survey
4598 McArthur Boulevard, NE
Washington, DC 20007
Phone (202) 342-1443 FAX (202) 282-103 1

Dr. Kenneth Olson
Associate Professor of Pedology
College of Agriculture
University of Illinois
N475 Turner Hall
1102 S. Goodwin Avenue
Urbana. Illinois 5 1801

Dr. Pierre C. Robert
Associate Professor of Pedology
Department of Soil, Water, and Climate
College of Agriculture, Food and Environmental Sciences
University of Minnesota
St. Paul, MN 55108
Phone(612) 625-3125

Mark S. McClain
President-Elect, National Society of Consulting Soil Scientists (NSCSS)
Soil Horizons, Inc.
13 Drawbridge Lane
Lafayette, Indiana 479057814
Phone (317) 449-1665

ADDITIONAL INFORMATION WAS SUPPLIED BY:

Dr. Jim Baker
Associate Professor Soil Genesis
Department of Agronomy
Virginia Polytechnic Institute
Blacksburg, VA 24061-0404

Sid Pilgrim
Adjunct Professor
University of New Hampshire
87 Mill Road
Durham, NH 0382468w 0.90548 Tc.911687 Tw 0.8636 0 0 Tc 8 54 7.2544 Tmteven Hundley82468w 1715548

The following panel responses were received by mail. Many of the participant responses during the actual panel discussion on July 13, 1995, closely followed these comments. Panel members present at the conference included: Kipen J. Kolesinskas, Dr. Kenneth Olson, Dr. Pierre Robert, and Mark S. McClain.

1. Report **on what has been** done on a regional basis.

KOLESINSKAS - There have been two NCSS Northeast Regional Committees that have dealt with public/private soil scientist interactions and Order I/site specific surveys.

The 1992 Committee dealt largely with the concept of MOU's between NCSS and private sector soil scientists. The 1994 Committee examined the possible inclusion of private sector Order 1 surveys into NCSS, standards for Order 1 soil surveys, Order 1 vs. Order 2 legends, and the composition and documentation of Order 1 map units. The Committee reports are attached.

At least three states have since developed MOU's between NRCS and professional societies of soil scientists (Florida, Illinois, and New Hampshire). A number of other states maintain informal relationships for data sharing and maintaining standards. New Hampshire's MOU relates specifically to Order 1 standards and the utility of consultants information for the statewide legend and database.

PATTERSON - The National Park Service is cooperating with the NCSS in mapping Catoctin Mountain Park in north-central Maryland. This is the park which surrounds Camp David, the Presidential Retreat.

A few of the site specific soil information we are looking for include:

Recognizing new soil series in the park because of the acreages involved. Traditionally these soils have been lumped into a related series (sometimes it's related) and not delineated. However, because of the work at CATO, these soils are different and expansive enough as well as have acreage in adjacent states to warrant the effort to have them recognized as a new series. We are supporting the project leader and pushing to achieve this.

- There are a number of "boulder streams" in the park and we're supporting full characterization of these conditions, including the underlying soils.
- There are a number of endangered plant species in the park and we are asking for special soil characterization of these locations.
- There has been on-going work with the USGS and the soil survey trying to characterize the effects of acid rain on both soils and stream and water quality as these relate to one another.

- The Center for Urban Ecology (CUR) has supported the soil survey with GIS information, GPS pit locations, and securing soil monoliths of selected soils. The monoliths are displayed at the CUE and in the park as a natural resource display. Two monoliths were made at each pit selected.

OLSON - I have attached Committee 1 report from the MW-W Regional Soil Survey Conference. This report related more to the role of the public soil scientist. The National Cooperative Soil Survey should develop a meaningful, memorandum of understanding with private soil scientists through the National Society of Consulting Soil Scientists at the national rather than regional level

ROBERT - I am not aware of substantial site specific soil survey in our region, only she specific investigations for applications such as septic tank, pollution, etc. However there is a tremendous potential for soil/site specific crop management as discussed after the six charges review.

2. What is the interface between private and public soil survey operations?

PATTERSON - Our efforts at CATO will include an effort to recognize minerals in the soil as they relate to the underlying geology.

There is an effort to dovetail the NPS detailed information with that of the Cunningham Falls State Park adjacent to the National Park.

OLSON - The private and public soil survey operations interface in the Midwest at the state level by: (1) memberships in Soil Classifer Associations, (2) memo of understanding signed by public organizations involved in the soil survey and any private Classifer Association, and (3) anytime private soil scientists present soils information to an organization in support of a client.

KOLESINSKAS - There is much interaction and interface between private and public soil scientists nationwide. Private sector soil scientists perform many valuable functions and interactions from contract mapping for NCSS to performing detailed on-site investigations and sampling studies for superfund sites. In the northeast, the largest amount of work related to site specific soil surveys relates to providing information for public health code requirements of on-site septic systems and in wetland delineations (state and federal) for development proposal permit applications. Public sector soil scientists site specific surveys relate to cooperator projects or agency projects.

Private soil scientists look to NCSS for a variety of information. A tie to national standards is important, it not only provides consistency for mapping, and describing soils, but adds credibility in a court of law. Additionally. NCSS is a source of sties descriptions, interpretations, taxonomic changes, hydric indicators, airphotos, FEMA maps, geology maps, and published surveys. NCSS contacts are also important to achieve technology transfer of information from universities. Private soil scientists also value the role NCSS soil scientists play in educating potential customers (realtors, developers, landowners) about the limitations and proper use of Order 2 and Order 3 surveys, and the benefits of Order 1 surveys and site specific investigations.

Public sector soil scientists look to the private sector as a source of contractors for production mapping and compilation. Consultants help test series concepts, map unit concepts, and can be effective sounding boards for proposed changes to taxonomy, hydric indicators, and impacts of federal, state, and local laws. They are out there daily using our products, and can provide a valuable critique of the quality of existing surveys. In addition, we expect them to be advocates for using soils information and supporting NCSS programs and products. NCSS and professional societies of public and private soil scientists co-sponsor workshops and conferences to educate members as well as other professions. Both sectors are a source of expertise and speakers for these endeavors as well as participants in other profession's conferences.

ROBERT - I am not aware of interfacing between private and public soil survey operations but only between private contractors and state health and pollution agencies.

3. **How do consultants document and report information for NCSS?**

OLSON - Soils information including interpretations are often privileged until such time as the client uses the information to support a position before a government organization. At that time the information becomes part of the public record.

PATTERSON - My experience has been that they come to us to secure site specific information and then turn around and sell that very information back to the government when the government originally generated the information. We generally do not publicly offer this information but rather supply it only if requested.

KOLESINSKAS - In general, mechanisms for information exchange between NCSS and consultants are informal, In the Northeast this appears to be for a variety of reasons including: landowner confidentiality (they own the data), lack of agreed upon Order 1 standards, lack of time and motivation to provide written documentation. In many cases the client is paying for specific information for a specific need which often requires much less documentation than is necessary for NCSS. Typically information is gained on a one-on-one basis in the field or by phone.

There are two known exceptions. The Florida Association of Environmental Soil Scientists and NRCS portion of Florida NCSS have a Memorandum of Understanding (MOU). The purpose is to promote the exchange of technical information. The MOU is active, but little information has thus far come to NRCS. In New Hampshire, the New Hampshire State Board of Certification of Natural Scientists and the NRCS portion of New Hampshire NCSS have an MOU. The purpose is to develop and maintain a set of Order 1 soil mapping standards, and promote the exchange of information. It relays on well trained, certified consultants who maintain their expertise through CEU's, and NRCS, who provides training opportunities and a library of information. Consultants are using the Order 1 standards, testing the statewide legend and adding to it. So far the NRCS staff seem satisfied with the level of documentation of Order 1 mapping.

MOKMA - Enclosed is a copy of the Western/Midwestern Regional Cooperative Soil Survey Committee 1 report. This committee dealt with the role of NCSS in Site Specific Soil Survey. We developed some guidelines for multi-use Order 1 soil surveys; however, I doubt many of the site specific soil surveys will be for multi-use. I believe there will be more site specific work done by non-NCSS personnel than by NCSS personnel. One question that needs to be addressed is who owns these data and how does NRCS obtain them to store them in an appropriate manner? I believe the land owner and not the soil scientist owns the data. What incentive is there for an owner of site specific soils data to provide it to NRCS? What incentive does an owner have to obtain multi-use soils data rather than single-use soils data? Currently, I see no incentives for this to be done. If a land owner wants a map showing the location of hydric and non-hydric soils, why should he/she pay for soil borings to two meters when no one will look at the data below 0.5 meter? It will only increase the cost of their product. I am not challenging the guidelines because I believe we need this type of data for an Order 1 soil survey. I doubt there will be much site specific soils data that will qualify for an Order 1 soil survey.

I believe there will be a need to provide training for private soil scientists in site specific soil surveys. They will need help in making and interpreting site specific soil surveys. They will also need help in knowing what NCSS requires for Order 1 soil surveys. They need training in developing legends for these soil surveys. I do not believe we should leave it to the private sector to determine the legend for soil maps that are to become part of an Order 1 soil survey. With the reorganization of NRCS and reduced budgets, how will NRCS assist the private soil scientists in developing legends and acquiring the correct data?

My comments have been made from the perspective the NCSS can only influence Order 1 soil surveys for multi-use. If a land owner wishes to hire a private soil scientist to make a single-use soil map, we can do nothing to prevent that nor can we force them to use our standards. I am not convinced we can, or want to, help every private soil scientist to develop legends, interpretations, etc. for every site specific soil survey.

4. Bow does **the private sector input data into** NASIS?

OLSON - Once the soils information becomes part of the public record it can be stored in any computer data bases by public soil scientists.

KOLESINSKAS - Assurances of data quality meeting national standards are necessary before data can be accepted. Series and Map Unit information generated from Order 1 surveys by consultants could greatly add to our database and knowledge. Information should be georeferenced. Would permission from the client be necessary? Locations of site specific information and Order 1 mapping by consultants could be included in SSURGO as a spot symbol, or as actual digitized information. Would the user be interested in this additional data? Opportunity abounds, but there must be some incentive to make it worth the consultants (and clients) time to prepare the documentation, dig that extra 20 inches, use a scale accurate base.

5. What is the private sector perspective on interpretations?

KOLESINSKAS - Many of the consultants utilize our standard interpretations in their work. They may use information from published surveys or from up-to-date interpretation records. Many NRCS offices and universities maintain informal mechanisms for consultants to access updated information; by supplying the professional society a “library,” or a policy of unlimited access. Many consultants develop site specific interpretations for a specific client need, or to correspond to the state health code, federal regulation, or state wetlands law. Private sector soil scientists do rely on NCSS to maintain and supply “official lists” of interpretations for Hydric soils and Prime and Important Farmland. Consultants also rely on NCSS to facilitate the development of soil potential studies and soil-based landuse tax assessment criteria. They may contribute as committee members, but generally NCSS is the lead. In general, consultants feel NCSS lacks some of the most current interpretations needed for work on wetland mitigation/creation, water quality BMP's and other urban/suburban issues.

PATTERSON - From my perspective, I or we must go to parks and educate our people to NCSS information and its use. We try to provide training through our regional training courses and occasionally on an as-requested basis from a park.

We are in need of more detailed information and interpretations than are normally published. Also, since we deal with many sites which have been heavily manipulated by human activities, we often must resort to site specific information and interpretations rather than the broad brush information provided by traditional surveys. Generally, we do these site analyses in-house with our own personnel, either the soil scientists or agronomist provide the effort. If we are unable to provide the detailed information, we may seek outside assistance to provide the information.

I will say that human activities certainly do significantly alter many soil situations so that these soils may only remotely resemble their original counterparts.

ROBERT - Interpretations must be based on quantitative data sets. Interpretations are the property of private surveyors but could be transferred to NRCS under agreements.

OLSON - The private consultants data is generated on a fee basis for a client and would not become public information unless it is provided to a public agency to support a soil interpretation. At this point it could become public information. If it meets the standard of the agency with program responsibility requiring the data, the agency could then electronically store the soils information.

6. What kind of legends do private sector soil scientists use?

OLSON - The legends used by soil scientists vary with each project and depend on the scale. For some projects the existing Cooperative Soil Survey legend (designed for 1: 15840) is used even when the scale is dramatically changed (1:4800). An example is for tax assessment. In other situations a new legend is developed. Often soil properties are identified in a grid and then an interpretational map is made for urban purposes (for home sites, streets and septic tank leach fields).

The legend for an Order 1 soil survey should be different from the Order 2 soil survey due to scale. Phases of the soil series should be mapped with no dissimilar inclusions in soil mapping units at the scale of at least 1:6000. Observations should be made on transects or grids, georeferenced and to a two meter depth. Detailed descriptions are required for each soil series, for each soil mapping unit. Map unit descriptions should include the range of taxonomically related data. META data will be submitted with each Order 1 soil survey. Any laboratory data should be collected using the procedures in the "Soil Survey Laboratory Methods Manual". Soil interpretations will not be stored, only data. Interpretations can be generated by computers or private soil scientists.

KOLESINSKAS - The kind of legend used is based on a number of criteria. They include: What are the clients expectations? What requirements or regulations need to be met? What is the level of expertise of the consultant? The legends for site specific surveys used fall into the following categories:

- Use of the published Order 2 legend for the county
- Use of Order 2 legend and map units from other counties
- Use of connotative/single purpose legend i.e. wetland/non-wetland, drainage classes, depth to bedrock classes. The New Hampshire HIS standards are a good example.
- Use of site specific legend - use of a legend constructed for a specific project or parcel
- Use of an Order 1 statewide legend of their own design
- Use of NCSS statewide legend

Many consultants feel it is not worth the time or effort to map what is really on the site. Order 1 mapping reveals the true complexity of the landscape and the variability of the range of characteristics. Many pedons end up falling out of a known series concept, are a taxajunct, or a different phase, but for the purposes of the client, interpret "just like" a previously NCSS recognized map unit. In addition, the concept that if Order 2 map units are complexes, then Order 1 will be consociations is not always true. In glaciated bedrock controlled landscapes or complex wetland landscapes they may still be complexes with the same percentage components.

Some consultants simply do not have the background knowledge to construct a legend. They may make precise wetland maps or excellent test pit logs but do not have the training and experience to develop a legend. Workshops and CEU's can help till this need.

In some areas where there is a long history of using published survey data to assist in regulation or landuse decisions, consultants who develop Order 1 or connotative legends find themselves at a disadvantage. Officials or regulators reviewing the data are confused and suspicious of map unit names and symbols that don't correspond to the published surveys. Education of these groups by public and private sector soil scientists is a must.

Additional Comments:

Robert - Here are some additional remarks that relate to a new soil and crop management concept that has been called in many ways such as farming by soil, farming by the foot, soil specific crop management, site specific crop management, variable rate technology, precision farming, etc. The concept refers to micro-managing fields according to the spatial conditions of the soilscape or site. We have proposed this definition: Soil/Site specific farming is an information and technology-based agricultural management system to identify, analyze, and manage site/soil/plant spatial and temporal variability within fields for optimum profitability, sustainability, and protection of the environment.

I have been involved for more than ten years in the development of this agricultural system seen as the system of the 21st century. We thought that we could use the standard 1:20,000 standard county soil survey for soil/crop management. But dissimilar inclusions in mapping units are reducing substantially its benefit. There is a need for a site specific soil survey or Order 1 soil survey at a scale of approximately 1:5,000 to optimize this agricultural management system.

There is a fantastic potential for soil survey and NRCS/NCSS but we need to look at a different approach. NRCS will not have the people-power to do this. The survey will be done by private surveyors under the supervision of NRCS and following guidelines that we have to develop. Some suggestions follow:

Scale: From our work in Minnesota, a scale of 1:5,000 or 1:6,000 seems most appropriate.

Map Unit The main goal of the survey is to have consociations of series. Dissimilar soil inclusions within map units must be avoided. Soil series for which soil characteristics have no or little effects on soil/plant management could be assembled in a map unit. This would result ***on*** a "practical" soil survey specifically developed for ag-management. This of course presents advantages and disadvantages. For example, easier, faster, cheaper. to make but less usable for other applications.

Precision: Accuracy of line placement should be less than five meters.

Base Map: Crop (residue) free low altitude photography at a 1:5,000 scale should be used for field mapping. Orthophotos should be used for final document whenever available or 1:10,000 NAPP photography.

Digitizing: These soil maps may have to be overlaid over other digitized maps in a GIS based decision support system for best management recommendations. Some reference points should be collected using a GPS system or equivalent for precise georeferencing. Scanner will normally be used for digitization. Software such as LTPLUS could be used, A standard tile format should be used. It should be compatible with .DLG format and standard raster formats.

Audience Discussions:

- There may be a problem with sharing private sector client data in the NRCS database. Many clients consider it proprietary and are not always willing to share it.

- The amount of data collected by private sector soil scientists could be overwhelming if included in the NRCS database. We may need to prioritize the kind and utility of data needed.

- The use of "fuzzy logic" to explain and predict transitions and fuzzy soil lines

- MOU's and standards have great utility in protecting the activities and domain of professional soil scientists.

- One set of standards cannot meet the needs of all users because the purposes of surveys change.

- There are many different interpretations of the terms' Order 1 survey, site specific survey, high intensity survey, and high resolution survey. We need to clarify them.

COMMITTED 4
NATIONAL COOPERATIVE SOIL SURVEY (NCSS) AND PRIVATE SECTOR COOPERATION

COMMITTEE MEMBERS:

John C. Meetze, Chair (South)
Russell J. Kelsea, Vice Chair (Northeast)

South

Samuel J. Dunn
Charles L. Fultz
B.L. Harris
David L. Jones
William H. Craddock
Joe Kleiss
Kevin Martin
Dennis Osborne
Carroll Pierce
Jerry Ragus
Ray P. Sims
J.M. Soileau
Frankie Wheeler

Northeast

Edward P. Ealy, Jr.
Lee Daniels
David E. Hill
Kip Kolesinskas
Charles Krueger
Garland Lipscomb
Laurel Mueller
Donald Owens
Raymond F. Shipp
Karl Langlois, Jr.

NHQ & National Soil Survey Center

Richard W. Arnold
Ray Sinclair

FOREWORD: I would like to thank the members of this committee 'for their responses and cooperation in working on this committee. I especially want to thank Russ Kelsea, Vice Chair of the Committee, for taking notes during the committee sessions and in preparation of this report. I also want to think Kip Kolesinskas for his assistance in keeping the flip chart during the Committee Meetings and for his assistance in the preparation of this report.

The Committee instructed the chair to send a copy of this report to the National Leader of the National Cooperative Soil Survey with a request that he take steps to initiate action on these recommendations, The Committee recommends that this committee remain active if needed to aid in resolving issues that could occur from the actions taken on these recommendations.

The Charges assigned to the Committee and the Committee's Recommendations to each Charge are given on the following pages.

BACKGROUND:

There is a need for more cooperation between NCSS and private sector soil scientists. NCSS has information such as manuals, guides, and handbooks that are of interest and use to private sector soil scientists. Private sector soil scientists develop interpretations and other products that are of interest to NCSS. It is desirable to establish working protocols that will enhance the professionalism in soil science.

CHARGE 1:

Investigate the need to develop Memorandums of Understanding between NCSS and private sector soil scientists. Should a Memorandum of Understanding be developed between an individual, groups, or organizations?

COMMITTEE'S RECOMMENDATIONS:

1. Develop a National MOU between SCS, as lead agency for NCSS, and "National" professional organizations of private soil scientists.
2. The National MOU developed between SCS and professional organizations should be general in nature and may serve as a model for state or regional MOU's.

CHARGE 2:

If a Memorandum of Understanding is developed, suggest potential responsibilities of NCSS and private sector soil scientists.

COMMITTEE'S RECOMMENDATIONS:

The MOU should include as a minimum:

1. Specific guidance for both SCS and private sector regarding roles and responsibilities. The kind and extent of services provided by SCS relative to Title 42 should be clearly stated in the MOU so that both SCS and the private sector understand the roles and responsibilities. SCS field staffs must be made aware of these roles and responsibilities.

2. Methods for data sharing, with an emphasis on electronic data compatibility and standard format and nomenclature in soil information.

3. Development of protocols specifying quality coordination and quality control relative to mapping and data collection using NCSS standards.

4. Methods to address ethics and complaints.

CHARGE 3:

As cooperation between NCSS and private sector soil scientists develops, how should ethics and professionalism be addressed?

COMMITTEE'S RECOMMENDATIONS:

1. Any national organization should have a strong codes of ethics and method of'enforcement.

2. The public should be protected by strongly encouraging state legislation for licensing or certification.

CHARGE 4:

Clarify the definition of "Cooperators" and type of NCSS assistance provided to cooperators and non-cooperators.

COMMITTEE'S RECOMMENDATIONS:

1. Committee 4 is not aware of any restriction on the inclusion of non-federal parties as NCSS cooperators.

2. Two kinds of cooperators are identified. First, conservation district cooperators and second, NCSS cooperators.

    a. Generally NCSS cooperators work together to produce and document soil surveys.

    b. Services to conservation district cooperators are in line with SCS program responsibilities.

3. In addition, SCS services are available to non-cooperators to the extent described in Title 42 and as described in charge 2.

CHARGE 5:

As an NCSS cooperator, please expound (positive or negative) on **your** experience with private sector soil scientists. If you have worked as a soil scientist in the private sector, please give your experience (positive or negative) in working with the NCSS.

COMMITTEE'S RECOMMENDATIONS:

1. Generally, comments received by committee 4 indicate positive experiences with public/private cooperation. Some of the negative experiences **have been addressed in charges 1 through 4. However, a negative aspect not addressed in charges 1 through 4 relates to a** misunderstanding by contracting officers, state agencies, and others of the requirements for education and experience necessary for individuals who provide soil science services.

2. **Contracts for services should specify education and experience requirements of the soil scientist and technical standards necessary to complete the contract.**

Submitted By:

John C. Meetze,
Chair, Committee 4

COMMITTEE 1

ORDER 1 SOIL SURVEYS

COMMITTEE MEMBERS
James C. Baker, Chair
Gerald Rosenberg, Vice Chair

Richard Bartlett	James Doolittle	Herb Gardner
William Jokela	Travis Neely	Pamela Thomas
Lewis A. Daniels	Danny Hatch	Robert F. Grossman
Kipen Kolesinkas	Walter Russell	Peter L.M. Veneman
Rick Day	William Hatfield	James H. Brown
Henry Mount	John Short	

BACKGROUND

The NCSS has been involved with conducting soil surveys for many uses. These surveys have generally been published as Order 2 or Order 3 Soil Surveys. The NCSS has seldom conducted Order 1 Soil Surveys. Most of the detailed information that NCSS soil scientists have gathered in Order 2 Soil Survey areas is considered on-site investigations.

In recent years, especially in the Northeast, detailed soil maps are being made by private consultants. These maps, and corresponding information, can be considered Order 1 Soil Surveys. The legends used for Order 1 Soil Surveys are either; the same as Order 2 surveys, or are legends made just for that Order 1 Soil Survey area.

Most private consultants would like to follow standards for Order 1 Soil Surveys. The private consultants and NCSS soil scientists, need to know what type of legend is needed for Order 1 Soil Surveys and whether the legend should be the same for Order 1 and Order 2 Soil Surveys.

Committee 1, Order 1 Soil Surveys met and, with spirited discussion, considered the original committee charges and issues presented to us by the conference steering committee. There were excellent arguments on both sides of several issues. We came to a consensus on some issues; on others, we were divided. We reviewed several sets of materials contributed by members and non-members of the committee. A summary of our deliberations and recommendations are presented to the Northeast Soil Survey Conference Steering Committee.

Committee Charges

Charge 1. Should Order 1 Soil Surveys, made by the private sector be included as a part of the National Cooperative Soil Survey?

Committee Recommendations:

There is a divergence of opinion on this issue.

A. An opinion voiced by a significant portion of the committee says no.

The opposition to charge one stems from several factors.

1) There is currently no formal review process to evaluate or critique the work of the private sector in the National Cooperative Soil Survey. With out such a review process, this would be an open invitation to potential challenges through the courts if problems surfaced.

2) Currently the National Cooperative Soil Survey, with leadership by the USDA Soil Conservation Service, has no mandate to do this work. Additional staff time and funding would be required to expand current responsibilities of the SCS into Order 1 Surveys made by the private sector.

B. An opposite opinion expressed by several members of this committee is that since there are many private sector consultants currently makina Order 1 Surveys and collecting data; these data could (should) be incorporated into the NCSS data base and tested. However, without guidelines and/or standards that are approved by the NCSS, these data may never get to be utilized. The SCS has responsibility for the leadership of the NCSS and has the technical staff to help set the rules for Order 1 Surveys.

Thus to "serve the public good," SCS should help develop guidelines such that a single set of "rules" is adopted, approved, and applied to Order 1 Surveys by NCSS.

Charge 2. Are standards as currently defined adequate for Order 1 Soil Surveys?

Committee recommendations:

NO. A better definition or differentiation of degrees of Order 1 Surveys should be made. As currently defined, an Order 1 Survey is anything: more detailed than Order 2, yet, it is still a comprehensive, multi-use, survey. This includes surveys that are somewhat more detailed than current Order 2 Surveys, and ranges to very detailed, high intensity (perhaps special purpose) surveys.

There are likely to be more Order 1 Surveys made in the future, and they will probably cover the whole range of mapping intensities. It was suggested that perhaps some level of cartographic detail; as well as. some level interpretative accuracy be specified by each survey regardless of who makes it.

Charge 3. Should the Order 1 legend be the same as the Order 2 legend?

Committee recommendations:

A difference of opinion was expressed on this issue.

A. NO, the Order 1 surveys meet different needs from Order 2 Surveys thus the legends should be different.

B. YES, there may be the same series and map units in the more intensive surveys but occurring in smaller delineations. If the same series are used the amount of detail should not influence interpretations

Charge 4. A. Is the composition of map units the same in Order 1 mapping as in Order 2 mapping?

Committee recommendation:

We don't really know the answer to this. It could be argued that in some instances they could be the same, in others, they are different.

Charge 4. B. What data needs to be collected to assess this?

Committee recommendation:

We need some studies of Order 1 Soil Surveys that relate to reliability for interpretative purposes, and map unit purity.

Charge 4. C. By what mechanisms would such data be acquired?

Committee recommendation:

The necessary data should be collected by standard methods for statistical

analysis of map units.

Charge 5. Pertinent References and Literature cited are listed. (See attachment.)

Final Recommendations for Committee 1: Order 1, Soil Surveys.

I) Our committee feels this is an important issue that needs further study, discussion, and evaluation. We recommend it involve a much larger segment of the NCSS, the soil science community in general, and may require national policy changes for the NCSS.

Literature Reviewed
Committee 1, Order 1 Soil Surveys

1. __________ 1993. Order 1 Soil Mapping Standards for New Hampshire. Sponsored by the Society of Soil Scientist of Northern New England. SSSNNE Publication No. 2, P.O. Box 986, Durham, NH 03824. 15 p.

2. __________ 1994. Memorandum of Understanding, Relative to Order 1 Soil Survey Mapping Standards for New Hampshire.

3. Grossman, R.B., 1994. Information Pertaining to Interpretive Soil Property Reliability form Standard Soil Survey Operations. Draft 1. National Soil Survey Center. USDA SCS. 8 p.

4. Soil Survey Staff, 1994. Order 1 Soil Survey Criteria for Research Areas. Soil Technical Note. No. 6.(not released) National Soil Survey Center, USDA SCS. 6 p.

5. Mount, H., W. Lynn, R. Vick, and B. Dubee. 1993. Unpublished. Micro Soil Survey of the El Verde Long-Term Ecological Research Grid, Puerto Rico. USDA-SCS.

6. Hatch, D. 1993. Fauquier County, Virginia, Zoning Ordinances, Soils, Hydrologic Testing. Personal communication.

7. Edmonds, W.J., A.C. Blackburn, and J.M. Gass. 1994. Use of Soil Taxonomy for Sustainable Agriculture and Environmental Stewardship. (Accepted) Proceedings of International Soils Conference, Mexico City, Mexico.

8. Soil Survey Staff. 1992. National Soils Handbook (Draft) USDA-SCS National Soil Survey Center, Lincoln, NB.

9. Soil Survey Division Staff. 1993. Soil Survey Manual. USDA Handbook no. 18. USDA. U.S. Govt. Printing Office, Washington, D. C. 20402

10. Thomas, P.J., J.C.Baker, and T.W. Simpson. 1989. Variability of the Cecil Map Unit in Appomattox County, Virginia. Soil Sci. Soc. Am. J., 53:1470-1474

11. Edmonds, W.J., J.C. Baker, and T.W. Simpson. 1985. Variance and Scale Influences on Classifying and Interpreting Soil Map Units. Soil Sci. Soc. Am. J., 49:957-961

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 lsnd use will determine some data obtained. T-e 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.

META data will be submitted with each order 1 coil survey. These data will serve for certification. The Soil Conservation Service will keep the META 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 snd 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 Hunger. New Mexico
Gerald Nielson, Montana
Ken Olson, Illinois
Pierre Robert, Minnesota
Richard Schlepp, Kansas
Gary Stienhardt, Indiana
Tim Sullivan. Colorado
Carol Wettstein, Colorado

National Soil Information System

NASIS
The Big Picture

Ken Harward, NASIS Project Manager, NRCS, Fort Collins, Colorado
Presented at the
National Cooperative Soil Survey Conference, San Diego, California
July 10–14, 1995

Team USDA

TOPICS

- Federal Policy and Standards
- National Soil Data Access Facility (NSCAF)
- NASIS Objectives and Timeline
- Hardware & Software for NRCS Soils

Federal Policy & Standards

- National Performance Review
  - (67) Federal ● gcncles will develop and market databases to business

*Data is

- The Federal Geographic Data Committee

Team USDA

Federal Policy & Standards

Team USDA

Federal Policy & Standards

- Draft Executive Order
  - *National digital geospatial data framework
  - ★ Development of standards
  - ★ Adherance to standards
  - ● Geospatial data clearinghouse
  - ★ Compliance

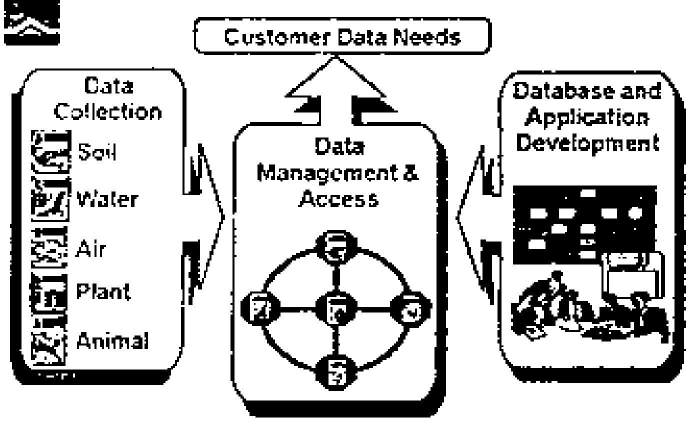
Team USDA

Federal Policy & Standards

- Federal Standards (Categories)
  - *Geographic Reference (NAD83)
  - *Information Content (Data Dictionary, Data Structure, Minimum Dataset)
  - *Data Quality
  - *Procedures / Rules (NCSS)
  - ★ Geospatial Data Management (Access, Archive, Integration, Metadata)
  - ★ Transfer (SDTS)

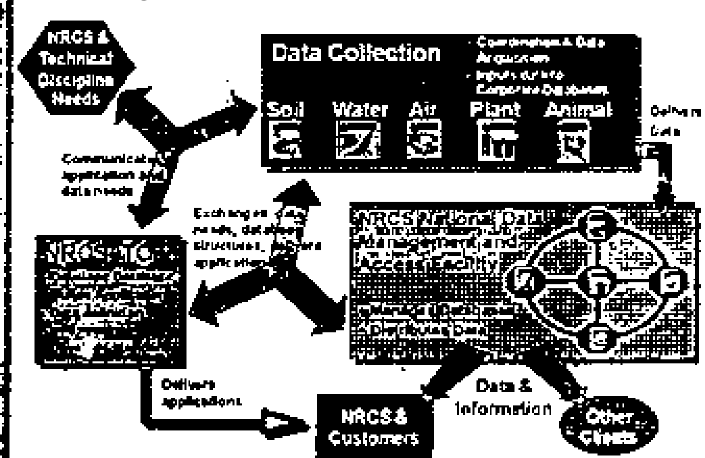
Team USDA

Components of an Information Management Framework



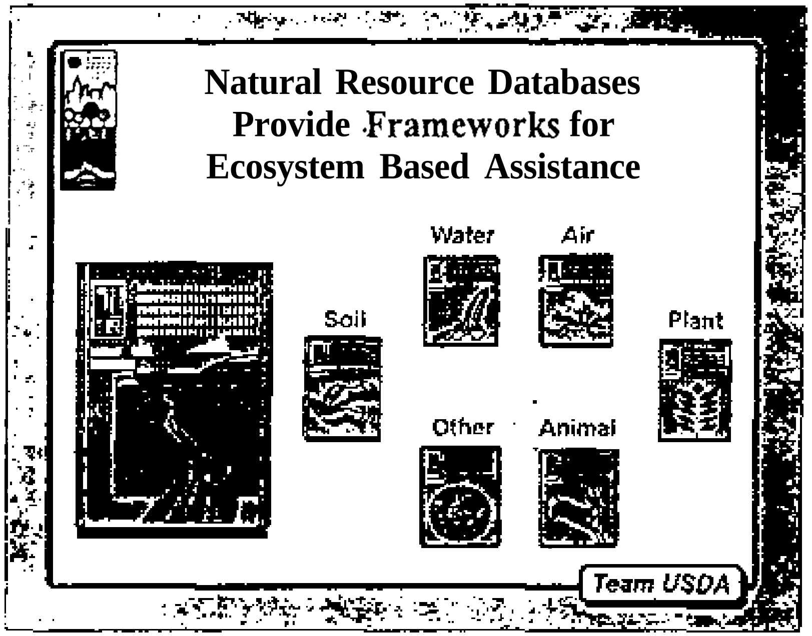
Team USDA

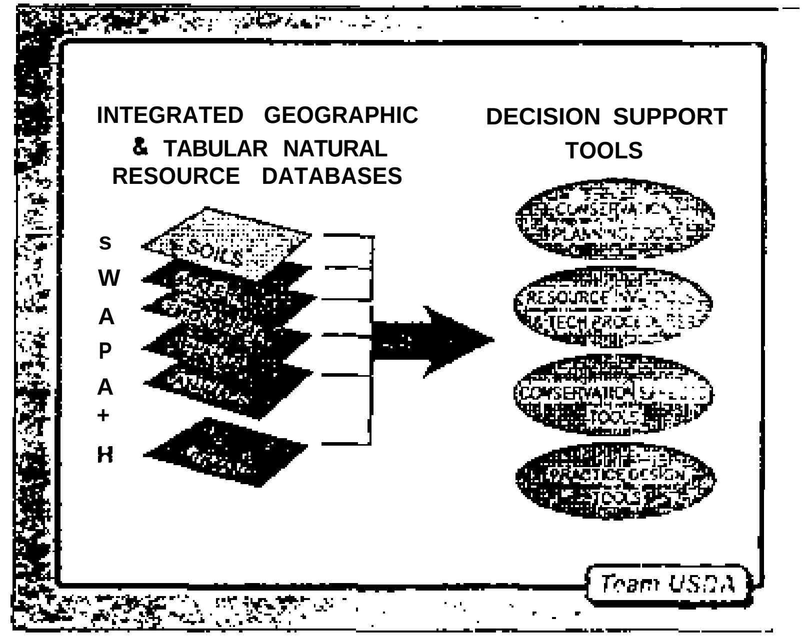
Meeting NRCS's Needs for Resource Data

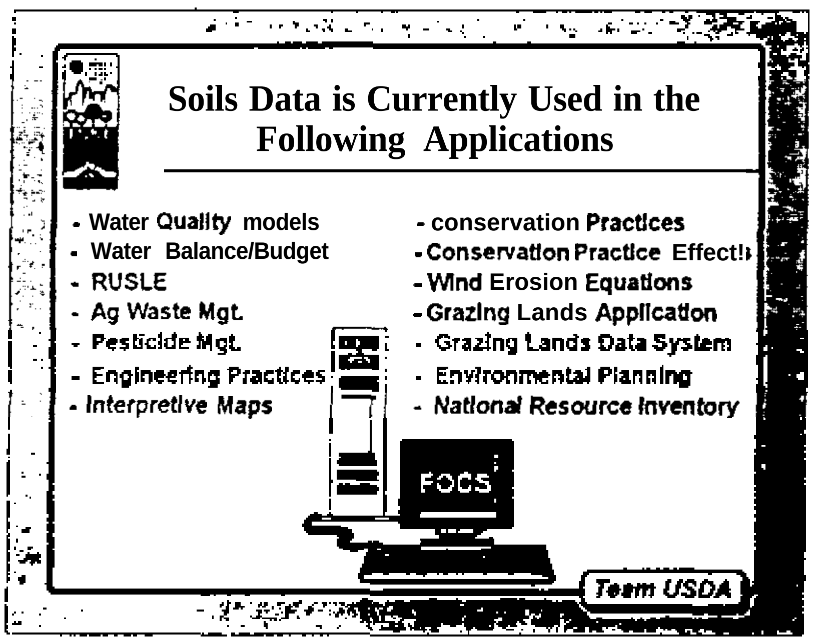


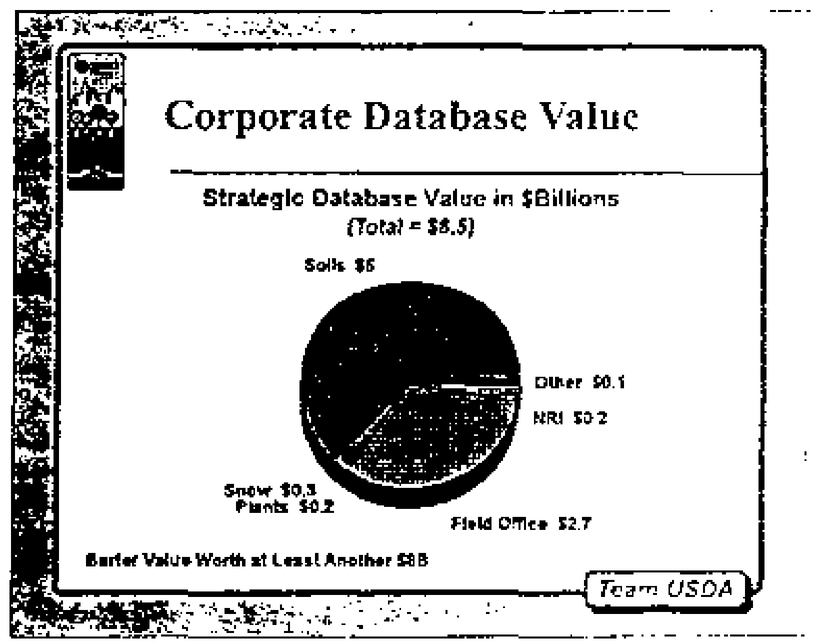
Team USDA

54


Natural Resource Databases
Provide Frameworks for
Ecosystem Based Assistance
Water
Air
Soil
Plant
Other
Animal
Team USDA


INTEGRATED GEOGRAPHIC
& TABULAR NATURAL
RESOURCE DATABASES
DECISION SUPPORT
TOOLS
S
W
A
P
A
+
H
SOILS
Team USDA


Soils Data is Currently Used in the
Following Applications
- Water Quality models
- Water Balance/Budget
- RUSLE
- Ag Waste Mgt.
- Pesticide Mgt.
- Engineering Practices
- Interpretive Maps
- conservation Practices
- Conservation Practice Effecti
- Wind Erosion Equations
- Grazing Lands Application
- Grazing Lands Data System
- Environmental Planning
- National Resource Inventory
FOCS
Team USDA


Corporate Database Value
Strategic Database Value in $Billions
(Total = $8.5)
Soils $5
Other $0.1
NRI $0.2
Snow $0.3
Plants $0.2
Field Office $2.7
Barter Value Worth at Least Another $8B
Team USDA

NASIS

Objectives

- Provide a flexible and dynamic management system for soil data and information
- Improve the quality of soil data and information
- Improve automated map unit management

Team USDA

NASIS

Current Status

★ NASIS 1.0 released to NRCS state offices October 1994.

★ NASIS 2.0 under development. Scheduled for release to NRCS state offices October 1995.

Team USDA

NASIS

Major Components by Release

1.0: Conversion from SSSD to NASIS, Dynamic Data Dictionary, NASIS Foundation, Security

input & edit interpretation criteria)

4.0: Data Accumulation, Manuscript Generation, Import & Analyze PEDON data

5.0: Data Aggregation, Data Comparison, GIS Functionality

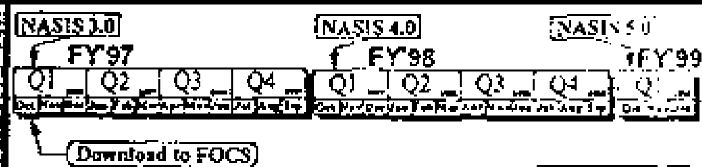
Team USDA

NASIS

Implementation Timeline

NASIS 1.0

NASIS 2.0 Official Database System



Team USDA

NASIS

Hardware & Software: NRCS State Offices

★ Hardware: Sun SPARC 10 or 20 Workstation, 2 Gb Hard Drive, Network Connection (i.e., USDA Internet)

★ Software: SunOS 4.1.3 (Solaris 1.1), Motif Window Manager 1.2, Informix OnLine 5.0, NASIS & PEDON

Team USDA

NASIS

Team USDA

NASIS

Hardware & Software: NRCS Project Offices

A *"remote"* NASIS *site*

★ Hardware: Intel 80486 PC or higher, high speed modem

★ Software: Windows 3.x, X Windows emulator (to connect to an MLRA

Pedon)

Team USDA

★ Use: Data Access, Data Collection, Data Contribution, Data Analysis, Data Distribution

Team USDA

NASIS 2.0 Requirements & Specifications

New Menu Functions

File Menu

- **New**
- ***Save Conflict Resolution***
- ***Select***
  - Query Data Access
  - Query Editor
  - Select Manager
  - Always Appends
  - What Tables Must Be In From Clause
  - Default/Possible Target Table(s)
  - Joins & Outer Joins
  - Query Parameters
  - Explicit Relationship Names
  - Compare To SQL (no "select" field names)
  - Query Language

Edit Menu

- ***Cut Objects***
- ***Copy***
- *Copy Rows*
- ***Paste***
- ***Paste Special***
- ***Global Assign***
- ***Global Delete***
- ***Global Undelete***

Options Menu

- *Ad Hoc* ***Reports***
  - *Report* Data Access
  - Report Language
  - Calculations

Functionality Enhancements

- *Selection* **Model**
- **Update/Delete Rules**
- **Save (See Save Conflict Resolution)**
- **Help**

Miscellaneous

- **Multiobject Function Behavior**
- **Inactive Codes**
- **Load All Changes**
- **Selecting Data &Target Table Idiosyncracies**

Generalized System Architecture

- ***Billary***
- *ODD* ***Changes***
  - *New* Data Types
- *ODD* ***Database Structure Guide***

Soils Specific System Architecture

- *NASIS Data* Model *Changes*
- *NASIS* ***Database Structure*** *Guide*

1.0 To 2.0 Conversion

- *ODD Changes*
- *NASIS* ***Database Changes***
  - **What Types Of Changes Can Be Handled**
  - **How Changes Are Recorded/Detected**
  - **How Changes Are Implemented**
    - ***Preconversion*** *Checks*

Southrrn Region Experiment Stations' Report to the National Cooprrativc Soil Survey

Mary E. Collins

The Southern Region Experiment Stations' Soil Survey Information and Exchange Group (SRIEG-22) met at the Southern Region Soil Survey Work Planning Conference in Little Rock, AR, June 20-24, 1994. There were 14 participants including Warren Lynn representing the NRCS and Everett Emino, Experiment Station Advisor to SRIEG-22. The Southern Region consists of the states listed in Table 1.

Business that took place at the meeting included Dr. Emino informing us that SRIEG-22 is coming up for renewal. He would submit all documentation necessary for us to continue.

COMMITTEE REPORTS

There were reports from several committees.

NSSC-Technical Advisory Committee - Mary E. Collins, Southern Representative, stated that the committee had not met since she was appointed. She replaced Larry Wilding. The committee was scheduled to meet in July, 1994.

National Characterization Committee - Wayne Hudnall reported for Tom Hallmark The soil characterization data is available from Lincoln and is on CD-ROM.

NCSS Standards Committee - Tom Ammons discussed the definitions and responsibilities of the committee. The standards will be published by NCSS.

Soils of the Southern States and Puerto Rico Committee is chaired by Larry West. The publication is being updated The STATSGO map of the region is available as the base map for the publication. Individuals will be contacted to write sections of the publication. It will be published by a private company.

Soil **Taxonomy Committee-Elected** new members to this committee. Tom Hallmark will serve for a two-year term (1995-1997). A.D. Karathanasis will serve from 1996-1998.

NEW BUSINESS

New officers of SRIEG-22 are Mary E. Collins, Chair; Wayne Hudnall, Vice-Chair; and Tom Ammons, Secretary.

New business involved discussion on the resolution from the Northeast Region on hydric soil indicators. The discussion was quite lengthy and lively. It was decided that a response to the Northeast's resolution should be positive and constructive. We decided that this issue should be discussed at the general business meeting. The fragipan proposal was also discussed. It was also agreed that it should be discussed at the general business meeting,

ISSUES AND CONCERNS

The following are some comments that were made at the SRIEG-22 meeting on the program and organization of the work planning conference. Some of the comments/concerns were(i) only four of the 30 time slots were filled by university representatives, (ii) no university reps were chairs of committees, (iii) none of the panel discussions had a rep from a university, (iv) only two university reps gave reports, (v) there has been little involvement or input from the university reps to "cooperative" efforts, and (vi) the meeting had one of the lowest attendance ever of university representatives at the Southern Regional Soil Survey Work Planning Conference

The members of SRIEG-22 are concerned about the present situation with the National Cooperative Soil Survey Program. There appears to be a lack of interest and limited involvement in the NCSSP. As an example, I asked for input for this report on the feelings the reps have on the restructuring and reorganization of NRCS and the soil survey program. 1 received four responses. Only two gave substantive comments that I have added to this report. Maybe it is due to a lack of active involvement in the changes. Some of the university reps are changing their responsibilities. Because there are fewer funds associated with soil survey activities, because there is increased pressures on teaching more classes and students, and because there are research funds from other sources, faculty have less time to devote to soil survey issues. Faculty are not happy with this situation, but their research or administrators have taken them to non-soil survey programs. They believe these changes are necessary to promote the science by increasing the interest of undergraduate students. As one administrator told me, without an academic program you have no science. Have we become the "arm chair pedologists" that Dr. Marlin Cline warned against in his 1976 paper presented at the ASA meeting in Houston?

The stability and future of the NCSSP lies with the universities as the pedologists at universities generally remain at one location for long periods of time and help to maintain continuity and stability. The future of the NCSSP is a concern, but more important is the question of the future of the science. That concerns us more. Are we looking at the end of our science? A science terminates when there are no longer academic programs in that area. We must have students, as we were students, to continue. Without them, we will become extinct. The science of pedology will eroded into wetland scientists, biological technicians, geologists, environmental engineers, etc. We will be teaching students in other disciplines our science.

Therefore, a concern that agricultural experiment stations have is not just the cooperative nature of the soil survey, but the science. We at the universities can survive, for awhile. At each university we must prove to our administrators the importance of our program, and how important we are to the overall mission of the agricultural college. If they feel that we are not accomplishing the mission of the college, our program can be redirected.

FUTURE INVOLVEMENT WITH SRIEG22 in NRCS ACTIVITIES

SRIEG-22 may face administrative restrictions on the future activities of university reps to soil survey activities. We, in the south, are authorized to attend the soil survey work planning conferences because of our involvement in soil survey activities - mapping, sampling, research. With the recent reorganization of soil survey activities, the experiment station director's are asking us, "What are you doing?"

As it looks now, SRIEG-22 may not be able to function with the MLRA concept. In the NRCS, there now are State Offices, Regional Offices and MLRA offices (MO's). There are many questions as to where the experiment stations go for support.

Table I. States in Southern Region, Pedologists at each Experiment Station, and NRCS MO(s) and State Office in each state.

STATE	EXPERIMENT STATION	PEDOLOGIST	MO(s)
Arkansas	University of Arkansas	E. Moye Rutledge	Little Rock
Alabama	Auburn University	Ben Hajek	Auburn Morgantown Raleigh
Florida	University of Florida	Mary E. Collins	Auburn Raleigh
Georgia	University of Georgia	Larry T. West	Auburn Morgantown Raleigh
Kentucky	University of Kentucky	A.D. Karathanasis	Morgantown Little Rock
Louisiana	Louisiana State University	Wayne H. Hudnall	Little Rock Auburn
Mississippi	Mississippi Slate University	David E. Pettry	Little Rock Auburn
North Carolina	North Carolina State University	Stanley W. Boul	Raleigh Morgantown
Oklahoma	Oklahoma State University	Brian J. Caner	Temple Salina Little Rock
Puerto Rico	University of Puerto Rico	Fred H. Beinroth	Auburn
South Carolina	Clemson	Bill R. Smith	Raleigh Morgantown
Tennessee	University of Tennessee	J. Tom Ammons	Morgantown Auburn Little Rock
Texas	Texas A&M	Larry P. Wilding C. T. Hallmark	Temple Little Rock Phoenix

Morgaª3 //2 0 999Stil water Td (Ro277 (Mo2.5~7ðð Rock)Ti 8g2 8.08523 //23W0 8.3San Juan)Ti -0248C

NATIONAL SOIL SURVEY STANDARDS COMMITTEE REPORT

TO THE NATIONAL SOIL SURVEY CONFERENCE

San Diego, **California,** July **1995**

Original Committee Charges

1. Define what standards are or what NCSS means by NCSS standards.

2. Receive recommendations from other committees and be the clearinghouse for issues dealing with standards.

3. Establish subcommittees to deal with issues identified.

4. Consider establishing subcommittees to deal with the following areas which are issues of immediate importance:

   a. NCSS Data Management Standards (spatial and attribute data),

   b. Soil landscape terminology.

5. Develop a methodology for distributing standards and make recommendations to the Steering Committee on disposition of issues raised, and.

6. The Standing Committee will report its activities at each National Conference.

Recommendations

Drop Charge 4 (Done).

Accept all but the provisional standards in the attached compilation as official NCSS standards.

Consider as provisional those procedures and descriptive classes that have not undergone extensive field testing and formal NCSS verification of merit.

Interpretations specific to, or controlled by, entities outside NCSS should not be listed as rigid NCSS Standards, but valid processes or statements of reliability should be developed and adopted.

Begin contacting other standard-setting groups to compare NCSS Standards with those of others, and to make them aware of our existence as a vigorous organization with Standards.

Continue the Committee.

Charge 1.

The 1993 report to this conference reported as follows:

National Cooperative Soil Survey standards relate to:
- quality of products, and
- quality of communication.

Quality of products can be broadly broken into:
(1) qualify of the information gathering process. and
(2) quality of derivations and interpretations.

The Committee easily agreed that (1) above is within the scope ojthr charge, including such things as description. documentation, and map compilation. However, (2) above merges with activities outride NCSS, and the Committee will look at several individual examples before recommending how to make the distinction among standards, procedures, and guidelines relative to derivations and interpretations. Quality of communications relates to consistent and effective uses of terminology, concepts. codes, including data dictionaries, Federal Data Transfer Standards, and descriptive terminology.

Since the last report, Gary Muckel has compiled the accompanying summary of documented standards. The Committee reviewed, modified, and accepted the compilation as suitable to he designated NCSS standards. A definition fitting this compilation was agreed upon and precedes the compilation.

The Committee concluded that written NCSS standards cover procedures and terminology that enable people to achieve and maintain particular levels of quality in products and communications. Communications are both internal and external. Some standards, as our official soil taxonomy, are important to the achievement of technical and scientific quality and to both phases of communications. A few NCSS activities address reliabilities of the products themselves.

Although NCSS standards are selected to accomplish targeted levels of quality, there are few rigid standards for reliability or for assessing quality. That aspect is dealt with mostly in the NCSS structure and in memorandums of understand that specify purposes of soil surveys and responsibilities for quality. Responsible agencies supply experienced people to assure that standards were followed. and to do quality assessment in accord with requirements of the particular survey or group of surveys.

One of the next subjects for consideration is the extent to which NCSS should have standards for quality assessment and reliability, and for selection and documentation of procedures and models that were used to create the products (predictive models used in mapping, and in development of other products).

Much of the derivative or interpretive information is still considered borderline regarding suitability for NCSS standards. The proposed yardstick is whether the derivative is specifically within the control of the NCSS, or whether it is specific to, or controlled by a single agency or program outside NCSS. Ponding, flooding, and corrosion are in the accompanying summary as interpretive derivatives or estimates that would quality as NCSS standards.

Most interpretations reported in soil surveys would be outside the list of NCSS standards by the proposed definition. If we say they are outside NCSS standards, but are products of the soil survey, our logic and our claims of standard quality could be questioned. There are two possible solutions: (1) requirements of reliability statements, or (2) requirements for the validity of the process.

People are working on procedures for (1) above, but not to the point of creating standards. The accompanying summary includes a start toward (2).

Charge 2.

In its' clearinghouse role, the Committee looked at two things in materials submitted for consideration: (1) which topics are suitable for NCSS standards, and (2) whether they have undergone appropriate NCSS review. The Committee did not conduct technical reviews of material. Committee members were free to make non-binding technical comments as peers.

The Federal Geographic Data Committee (FGDC) submitted Federal Data Transfer Standards for consideration as NCSS standards, and standards for digitizing and map compilation were reviewed. The former is discussed in a report to this conference by Jim Fortner.

The metadata selected for Federal Data Transfer Standards will be mandatory for use by all Federal agencies. The question for the NCSS Standards Committee was whether all in NCSS should accept the standards as binding. The Committee agreed that the metadata submitted by the FGDC, which is taken from the data dictionary, and other sources is suitable for NCSS standards. The Committee expressed concern that although several parallel documents cited in the attached compilation should match, there are logistical lags in updating the National Soil Survey Handbook of NRCS, the agency data dictionaries, and the Federal Transfer Standards.

Map compilation and digital data capture standards were submitted to the Committee before a NCSS-wide review had been completed. Therefore, the Committee recommends a provisional status until the review is completed and NCSS comments evaluated.

Pedon description.--The Committee's opinion was requested about whether a new NRCS-led. automated pedon description program for MS-WINDOWS should eventually become an NCSS standard. The opinion was that a minimum set of standard codes for storing and transferring pedon data would be suitable after it has gone through a NCSS review process. Codes shown on data entry forms were more questionable. as incorporation into standards might limit flexibility.

Charge 3.

No new subcommittees were needed.

Charge 4.

Agency and interagency committees are dealing with the subjects of this charge. Besides the FGDC, the major Federal NCSS agencies with AES participation are working to create at least a minimum set of stand terms and metadata that are common to the agency data bases. As this work progresses, the NCSS Standards Committee is prepared to consider the products for NCSS-wide standards.

Charge 5.

The attached summary is a device for distinguishing NCSS standards from individual agency standards.

Charge 6.

Summary of Standards.

The accompanying summary lists standards that are accepted as NCSS standards, plus several identified as provisional that have yet to undergo sufficient testing, review, or validation to be accepted.

Some Activities Affecting Standards

Soil Taxonomy revisions

Automated Pedon descriptions

NASIS development

Data dictionary/FGDC

Laboratory reliability definitions

Field procedures development

Interpretive reliability estimates (fuzzy sets)

Interagency minimum data set development

DRAFT

FOR

SUMMARY -

NCSS

OUTLINE OF SOIL SURVEY STANDARDS

Introduction

Over the past one hundred years, standards have developed lo provide coordination and consistency among the National Cooperative Soil Survey participants. Early standards included USDA tenlures, soil color descriptions, and soil classification procedures. Consistency of terminology has always been a challenge and the Soil Survey Manual published in 1937 and 1952, and now again in 1993 provided a base for terms and classes. Soil Taxonomy and the Keys to Soil Taxonomy provide a common procedure lo classify soils. The Munsell Color book provides a standard for describing color. Laboratory procedures are standardized. The Federal Geographic Data Committec is now charged with insuring common linkages and procedures for geographic and tabular data bases. This requires common data dictionaries and standardization of data recording among Federal agencies. Standards have been continuous within the soil survey and provide a basis for strength and continuity.

Many of the standards for soil survey have been recorded in various manuals, handbooks, and references. It is the purpose of this listing to assemble these standards in one list.

Map quality and requirements for recording mapping models are difficult to formulate, but several efforts are under way to test and validate methodologies and added documentation. Soil scientists trained in the field gain experience and achieve expected quality through skills gained through training. Testing of quality is through field observations by other experienced scientists, rather than through specific written procedures.

Soil surveys are intended to

Soil Survey Documentation Standards

Support Data for Map Units by Soil Survey Order

(PROVISIONAL)

The standards for validating map unit delineations are dependent on the order of the soil survey. Map units are validated by four primary procedures. each with a different level of intensity. These procedures in order of decreasing intensity are: transecting. traversing, observation, and air photo

Soil Survey Order Validation procedure	Order 2	Order 3	Order4
Transecting	15-30	10-15	1-5
Traversing	SO-65	25-50	10-15
Observation	5-15	25-50	40-60
Air photo interpretation	<5	10-20	20-30

Note: Where more than one method is used on a delineation only the most intensive is reflected in this standard

Definitions:

Transecting-The field procedure of crossing delineations or landscape units along selected lines to determine the patterns of soil components with respect to landforms, geologic formations, or other observable features. Gridding and point or line-transects are included. Pedon descriptions of all points in a transect are not required in the standard. Adequate data is required to Identify each component at each point in the transect.

Traversing-Validation of the predicted boundaries or composition of a delineation by entering it, or crossing it, and identifying pedons at selected or random positions. Significant horizons of each component soil is examined physically by shovel, auger, probe, or other means.

Observation-Visual checking of landscape features, exposed geologic formations. or chance exposures of pedons within or without a delineation to project boundaries and composition from previously determined relations. Identification by observation requires a" on-ground view close enough that individual shrubs, stones, and chance exposures of soil horizons can be see" clearly.

Air photo intctvretation-Plotting boundaries and

interpretation. Individual map units are validated by one of these procedures by the field soil scientist. The support documentation for the map unit in total is a combination of these procedures. The standards for support and validation specify the proportion of all the individual map unit delineations that are to be observed during the validation process.

The following table shows the standard for map unit validation for order 2. 3, and 4 soil surveys. The values are percent of the delineations occurring for each map unit.

estimating composition of delineations based on air photo features that have been related to soils and landscape features.

Support Data for Legends and Descriptions of Taxonomic and Mapping Units

Legend

A" identification legend listing all map symbols and name of the correlated map unit is required.

Soil **descriptions**

A typical pedon is selected to characterize each named component in a map unit.

Soil series that have more than one phase mapped in the survey area are represented by at least one pedon description from each phase.

Taxonomic units

Each named component in a map unit must be described.

Three complete pedon descriptions that represent the concept of the taxon in the survey area are recorded before a taxonomic unit is added to the descriptive legend.

(For map units that are 1,000 to 10.000 acres in extent, one additional pedon description per 3,000 acres is recommended. One additional pedon description is recommended for each additional 10,000 acres of a map unit surveyed.)

Map **units**

Three 10 observation transects (30 points) of representative areas of each map unit are recorded before a map unit is added to the descriptive legend.

Support Data for Establishing a Soil Series

Each soil series must be clearly differentiated from all other soil series.

A pedon that is typical of the soil series concept is selected as a reference specimen. Ranges in soil characteristics are defined.

If the total extent of a new soil series is more that 1,000 acres, the official description of the new series is based on descriptions of at least 10 pedons that are within the concept of the soil series. If the extent is less than 1.000 acres the state soil scientist determines the required documentation.

Official soil series must follow the format for descriptions in the NSSH Exhibit 614-2.

Soil Description Standards

- Carbonate effervescent classes
- Horizons and layers
  - Boundaries
  - Designations
- Particle size distribution
  - Groupings of soil texture classes
  - Soil Texture
  - USDA soil separates
- Rock fragments
- Salinity classes
- Soii coatings
- Soil color
- Soil concentrations
- Soil consistence
  - Rupture resistance classes (Provisional)
  - Penetration resistance (Provisional)
  - Plasticity
  - Toughness (Provisional)
- Stickiness
- Manner of failure (Provisional)
- Excavation difficulty (Provisional)
- Soil Pores
- Soil reaction
- Soil roots
- Soil structure
  - grade
  - shape
  - size

Carbonate Effervescence Classes
Reference: Soil Survey Manual. 1993. Chapter 3. page 192.

Cold 1 molar (about a 1:12 dilution of concentrated HCL) hydrochloric acid is used to test for carbonates in the field. The amount and expression of effervescence is affected by size distribution and mineralogy as well as the amount of carbonates. Four classes of effervescence are used:

Very slightly effervescent: few bubbles seen
Slightly effervescent: bubbles readily seen
Strongly effervescent: bubbles form low foam
Violently effervescent: thick foam forms quickly

Moisture and temperature conditions should be recorded.

Horizons and Layers

Boundaries of Horizons and Layers
Reference: Soil Survey Manual, 1993, Chapter 3. page 133-134.

A boundary is a surface or transitional layer between two adjoining horizons or layers. Most boundaries are zones of transition rather than sharp lines of division. Boundaries vary in distinctness and in topography.

Distinctness.--Distinctness refers to the thickness of the zone within which the boundary can be located without being within one or the other adjoining horizons. The distinctness of a boundary depends partly on the degree of contrast between the adjacent layers and partly on the thickness of the transitional zone between them. Distinctness is defined in terms of thickness of the transitional zone:

Abrupt: Less than 2 cm thick
Clear: 2 to 5 cm thick
Gradual: 5 to 15 cm thick
Diffuse: More than 15 cm thick

Topography.--Topography refers to the irregularities of the surface that divides the horizons. Even though soil layers are commonly seen in vertical section. they are three-dimensional. Topography of boundaries is described with the following terms:

Smooth: The boundary is a plane with few or no irregularities.
wavy: The boundary has undulations in which depressions are wider then they are deep.
Irregular: The boundary has pockets that are deeper than they are wide.
Broken: One or both of the horizons or layers separated by the boundary are discontinuous and the boundary is interrupted.

Designations for Horizons and Other Layers
Reference: Soil Survey Manual. 1993. Chapter 3. page 117-128

Master Horizons and Layers

The capital letters O, A, E, B, C, and R, represent the master horizons and layers of soils. The capital letters are the base symbols to which other characters are added to complete the designations. Most horizons and layers are given a single capital letter symbol; some require two.

0 *horizons or layers: Layers dominated by organic material. Some are saturated with water for long periods or were once saturated but are now artificially drained; others have never been saturated.*

A horizons: Mineral horizons that formed at the surface or below an 0 horizon, that exhibit obliteration of all or much of the original rock structure, and that show one or more of the following: (1) an accumulation of humified organic matter intimately mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons (defined below) or, (2) properties resulting from cultivation, pasturing, or similar kinds of disturbance. 7/

E horizons: Mineral horizons in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these, leaving a concentration of sand and silt particles. These horizons exhibit obliteration of all or much of the original rock structure 7/.

B horizons: Horizons that formed below an A. E,, or 0 horizon and are dominated by obliteration of all or much of the original rock structure 7/ *and show one or more of the following:*

(1) illuvial concentration of silicate clay, iron, aluminum, humus. carbonates, gypsum, or silica, alone or *in combination:*

7/ Rock structure includes fine stratification in unconsolidated, or pseudomorphs, of weathered minerals that retain their positions relative to each other and to unweathered minerals in saprolite from consolidated rocks.

(2) evidence of removal of carbonates;
(3) residual concentration of sesquioxides;
(4) coatings of sesquioxides that make the horizon conspicuously lower in value, higher in chroma, or redder in hue than overlying and underlying horizons without apparent illuviation of iron;
(5) alteration that forms silicate clay or liberates oxides or both and that forms granular, blocky, or prismatic structure if volume changes accompany changes in moisture content; or
(6) brittleness.

C horizons or layers: Horizons or layers. excluding hard bedrock. that ore little affected by pedogenic processes and lack properties of 0, A, E, or B horizons. Most are mineral layers. The material of C layers may be either like or unlike that from which she solum presumably formed. The C horizon may have been modified even if there is no evidence of pedogenesis.

R layers: Hard Bedrock

Transitional and Combination Horizons

Horizons dominated bv properties of one master horizon but having subordinate properties of another. Two capital letter symbols are used, as AB. EB, BE, or BC. The master horizon symbol that is given first designates the kind of horizon whose properties dominate the transitional horizon.

Horizons in which distinct parts have recognizable orooerties of the two kinds of master horizons indicated bv the capital letters. The two capitol letters are separated by a virgule (/), as E/B, B/E, or B/C. Most of the individual parts of one of the components are surrounded by the other.

The first symbol is that of the horizon that makes up the greater volume.

Subordinate Distinction5 Within Horizons and Layers

Lower case Inters are used as suffixes to designate specific kinds of horizons and layers. They are used for master horizons and transitional and wmbiiion horizons. The word “accumulation” is used in many of the definitions in the sense that the horizon must have more of the material in question than is presumed to have been present in the parent material.

The symbols and their meanings are as follows:

a Highly decomposed organic material
This symbol is used with ‘0” to indicate the most highly decomposed of the organic materials. The rubbed fiber content is less than about 17 percent of the volume.

b Buried genetic horizon
This symbol is used in mineral soils to indicate identifiable buried horizons with major genetic features that were formed before burial. Genetic horizons may or may not have formed in the overlying material, which may be either like or unlike the assumed parent material of the buried soil. The symbol is not used in organic soils or to separate an organic layer from a mineral layer.

c Concretions or nodules
This symbol is used IO indicate a significant accumulation of concretions or of nodules. Cementation is required. The cementing agent is not specified except it cannot be silica. This symbol is not used if concretions or nodules are dolomite or calcite or more soluble salts. but it is used if the nodules or concretions are enriched in minerals that contain iron, aluminum, manganese. or titanium.

d Physical root restriction
This symbol is used to indicate root restricting layers in naturally occurring or manmade unconsolidated sediments or materials such as dense basal till, plow pans, and other mechanically compacted zones.

e Organic material of intermediate decomposition
This symbol is used with ‘0” to indicate organic materials of intermediate decomposition. Rubbed fiber content is 17 to 40 percent of the volume.

f Frozen soil
This symhol is used to indicate that the horizon or layer contains permanent ice. Symbol is not used for seasonally frozen layers or for ‘dry permafrost’ (material that is colder than 0’ C but does not contain ice).

g Strong gleying
This symbol is used to indicate either that iron has been reduced and removed during soil formation or that saturation with stagnant water has preserved a reduced state. Most of the affected layers have chroma of 2 or less and many are

mottled. The low chroma can be the color of reduced iron or the color of uncoated sand and silt particles from which iron has been removed. Symbol "g" is not used for soil materials of low chroma. such as some shales or E horizons, unless they have a history of wetness. If "g" is used with "B," pedogenic change in addition to gleying is implied. If no other pedogenic change in addition to gleying has taken place. the horizon is designated Cg.

h Illuvial accumulation of organic matter
This symbol used with "B" to indicate the accumulation of illuvial, amorphous, dispersible organic matter-sesquioxide complexes if the sesquioxidc component is dominated by aluminum but is present only in very small quantities. The organosesquioxide material coats sand and silt particles. In some horizons, coatings have coalesced. filled pores, and cemented the horizon. The symbol "h" is also used in combination with "s" as 'Bhs" if the amount of sesquioxide component is significant but value and chroma of the horizon are 3 or less.

i Slightly decomposed organic material
This symbol is used with "0' to indicate the least decomposed of the organic materials. Rubbed fiber content is more than about 40 percent of the volume.

k &cumulation of carbonates
This symbol is used to indicate the accumulation of alkaline earth carbonates, commonly calcium carbonate.

m Cementation or induration
This symbol is used to indicate continuous or nearly continuous cementation. The symbol is used only for horizons that are more than 90 Percent cemented, although they may be fractured. The layer is physically root restrictive. The single predominant or codominant cementing agent may be indicated by using defined letter suffixes. singly or in pairs. If the horizon is cemented by carbonates. "km" is used; by silica, "qm"; by iron, "sm"; by gypsum, "ym"; by both lime and silica, "kqm"; by salts more soluble than gypsum, "zm."

n Accumulation of sodium
This symbol is used to indicate an accumulation of exchangeable sodium.

o Residual accumulation of sesquioxides
This symbol is used to-indicate residual accumulation of sesquioxides.

p Tillage or other disturbance
This symbol is used to indicate a disturbance of the surface layer by mechanical means, pasturing, or similar uses. A disturbed organic horizon is designated Op. A disturbed mineral horizon is designated Ap even though clearly once an E, B, or C horizon.

q Accumulation of silica
This symbol is used to indicate an accumulation of secondary silica.

r Weathered or soft bedrock
This symbol is used with "C" to indicate root restrictive layers of soft bedrock or saprolite, such as weathered igneous rock; partly consolidated soft sandstone; siltstone; and shale. Excavation difficulty is low or moderate.

s Illuvial accumulation of sesquioxides and organic matter
This symbol is used with "B" to indicate the accumulation of illuvial, amorphous. dispersible organic matter-sesquioxide complexes if both the organic matter and sesquioxidc components are significant and the value and chroma of the horizon is more than 3. The symbol is also used in combination with "h" as "Bhs" if both the organic matter and sesquioxide components are significant and the value and chroma are 3 or less.

ss Presence of slickensides
This symbol is used to indicate the presence of slickensides. Slickensides result directly from the swelling of clay minerals and shear failure, commonly at angles of 20 to 60 degrees above horizontal. They are indicators that other vertic characteristics, such as wedge-shaped peds and surface cracks, may be present.

t Accumulation of silicate clay
This symbol is used to indicate an accumulation of silicate clay that has formed and subsequently translocated within the horizon or has been moved into the horizon by illuviation, or both. At least some part should show evidence of clay accumulation in the form of coatings on surfaces of peds or in pores, or as lamellae, or bridges between mineral grains.

v **Plinthite**

This symbol is used to indicate the presence of iron-rich, humus-poor, reddish material that is firm or very firm when moist and that hardens irreversibly when exposed to the atmosphere and to repeated wetting and drying.

w Development of color or structure

This symbol is used with "B" to indicate the development of color or structure, or both, with little or no apparent illuvial accumulation of material. It should not be used to indicate a transitional horizon.

x Fragipan character

This symbol is used to indicate genetically developed layers that have a combination of firmness. brittleness. very coarse prisms with few to many bleached vertical faces, and commonly higher bulk density than adjacent layers. Some part is physically root restrictive.

Y Accumulation of gypsum

This symbol is used to indicate the accumulation of gypsum.

z Accumulation of salts more soluble than gypsum

This symbol is used to indicate an accumulation of salts more soluble than gypsum.

Conventions for using letter suffixes.--Many master horizons and layers that are symbolized by a single capital letter will have one or more lower case letter suffixes. The following rules apply:

Letter suffixes should immediately follow the capital letter.

More than three suffixes are rarely used.

When more than one suffix is needed, the following letters, if used, are written first: a, d, e, h, i. r, s, t. and w. Except for the Bhs or Crt horizons. none of these letters are used in combination in a single horizon.[8/]

Particle **Size Distribution**
Reference: Soil Survey Manual. 1993, Chapter 3, page **136-140**

The finer sizes are called tine earth (smaller than **2** mm diameter) as distinct from rock fragments (pebbles, cobbles, stones, and boulders).

USDA Soil Separates

The United States Department of Agriculture uses the following **size** separates for the **<2** mm **mineral** material:

Very coarse sand:	**2.0-1.0** mm
coarse sand:	1.0-0.5 mm
Medium **sand:**	**0.5-0.25** mm
Fine sand:	0.25-0.10 mm
Very fine sand:	0.10-0.05 **mm**
Silt:	0.05-0.002 mm
Clay:	Smaller than **0.002** mm

NCSS standards require recording of the percentage of sand. **silt,** and clay. **(PROVISIONAL)**

Soil Texture

Soil texture refers to the weight proportion of the separates for the less than 2 mm as determined from a **laboratory** particle-size distribution. The texture classes arc sands. loamy sands, sandy loams. loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay. silty clay, and clay. Sands are subdivided **into coarse** sand. sand, **fine** sand, and very **fine** sand. Subclasses of loamy sands and sandy loams that are based on **sand size** are named similarly.

Definitions *of the* soil **texture** classes follow:

***Sands*:** More than 85 percent sand, the percentage of silt plus 1.5 times the percentage of clay is less **than 15** percent.

Coarse ***Sand*:** A total of 25 percent or more very coarse and **coarse** sand and less than 50 percent any **other** single grade of sand.

Sand: A total of 25 percent or more very coarse. coarse. and medium sand, a total of less than 25 **percent** very coarse and **coarse** sand, and less than 50 percent fine sand and less than 50 percent very fine sand.

Fine sand: 50 percent or more tine sand; or a total of less than 25 percent very coarse, coarse, and medium sand and less than 50 **percent very fine** sand.

Very fine *sand: 50* percent or more very fine sand.

Loamy sands: 71 to 90 percent sand and **the** percentage of silt plus 1.5 times the percentage of clay is 15 **percent** or more; and the percentage of silt plus twice the percentage of clay is less than 30 percent.

Loamy ***coarse*** sand: A total of 25 percent or more very coarse and coarse sand less than 50 percent any other single grade of sand.

Loamy sand: A total of 25 percent or more very coarse, coarse, and medium sand, a total of less than 25 percent **very** coarse and coarse sand, and less than 50 percent tine sand and less than 50 percent very **fine** sand.

***Loamy fine sand*: 50** percent or more fine sand; or less than 50 percent very **fine sand** and a total of less than 25 percent **very** coarse, **coarse,** and medium sand.

Loamy ***very fine sand*:** **50** percent or more **very** fine sand.

Sandy ***loams*:** 7 to 20 percent clay, more than 52 percent sand and the percentage of silt plus twice the percentage of clay is 30 percent or more; or less than 7 percent clay. less than 50 percent silt, and more than 43 percent sand.

Coarse sandy loam: A total of 25 percent or more very coarse and coarse sand and less **than** 50 percent any other single grade of sand.

Sandy loam: A total of 30 percent or more very coarse, coarse, and medium sand, but a total of less than 25 percent very coarse and coarse sand and less than 30 percent **fine** sand and less than 30 percent **very fine** sand; or a total of 15 percent or less very **coarse,** coarse, and medium sand, less than 30 percent tine sand and less than 30 percent very fine sand, and a total of 40 percent or less fine and very fine sand.

Fine sandy loom: 30 percent or more fine sand and less than 30 percent very fine sand; or a total of 15 to 30 percent very coarse, coarse. and medium sand and less than 30 percent very fine sand; or a total of more than 40 percent fine and very fine sand, one half or more of which is fine sand, and a total of 15 percent or less very coarse, coarse, and medium sand.

Very fine sandy loam: 30 percent or more very fine sand; or more than 40 percent tine and very fine sand, more than one half of which is very line sand, and a total of 15 percent or less very coarse, coarse. and medium sand.

Loam: 7 to 27 percent clay. 28 to 50 percent silt, and less than 52 *percent* sand.

Silt loam: 50 percent or more silt and 12 to 27 percent clay, or 50 to 80 percent silt and less than 12 percent clay.

Silt: 80 percent or more silt and less than 12 percent clay.

Sandy *clay* loam: 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.

Clay loam: 27 to 40 percent clay and 20 to 45 percent sand.

Silty clay loom: 27 to 40 percent clay and less than 20 percent sand.

Sandy clay: 35 percent or more clay and more than 45 percent sand.

Silty *clay*: 40 percent or more clay and 40 percent or more silt.

Clay: 40 percent or more clay, 45 percent or less sand. and less than 40 percent silt.

Rock *Fragments*
Reference: Soil Survey Manual. 1993. Chapter 3. page 141-146

Rock fragments are unattached pieces of rock 2 mm in diameter or larger that are in the upper range of moderately__________

____

Terms for rock fragments

Shape [1/] and size	Noun	Adjective
Rounded. subrounded, angular. or irregular:		
w		
2-75 mm diameter	Pebbles	Gravelly.
2-5 mm diameter	Fine	Fine gravelly.
5-20 mm diameter	Medium	Medium gravelly.
20-75 mm diameter	Coarse	Coarse gravelly.
75-250 mm diameter	Cobbles	Cobbly.
250400 mm diameter	Stones	stony.
>600 mm diameter	Boulders	Bouldery.
Flat:		
2-150 mm long	Channers	Channery.
150-380 mm long	Flagstones	Flaggy.
380-600 mm long	Stones	stony.
>600 mm long	Boulders	Bouldety.

The adjectival form of a class name of rock fragments is used as a modifier of the textural class name: 'gravelly loam.' "stony loam." The following classes based on volume percentages are used:

Less than 15 percent: No adjectival modifying terms are used in writing for contrast with soils having more than 15 percent pebbles, cobbles, or flagstones. The adjective "slightly" may be used, however, to recognize those soils used for special purposes.

15 to 35 percent: The adjectival term of the dominant kind of rock fragment is used as a modifier of the textural term: 'gravelly loam," "channery loam," "cobbly loam" (fig. 3-17).

35 to 60 percent: The adjectival term of the dominant kind of rock fragment is used with the word "very" as a modifier of the textural term: 'very gravelly loam,' 'very flaggy loam".

More than 60 percent: If enough fine earth is present to determine the textural class (approximately 5 percent or more by volume) the adjectival term of the dominant kind of rock fragment is used with the word 'extremely" as a modifier of the textural term: 'extremely gravelly loam.' 'extremely bouldery loam." If there is too little tine earth to determine the textural class (leas than about 5 percent by volume) the terms 'gravel," "cobbles,' "stones," and 'boulders" are used in the place of tine earth texture.

1/ If significant to classification or interpretation, the shape of the fragments is indicated: 'angular pebbles," "irregular boulders."

Salinity Classes
Reference: Soil Survey Manual, 1993. Chapter 3. page 193

The electrical conductivity of a saturation extract is the standard measure of salinity. Electrical conductivity is related to the amount of salts more soluble than gypsum in the soil, but it may include a small contribution (up to 2 dS/m) from dissolved gypsum.

The following classes of salinity are used if the electrical conductivity has not been determined, but salinity is inferred:

Class	Electrical conductivity dS/m (mmhos/cm)
0 Non saline	o-2
1 Very slightly saline	2-4
2 Slightly saline	4-8
3 Moderately saline	8-16
4 Strongly saline	>16

Soil Color
Reference: Soil Survey Manual, 1993, Chapter 3, page **146-157**

Munsell color system is the standard for NCSS color citations. Standard for quality is the match to the Munsell system.

Elements of soil color descriptions are the color name, the Munsell notation, the water state, and the physical state: "brown (10YR 5/3), dry. crushed, and smoothed.-

Physical state is recorded as broken. rubbed, crushed, or crushed and smoothed. The term "crushed" usually applies to dry samples and 'rubbed" to moist samples. If unspecified, the surface is broken. The color of the soil is recorded for a surface broken through aped if a ped can be broken as a unit.

The water state of a sample is always given. The water state is either 'moist' or 'dry.'

Munsell notation is obtained by comparison with a Munsell system color chart. The Munsell color system uses three elements of color-hue. value, and chroma--to snake up a color notation. The notation is recorded in the form: hue. value/chroma--for example, 5Y 613.

Mottling

Mottling refers to repetitive color changes that cannot be associated with compositional properties of the soil. A color pattern that can be related to proximity to a ped surface or other organizational or compositional feature is not mottling. Mottle description follows the dominant color. Mottles are described by quantity, size, contrast, color, and other attributes in that order.

Quantity is indicated by three areal percentage classes of the observed surface:

few: less than 2 percent,
common: 2 to 20 percent, and
many: more than 20 percent.

Size refers to dimensions as seen on a plane surface. If the length of a mottle is not more than two or three times the width, the dimension recorded is the greater of the two. If the mottle is long and narrow, as a band of color at the periphery of aped, the dimension recorded is the smaller of the two and the shape and location are also described. Three size classes are used:

fine: smaller than 5 mm,
medium: 5 to 15 mm, and
coarse: larger than 15 mm.

Contrast refers to the degree of visual distinction that is evident between associated colors:

Faint: Evident only on close examination. Faint mottles commonly have the same hue as the color to which they are compared and differ by no more than 1 unit of chroma or 2 units of value. Some faint mottles of similar but low chroma and value differ by 2.5 units (one card) of hue.

Distinct: Readily seen but contrast only moderately with the color to which they are compared. Distinct mottles commonly have the same hue as the color to which they are compared but differ by 2 to 4 units of chroma or 3 to 4 units of value; or differ from the color to which they are compared by 2.5 units (one card) of hue but by no more than 1 unit of chroma or 2 units of value.

prominent: Contrast strongly with the color to which they are compared. Prominent mottles are commonly the most obvious color feature of the section described. Prominent mottles that have medium chroma and **value** commonly differ from the color to which they **are** compared by at least 5 units (two pages) of hue if chroma and value are the same; at least 4 units of value or chroma if she hue is the same; or **at** least I unit of **chroma** or 2 units of **value** if hue differs by 2.5 units (one card).

Shape. location, and character of boundaries of mottles are indicated as needed. **Shape** is described by common words such as streaks, bands, tongues, tubes, and spots. Location of mottles as related to structure of **the** soil may be significant. Boundaries may be describe4 as **sharp (like** a knife edge). **clear** (color grades over less than 2 mm). or **diffuse** (color grades **ovcr** more **than** 2 mm).

Soil Concentrations

Reference: Soil Survey Manual, 1993. Chapter 3, page **169-172**

Amount or **quantity** of concentrations refers to the relative volume of a horizon or other specified unit occupied by the bodies. **The** classes used for quantity of mottles are also used for these features.

Size may he measured directly or given by the classes listed below. If the body is nearly uniform, **size** is measured in the shortest dimension. For irregular bodies, **size** refers to the longest dimension unless that creates an erroneous impression; **measurements** can **be** given if needed. The following size classes are used:

fine	Smaller than 2 mm
medium	**2 to 5 mm**
coarse	5 to 20 mm
very coarse	20 to 76 mm
extremely coarse	Larger than **76** mm

Shape of concentrations is variable both among kinds of concentrations and commonly within **a** concentration. The following terms are suggested:

rounded: Approximately **equidimensional,** a few **sharp** corners. **and** at least approximately regular.

cylindrical: At least crudely cylindrical or tubular; one dimension is much greater than the other two.

platelike: Shaped crudely like a plate; one dimension is very much smaller than the other two. The term 'platelike" is used to avoid confusion with platy structure.

irregular: Characterized by branching. convoluted, or **mycelial** form.

Soil Consistence
Reference: Soil Survey Manual, 1993. Chapter 3. page 172-184

Consistence includes: (1) resistance of soil material to rupture. (2) resistance to penetration, (3) plasticity, toughness, and stickiness of puddled soil material, and (4) the manner in which the soil material behaves when subject to compression. Although several tests are described, only those should be applied which may be useful.

Rupture Resistance Classes for Blocklike Specimens
(PROVISIONAL)

Moderately dry and very dry	Slightly dry and wetter
Loose	Loose
Soft	Very friable
Slightly hard	Friable
Hard	Firm
Hard	Very firm
Very hard	

			placing on a **nonresilent** surface and applying **gentle** force underfoot.	
Extremely bard	Extremely **firm**	Moderately cemented	**Cannot** be failed in hands but can be underfoot by **full** body weight **(ca 800N)** applied slowly.	**160** to SOON
Rigid	Rigid	**Strongly** cemented	Cannot be failed underfoot by **full** body weight but can be by < 31 blow.	**800N** to **3J**
Very rigid	**Very** rigid	Indurated	Cannot be failed by blow of **3J.**	> 3J

a/ Both force **(newtons; N)** and energy (joules; J) are employed. The number of newtons is 10 times the kilograms of **force. One** joule is the energy delivered by dropping a 1 kg weight 10 cm.

Rupture **Resistance Classes** for Crushing Plate-shaped Specimens
(PROVISIONAL,)

Classes	Force N
Fragile	**< 3**
Extremely **weak**	Not removable
Very weak	Removable; < **1**
Weak	l-3
Medial	**3-20**
Moderate	3-8
Moderately strong	**8-20**
Resistive	> 20
Strong	**20-40**
Very **strong**	**40-80**
Extremely **strong**	> 80

Resistance to **Penetration**

(PROVISIONAL)

Resistance to penetration is the capacity of the soil in its confined state to resist penetration by a rigid object. Shape and size of tie penetrating object must he defined. Penetration resistance depends strongly on the water state. which should bc specified.

Penetration Resistance Classes.

Classes	Penetration Resistance MPa	
Small	<0.1	
Extremely low		<0.01
Very low		0.01-0.1
Intermediate	0.1-2	
Low		0.1-l
Moderate		1-2
Large	>2	
High		2-4
Very high		4-8
Extremely high		>8

Plasticity

Plasticity is the degree to which puddled soil material is permanently deformed

Toughness (PROVISIONAL)

Toughness is related to plasticity. The classes are based on the relative force necessary to form with the fingers a roll 3 mm in diameter of < 2 mm soil material at a water content near the plastic limit (test D 2488 in Am. Soc. Test. Mat. 1985).

Toughness Classes

Classes	Criteria
Low	Reduces the specimen diameter at or near the plastic limit to 3 mm by exertion of < 8N.
Medium	Requires 8.20 N to reduce the specimen diameter at or near the plastic limit to 3 mm.
High	Requires > 20 N to reduce the specimen diameter at or near the plastic limit to 3 mm.

Stickiness

Stickiness refers to the capacity of a soil to adhere to other objects. The determination is made on puddled < 2 mm soil material at the water content at which the material is most sticky. The sample is crushed in the hand; water is applied while manipulation is continued between thumb and forefinger until maximum stickiness is reached.

Stickiness Classes

Classes	Test Description
Non-sticky	After release of pressure. practically no soil material adheres to thumb or forefinger.
Slightly sticky	After release of pressure, soil material adheres perceptibly to both digits. As the digits are separated, the material tends to come off one or the other rather cleanly. The material does not stretch appreciably on separation of the digits.
Moderately sticky	After release of pressure, soil material adheres to both digits and tends to stretch slightly rather than pull completely free from either digit.
Very sticky	After release of pressure. soil material adheres so strongly to both digits that it stretches decidedly when the digits are separated. Soil material remains on both digits.

Manner of Failure

(PROVISIONAL)

The manner in which specimens fail under increasing force ranges widely and usually is highly dependent on water state. To evaluate the manner of failure. a roughly cubical specimen **25-30** mm on edge is pressed between extended forefinger and thumb and/or a handful of soil material is squeezed in the hand. Some soil materials although wet are brittle; some may be compressed markedly without cracks appearing; others, if wet, behave like liquids, and still others smear if stressed under shear to failure.

Manner of Failure Classes

	Test Description	
Classes	Operation	Characteristics
Brittle	Gradually increasing compressive pressure applied to a **25-30mm** specimen held between extended thumb and forefinger.	Specimen retains its size and shape (no deformation) until it ruptures abruptly into subunits or fragments.
Semideformable		Deformation occurs prior to rupture. Cracks develop **and** specimen ruptures before **compression** to half its original **thickness.**
Deformable*		Specimen **can** be compressed to half its original **thickness** without **rupture.** Radial cracks may appear and extend inward leas than half the radius normal compression.
Nonfluid*	A handful of soil material is squeezed in the hand.	None flows through the fingers after exerting **full** compression.
Slightly **fluid***		**After** exerting **full** compression, some flows through the **fingers,** but most **remains** in the palm of the hand.
Moderately fluid*		**After** exerting full pressure. most flows through the fingers; a small residue remains in the palm of the hand.
Very fluid*		Under very gentle pressure most flows through the fingers like a slightly viscous fluid; very little or no residue remains.

Non-smeary	Gradually increasing pressure applied to a 25-30 mm specimen held between extended thumb and forefinger in such a manner that some shear force is exerted on the specimen.	At failure. the specimen does not change suddenly to a fluid. the fingers do not skid, and no smearing occurs.
Weakly smeary		At failure, the specimen changes suddenly to fluid, the fingers skid, and the soil smears. Afterward, little or no free water remains on the fingers.
Moderately smeary		At failure, the specimen changes suddenly to fluid, the fingers skid,
and		the soil smears. Afterward, some free water can be seen on the fingers.
Strongly smeary		At failure. the specimen suddenly changes to fluid, the fingers skid, and the soil smears and is very slippery. Afterward, free water is easily seen on the fingers.

*'The approximate equivalent n-values, Pons and Zonneveld (1965). are as follows:

Deformable	< 0.7 n-value
Slightly fluid	0.7-l
Moderately fluid	1-2
Very fluid	7 2

Excavation Difficulty

(PROVISIONAL.)

Excavation of soil is a very common activity. The classes may be employed to describe horizons. layers. or pedons on a one-time observation or over time. In most instances, excavation difficulty is related to and controlled by a water state.

Excavation Difficulty Classes

Classes	Test Description
Low	Can be excavated with a spade using arm-applied pressure only. Neither application of impact energy nor application of pressure with the foot to a spade is necessary.
Moderate	Arm-applied pressure to a spade is insufficient. Excavation can be accomplished quite easily by application of impact energy with a spade or by foot pressure on a spade.
High	Excavation with a spade can be accomplished, but with difficulty. Excavation is easily possible with a full length pick using an over-the-head swing.
Very high	Excavation with a full length pick using an over-the-head swing is moderately to markedly difficult. Excavation is possible in a reasonable period of time with a backhoe mounted on a 40 to 60 kW (50-80 hp) tractor.
Extremely high	Excavation is nearly impossible with a full length pick using an over-the-head arm swing. Excavation cannot be accomplished in a reasonable time period with a backhoe mounted on a 40 to 60 kW tractor (SO-80 hp).

Soil Pores
Reference: Soil Survey Manual, 1993. Chapter 3. page 188-190

Pore space is a general term for voids in the soil material. The term includes matrix. nonmatrix, and interstructural pore space. Matrix pores arc formed by the agencies that control the packing of the primary soil panicles. These pores are usually smaller than nonmatrix pores. Additionally, their aggregate volume and size distribution may. as in a soil horizon or layer with high extensibility. change markedly with water state. Nonmatrix pores are relatively large voids that are expected to be present when the soil is moderately moist or wetter, as well as under drier states. The voids are not bounded by the planes that delimit structural units. Interstructural pores, in turn, are delimited by structural units. Inferences as to the interstructural porosity may be obtained from the structure description. Commonly, interstructural pores are at least crudely planar.

Nonmatrix pores arc described by quantity, size, shape, and vertical continuity--generally in that order. Quantity classes pertain to numbers per unit area--l cm^2 for very fme and fine pores, 1 dm^2 for medium and coarse pores and 1 m^2 for very coarse. The quantity classes are:

Few	Less than 1 per unit area
Common	1 to 5 per unit area
Many	More than 5 per unit area

Pores are described relative to a specified diameter size. The five size classes arc:

Very line	Less than 0.5 mm
Fine	0.5 to 2 mm
Medium	2 to 5 mm
Coarse	5to 10 mm
Very coarse	10mm or more

Soil Reaction
Reference: Soil Survey Manual, 1993, Chapter 3, page 192

The NCSS standard requires recording the measured pH value.

The descriptive terms to use for ranges in pH are as follows:

Ultra acid	Less than 3.5
Extremely acid	3.5-4.4
Vety strongly acid	4.5-5.0
Strongly acid	5.1-5.5
Moderately acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Slightly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	More than 9.0

Soil **Coatings**
Reference: Soil Survey **Manual,** 1993, Chapter 3, page

Clay films (synonymous with clay skins) are thin layers of oriented, translocated clay.

Clay bridges link together adjacent mineral grains at contact points.

Sand or silt coats are sand or silt grains adhering to a surface. Some sand and silt coats are concentrations of the sand and silt originally in the horizon from which finer particles have been removed. Some sand and silt coats are material that has been moved from horizons above and deposited on surfaces. In some coats the grains are almost free of finer material; in others, the grains themselves are coated. If known, the composition of the coat is noted.

Other coats arc described by properties that can be observed in the field. The coats are composed variously of iron, aluminum or manganese oxides, organic matter, salts, or carbonates. Laboratory analyses may be needed for a positive identification.

Stress surfaces (pressure faces) are smoothed or smeared surfaces. They arc formed through rearrangement as a result of shear forces. They may persist through successive drying and wetting cycles.

Slickensides are stress surfaces that are polished and striated and usually have dimensions exceeding 5 cm. They are produced by relatively large volumes of soil sliding over another. They are common below 50 cm in swelling clays which are subject to large changes in water state.

Location.--The various surface features may be on some or all structural units, channels, pores, primary particles or grains, soil fragments, rock fragments, nodules, or concretions. The kind and orientation of surface on which features are observed is always given. For example, if clay skins arc on vertical but not horizontal faces of peds, this fact should be recorded.

Amount.--The percentage of the total surface area occupied by a particular surface feature over the extent of the horizon or layer is described. Amount can be characterized by the following classes:

very few: Occupies less than 5 percent.
few: Occupies 5 to 25 percent.
common: Occupies 25 to 50 percent.
many: Occupies more than 50 percent.

The same classes arc used to describe the amount of "bridges' connecting particles. The amount is judged on the basis of the percentage of particles of the size designated that are joined to adjacent particles of similar size by bridges at contact points,

Distinctness.--Distinctness refers to the ease and degree of certainty with which a surface feature can be identified. Distinctness is related to thickness, color contrast with the adjacent material, and other properties. It is. however, not itself a measure of any one of them. Some thick coats. for example, are faint; some thin ones arc prominent. The distinctness of some surface features changes markedly as water state changes. Three classes are used.

faint: Evident only on close examination with 10X magnification and cannot be identified positively in all places without greater magnification. The contrast with the adjacent material in color. texture. and other properties is small.

distinct: Can be detected without magnification, although magnification or tests may be needed for positive identification. The feature contrasts enough with the adjacent material to make a difference in color, texture, or other properties evident.

prominent: Conspicuous without magnification when compared with a surface broken through the soil. Color. texture, or some other property or combination of properties contrasts sharply with properties of the adjacent material or the feature is thick enough to be conspicuous.

Soil Roots
Reference: Soil Survey Manual, 1993. Chapter 3. page 184-188

Quantity. size. and location of roots in each layer are recorded.

Quantity of roots is described in terms of numbers of each size per unit area. The class placement for quantity of roots pertains to an area in a horizontal plane unless otherwise stated. This unit area changes with root size as follows: 1 cm^2 for very fine and fine, 1 dm^2 for medium and coarse, and 1 m^2 for very coarse.

The quantity classes are:

Few	less than 1 per unit area
Very few	less than 0.2 per unit area
Moderately few	0.2 to 1 per unit area
Common	1 to 5 per unit area
Many	5 or more per unit area

Tbc size classes are:

Very fine	Less than 1 mm
Fine	1 to 2 mm
Medium	2 to 5 mm
Coarse	5 to 10 mm
Very coarse	10 mm or more

Soil Structure
Reference: Soil Survey Manual, 1993. Chapter 3, page 157-168

lo soils that have structure, the shape, size. and grade (distinctness) of the units are described.

Shape.--The following terms describe the basic shapes and related arrangements:

platy: The units are flat and platelike. They are generally oriented horizontally and are usually overlapping. A special form. **lenticular** platy structure, is recognized for plates that are thickest in the middle and thin toward the edges.

prismatic: The individual units are bounded by flat or slightly rounded vertical

Size classes of soil structure

Size Classes	Shape of structure	
	Platy[1/] mm	Prismatic and Columnar
Very fine	**<1**	
F i i	1-2	
Medium	2-5	
Coarse	5-10	
Very coarse	**≥10**	

Soil Laboratory Characterization Standards

Standard methods for laboratory characterization are recorded in Soil Survey Investigations Reports Number 1 and 42. Data from other methods are stored in characterization data bases and methods are indicated.

Soil Classification Standards

Classification of families and higher categories
Reference: Soil Taxonomy, Amendments to Soil *Taxonomy*. *Keys* to Taxonomy.

Soil classification standards are made up of the latest reference for the United States soil classification system of Soil Taxonomy and its amendments. The latest schema for applying these amendments in the current version of Keys to Taxonomy.

Classification into soil series
Reference: OSED (official soil series descriptions)

Soil classification standards for classification into soil series require classification into the same taxonomic family and require the soil properties to fit within the range of characteristics as listed in the official soil series record. The standard requires a peer review.

Soil series criteria are maintained in the National Soil Information System. Lists of taxonomic classes to the series level are recorded in *Soil Series of the United States, Puerto Rico, and the Virgin Islands.*

Soil Derivations

The method of derivation is to be referenced. (PROVISIONAL)

Corrosion
Reference: National Soil Survey Handbook, 1993. part 618.11

(a) Uncoated steel.
(1) Definition. Risk of corrosion for uncoated steel is the susceptibility of uncoated steel to corrosion when in contact with the soil.

(2) Classes. The risk of corrosion classes are low, moderate. and high.

(b) Concrete.
(1) Definition. Risk of corrosion for concrete is the susceptibility of concrete to corrosion when in contact with the soil.

(2) Classes. The risk of corrosion classes are low. moderate, and high.

Guides for **Estimating** Risk of Corrosion **Potential** for Uncoated Steel. 1/

Property	Limits		
	Low	Moderate	High
Drainage class and texture	Excessively drained. coarse textured or well drained coarse to medium textured soils; or moderately well drained, coarse textured soils; or somewhat poorly drained. coarse textured soils	Well drained, moderately fine tenured soils; or moderately well drained, coarse and medium textured soils; or somewhat poorly drained, moderately coarse textured soils; or very poorly drained soils with stable high water table	Well drained, tine textured or stratified soils; or moderately well drained fine and moderately fine textured or stratified soils; or somewhat poorly drained, medium to tine textured or stratified soils; or poorly drained soils with fluctuating water table
Total eacidity 2/ (cmol/100g)	<8	8-12	≥12
Resistivity at saturation-(ohm/cm) 3/	≥5,000	2,000-5,000	<2,000
Conductivity of saturated extract (dSm^{-1}) 4/	<0.3	0.3-0.8	≥0.8

1/ Based on data in the publication 'Underground Corrosion.' table 99, p. 167. Circular 579. U.S. Dept. of Commerce. National Bureau of Standards.
2/ Total acidity is roughly equal to extractable acidity (as determined by Soil Survey Laboratories Method 6Hla, Soil Survey Investigations Report No. 42, Soil Survey Laboratory Methods Manual, August 1992).
3/ Roughly equivalent lo resistivity of fine-and medium-textured soils measured at saturation (Method 8E1, Soil Survey Investigations Report No. 42. Soil Survey Laboratory Methods Manual, August 1992). Resistivity at saturation for coarse-textured soil is generally lower than when obtained at field capacity and may cause the soil to be placed in a higher corrosion class.
4/ Method 8Ala, Soil Survey Investigations Report No. 42. Soil Survey Laboratory Methods Manual, August 1992. The relationship between resistivity of a saturated soil paste (Method 8E1) and electrical conductivity of the saturation extract (Method 8A1a), is influenced by variations in the saturation percentage, salinity, and conductivity of the soil minerals. These two measurements generally correspond closely enough to place a soil in one corrosion class.

Guide for Estimating Risk of Corrosion Potential for Concrete.

Property	Limits 1/		
	Low	Moderate	High
Texture and reaction	Sandy and organic soils with pH > 6.5 or medium and fine tentured soils with pH > 6.0	Sandy and organic soils with pH 5.5-6.5 or medium and tine textured soils with pH 5.0 to 6.0	Sandy and organic soils with pH < 5.5 or medium and tine tentured soils with pH < 5.0
Na and/or Mg sulfate (ppm)	Less than 1000	1000 to 7000	More than 7000
NaCl (ppm)	Less than 2000	2000 to 10000	More than 10000

1/ Based on data in National Handbook of Conservation Practices, Standard 606, Subsurface Drain. 1980.

Soil Map Unit Description Standards for Terms and Classes

Flooding Frequency, Duration, **and Month**
Reference: National Soil Survey Handbook, 1993, part 618.21

Definition. Flooding is the temporary covering of the soil surface by <u>flowing water</u> from any source. Shallow water standing or flowing that is unconcentrated as local runoff during or shortly after rain or snowmelt is excluded from the definition of flooding. Standing water (ponding) or water that forms a permanent covering is also excluded from the definition.

Flooding frequency class. The classes of flooding are defined as follows:

Class	Definition
None	No reasonable possibility of flooding; near 0 percent chance of flooding in any year;
Very rare	Flooding is very unlikely, but possible under extremely unusual weather conditions; less than 1 percent chance of flooding in any year or less than 1 time in 100 years but more than 1 time in 500 years. (PROVISIONAL)
Rare	Flooding unlikely but possible under unusual weather conditions; 0 to 5 percent chance of flooding in any year or near 0 to 5 times in 100 Years
Occasional	Flooding is expected infrequently under usual weather conditions; 5 to 50 percent chance of flooding in any year or 5 to 50 times in 100 years
Frequent	Flooding is likely to occur often: under usual weather conditions, more than a 50 percent chance of flooding in any year or mote than 50 times in 100 years

Flooding duration classes. The average duration of inundation per flood occurrence is given only for occasional and frequent classes.

Class	Duration
Extremely brief	0.1 to 4.0 hours
Very brief	4 to 48 hours
Brief	2 to 7 days
Long	7 days to 30 days
Very long.	More than 30 days

Linear **Extensibility** Percent
Reference: National Soil Survey Handbook, 1993. part 6tR.29

(PROVISIONAL)

(a) **Definition. Linear** extensibility percent is the **linear** expression of the volume difference of natural soil fabric at 1/3 bar or 1110 bar water content and oven dryness. **The** volume change is reported as percent **change** for the whole soil.

Classes.

Class	LEP	COLE
Low	c3	**<0.03**
Moderate	3-6	0.03 - 0.06
High	6-9	0.06 - 0.09
Very High	**>9**	**>0.09**

Permeability
Reference: National Soil Survey Handbook, 1993, part 618.35

Definition. Soil permeability is the quality of the soil that enables water or air to move **through** it. It is expressed in inches per hour.

Classes. **Permeability** classes are as listed in the following chart:

Permeability Class	in hr^{-1}
Extremely slow 0.0	0.01 **(PROVISIONAL)**
Very slow	0.01 - 0.06
Slow	0.06 - 0.2
Moderately slow 0.2	- 0.6
Moderate	0.6 - 2.0
Moderately rapid2.0	- 6.0
Rapid	6.0 - 20.0
Very rapid	**≥20**

Ponding Depth, Duration, **Frequency** Class, and Month.
Reference: National Soil Survey Handbook, 1993, part 618.37

Ponding is standing water in a closed depression. **The** water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding of soils is **classified** according to depth, frequency, duration, and the beginning and ending months in which standing water is observed.

Ponding depth.
(1) Definition. Ponding depth is the depth of surface water that is **ponding** on the soil.

(2) Entries. **The** normal depth range of standing water is given to the nearest half foot if the water is more than **1/2** foot **deep,** for example, **0.5-1.5.** It is given to the nearest tenth of a foot if the water is less than **1/2** foot deep, for example, 0.1 to 1 **.0.** Entries range from 0.0 to 6.0.

Ponding frequency class.

(1) Definition. Ponding frequency class is the number of times ponding occurs over a certain period of time.

(2) Classes. The ponding frequency classes are:

NONE	No reasonable possibility of ponding, near 0 percent chance of ponding in any year
RARE	Ponding unlikely but possible under unusual weather conditions; from near 0 to S percent chance of ponding in any year or near 0 to 5 times in 100 years
OCCASIONAL	Ponding is expected infrequently under usual weather conditions; S to SO percent chance of ponding in any year or near 5 to SO times in 100 years
FREQUENT	Ponding is likely to occur under usual weather conditions: more than SO percent chance in any year or more than SO times in 100 years

Ponding duration class.

(1) Definition. Ponding duration class is the duration. or length of time, or the ponding occurrence.

(2) Classes. The ponding duration classes for ponding occurrence are:

VERY BRIEF	Less than 2 days
BRIEF	2 to 7 days
LONG	7 to 30 days
VERY LONG	More than 30 days

Ponding month.

(1) Definition. Ponding month is the calendar month(s) in which ponding is expected.

(2) Classes. The time of year when ponding is likely to occur is expressed in months for the expected beginning to expected end of the ponding period, for example, DEC-APR. The time period expressed includes two-thirds to three-fourths of the occurrences.

Soil Map Digitizing Standards

Standards in draft to be issued as updated part 647 of NSSH. (PROVISIONAL)

Soil Data Base Population and Exchange

1

Hard copy reference of NCSS data dictionary and FGDC Spatial Data Transfer Standards unavailable at this time. (PROVISIONAL)

Soil Interpretation Criteria Development

Reference: National Soil Survey Handbook part 617.11.

(PROVISIONAL)

The following soil interpretation criteria development procedure establishes the procedure and documentation required for new and revised soil interpretations:

Writing Soil **Interpretation Criteria.**

In developing interpretations criteria, user involvement and documentation should be included and the clarity, accuracy, and the ability of the criteria to be easily created and modified should be considered. Criteria can be developed at local, State, regional, and National levels to represent user needs. They should follow a consistent procedure and firmly established principles for documentation. The ease of development and the stability of the interpretation should be considered. The expert judgement of specialists should be used. People who work with the intended use and application know more than what can be speculated by those people with less experience. The following steps lead to the goals for interpretation criteria.

Step I. Define the Activity.

Clearly and very specifically define the activity or use to be interpreted. When defining the activity:

- describe the activity or use;
- identify the purpose or purposes of the activity or use;
- define the desired performance of the activity or use:
- specify the soil depths that are affected:
- identify the type of equipment for installation;
- mention resource conditions that indicate a different activity or use or the misuse of this practice;
- define the needed specific geographic detail, including the length and width and the direction of application if important; and
- define the needed map and interpretation reliability and uniformity.

Cite references that help to define the activity. Literature citations, such as information from the State Health Department, bulletins, or soil performance research, support the decision made and help track the procedure.

Step 2. Separate Aspects.

Separate different aspects of the activity for separate interpretations. Aspects of interpretations are planning elements that require different criteria, such as installation, performance, maintenance, and effect. Proceed through the steps to develop criteria for each aspect. Each aspect is a unique interpretation that has separate criteria and users. Mention other aspects that may need interpretation but are not addressed.

Step 3. Identify Site Features.

Identify significant site features significant for the interpretation and any assumptions about them. Site features are not soil properties, but are features such as climate factors, landscape stability hazard. vegetation, surface characteristics, etc. Identify and record the Implied affect of site features on each aspect of the Interpretation. Although site features are not soil properties, they are commonly recorded on soil databases and are valuable for developing interpretations because they are geographically specific to soils.

Step 4. List Soil Properties.

Identify and list the specific soil properties that are significant to the interpretation. Use only basic properties, qualities, or observed properties and do not make interpretations from previous interpretations or models. Generally, terms that refer to classes are included in this category. Derived soil qualities should be used only when they are derived within tbe criteria to ensure the integrity of the data and the resultant interpretation. Terms used as properties or qualities tha! have inconsistent entries or derivation pathways result in inconsistent interpretations. Concentrating on the basic influencing property that has the most consistent database entries provides for more consistent interpretations. For example, consider the high water table during a construction period and not the drainage class. Minimize the list of properties by identifying only the basic properties. Review the list to ensure that the same property is not implied several times. For example, USDA texture, clay, and AASHTO do not need to appear on the same list.

Step 5. Select the Number of Separations.

Select the number of interpretative separations, and define the intent of the separation or classification. Each separation should have a purpose, which normally represents a significant management grouping and a need for separate treatment. Commonly used terms in separations are slight, moderate, and severe or good, fair, and poor. User needs should dictate the number of separations. The levels of user needs may vary. Some users do not use groupings.

Step 6. Document Assumptions.

Document assumptions about the significance of the property and established values for separating criteria.

(a) A record of the significance of the property helps to define the property and allows for future understanding and modification. It provides a basis for the criteria so that changes can be made if different equipment is used.

(b) Indicate why the feature is important and why the specific break was chosen, such as why 6 percent slope was used instead of IO percent slope. If the limit is arbitrary or speculated, state that it is but also indicate the intent of the separation.

(c) Establish values that are significant to the interpretation and not to the mapping. The values should represent the significance to an activity. Do not consider how soils were grouped in mapping since these groupings may have been made for other interpretations.

Step 7. Develop the Criteria Table.

Assign feature and impact terms. and develop the criteria table. The following categories of column headings are recommended for use in the criteria table:

-- Factor (this is the soil property):
-- Degree of Limitation (such as Slight, Moderate, Severe);
-- Feature (the term to be displayed for soil property); and
-- Impact (the dominant impact that the soil property has on the practice being rated).

Information in the feature and impact columns is helpful in designing ways to overcome the limitation. Ensure that all terms are added to data dictionary.

Step ft. Application, Presentation, and Testing.

(a) Database needs.

Provide a description of the calculation procedure. The calculation procedure is a set of instructions for the correct access to dataset entries. It is needed to sort criteria from a database without questioning the intention of the interpretation. The description should be specific to the database being used. Instructions for using high, low. or central values of data should be given in this description.

(b) Temporal considerations for application.

The time dependent or temporal properties or events from the measured permanent features of the soil.

(1) Flooding and periods of freezing, wetness, or dryness are significant at the time they occur but not at all times. For example, in planning an installation phase. remember that this phase can be scheduled for alternate times when these events are not significant to the Criteria. In these situations, temporal

modified, it may not be apparent that the tables were not also made from current criteria.

References

(1) Chapter **3-Examination** and **Description** of Soils, Soil **Survey Manual**

(2) **Munsell** Color Book-color notations

(3) Soil **Survey** Investigation Report 1

(4) **Soil** Survey Laboratory Methods Manual, SSIR 42

(5) Soil Taxonomy and updates through Keys to Soil Taxonomy

(6) Official Series Description tile **(OSED)**

(7) National Soil Survey Handbook, part 618

(8) National Soil Survey Handbook part 639 Soil Data Dictionary

(9) Draft NSSH part 647 Chapter 5

(10) SCS National Instruction No. **170-303, Technical** Specifications for Line Segment Digitizing Soil Survey Maps Using the **DLG-3** Optional Format, April 1990

(11) NCSS data dictionary

(12) Spatial Data Transfer Standards **(SDTS)** FIPS173

(13) **National** Soil Survey Handbook, 1993. **part** 617

April 1995

A Publication of
the Federal Geographic

Federal
Geographic
Data
Committee

National Geospatial Data Clearinghouse Update

The NSDI Executive Order set January 11, 1995. as the deadline for Federal agencies to establish a process to document all new geospatial data collected or produced using the FGDC's Content Standards for Digital Geospatial Metadata.

Many agencies have put up sites on the World Wide Web using httpd (hypertext transfer protocol daemon)c 0Ferss toc 0Fe (geospatiar)Tj -0.0885 Tc -0.0674 Tw 1 0 0 1 70.56 340.48 Tm adatag

protocol2390.5a.
twon

Content Standards for Digital Geospatial Metadata

Workbook on Metadata

A workbook to help managers of digital geospatial data document their data using the FGDC's Content Standards for Digital Geospatial Metadata will be published shortly in book form and as a hypertext document on the NSDI home page.

Metadata Implementor's Workshop

A Metadata Impltmentor's Workshop was held on March 10, 1995 in Reston, Virginia, with video and teleconferences to Sioux Falls, South Dakota; Alexandria, Minnesota; Hanover. New Hampshire; Fayetteville, Arkansas; Denver, Colorado; and Madison, Wisconsin. The meeting served as a health check on the standard. Participants were asked to identify strengths and weaknesses of the standard and to discuss any changes that might be necessary. Questions that arose from these discussions were categorized into six groups: 1) issues of extensibility, profiles, or subsets; 2) definitions of data sets with different levels of granularity, hierarchy, and inheritance of information; 3) lineage tracking; 4) reference implementations (e.g., development of a prototype data model for relational or object-based approaches to serve as a starting point for implementors) and metadata transfer mechanisms; 5) education; and 6) editorial changes for technical corrections and to accomodate uncertainty.

Teams were formed to address each of these general areas. Each team will formulate a plan addressing the scope of the problem, identifying the resources that might be brought to bear, and setting a timetable for solving the problem. Discussions among team members will be through the NSDI-L discussion list.

Teams are actively seeking members from the geospatial data community throughout the country to work on these issues. The agenda and a summary of the workshop are available on the NSDI home page at <http://fgdc.er.usgs.gov> Workshop materials are also available in hardcopy from the FGDC Secretariat.

To subscribe to NSDI-L and join the discussion of these metadata issues send email to: majordomo@fgdc.er.usgs.gov with the following message:
subscribe NSDI-L your name (i.e. Jane Smith)
To submit a message to other NSDI-L users send email to NSDI-L@fgdc.er.usgs.gov.

National Digital Geospatial Data Framework

The NSDI Executive Order called for a plan and schedule to implement a national digital geospatial data framework by January 2000. The FGDC convened a Framework Working Group comprised of local. regional, State and Federal agency representatives to develop the plan. Members of the working group presented the concepts of the framework for discussion at several national and regional public meetings, and provided the draft report for public written review. The final draft of the report, 'Development of a National Digital Geospatial Data Framework", was submitted to the FGDC Steering Committee on March 17, 1995. To receive a copy of the report send a request to the FGDC Secretariat.

Is your agency an Area integrator?

A key institutional role identified in the report is that of area integrator. An integrator (1) incorporates new data into the framework; (2) coordinates data creation and maintenance; (3) implements certification policies and procedures to ensure conformance to standards; (4) implements the technical standards that describe the essential characteristics of the theme data; and (5) provides guidance to data producers. In the initial implementation phase, the FGDC will conduct framework "proof of concept" pilot projects. If your agency performs area integrator tasks and you are willing to be considered for participation in an FGDC framework pilot project, please send a brief (one-page) overview summarizing your involvement in one or more of the integrator functions to the FGDC Secretariat. The overview should include: project description, categories or themes of data collected and/or coordinated, geographic area of interest, current funding and time frames. Please include the name and agency affiliation of a point of contact.

NSDI Competitive Cooperative Agreement Program (CCAP)

The NSDI CCAP has provided funding to State and local government agencies, institutions of higher education, and private organizations to encourage the development of the National Spatial Data Infrastructure in the non-Federal sector. Nine proposals were funded in 1994 to collaborating organizations in Florida, Iowa, Minnesota, Montana, North Carolina, New Jersey, New Mexico, Texas and Wisconsin. To learn more about the 1994 proposals, request the NSDI CCAP October 1994 Factsheet from the FGDC Secretariat.

The 1995 program announcement invited proposals in one of three areas: (1) implementation of the National Geospatial Data Clearinghouse (e.g., provide the means to search, query, find. access, and use geospatial data): (2) use of FGDC-endorsed standards (e.g., the Content Metadata Standard for Digital Geospatial Data and the Spatial Data Transfer Standard (SDTS); and (3) development of training and software tools to make it easier to implement the clearinghouse and standards. The 1995 program announcement closed on February 2 I, 199.5. Forty-seven proposals were received. Awards will be announced by July 1. Look for the 1996 program announcement this fall

Cooperative Participation in Support of NSDI

FGDC supports cooperation among all parties with a stake in the development and use of geospatial data. To encourage such partnerships, FGDC recognizes groups through a Cooperating Group Agreement.

The Texas Geographic Information Systems Planning Council under the chairmanship of Nancy Vaughn has been recognized through such a cooperating agreement.

For more information about becoming a cooperating group, contact the FGDC Secretariat..

Spotlight on FGDC Subcommittees

Sethymetric Subcommittee
Department of Commerce
National Ocean Service
Frank Maloney, Chair

Coastal Zone 95: A Spotlight on Solutions

Coastal Zone 95 (CZ95). to be held in Tampa, Florida, July 16-21, 1995. will provide an opportunity for an in-depth exchange of ideas and techniques for solutions to ocean and coastal management issues

One of the CZ95 programs of particular interest to the FGDC community is an "Open Forum" on the (NSDI), especially those aspects relating to the coastal zone. The time and location of the forum are:

Federal Geographic Data Committee:
Coastal GIS Open Forum
Monday, July 17, 1995
Hyatt Regency Hotel
Buccaneer Room
1:00 to 4:00 p.m.

This Forum is open to all CZ95 participants. Representatives of many Federal, State, and local government agencies will be participating and sharing their experiences as they begin lo implement the metadata standard and clearinghouse. CZ95 attendees who have an interest in GIS. in consolidating data requirements and locating data in Federal agencies, in building framework data sets, and in learning more about the availability of partnership grants for cooperative coastal zone projects are urged to participate in this technical meeting.

In addition to the open forum, there are a number of technical sessions, exhibits, and poster displays that describe various aspects of the NSDI and the use of GIS technology in the coastal zone. For more information about the open forum or other technical aspects of the meeting. contact Millington Lockwood, Executive Secretary of the FGDC Bathymetric Subcommittee at (301) 713-3070x147, or e-mail mlockwood@ocean.nos.noaa.gov.

Registration costs for CZ 95 will be $235 in advance (before June 16) and $285 after June 16. More information on registration will be available when the CZ 95 Preliminary Program is ready sometime in April. To request a preliminary program or an Exhibitor's Prospectus, please contact Man Menashes, CZ95 National Coordinator, by voice at (301)713-3086 ext. 105, by fax at (301)713-4370 or via e-mail at mmenashes@coasts.nos.noaa.gov.

Cultural and Demographic Subcommittee
Department of Commerce
Bureau of the Census
Fred Broome, Chair

The FGDC's Subcommittee on Cultural and Demographic data has set a challenging 1995 agenda. The Subcommittee is concerned with economic, health, population, agricultural, historic, and other cultural data. While possessing characteristics in common with other types of geospatial data, cultural and demographic data have distinguishing characteristics as well. These data represent human activity and may well represent the majority of the data transferred over the national information highway.

Developing a content standard for cultural and demographic metadata tops the Subcommittee's agenda items. While many aspects of cultural and demographic data sets may be thoroughly described using the content standards for digital geospatial metadata, the content standard for cultural and demographic metadata will form the basis for describing the topical aspect of highly diverse and interrelated sets of geospatially referenced cultural and demographic data. Using the content standard for cultural and demographic metadata will allow metadata producers to (1) create metadata to identify the cultural and demographic content of data sets; and (2) facilitate the production of geospatial metadata.

The Subcommittee plans to complete its initial work on the profile for cultural and demographic metadata in April. The standard will then proceed through the FGDC's 14-step standards process, including public review. Inquiries on the Subcommittee's work may be directed to Fred Broome or Leslie Godwin at the Geography Division, U.S. Census Bureau. Washington, DC 20233-7400; telephone (301) 457-1056; e-mail fbroome@census.gov.

Geodetic Control Subcommittee Department of Commerce National Geodetic Survey Captain Lewis Lapine, Chair

Interagency Council Coordinates GPS Use

A Global Positioning System (GPS) Interagency Advisory Council (GIAC) recently has been formed within the Federal Geodetic Control Subcommittee (FGCS) of the Federal Geographic Data Committee (FGDC). The GIAC will be chaired by the Chief of NOAA's National Geodetic Survey, who also chairs the FGCS. The GIAC will assist the Department of Transportation's Position-Navigation (Pos-Nav) Executive Committee in coordinating Federal civilian GPS activities.

A joint task force commissioned by the Secretaries of Transportation and Defense studied the rapidly growing uses of GPS technology and recommended forming the GIAC and the Pos-Nav executive committee. The task force's report, "The Global Positioning System (GPS): Management and Operation of a Dual Use System," published in December 1993 outlines priorities and requirements for both civilian and military GPS applications.

In his role as FGDC Chairman, Secretary of the Interior Babbitt, requested of Secretary of Transportation Peña, recognition of the FGCS as the interagency coordination committee. This linkage will strengthen the ties among the GPS navigation, positioning, and timing communities. The FGCS coordinates the planning and execution of geodetic. land, and resource surveys, and develops surveying standards and specifications. In the future, FGCS will coordinate GPS positioning and timing applications within the Federal Government.

For more information, contact:

Captain Lewis A. Lapine
Chief, National Geodetic Survey, N/CGI
U.S. Department of Commerce, NOM
1315 East-West Highway, Station 8657
Silver Spring, MD 20910
Telephone:(301) 713-3222. Fax: (301) 713-4175

Wetlands Subcommittee Department of Interior U.S. Fish and Wildlife Service Bill Wilen, Chair

Pilot Study in Wicomico County, Maryland

The Wetland Data Coordination Working Group of the FGDC Wetlands Subcommittee has completed a pilot study to evaluate the consistency of Federal and State wetland data collected in Wicomico County, Maryland. The study is part of a strategy being implemented by the Wetlands Subcommittee to improve the coordination of government collection of wetland data used for the development of status and trends and inventory estimates. The Wetlands Subcommittee report, "Strategic Interagency Approach to Developing a National Digital Wetlands Data Base" is available from the FGDC Secretariat.

In the Wicomico County study area. wetland data were compared from the U.S. Fish and Wildlife Service National Wetlands Inventory. the Natural Resources Conservation Service Wetlands Inventory and National Resource Inventory. the NOAA Coastal Change Analysis Project, and the State of Maryland Water Resource Administration The USGS's Mapping Application Center assisted the Working Group in implementing the analysis through the use of Geographic Information System (GIS) technology.

In addition, two field tests were conducted in order to compare wetland delineations made on the ground with those recorded in the Federal and State data sets.

The four data sets with polygon data disagree in over 90 percent of the area that at least one of the four data sets delineates as wetland. This disagreement is not just among wetland classes or systems, but rather on the fundamental question of whether or not an area is a wetland. Comparisons between the National Resource Inventory, which has point data, and the four data sets with polygon data produce similar results. In these comparisons, there is disagreement in over 99 percent of the points that are classified by at least one data set as wetland.

The results highlight the difficulties associated with delineating wetlands in forested areas using remotely-sensed data.

As a result of this study, additional research on effective ways to delineate wetlands in forested areas is continuing both within Wicomico County and elsewhere.

The report "Coordination/Integration of Wetland Data for Status and Trends and Inventory Estimates," describing the Wicomico County study is scheduled for publication in 1995. The report, will be available from the FGDC Secretariat.

FGDC Contact Information

The FGDC Newsletter describes the activities of the spatial data community and the development of a national spatial data infrastructure. Subscriptions are free of charge. Correspondence or contributions may be directed to the FGDC Secretariat as indicated below:

Mail FGDC Secretariat
590 National Center
Reston, VA 22092
Voice (703) 648-4533
Fax (703) 648-5755
Email gdc@usgs.gov

FGDC Information and Documents
FTP via Internet
Address: isdres.er.usgs.gov (130.11.48.2)
User name: anonymous
After connecting: cd gdc
README.DOC file has current information on the tiles in each subdirectory.

FGDC Publications

To subscribe to the newsletter or request the FGDC's publication list, please complete the information below and return it to the FGDC Secretariat by facsimile or mail. Be sure to provide the information requested below in your message.

Name/Position
Organization
Street Address
City/State/Zip (Postal Code)/Country
Telephone/FAX
Email

❑ Please add me to the newsletter mailing list.

❑ Please send me the FGDC publication list.

❑ I am currently on this mailing list. This is a new address.

NCSS DATA MANAGEMENT COMMITTEE ACTIVITIES -- STANDARDS DEVELOPMENT

Jim R. Former
Soil Scientist, NSSC, NRCS
Lincoln, Nebraska

presented to
NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE
San Diego, California
July 13, 1995

Good afternoon. I appreciate the opportunity to report to you the progress of the NCSS DATA MANAGEMENT COMMITTEE and related activities of other groups.

As an introduction, I would like to give you a summary of the purpose and history of this committee.

BACKGROUND AND HISTORY

The committee was organized in 1992 with the charge of developing a common data dictionary for soil properties and related terms reported in soil surveys as part of the National Cooperative Soil Survey (NCSS). Representatives of the Natural Resources Conservation Service (NRCS), US Forest Service, and Bureau of Land Management were members. Two work sessions were held in 1992, with progress made as to the names of terms or data elements to be used.

In July 1992, the Spatial Data Transfer Standard (SDTS) was approved at the federal government level for all agencies to follow. The purpose of the SDTS is to facilitate the availability and sharing of digital data within and between federal agencies? and hopefully state and local units of government. Federal agencies were to have it implemented within one year.

The Federal Geographic Data Committee (FGDC) was formed to lead the effort of implementing the SDTS. One charge from FGDC was that common transfer standards would be developed for each data layer. The purpose of the standards is to designate a format, standard terminology and definitions by which data will be transferred no matter who the originator of the data is. By adopting such a standard, the user of the data would then only have to develop one import routine in order to use the data in his/her application. Conversely, producers of data would need to develop only one export routine.

Various subcommittees of the FGDC were formed to lead the effort as related to specific data layers. The Natural Resources Conservation Service was designated to lead the Soils Subcommittee. Various other agencies that commonly use and/or develop soils information are members. Tommy Calhoun, Program manager, Soils Division, NRCS, currently serves as the chairman of the Soils Subcommittee.

In 1994, the Clinton Administration's Information Highway initiative to facilitate the availability and sharing of electronic data accelerated the effort. On April 11, 1994, Executive Order 12906 was issued. It directed federal agencies to contribute to the development of the National Spatial Data Infrastructure (NSDI). Federal agencies were to have plans in place by April 1995 detailing their plans for contribution to NSDI.

The FGDC Soils Subcommittee identified the following categories for which standards were to be developed as part of the overall Soil Geographic Data Standard:

- -- Data Collection Rules and Procedures
- -- Reference Model
- -- Definitions, Terminology, and Content
- -- Georeferencing
- -- Metadata
- -- Data Quality
- -- Data Exchange and Transfer

I will now turn my attention to summarizing content and progress made on each of these categories.

DATA COLLECTION RULES AND PROCEDURES

This category includes the standards by which we will develop the Soil Survey Geographic (SSURGO) database. These standards include the digitizing standard for SSURGO contained in Part 647, Chapter 5, of the National Soil Survey Handbook. This part of the NSSH has been distributed to the NRCS state offices for comment and is scheduled for general release this fall.

The SSURGO digitizing standard was submitted for acceptance by the FGDC as a part of the Soil Geographic Data Standard, 6/95.

The category also includes the standard procedures by which data is collected in the field. These procedures are documented in various sections in the National Soil Survey Handbook and the Soil Survey Manual, as well as other documents such as the Soil Survey Laboratory Methods Manual. The NCSS Standards Committee is currently reviewing these procedures for acceptance as NCSS standards.

Standards for map compilation procedures are also included. These may be found in Part 647, Chapter 4, NSSH.

REFERENCE MODEL

This category refers to the format in which the digital map data will be transferred. Part 647, Chapter 5, NSSH designates the USGS Digital Line Graph (DLG-3) Optional format as the standard we will follow. This is a part of the SSURGO digitizing standard.

DEFINITIONS, TERMINOLOGY AND CONTENT

The above mentioned developments at the federal level have somewhat altered the focus and composition of the NCSS Data Management Committee. It was decided to expand the group to include our Agricultural Experiment Station partners and other federal agencies such as Environmental Protection Agency, Agricultural Research Service, and Department of Defense as members. The group is now known as the INTERAGENCY SOILS DATA BASE TEAM.

Current members of the Team are:

Jim Former, NRCS, Lincoln, NE, team leader
Rick Bigler, NRCS, Lincoln, NE
Jim Keys, USFS, Atlanta, GA

Scott Davis, BLM, Denver, CO
Wayne Hudnall, LSU, Baton Rouge, LA
Craig Palmer, EPA. Las Vegas, NV
John Doran, ARS, Lincoln, NE
Bill McMahon, DOD, Fairfax, VA

One additional member representing Agricultural Experiment Stations remains to be appointed.

Work sessions were held in April 1991 and April 1995 to continue the efforts of the earlier members. The team is also charged with developing and maintaining a standard to be followed when transferring soils attribute information. Top priority was given to developing the standard for transferring data of and about map units associated with soil maps at the traditional 1:12,000 to approximately 1:31,000 scales of our detailed soil surveys. Standards are currently being developed for point data, including laboratory data. Standards may later be developed to deal with maps at others scales, such as STATSGO and NATSGO.

The transfer standard developed for the soil survey attribute data is composed of the data dictionary, table structure, and other attribute information of a minimum dataset of the standard Map Unit Record (MUR) data. The data dictionary includes agreed upon data element names, definitions, units of measure, allowable ranges, and valid entries where choices are allowed. As used here, the minimum dataset means that all the included data elements have been considered, but not necessarily populated, for each dataset transferred.

Not all data elements included in MUR are currently a part of the transfer standard. Two other interagency groups are working to standardize terminology to be used for describing landforms/landscapes, and vegetation including land cover/use. As these groups complete their work, the results will be considered for inclusion in the transfer standard. The remainder of the MUR data will be available to the various users who wish to have it. The data dictionary will also be coordinated for the additional data.

The team has elected to use the data structure of NASIS for transferring this data. The main reason for this choice is that NASIS appeared to be the furthest along in development of all the data management systems of the agencies involved. NRCS personnel were also designated as the caretakers of the transfer standard. A process by which changes and additions will be made to the standard has been adopted. A further explanation of how this team will function is included for your information.

This transfer standard has been submitted to FGDC for acceptance, 6/95.

GEOREFERENCING

Part 647, Chapter 5, NSSH states that Universal Transverse Mercator (UTM) will be the standard map projection. Point data is to be located using latitude and longitude coordinates. NAD83 is the standard datum to be used.

METADATA

Metadata is data about data. This includes such things as the source of the data, how it was collected or generated, by whom, availability of and access to the data, when produced, data quality, etc. Metadata also includes a description of the data contents including file format and a data dictionary.

The FGDC has adopted a standard metadata template to be used for all data. We have modified this standard template for use with SSURGO data. Part 647, Chapter 5, NSSH includes a copy of the SSURGO template.

The SSURGO metadata template was submitted to FGDC for acceptance, 6/95. The SSURGO template will likely be modified to better describe the MUR data portion of the SSURGO database.

DATA QUALITY

Development of standards for assessing data quality have not been completed. There is a team at the National Soil Survey Center working on a method to evaluate the quality of data developed by the various soils laboratories. The team is considering an assessment based on standard laboratory methods being used, the existence of a quality control system within the lab, experience and expertise of technicians, sample handling procedures, etc. A list of potential assessment criteria has been routed to various laboratories for comment. It is hoped their product can be modified for assessment of other kinds of data.

QATA EXCHANGE AND TRANSFER

The standards for transferring soils data are identified as part of the digitizing standards and MUR data standards discussed above.

These standards were submitted to FGDC for acceptance, 6/95.

SUMMARY

In summary, standards have been developed and submitted to the Federal Geographic Data Committee for the following categories of soils data:

-- SSURGO data
-- Soil attribute data (MUR)
-- Georeferrencing standards
-- Metadata
-- Data exchange and transfer

Prior to being submitted to the FGDC for acceptance, the various portions of the Soil Geographic Data Standard received rather extensive review. They were first reviewed by the team developing them. In some cases this was an interagency or NCSS effort. Some team members further routed them to others within their respective agencies. The NCSS Standards Committee then reviewed and accepted the proposals, followed by the FGDC Soils Subcommittee. The individual portions were then combined for submission to the FGDC.

Work is progressing with development of standards for:

-- Point data definition and transfer
-- Data quality assessment
-- NCSS standards for field data collection

SOIL GEOGRAPHIC DATA STANDARD

Map Unit Attribute Data
Jim R. Fortner
June 1, 1995

Purpose:
The purpose of this standard is the partial fulfillment of the mandate of OMB Circular 16 and the Federal Geographic Data Committee (FGDC) that standards be developed to facilitate the transfer of spatial data between governmental agencies. The Natural Resources Conservation Service (former Soil Conservation Service) was charged with coordinating the development of standards for the transfer of soils data.

When adopted, this standard will facilitate the transfer and use of soils related data. It will allow users of such data to receive data in a common format, no matter who the developer of the data is. It will allow much more data to be available to a more diverse group of users.

Scope:
This standard applies to the tabular data associated with the digital soil survey maps developed by the National Cooperative Soil Survey (NCSS) at scales of about 1:12,000 to 1:30,000. It contains data of and about soil map units and map unit components.

Limits:
This standard is limited to data associated with soil map units (aggregated data), at scales of about 1: 12,000 to 1:30,000. As presented at this time, the standard does not contain information dealing with the description of landforms and landscapes, or vegetation as related to soil map units. This information will be added at a future time once the respective interagency groups complete work on these subjects.

It should be understood that this standard will likely be modified and added to as time goes on. These modifications will be advertised to known users of the standard.

An additional part of the standard will be developed to deal with point or site (pedon) data. Other additions may also be developed for data to ‘accompany soil maps at other scale levels.

Development Process:
This standard is the result of a cooperative effort. Initial meetings were held in the Fall of 1992 with progress made since that time. Representatives of several federal agencies and universities have contributed to the effort. Agencies involved include the Natural Resources Conservation Service, Forest Service, Bureau of Land Management, Environmental Protection Agency, and Agricultural Research Service.

Maintenance:
A team has been approved and members appointed by the Soils Subcommittee of the Federal Geographic Data Committee to maintain and enhance this standard.

Membership is as follows:

Jim Fortner, NRCS, Lincoln, NE, (team leader)
Ricky Bigler, NRCS, Lincoln, NE
Jim Keys, USFS,

John Doran, ARS, Lincoln, NE
William McMahon, DMA-DOD, Fairfax, VA
Craig Palmer, EPA, Las Vegas, NV

One additional member representing the Agricultural Experiment Stations remains to be named.

Membership terms are for three years, expiring on a staggered basis -- three expiring each year beginning after the first three years.

Other agencies/entities such as the US Fish and Wildlife Service, Bureau of Indian Affairs, Bureau of Reclamation, Bureau of Mines, Biological Survey, and US Park Service may be contacted for input related to data relative to their specialty. The existing NCSS work planning processes and state contacts will be utilized to allow for input from other concerned parties.

This team will use the following procedure to process proposals to modify or add to the standard:

* Each team member will receive, review and organize proposals originating within their respective agency/entity. They will then forward a recommendation for action to the team leader.

* The existing NCSS Work Planning Conference structure, and state contacts, will be used to allow for input from industry, non-industrial landowners, and non-traditional users to the team.

* The team leader will route the proposal along with the originating agency's recommendation to team members for review and recommendation.

* The 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 team leader.

* A feedback and tracking mechanism will be established to ensure that originators of proposals are informed of actions taken on their proposals.

* A minimum standard for documentation to accompany all proposals will be established.

* A mechanism to get input and/or review of proposals from agencies not represented on the team will be established.

* A scheme to ensure timely review and processing of proposals will be established.

*The data set will be maintained by the Natural Resources Conservation Service staff.

GLOBAL SOIL MOISTURE AND TEMPERATURE REGIMES

H. Eswaran, E. van den Berg, P. Reich
R. Almaraz, B. Smallwood, and P. Zdruli

World Soil Resources
USDA Natural Resources Conservation Service
Washington DC 20013

July 1995

GLOBAL SOIL MOISTURE AND TEMPERATURE REGIMES

H. Eswaran, E. van den Berg, P. Reich,
R. Almaraz, B. Smallwood, and P. Zdruli

(World Soil Resources, Natural Resources Conservation Service,
P.O. Box 2890, Washington D.C. 20013)

INTRODUCTION

Knowledge of soil moisture and temperature regimes (SMR and STR) for land use and other applications of climatic data, is as useful information as air temperature and rainfall. SMRs and STRs are studied by meteorologists, climatologists, ecologists, agronomists, soil scientists, civil engineers, farmers, and many others who use soils. Both SMR and STR affect physical, chemical and biological processes in soils. Growth, multiplication, and activities of soil-borne organisms are influenced by soil climate. Seed germination is determined by both the availability of adequate moisture and by a limited range of soil temperature. Soil temperatures above or below critical limits severely inhibits seed germination even if there is adequate soil moisture. The life-cycles of many soil-borne pests and diseases are controlled by SMR and STR.

The soil is a kind of buffering system. When rain falls on the soil, the moisture is absorbed by soil aggregates and retained until released through slow release or evaporation. Excess water is either lost through run-off or drained away. If there are impermeable layers in the soil and there is no facility to discharge water out of the soil, water accumulates and a water-table develops in the soil. For some uses, such as growing rice, a water-table maintains a water-saturated zone in the rooting zone and this is a useful property of the soil. But for most other uses, such as use of the soil as septic-tank filter fields, this is a constraint. In soils with deep or no water-tables, when rain stops, the soil may still have water for the plants so that if the dry-spell is short, the soil enables the plant to survive until the next rains. This buffering capacity of the soil is a basic reason for evaluating soil moisture and temperature conditions.

Soils also buffer temperature. The soil temperature at 100 cm or more is relatively constant throughout the year. In fact the easiest way to obtain a good measurement of the mean annual soil temperature is to measure the temperature of well water during any time of the year. The soil temperature at 50 cm depth, and its variations, is used as a reference for soil classification purposes.

The temperature of the top few centimeters of the soil fluctuates considerably during the year. It can get very hot or very cold. In the dry tropics, surface soil temperatures of more than 50°C have been measured and at this temperature, many plant tissues are killed. When the surface soil temperature is very low, uptake of mineral nutrients is significantly reduced. In the cold regions of the world, where the surface soil temperature remains at about 1°C or lower for long periods, the trees are dwarfed and if the low temperatures persist, plants do not grow at all. The day-night or diurnal fluctuations in soil temperature is maximum at the soil surface and decreases with depth, reaching a minimum at 50 cm or more. Many rodents burrow to 1 m depth where it is much warmer than the cold temperatures on the soil surface. Some desert lizards and beetles stand vertically on their fore-feet during the early morning so that the morning dew condenses on their body and provides them with life-saving moisture; during the heat of the day, they also stand on their feet so that their body is not scorched by the hot sand but is cooled by the flow of air on the soil surface. Although the soil temperature in the upper few centimeters of the soil is important in some situations, for global or regional assessments the temperature at 50 cm depth is evaluated as a convention in Soil Taxonomy.

<u>Measurins soil moisture and temperatures</u>

S_M and S_T are measured at different depths in the soil; the usual depths are at 5, 10, 20, 50, and 100 cm. Moisture and temperature sensors are available to continuously monitor moisture and temperatures throughout the year. These are however expensive pieces of equipment (about $1,500 each) and there are only a few installations around the world. Prior to the availability of these instruments, soil moisture was measured by taking soil samples and measuring their moisture content gravimetrically -- by weighing them. Soil temperature can also be measured manually by inserting thermometers at critical depths in the soil.

In order to make global assessments of soil moisture and temperature conditions, it is necessary to have a good density of stations. In many countries of the world, particularly the developing countries, this is not available. Therefore, a model must be used to evaluate these.

In 1972, Franklin D. Newhall and Reese Per Daniel of the Soil Conservation Service (SCS) developed a computer based mathematical model to estimate soil moisture and temperature regimes (SMR and STR) from atmospheric precipitation and temperature data. The procedure was only published as a SCS internal report but later Dr. A. Van Wambeke (1981, 1982, 1985), currently at Cornell University, developed a personal computer version of Newhall's Fortran model and incorporated some proposals for subdivisions of the SMR as defined in Soil Taxonomy (Soil Survey Staff, 1975). Minor changes to Van Wambeke's model was made recently at SCS and the results presented here are based on this.

The model (explained in Appendix I) was never intended to provide site specific information or to be a substitute for actual field measurements. It is, however, very useful for showing the geographical distribution of the SMR and STR classes on small scale maps. It uses monthly data though one could process annual data for a period of 25 or more years and estimate the SMR class on a probability basis.

STR and SMR was computed for 27,000 climatic stations around the world and these were critically evaluated. Station data, average for 25 or more years, were supplied by national meteorological departments or from publications. The basic data set is from Wenstedt (1972). This data set was substituted with more recent data when available. Recent data is not readily available for many of the East European countries and the former Soviet Republics. Thus the data set is not uniform with respect to the period of the data. An evaluation was done at a few locations by on-site visits and in most cases by comparisons of the computed SMR and STR with other climatological maps and vegetation maps. Geographical patterns were the main criteria for assessment and if within a given area a station has aberrant rainfall and/or temperature conditions, this station was eliminated from the database.

Definition of STR and SMR

The definitions as provided in Soil Taxonomy (Soil Survey Staff, 1975) has some deficiencies and an attempt is made to modify some of the definitions. Appendix 11 and III lists the 'Key' to identification of the proposed new STR and SMRs.

Some of the changes we have introduced are the following:

1. We have split the current Pergelic STR into Gelic, Pergelic, and Hypergelic. Our initial testing indicates that the Hypergelic corresponds to areas with continuous permafrost and the Pergelic with areas with intermittent permafrost. We are

proposing that areas with Hypergelic or Pargelic STRs have Permafrost or Interfrost as SMR designation. They will not carry any of the other SMR designations.

2. We have introduced a lower limit to the temperature regime of the Xeric SMR. With the new definition, Xeric SMR cannot have a Gelic, Pergelic, or Hypergelic STR. In addition we have introduced a 'Udic Xeric' as a udic transition of the Xeric SMR to a Udic SMR.

3. We have modified the frigid/cryic definitions. We cannot use the definition in Soil Taxonomy as our database contains no information about vegetation and '0' horizons. Apart from that, we think that the definition of Cryic in Soil Taxonomy deviates from the logic of the system!

4. We have introduced Megathermic and Isomegathermic with a MAST of 29°C or higher.

5. We have deleted ISOFRIGID as we have no station which is designated as such (in our database of 27,000 stations around the world).

6. In table I, we present the "GLOBAL PEDO-CLIMATIC DOMAINS". We have always been troubled by the fact that Geographers and Ecologists do not use our system. They do not understand our terms and the matrix shown should be attractive to them. These can be made equivalent to Holdridge's Lifezones, Koppen Classification or other global systems. In table I., the SMRs and STRs are grouped to reflect commonly used classifications such as temperate, tropical, boreal, mediterranean etc.

Application of the model

Data from about 27,000 climatic stations around the world was processed to evaluate the global geographic distribution of SMR and STR. The computation of soil climatic parameters and classification of soil moisture and temperature regimes are based on climatic data. The climatological normals are based on records for a 25-year period in most cases; some stations had data for fewer years. A normal of a climatological element is the arithmetic mean computed over a time period spanning three consecutive decades. Homogeneity of instrument exposure and station location is assumed. If no exposure changes have occurred at a station, the normal is estimated by simply averaging the 25 values from the record.

The World Soil Resources staff of NRCS are currently preparing maps at a scale of 1:5 M which will depict the SMR, STR, and the length of the growing season. Table 2 is an example of a print-out of a selected station from the database. Each month has for convenience 30 days and the calendars depict an average condition. The moisture calendar shows the days when the soil is dry, partly dry or moist, and moist. There is adequate moisture in the soil during the period indicated as moist. There is no moisture in the soil during the period indicated as dry and the period indicated as M/D is a transitional situation.

The model also estimates the duration, commencement and end of the growing season. The growing season is considered as the period when there is no temperature or moisture stress. Temperature stress occurs when soil temperature is less than 5oC. Moisture stress sets in when the soil moisture control section is at or close to a tension of 15 bar (indicated as dry on the moisture calendar). On the temperature calendar, plant growth begins when the soil temperature is greater than 8°C and ends when it is less than 5°C. Consequently, the actual growing season is determined both by the period when the soil temperature meets the above criteria and by the availability of moisture during this period.

Dry conditions can also be expressed as a moisture stress severity index. The higher the value of the index, the greater the stress. When the moisture stress severity index (MSSI) is greater than 0.65, the land is a desert. The semi-arid regions of the world have a MSSI of 0.25 to 0.64, and the remaining are humid.

The tropical regions are demarcated by the iso-temperature regimes -- isomesic, isothermic, isohyperthermic, and isomegathermic. The temperate regions are demarcated by the mesic, thermic, hyperthermic, and megathermic STRs while the cold boreal regions are demarcated by the frigid, cryic and pergelic STRs. The regions with pergelic STR are also described as the tundra and many soils in this region have permafrost or remain frozen for long periods.

Such assessments are needed to develop global estimates of arable land and food production capability. Climate is not the only factor controlling food.and fiber production. The other important factor is soils. In addition, other factors such as socioeconomic conditions of the country and its farmers, political will, marketing and other infra-structures all determine a country's capability to produce food. A comprehensive analysis of the population supporting capability of the world would require all of this information.

Table 1.

GLOBAL PEDO-CLIMATIC DOMAINS

		TROPICAL				TEMPERATE				BOREAL		
	STR / SMR	Isomega-thermic	Isohyper-thermic	Iso-thermic	Iso-mesic	Mega-thermic	Hyper-thermic	Thermic	Mesic	Frigid	Cryic	Gelic
ARID	Extreme Aridic	AM1	AT1	AT4	AT7	AG1	AW1	AW4	AW7	AB1	AB4	AB7
	Typic Aridic	AM2	AT2	AT5	AT8	AG2	AW2	AW5	AW8	AB2	AB5	AB8
	Weak Aridic	AM3	AT3	AT6	AT9	AG3	AW3	AW6	AW9	AB3	AB6	AB9
MEDITER.	Dry Xeric							XW1	XW4	XB1	XB4	
	Typic Xeric							XW2	XW5	XB2	XB5	
	Udic Xeric							XW3	XW6	XB3	XB6	
SEMI-ARID TROPIC.	Aridic Tropustic	SM1	ST1	ST4	ST7							
	Typic Tropustic	SM2	ST2	ST5	ST8							
	Udic Tropustic	SM3	ST3	ST6	ST9							
SEMI-ARID TEMPER.	Xeric Tempustic					UG1	UW1	UW4	UW7	UB1	UB4	UB7
	Wet Tempustic					UG2	UW2	UW5	UW8	UB2	UB5	UB8
	Typic Tempustic					UG3	UW3	UW6	UW9	UB3	UB6	UB9
HUMID	Typic Udic	DM1	DT1	DT3	DT5		DW1	DW3	DW5	DB1	DB3	DB5
	Dry Tropudic	DM2	DT2	DT4	DT6							
	Dry Tempudic					DG1	DW2	DW4	DW6	DB2	DB4	DB6
	Perudic		PT1	PT2	PT3		PW1	PW2	PW3	PB1	PB2	PB3

If STR is Hypergelic, SMR is PERMAFROST (PF)
If STR is Pergelic, SMR is INTERFROST (IF)

July 1995

USDA-NRCS
WORLD SOIL RESOURCES

*********10*********20*********30

REFERENCES

Newhall, F. 1972. Calculation of soil moisture regimes from climatic records. Unpublished. Soil Conservation Service, USDA. Rev. 4. Washington D.C.

Soil Survey Staff, 1975. Soil Taxonomy. A basic system of soil classification for making and interpreting soil surveys. Soil Conservation Service, USDA. Agr. Handbook No. 436. Washington D.C.

Van Wambeke, A. 1981, 1982, 1985. Calculated soil moisture and temperature regimes of South America, Africa, and Asia. SMSS Tech. Monograph No. 2, 3, and 9. Washington D.C.

Wenstedt, F.L. 1972. World Climatic Data. Climatic Data Press. Lemont, Pennsylvania, USA.

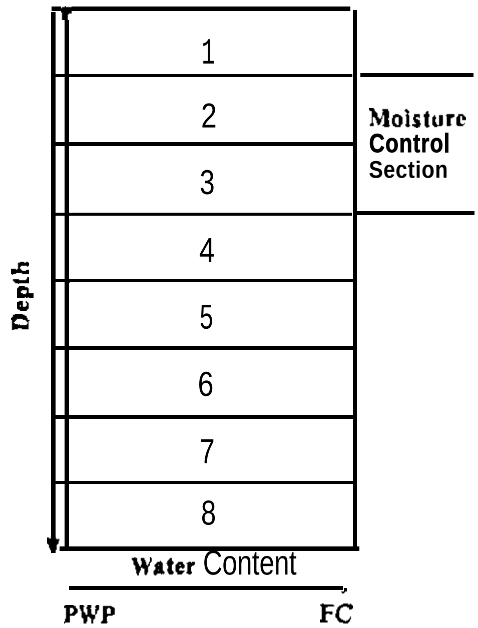


Fig. 1. The soil moisture profile

1.2 **Water Uptake and Water Removal**

Table 1. Soil moisture diagram and slot sequence during depletion.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

The model simulates the downward movement of moisture into the soil as the progression of a wetting front; it is further referred to as accretion. The distance that the wetting front moves downward depends on the amount of water needed to bring all the soil above it to field capacity. When the wetting front reaches the bottom of the profile and all the soil above is at field capacity, the excess *water is* lost either by *percolation or* by *runoff.*

The rate of *removal of water* out *of the soil*, or depletion depends on the energy available for moisture extraction, expressed in terms of *potential* *evapotranspiration (PE),* which acts on the soil and the plants growing in the soil. The energy required to remove moisture from the soil depends on the amount of water (AW) present and the force exerted by the soil to retain it. Water is removed more readily when the soil water is at low tensions than when the water content in the profile is at a minimum. Less energy is used by the model to remove water from the upper layers of a soil than from the lower layers. The depth at which moisture sislocated in the profile influences the time needed to extract it from the soil; this is also in line with the fact that roots are more abundant near the surface than in deeper layers.

Depletion continues until the soil is at wilting point, that is when the soil moisture tension is 1500 kPa. The amount of water held in the soil is assumed not to be reduced below the amount held at 1500 kPa.

1.3 The Climatic Factors

The distribution of rainfall - The monthly precipitation (MP) is assumed to be distributed within each month according to the following sequence:

(a) One half of the monthly precipitation (HP for *heavy precipitation)* falls during one storm in the middle of the month; thiss moisture enters the soil immediately without losses, except when the available water capacity is exceeded.

(b) One half of the monthly precipitation (LP for *light recipitation)* occurs in several light falls, and is partly Yost by evapotranspiration before it can enter the soil; it can only infiltrate into the soil when LP exceeds the potential evapotranspiration .

The **potential evapotranspiration** (PE) is assumed to be uniformly distributed during each month. Not all its energy is used to extract water from the soil. A part is used to dissipate as much light precipitation as possible before it reaches the soil If there is surplus energy, it is used for water extraction from the profile.

2 The Time-Step Progression of the Model

Each month, all of which have 30 days, is divided into three parts. The first is a 15-day period of light precipitation (LP), the second is the heavy rainfall (HP) which occurs at midnight between the 15th and 16th of the month, and the third corresponds to another fortnight of light precipitation.

For each of these events water is either added to the soil or extracted from it. At the completion of each step,, the *moisture condition* of the soil is determined, and if it changed, the model computes the number of days during which each condition prevailed *in* the moisture control section.

The starting soil moisture condition of the profile is determined by running the simulation program for a number of consecutive iterations using each time the same input each year until the moisture content for December 30th does not differ by more than one hundredth of the content found at the same date in the immediately preceding iteration. The program then starts, the diagnostic processing of month y data with an initial amount of water in each slot equal to the one found on December 30th.

When all months are processed the soil moisture conditions for each day are combined into the moisture *condition calendar* which forms the data base for the determination of the soil moisture regime according to the definitions of *Soil Taxonomy.*

2.1 Processing Sequence During One Year

Each *half-month interval is* processed using the following inputs: monthly precipitation (MP) and monthly potential evapotranspiration (PE). The steps are as follows:

(a) compute light precipitation (LP), where

LP = MP/2

(b) compute the net potential evapotranspiration (NPE):

NPE = (LP - PE)/2

if NPE > 0, accretion will take place during the period being processed; if NPE < 0, the profile will be depleted.

All *heavy precipitations in* the middle of each month are processed using the following inputs:

(a) compute heavy precipitation (HP), where

HP = MP/2

(b) enter this amount in the profile as accretion.

2.2 Changes in Water Content During Each Period

2.2.1 Accretion

To simulate the additions of moisture to the profile, water is entered in the soil in each nonfull slot following a specific order as shown in the soil moisture diagram of table 1.

The sequence starts with the left slot in the top row. Water is added to each successive slot in a row until the row is filled, or until the water supply is exhausted; when a layer of slots is filled the program proceeds with the immediately underlying layer, starting again with the left side of the moisture diagram.

By following the specified order and withholding the accretion of moisture into one layer until the layer above is completely filled the arithmetic model approximates a downward advancing wetting front.

2.2.2 Depletion

Table 2 Sequence of slots during depletion

29	22	16	11	7	4	2	1
37	30	23	17	32	8	5	3
44	38	31	24	18	13	9	6
50	45	39	32	25	19	14	10
55	51	46	40	33	26	20	15
59	56	52	47	41	34	27	21
62	60	57	53	48	42	35	28
64	63	61	58	54	49	43	36

In simulating the extraction of water from the profile, the slots are processed in a different order. The sequence starts with the top right-hand slot and scans the slots in successive right-downward diagonals (table 2).

During the sequence each slot is examined, and if water is present, it is removed from it. The depletion stops when the potential evapotranspiration, or the energy it represents for the period being processed, is exhausted.

The rate of depletion is inversely proportional to the tension under which the water is held. It also varies with the depth of the layer. Both factors are taken into account in the calculations by means of the *depletion requirement diagram* which indicates the value

Table 3 Depletion Requirement Diagram

1.65	1.40	1.23	1.13	1.05	1.00	1.00	1.00
2.07	1.69	1.43	1.26	1.15	1.07	1.02	1.00
2.68	2.14	1.74	1.46	1.28	1.17	1.09	1.00
3.58	2.80	2.22	1.78	1.49	1.31	1.19	1.11
4.98	3.80	2.93	2.30	1.84	1.53	1.34	1.21
5.00	5.00	4.03	3.07	2.38	1.89	1.57	1.37
5.00	5.00	5.00	4.31	3.22	2.47	1.95	1.61
5.00	5.00	5.00	5.00	4.62	3.39	2.57	2.01

by which a unit of energy (expressed as evapotranspiration) has to be multiplied to extract one unit of water from the soil. This matrix of values is given in table 3.

The processing continues until the entire evapotranspiration potential has been used, or until all slots have been set to zero. In the latter case any remaining depletion amount is not carried forward but is discarded.

2.2.3 Definitions of Soil Moisture Conditions

Soil *Taxonomy* recognizes three soil moisture conditions. They are diagnostic for compiling the moisture regime of a pedon. and are evaluated in the moisture control section.

(a) The moisture control section is dry *in all parts.* It is also called *completely dry.* The Newhall model accepts this condition when the leftmost slots numbered 09, 17, and 25 in table 1 are all empty.

(b) The moisture control section is *moist in all parts,* or *completely moist.* The Newhall model defines this condition when none of the leftmost slots numbered 09, 17, 25 in table 1 is empty.

(c) The moisture control section is *dry in some parts or moist in some parts .* It is also called *partly dry or partly moist.* The Newhall model considers this condition only when the moisture control section does not fulfill the requirements for (a) nor (b) when it is either dry or moist in all parts.

The Newhall model uses slot 25 which is located outside the moisture control section (MCS) to determine the soil moisture condition. In an accretion step this slot signalsthat the MCS

it increases the amount of water to be extracted from the soil before a change to the completely dry condition is recorded. The inclusion of slot 25, and the diagonal extraction pattern, compensate in part for the fact that the model ignores all upward movements of water in the soil which in reality participates in the moisture supply to the MCS.

2.3 Number of Days of Moisture Conditions in each Period

If the moisture condition changes during a period of light precipitation, the relative durations of each moisture condition is computed.

The following equations are used:

DX = 15 * RPEX/NPE

where DX is the duration in days of condition X, and RPEX is the amount of potential evapotranspiration needed to change this condition into the next one (for example from completely moist to partly moist). NPE is the potential evapotranspiration which wasavailable during the half-month being processed. The duration of the moisture condition which ends a half month is calculated by difference, or

DE = 15 - DX - DX2

where DE is the duration of the soil moisture condition which ends the half-month, and where DX and DX2 are the durations of the preceding conditions.

The same equations are used when the conditions change from dry conditions into more humid conditions. In this case rainfall instead of evapotranspiration is used to compute the number of days.

2.4 Changes in Soil Temperature

The beginning and ending dates of the time when the soil temperature is above or below a given critical value, i.e. 5 or 8 degrees C, is approximated from the sequence of mean monthly temperatures.

The onset of a period when the soil temperature rises above a critical level is obtained by linear interpolation between the 15th of each month. 21 days are then added to this date to compensate for the time lag between air and soil temperature.

The date at which the soil temperature falls below a critical level is calculated following a similar process, except that ten days are added to the result.

3 Determination of the Moisture and Temperature Regimes

The computer model developed for this study processes for each station the climatic record of one average year, which only provides input for 12 months. For the calculations of periods of soil conditions extending across calendar years, the model attaches an identical second year to the input.

The two-year calendars are then scanned and the number of consecutive or cumulative days during which given soil climatic conditions prevail are calculated. These are included in the output, and listed in the tables.

APPENDIX II

CLASSES OF SOIL TEMPERATURE REGIMES

Mean soil temperatures are estimated by the following relationships:

$$MAST = 2.180 + 0.969(MAAT) \qquad r^2=0.958^{***}$$

NOTE: 0.66 is used to reduce (MSAT-MWAT) to determine (MSST-MWST).

MAAT = Mean Annual Air Temperature
MSAT = Mean Summer Air Temperature
MWAT = Mean Winter Air Temperature
MAST = Mean Annual Soil Temperature
MSST = Mean Summer Soil Temperature
MWST = Mean Winter Soil Temperature

Hypergelic - (G. *hyper*, continuous, and L. *gelare*, to freeze; connotes permanent frost or permafrost conditions). The mean annual soil temperature is lower than 0 degrees C and the mean summer soil temperature is less than 5 degrees C.

Pergelic - (L. *per*, throughout in time and space, and L. *gelare*, to freeze; connoting intermittent permafrost conditions). Soils with a pergelic temperature regime have a mean annual temperature lower than 0 degrees C and the mean summer soil temperature is 5 to 10 degrees C.

Gelic - (G. freeze; connoting very cold conditions). Soils with gelic soil temperature regimes have a mean annual soil temperature lower than 0 degrees C and a mean summer soil temperature equal to or higher than 10 degrees C.

Cryic - (Gr. *kryos*, coldness; connoting very cold soils). In this regime soils have a mean annual temperature 0 degrees C or higher but lower than 8 degrees C. The mean summer soil temperature is lower than 15 degrees C.

Frigid - The frigid regime and some of the others that follow are used chiefly in defining classes of soils in the lower categories of Soil Taxonomy. In the frigid regime the soil is warmer in summer than the one in the cryic regime, but its mean annual temperature is lower than 8 degrees C, and the difference between mean winter and mean summer soil temperature is more than 5 degrees C at a depth of 50 cm or at a lithic or paralithic contact, whichever is shallower. The mean summer soil temperature is 15 degrees C or higher.

Mesic - The mean annual soil temperature is 8 degrees C or higher but lower than 15 degrees C and the difference between mean summer and mean winter soil temperature is more than 5 degrees C at a depth of 50 cm or at a lithic or paralithic contact, whichever is shallower.

Thermic - The mean annual soil temperature is 15 degrees C or higher but lower than 22 degrees C, and the difference between mean summer and mean winter soil temperature is more than 5 degrees C at a depth of 50 cm or at a lithic or paralithic contact, whichever is shallower.

Hyperthermic - The mean annual soil temperature is 22 degrees C or higher but lower than 29 degrees C, and the difference between mean summer and mean winter soil temperature is more than 5 degrees C at a depth of 50 cm or at a lithic or paralithic contact, whichever is shallower.

Megathermic - The mean annual soil temperature is 29 degrees C or higher, and the difference between mean summer and mean winter soil temperature is more than 5 degrees C at a depth of 50 cm or at a lithic or paralithic contact, whichever is shallower.

If the name of a soil temperature regime has the prefix "iso," the mean summer and winter soil *temperature differ by 5 degrees C or less, at a depth of 50* cm or at a *lithic or paralithic contact, whichever is shallower.*

~~**Isofrigid** - The mean annual soil temperature is lower than 8 degrees C.~~ *This class is eliminated. Any* soil *which was previously designated as Isofrigid is now* cryic.

Isomesic - The mean annual soil temperature is 8 degrees C or higher but lower than 15 degrees C.

Isothermic - The mean annual soil temperature is 15 degrees C or more but lower than 22 degrees C.

Isohyperthermic - The mean annual soil temperature is greater than or equal to 22 degrees C or less than 29 degrees C.

Isomegathermic - The mean annual soil temperature is greater than or equal to 29 degrees C and the difference between mean summer soil temperature and mean winter soil temperature is less than or equal to 5 degrees C.

APPENDIX III

KEY TO SOIL MOISTURE REGIMES

All the moisture conditions in this key are assumed to occur at least six years out of ten. The aquic moisture regime is not included in the key. The months of June, July, August, designate 'summer' and the months of December, January, February, designate 'winter' in the northern hemisphere; it will be converse in the southern hemisphere.

1. The STR is hypergelic

if true, **PERMAFROST**
if false, go to...2

2. The STR is pergelic

if true, INTERFROST
if false, go to...3

3. The moisture control section is completely dry more than 60% of the time (cumulative) that the soil temperature is over 5 degrees C, and the STR is mesic, cryic, frigid, or gelic.

if true, go to 5
if false, go to...4

4. The moisture control section is completely dry more than 50% of the time (cumulative) that the soil temperature is over 5 degrees C

if true, go to...5
if false, go to...6

5. When the soil temperature is over 8 degrees C, the moisture control section is partly or completely moist for 90 consecutive days or more

if true, go to...7
if false...**ARIDIC**

6. The mean annual soil temperature is less than 22 degrees C

if true, go to...7
if false, go to...10

7. The difference between winter and summer soil temperatures at 50 cm depth is equal to or higher than 5 degrees C

if true, go to...8
if false, go to...11

8. The STR is gelic

if true go to 11
if false, go to ..9

9. Within the four months that follow the summer solstice the moisture control section is completely dry for at least 45 consecutive days

if true, go to...10
if false, go to...11

10. Within the four months that follow the winter solstice the moisture control section is completely moist for at least 45 consecutive days

if true...XERIC
if false, go to...11

11. The moisture control section is completely dry or partly dry for 90 cumulative days or more

if true, . ..USTIC
if false, go to...12

12. The precipitation exceeds evapotranspiration in all months

if true...PERUDIC
if false go to 13

13. The moisture control section is moist for more than 90 cumulative days

if true...UDIC
if false...UNDEFINED

KEYS TO TENTATIVE SUBDIVISIONS OF MOISTURE REGIMES

The use of these keys should always be preceded by the identification of the soil moisture regime in terms of the five classes: udic, perudic, ustic, aridic, and xeric (see above). Each section on this page is an individual key, which is not connected immediately to the following key to form one flowchart leading from one set of subdivisions to another. The general key above constitutes the main framework which links the individual subdivision keys.

In these keys, all climatic requirements are assumed to occur in most years (at least six out of ten).

KEY TO SUBDIVISION OF ARIDIC

1. Soils with aridic moisture regimes in which the moisture control section (MCS) is completely dry during the whole year:

EXTREME ARIDIC

2. Other soils with aridic moisture regimes in which the MCS is moist in some or all parts for 45 consecutive days or

less during the period that the soil temperature at 50 cm depth is more than 8 degrees C:

TYPIC ARIDIC

3. Other soils with aridic moisture regimes:

WEAK ARIDIC

KEY TO SUBDIVISION OF XERIC

1. Soils with xeric moisture regimes in which the MCS is dry in all parts for more than 90 consecutive days during the four months following the summer solstice:

DRY XERIC

2. Soils with xeric moisture regimes in which the MCS is moist in all parts for more than 90 consecutive days during the four months following the winter solstice:

UDIC XERIC

3. Other soils with xeric moisture regimes:

TYPIC XERIC

KEY TO SUBDIVISION OF USTIC

1. Soils with an ustic moisture regime and an iso-temperature regime in which the number of consecutive days that the MCS is completely or partly moist when the soil temperature at 50 cm depth is more than 8 degrees C, is as follows:

a) less than 180 days:

ARIDIC TROPUSTIC

b) 180 or more but less than 270 days:

TYPIC TROPUSTIC

c) 270 or more days:

UDIC TROPIJSTIC

2. Other soils with an ustic moisture regime and without an iso-temperature regime:

a) soils in which the MCS is dry in all parts for more than 45 consecutive days during 4 months following the summer solstice, and where the MCS is moist in all parts for more than 45 consecutive days during 4 months following the winter solstice:

XERIC TEMPUSTIC

b) other soils where the MCS is moist in all parts for more than 45 consecutive days during 4 months following the winter solstice, and where the MCS is not completely dry for more than 45 consecutive days during 4 months following the summer solstice:

WET TEMPUSTIC

c) other soils:

TYPIC TEMPUSTIC

KEY TO SUBDIVISION OF UDIC

1. Soils with a udic moisture regime in which the MCS is dry in some or all parts for less than 30 cumulative days:
TYPIC UDIC

2. Other soils with a udic moisture regime in which the MCS is dry in some or all parts for 30 or more cumulative days:

a) with an iso-temperature regime:
DRY TROPUDIC

b) without an iso-temperature regime:
DRY TEMPUDIC

SOIL QUALITY/SOIL HEALTH COMMITTEE REPORT

INTRODUCTION

Soil quality is increasing in prominence as a concept. It is suggested as a tool for a sensitive and dynamic way to document the condition of soils, how they respond to management changes, and their resilience to stresses; either by natural forces or management practices. A soil quality standards symposium was sponsored by Divisions S-5 and S-7 at the SSSA meetings in 1990. A second symposium was sponsored by Divisions S-3, S-6. and S-2 of the SSSA and A-5 of the ASA at the 1992 meetings. A poster session was held at the Seattle meetings in 1994. The USDA Forest Service Regions have had various soil quality standards for several years. They have served as a focus for monitoring activities. Most of these standards are based on physical properties and conditions. Increasingly, there is concern and interest in chemical and biological indicators of soil quality. Recently, the NRCS has established a soil quality institute as a focus of technology transfer.

Following is a definition of soil quality. It is slightly modified from the current definition proposed by the SSSA Ad Hoc Committee on Soil Quality. However, we believe the essence of that definition is retained. Soil quality is defined as:

The capacity of a specific soil to function, within natural or altered ecosystem or land use boundaries, to sustain or improve plant and animal productivity, water, air quality, and human health and habitation.

Vital ecosystem functions that soils perform include: (1) sustaining biological activity, diversity, and productivity; (2) regulating and partitioning water and solute flow; (3) filtering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials, including industrial and municipal by-products and atmospheric depositions; (4) storing and cycling nutrients, energy, and other elements within the earth's biosphere; and (5) providing support for socioeconomic structures and protection for archeological treasures associated with human habitation.

The Steering Committee for the Conference establisehd this committee on soil quality and assigned the following charges:

Determine if there are better indicators than productivity measures.
Summarize research going on in Soil Quality and who is doing it.
Summarize current Soil Quality monitoring efforts.
Recommend how to form partnerships to develop and disseminate knowledge and technology about soil quality. Consider such things as funding, joint research and development, contributing to technology transfer, and other support.
Review how the Natural Resources Conservation Service or any other agency can incorporate Soil Quality concepts into its land or conservation planning efforts.
Suggest how Soil Quality measures can be linked to both attribute and geographic information systems.
Summarize and recommend Soil Quality Standards.

Charge 1. Determine if there are better indicators than productivity measures.

Discussion:

Some respondents suggested that productivity may be useful, but it is only one of the functions that soils perform. There is a consensus that soil quality indicators need to be defined for the various functions. Bach function may require several variables or measures. For example, physical, chemical and biological indicators may be useful.

Soil quality variables also need to be related to specific land uses. That is, agriculture, forestry, grazing, or wildlife habitat. Variables that promote yield and productivity may be deleterious to environmental quality. For example, high infiltration rates that promote soil moisture for plant growth, may contribute to leaching. Some suggest that the various indicators be combined into a single index. But that might be misleading end could mask individual variables of much significance.

Some examples of soil quality indicators for productivity include microbial biomass, enzyme activity, bulk density, porosity, end yields or other plant production measures. Indicators of water partitioning include infiltration, permeability, water-holding capacity. porosity, end hydrologic group. Indicators of ground water protection, include sorption potential and leaching potential together with a measure of sensitivity. For filtering, buffering, detoxifying, etc., stability of pore size distribution, adsorption isotherms, resistance to chemical changes end acidity may be useful. These are merely some examples. Specific variables need to be developed for the various soil functions end land uses within given ecosystems.

Recommendations:

1. Develop, use end test variables for the various soil functions. Usually, multiple variables will be needed for each function end/or use. Variables for agriculture will be different then for forestry or grazing. Variables for water partitioning will be different for detoxifying, buffering, filtering organic or inorganic materials.

2. Use variables that are relatively easily observable, measurable end repeatable.

Charge 2. Summarize research going on in Soil Quality end who is doing it.

Discussion:

Most respondents listed institutions where active research is occurring but did not list names of the scientists. Agricultural Research Service (ARS) facilities performing soil quality research include Pullman, Washington; Lincoln, Nebraska; and the National Soil Tilth Laboratory, Ames Iowa. This research is the focus for the North Central Regional Research Committee (NCR-591 that includes scientists from 14 states. The ARS in New Mexico is studying soil quality of range land systems.

The US Forest Service is conducting studies on long-term soil productivity that are intended to validate soil quality measures for tree growth. The variables are related to soil compaction and changes in organic matter. These studies are located in several region throughout the US.

The Northwest Area Foundation in Minneapolis. Minnesota, is funding research on soil quality as affected by the Conservation Reserve Program (CRP). John Gardner, North Dakota State University-Carrington, is a contact.

The United States Environmental Protection Agency (USEPA) in cooperation with USDA-ARS, Natural Resources Conservation Service (NRCS), Forest Service (FS), and National Agricultural Statistics Service (NASS) and Bureau of Land Management (BLM) are conducting research on soil quality indicators as part of the Environmental Monitoring and Assessment Program (EMAP).

The NRCS is conducting research on soil quality field morphology indicators, fragility indexing, aggregate stability tests, near surface properties and descriptors, and other field procedures at the National Soil Survey Center. They are also developing interpretations of soil quality and methods of displaying the interpretations via GIS products for use by land managers and conservationists.

Soil ecologists are active in researching biological aspects of soil quality. In addition to the previous research, scientists at Oregon State University, Colorado State University, University of Northern Colorado, Ohio State University, Michigan State University, University of Georgia, University of Minnesota, Washington State University, University of Wisconsin, University of Illinois, West Texas, and University of Nevada, Reno; arc studying various aspects of soil quality.

Research by Agriculture Canada has been summarized in the publication "Health of our Soils." European research is discussed in the book "Scientific Basis for Soil Protection in the European Community." The CABI publication "Soil Resilience and Sustainable Land Use," edited by Greenland and Szabolcs, ties degradation to soil quality. The FS is working with the Center for International Forestry Research (CIFOR) in Bogor, Indonesia in drafting plans for soil quality indicators. They are using plant function attributes (PFA's) which are adaptive morphological features of plants that are independent of species. The PFA's relate in a predictable way to soil quality.

The Soil Science Society of America Special Publication 35, "Defining Soil Quality for a Sustainable Environment," contains reviews of the active research in soil quality.

The National Research Council in the book "Soil and Water Quality: An agenda for Agriculture" described areas of data voids or research needs which include compaction, degradation of soil structure, organic matter levels, available water capacity, nutrient retention, and biological activity as related to cropping systems. They also suggested that new criteria for quantifying soil quality are needed and that soil management research at the farm level needs greater attention.

Recommendations:

1. Research is needed to answer questions such as:

   What are the elements of soil quality
   - How can you monitor changes in soil quality
   - How do management systems affect soil quality in the long term
   - What government policies would be effective in assuring high soil quality.

2. A framework should be developed for following soil quality research and applying it to soil quality ideas or needs of the land manager.

3. Pill data voids in soil quality to include information on soil

Recommendations:

1. The NCSS should work closely with scientists in developing approaches to monitor soil quality with particular attention to the effects of conservation systems and land use on soil quality.

2. The NASIS database should be adapted to store temporal properties important to montioring soil quality.

Charge 4. Recommend how to form partnerships to develop and disseminate knowledge and technology about soil quality. Consider such things as funding, joint research, and development, contributing to technology transfer, and other support.

Discussion:

The concept of soil quality is relatively new and it is broad. A variety of disciplines, skills and agencies or organizations is needed to make ths concept a useful working tool. Some respondents pointed out that there are efforts in other countries to develop and use concepts of soil quality. So, international participation in partnsrehips should be explored, in addition to those throughout the United States.

Partnerships need to include research scientists, field practitioners, and land managers. They also need to include educators, extension workers and expertise in writing, computer applications, and other aspects of technology transfer. Short courses, training sessions, symposia, popular articles and field demonstrations are a partial list of methods for exchange of technology and knowledge. Symposia and field demonstrations should be conducted for international particpation.

One of the primary functions of the Soil Quality Institute should be the formation of partnerships for research, development, and transfer of technology and information. They should be a focus for communicating about soil quality.

Recommendations:

1. The Soil Quality Institute should convene a partnership meeting soon after staffing is in place. The meeting should lay the foundation for research, extension, and application of soil quality methods. The meeting should also identify potential funding for research and technology development that includes non traditional sources such as environmental groups, private industry associations and others.

2. Bstablish an advisory team of scientists, educators, and end users to advise the Institute. Membership should include family farm, corporate farm, industry, environmental groups, agencies, research community and universities.

3. Convene a series of workshops or symposia with specific objectives. These workshops could focus on research needs, methods of technology and information transfer, educational needs. funding sources, and methods of monitoring and evaluating soil quality.

Charge 5. Review how the Natural Resources Conservation Service or any other agency can incorporate soil quality concepts into its land or conservation planning efforts.

Discussion:

Many of the respondents indicated that training is a key factor in incorporating soil quality into the NRCS and other agency programs. Field staff must be knowledgeable about soil quality concepts as they relate to ecosystem or watershed approaches to holistic planning efforts. Knowledgeable field people will then informally educate land managers in soil quality concepts.

One respondent suggests four steps for NRC.5 to incorporate soil quality standards into planning efforts: (1) develop a list of public concerns and prioritize the list; (2) coordinate with other land management agencies so that common standards are used; (3) test the standards in real world conditions; and (4) apply the standards as normal activities. In many cases land managers are already applying soil quality standards without realizing it, these applications need to be reinforced and perhaps modified to match current scientific knowledge.

The National Research Council in the book "Soil and Water Quality: An agenda for Agriculture" ret-nd, among other things, that NRCS incorporate soil quality indicators or standards in its Field Office Technical Guides (FOTG). Some respondents addressed this need and suggested the current soil condition section of the FOTG needs to be expanded to more fully represent soil quality. Others suggested that NRC.5 convert the conservation effects section to soil quality terms, develop tools and check sheets for land managers to use to evaluate soil quality, provide GIS products to resource planners, develop monitoring tools and procedures to monitor soil quality changes and the • ffmctm of conservation practices on the quality of soil and other resources, update leaching and other interpretative models for soil quality, and provide better photographic imagery for field offices for assessing resource conditions.

One respondent summarized the NRCS efforts to develop a soil condition index (SCI) to use with the Conservation Cropping Sequence practice standard. The SCI is used to determine the suitability of a cropping rotation in producing a sustainable cropping system.

The SCI rating is based on (1) the amount of organic matter returned to the soil as related to the decomposition rate--if organic matter is maintained or added the SCI is neutral or positive, if it is depleted the SCI is negative; (2) tillage systems are rated as to number of passes and type of tillage on compaction and excessive mixing of the soil; and (3) erosion rate is a measure of long term sustainability of the soil resource. If no erosion occurs the rating is neutral (0) but is negative if there is erosion at a site.

The SCI value is useful for a specific site and is not recommended for comparison between sites. The SCI is simply a rating of the difference between optimum conditions with conditions created by the current management system. For example, optimum conditions may be erosion less than "t", additions or maintenance of soil organic matter, and tillage systems that do not adversely impact aeration, compaction, or field rutting.

Recommendations:

1. Soil quality standards be incorporated into the NRCS FOTG

2. Training (interagency) be developed and conducted for field staff

3. Effects of conservation practices and systems on the quality of soil and related resources be incorporated into the FOTG.

Charge 6. Suggest how soil quality measures can be linked to both attribute and geographic information systems.

Discussion:

Soil data bases developed for soil survey data, such as the NRCS BASIS and the Forest Service SORIS, include many of the indicators of soil quality among the attributes. Most of the current indicators are physical and chemical attributes and may already be included. However. many of these are even lacking for each horizon. Biological indicators are generally absent. As more knowledge of biological indicstore is obtained, such as microbial biomass, species lists, and enzyme activity, such indicators need to be added to the data bases. Because these are dynamic variables, provisions for seasonal or other temporal entries are needed.

There also are many other sources of soil data than soil survey. Sources include research sites, monitoring sites, special studies, and others that could add to the knowledge base. The meta data, data about data, can identify the source by time, purpose of collection, author(s), reviewers, and other specifications that permit evaluation of their usefulness. Similarly, results of monitoring and evaluations of soil quality should be incorporated into the data base. Again, the specifications for the attributes should be sufficiently inclusive to permit evaluation of their quality and usefulness.

Data from either of the above source8 can be stored in a GIS so that a spatial framework of sample locations is established. Also, soil condition surveys can be conducted for broad assessments by remotely sensed methods. Such condition surveys can also be incorporated into a GIS and made available through CD ROM.

Recommendations:

1. Evaluate existing data bases and those under development to determine whether soil quality measures are adequately included. Where deficiencies occur, ensure that the indicators are included.

2. Survey research organizations and scientists to identify sources of data that could be included into broader, more widely shared, data bases. Include precise estimates of location so that they can be digitized and displayed spatially.

Charge 7. Summarize and recommend Soil Quality standards.

Discussion:

Responses to this charge were highly variable. Some felt they were not qualified to suggest standards. Another thought it was a "fatal error" to begin listing measurements for standards. Another suggested that it is better to offer interim standards than to wait for the "ultimate Standard." This charge also generated discussion about such things as "intrinsic soil quality," "soil quality for what purpose." questioning the difference between "soil quality and soil health," and "each soil has its inherent quality," given its climate, parent material, elope position, and biology. It seem8 clear that standards need to be related to the various soil functions and to specific uses. One example supporting soil quality standards a.8 being intrinsic is comparison of organic matter contents between a Mollisol and Ultisol. An organic matter content of 3 % may indicate a healthy Ultisol, but would indicate an unhealthy Mollisol.

Most respondents felt that soil quality standards must be dependent on the function or functions for which a specific kind of eoil is being used or evaluated. Others mentioned that indicators must be easy to use, easy to recognize or observe in the field, inexpensive, and indicative of short-term stability but early indicators of long-term changes.

Most respondents suggested that soil quality standards vary in time and space, thus must be tied to cropping or management systems and time of year.

Minimum data sets have been proposed by a number of researchers for use in establishing soil quality standards or measurements. The minimum data sets usually include soil organic matter, water infiltration, nitrogen content, biological activity, topsoil depth, and bulk density, compaction, or soil structure characteristics. Some respondents mentioned that comparision of present soil conditions to native conditions of a soil is not appropriate for production agriculture uses of the soil. For example N cycling and availability of a native prairie is not adequate for corn production.

Larson and Pierce discuss a procedure for evaluating soil quality in their paper in SSSA Publication 35. They suggest a process patterned after industrial quality control procedures using minimum data sets (soil attributes) and statistical procedures of the industrial models. In the same publication Karlen and Stott describe a framework for evaluating physical and chemical indicators of soil quality. Both approaches need to be adapted for use in the field and tested.

Following are some examples of standards that have been or currently are in use by the US Forest Service. The Forest Service has developed standards in various regions for a variety of activities. In the Pacific Northwest, there is a standard that requires at least SO percent of an activity area be left in condition of acceptable productivity potential for trees or other managed space of 50 percent or more, is detrimental. For volcanic ash and pumice soils, a bulk density increase of 20 percent or more is detrimental. Soils are considered severely burned when the top layer has been significantly changed in color to red, and the next one-half inch is blackened. Detrimental displacement is removal of more than 50 percent of the A1 and/or AC horizons from an area of 100 square feet or more and which is et least 5 feet in width. Other regions have similar kinds of standards that relate to productivity or hydrologic function.

Recommendations:

1. Experiences of monitoring projects and standards used should be assembled for use in developing a set of soil quality standards for angecy consideration and use.

2. A team of eoil quality experts should be convened to develop standards and procedures for their application for testing by agency field staff.

3. Standards for particular functions or land uses within an ecosystem should be the same regardless of land ownership. For example, a standard for soil compaction related to forest productivity should be the same for similar kinds of soils.

COMMITTEE MEMBERS

Dr. Maurice Mausbach, Co-chair
Acting Director, Soil Quality Institute
USDA Natural Resources Conservation Service
Soil Survey Division
P.O. Box 2890
Washington, D.C. 20013-2890
Phone (202) 720-1812 FAX (202) 720-4593

Dr. Bob Meurisse Co-chair
Regional Soil Scientist
USDA Forest Service
P.O. Box 3623
Portland, OR 97208-3623
Phone (503) 326-3391 FAX (503) 326-2469

Al Amen
Soil Scientist
USDI BLM

Phone

Dr. D.L. Karlen
Research Scientist
USDA Agriculture Research Service
National Soil Tilth Laboratory
2150 Pammel Drive
Ames, IA 50011
Phone (515) 294-1360

Jerrel L. Lemunyon
Conservation Agronomist
USDA Natural Resource Conservation Service
Fort Worth Federal Center
Bldg. 23, Room 60
P.O. Box 6567
Ft. Worth, TX 76115-0567
Phone (817) 334-5282 FAX (817) 334-5584

Gary Muckel
National Soil Survey Center
USDA Natural Resources Conservation Service
Federal Building, Rm 345
100 Centennial Mall North
Lincoln, N8 68508-3866
Phone (402) 437-5659 FAX (402) 438-5336

Dr. Paul McDaniel
Assistant Professor
Department of Plant, Soil, and Entomological Sciences
Collage of Agriculture
University of Idaho
Moscow, ID 83843
Phone (208) 885-6111

Batty McQuaid
Soil Scientist
USDA Natural Resources Conservation Service
1509 Varsity Drive
Raleigh, NC 27606
Phone (919) 515-3311

Dr. Andrew Moldenke
Research Associate Insect Ecology
Department Of Entomology
College of Agriculture
Oregon State University
Corvallis, OR 97331
Phone (503) 737-5496

Dr. John Moore
Systems Ecologist
Department of Biological Sciences
University of Northern Colorado
Greeley, CO 80639
Phone (303) 351-2973

Dr. Fran J. Pierce
Professor of Soil Management
Crop and Soil Sciences Department
College of Agriculture
Michigan State University
East Lansing, MI 48824
Phone (517) 355-0217

Jerry Ragus
USDA Forest Service
1720 Peach Tree Rd. NW
Rm 846, North Tower
Atlanta, GA 30367
Phone (404) 347-7211 PAX (404) 347-4448

Dr. Randy Southard
Assistant Professor of Soil Science
Department of Land, Air, and Water Resources
College of Agriculture
Ubniversity of California
Davis, CA 95616
Phone (916) 752-3607

Arlene Tugel
Assistant State Conservationist
USDA Natural Resources Conservation Service
101 S.W. Main St., Suite 1300
Portland, OR 97204-3225
Phone (503) 414-3208 FAX (503) 414-3102

Dr. Larry T. West
Assistant Professor of Soil Classification
Department of Agronomy
College of Agriculture
University of Georgia
Athens, GA 30602
Phone (404) 542-2373

Bob Misso
USDA Natural Resources Conservation Service
NRCS Wetlands Team
P.O. BOX 2890
Washington, D.C. 20013

Mitchell Reynolds
USDI U.S. Geological Survey
908 National Center
Reston, VA 22092
Phone (703) 648-6960 FAX (703) 648-6941

Gary L. Williams
Inventory and Monitoring Program Coordinator
USDI National Park Service
18th and C streets NW, Rm 3023
P.O. Box 31127 Stop 470
Washington, D.C. 20012-7127

Dr. Benno Warkenton
Professor, Soil Science
Department of Crop and Soil Science
Oregon State university
Corvallis, OR 97331
Phone (503) 737-3425

Dr. Herb Huddleston
Extensiojn Soil Scientist
Department of Crop and Soil Science
Oregon state university
Corvallis, OR 97331
Phone (503) 737-5713

Dr. R.P. Harris
Professor
Department Of Soil Science
University of Wisconsin
Madison, WI 53706-1299

Dr. Julian Dumanski
Land Resource Research Center
Agriculture Canada
K.W. Neatby Bldg.
Ottowa, Ontario
K1A OC6
Phone (613) 995-5011

Dr. Allen Tiarks
USDA Forest Service
Alexandria Forestry Center
2500 Shreveport Hwy.
Alexandria, LA 71360
Phone (318) 473-7204

NATIONAL COOPERATIVE SOIL SUHVEY CONFERENCE
San Diego, California
July 10-14, 1995
COMMITTEE 1 - IMPLICATION OF USDA REORGANIZATION ON NCSS

CHARGES: 1. Consider name changes, if appropriate for the National Cooperative Soil Survey (NCSS).

2. Review Regional structure in light of USDA reorganization.

3. Review NCSS by-laws and suggest needed changes.

4. Review the role of NCSS cooperators.

5. Review the make up of the Steering Committee

6. Review Articles 1 and 2 of the by-laws and suggest any needed revisions.

BACKGROUND:

The Soil Conservation Service has been renamed The Natural Resources Conservation Service (NRCS). Along with the name change is a broader perspective on conservation planning and resource inventory than the agency had in the past. The agency will provide technical assistance in resource conservation for soil, water, air, plants, animals, and human resources on an ecosystem basis. In providing these setvices, closer working relations will be developed with other land management agencies in particular, the U.S. Forest Service. The Soil Survey Program will remain with the agency. The organization of the NRCS is also being changed. which could impact the representation the agency has with the NCSS. The NRCS has been organized around 4 regions each with a National Technical Center (NTC). These regions were very closely aligned with those of the Agricultural Experiment Stations. Each NTC had a soil staff or a contact soil scientist who helped coordinate NCSS activities for that particular region. The NRCS will now be organized around 6 regions (map attached). The function of these regional offices will be budget development, program accountability and progress reporting, and strategic planning rather than providing technical expertise and assistance for the region. Technical specialists are being reassigned to the state offices. The soil survey program will be conducted through 17 MLRA offices rather than 52 state offices (map attached). This will allow for managing soil surveys on a Major Land Resource Area (primarily physiographic region) basis rather than on political boundaries such as states and counties. The National Soil Survey Center will remain, but the quality assurance functions will be assigned to the MLRA soil survey offices.

Similar changes are taking place in the Interior Department with the contacts for Soil Survey in BLM, BIA, and NPS all residing out of the Washington , D.C. area.

With these and other changes occurring, it is appropriate to review the by-laws of the NCSS and to make adjustments where needed that will maintain its strength and good work.

PARTICIPATING COMMITTEE MEMBERS:

Glen Bessinger, Soil Survey Program Contact, BLM, Lakewood, Colorado

Pierre Bordenave, National Society of Consulting Soil Scientists, Sand Point, Idaho

Mary Collins, Professor of Soils, University of Florida, Gainesville, Florida

Bill Dollarhide, NRCS State Soil Scientist, Reno, Nevada

Dawn Genes, NRCS State Conservationist, Durham, New Hampshire

T. Niles Glasgow, NRCS State Conservationist, Gainesville, Florida

Duane Johnson, NRCS State Conservationist, Lakewood, Colorado

David Jones, NRCS State Soil Scientist, Jackson, Mississippi

Karl Langlois, Soil Staff Head, NRCS, NENTC, Chester, Pennsylvania

Robert Rourke, Senior Soil Scientist, University of Maine, Orono, Maine

Gregg Schellentrager, NRCS State Soil Scientist, Ames, Iowa

Thomas E. Calhoun, Soil Survey Program Manager, NRCS, Washington, DC. - Chair

COMMITTEE RECOMMENDATIONS:

The committee operated primarily by correspondence. Three rounds of correspondence on the committee charges were conducted. After each round, the comments were summarized and provided back to the membership with additional questions where the Chair determined more input was needed to reach consensus. A draft report (attached) of the correspondence committee consensus was used at the NCSS Conference during the Committee breakout sessions. The input received at the conference is noted in this report,

Charge 1: Consider name changes, if appropriate, for NCSS

Committee: Do not change the name of the NCSS. We have gained the respect of our partners by the leadership role played in the national soil survey program. To change the name would not be in the best interest of this organization.

The NCSS is well known and respected. It is identified with a superior product that is basic to the needs of many resource agencies and planners.

Conference: Propose to the NRCS that the name of the soil survey program be changed to the Soil Resources Cooperative Program. If the agency elects to change the program name, then develop a proposal to change the name of the NCSS.

The discussion concerning this issue at the conference consisted of concern that the name soil survey does not convey all the different kinds of activities that constitute the program other than the physical survey itself. Providing a broader descriptive context to the program through a name change might make it easierfor some of the cooperators to justify their participation in the NCSS to their administrators.

Charge 2: Review Regional structure in light of USDA reorganization.

Committee: The committee recommends a lead NRCS soil scientist be designated in each of the 6 new NRCS regions as liaison to the NCSS Conference, but that the existing NCSS structure of four regions based on the Ag. Experiment Station Regions be maintained for the purposes of the regional conferences.

Conference: Concurred in this recommendation

Charge 3: Review NCSS by-laws and suggest needed changes.

Committee: See attached by-law proposals.

Charge 4: Review the role

agencies) reorganize, perhaps we can provide better service to a wider variety of customers by working through our cooperators to market our products. Federal, State, and Local partnerships and work through networking and access to databases.

Conference: Establish a National Cooperative Soil Research Agenda Standing Committee. Draft charges are attached.

Initiate and develop a soil educational activity that incorporates all agencies and members to accommodate the various kinds of land. This activity should be designed to provide a colorful and structural approach to promoting the interest and desire to sustain the productivity of the soil resource. Audiences including youth groups, schools, land users both public and private need to be accommodated. State of the art techniques, including involving National Educational Groups should be used. This needs to be a continuing activity to accommodate arising needs and to utilize the latest visual and educational approaches.

Propose an Ad-Hoc Committee on Global Climate Change activities. This Committee will report at the next Regional and National Conferences so that the membership will have a better understanding of the kinds of projects being carried out.

Charge 5: Review the make up of the Steering Committee.

Committee: The Steering Committee should be:

- o The NRCS Director, Soils Division; permanent chair
- o The U.S. Forest Service Soil Survey Leader
- o The Bureau of Land Management Senior Soil scientist
- o Four Ag. experiment station Soil Survey Leaders (one from each Ag. Experiment Station region)
- o Six NRCS Soil Scientists (one from each NRCS region)
- o A member from the NRCS National Headquarters Soil Staff
- o Two members from the NRCS National Soil survey Center as designated by the NRCS Director, Soil Division
- o One member from the private sector as designated by the National Society of Consulting Soil scientists

Conference: The Steering Committee should be as it currently is with the exception of the NRCS and Private Sector representation. The NRCS Representation should be as follows:

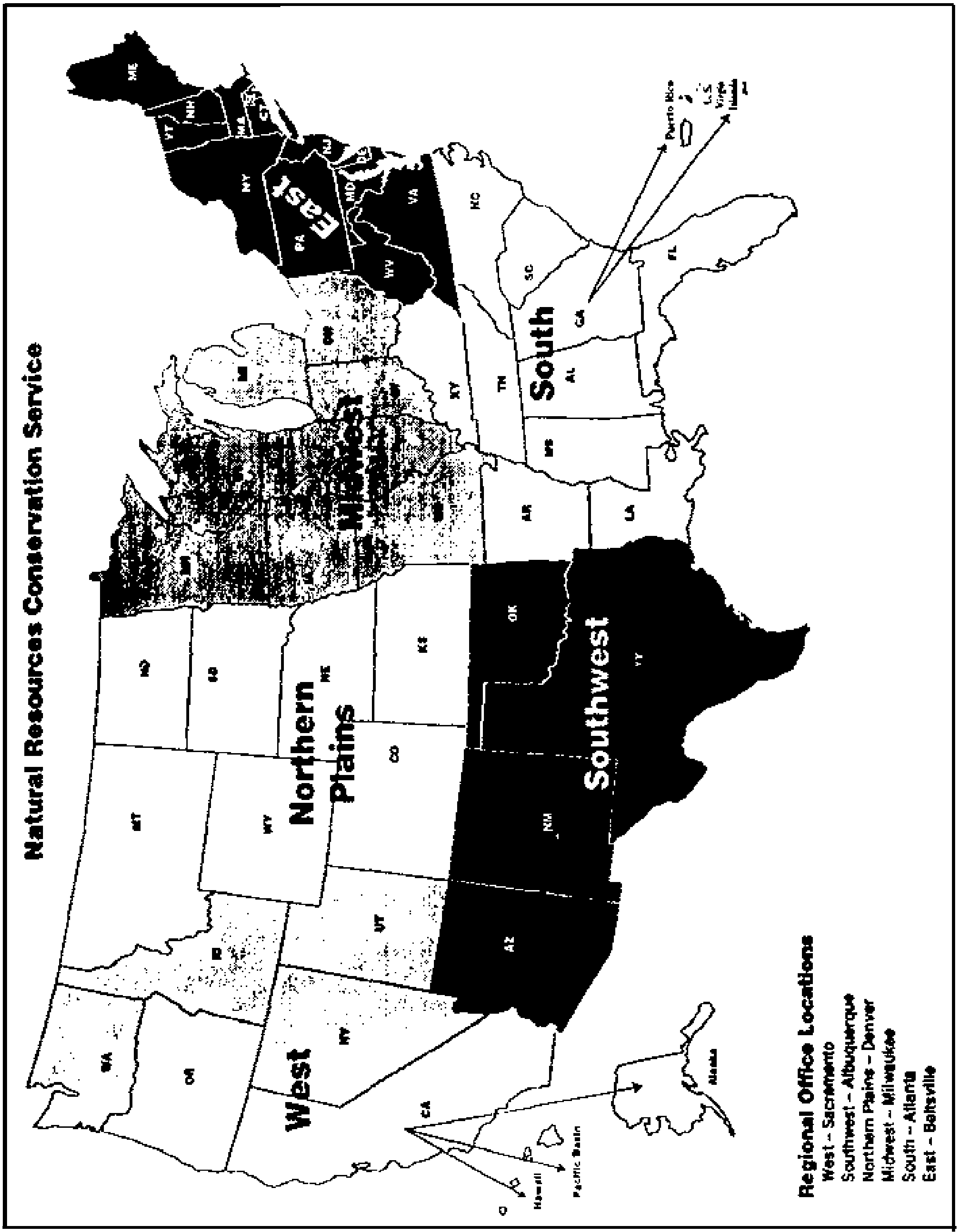
- o The NRCS Director, Soils Division; permanent chair

- Six representatives of the NRCS (made up of representatives of the National Headquarters, National Soil Survey Center, and Regional Soil Staffs as determined by the Director, NRCS Soils Division)

A member of the private sector should be added to the Steering Committee as designated by the National Society of Consulting Soil Scientists.

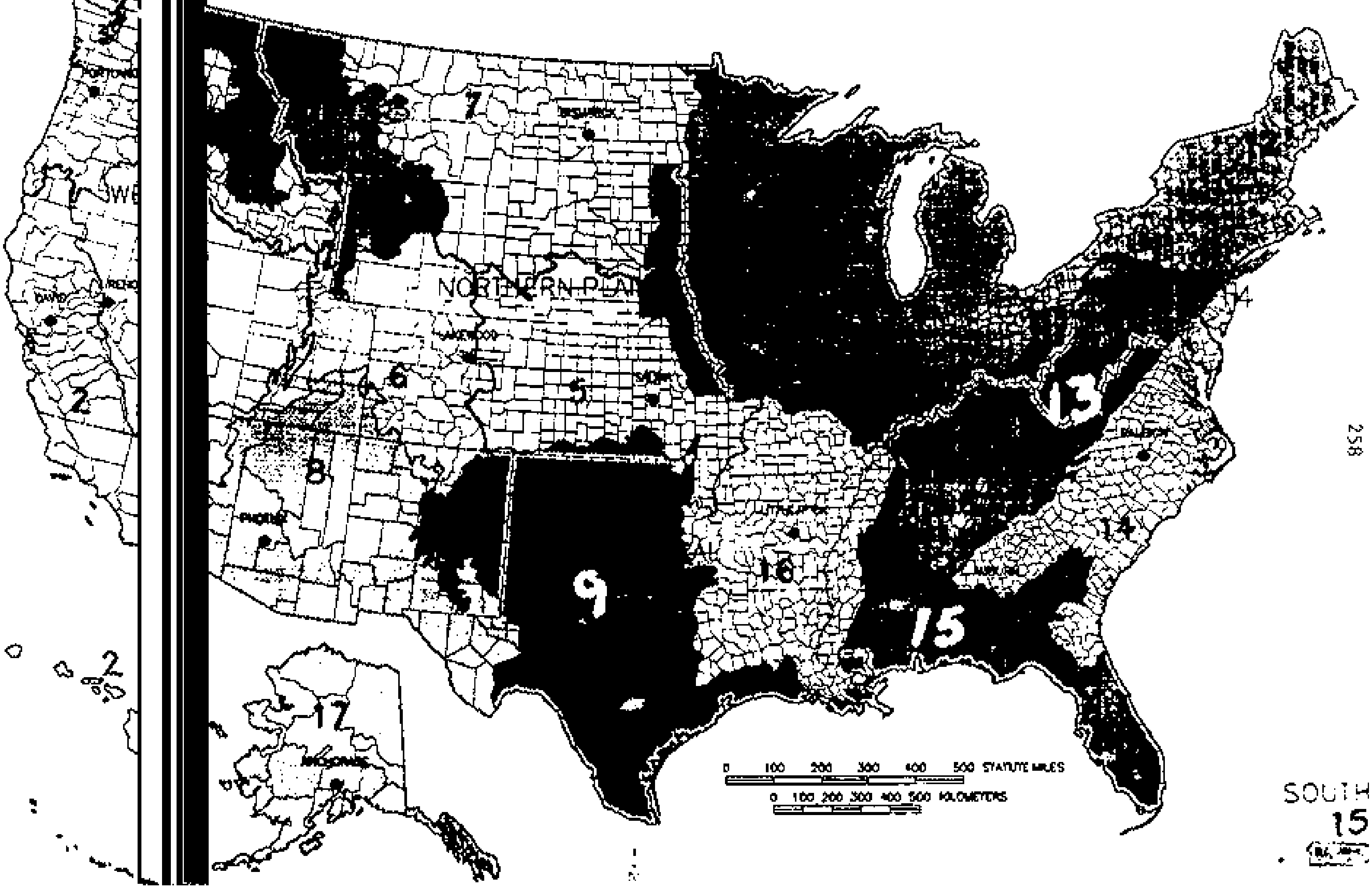
Charge 6: Review Articles 1 and 2 of the by-laws and suggest any needed revisions.
Committee: This charge is redundant. Charges 1 and 4 deal with the same sections of the by-laws.

NRCS Regional Boundary Chart



MAJ[illegible] AND RESOURCE AREA (MLRA) SOIL SURVEY REGIONS
USDA – NRCS SOILS DIVISION

DRAFT 6/27/95



Regions
'y Lines

BY LAWS
NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Article I. Name

The name of the Conference shall be the National Cooperative Soil Survey (NCSS) Conference.

Article II. Objectives

The objective of the Conference is to contribute to the general human welfare by promoting the use of soil resource information and by developing recommendations for courses of action, including national policies and procedures, related to soil surveys and soil resource information.

Article III. Membership and Participants

A. Permanent chairman of the Conference is Director of Soils, NRCS.

B. Permanent membership of the Conference shall consist of

1. Members of the Steering Committee.

2. Additionally, two State ~~and one Federal~~ members appointed by each of the four regional conferences, and six NRCS lead soil scientists as members representing each of the six NRCS Regions.

3. Individuals designated by the Federal Agencies listed in Appendix A.

C. Participants of the Conference shall consist of

I. Permanent members, and

2. Individuals invited by the Steering Committee.

Article IV. Regional Conference

Section 1.
Regional Conferences are organized in the northeast, north-central, southern, and western regions of the United States.

Section 2.
Regional Conferences determine their own membership requirements, officers, and number and kind of meetings.

Section 3.
Each Regional Conference adopts its **own purpose, policies,** and procedures, provided these are consistent with the bylaws and objectives of the NCSS Conference.

Section 4.
Each Regional Conference shall publish proceedings of regional meetings.

Article V. Executive Services

The National Headquarters Soils Staff of the Natural Resources Conservation Service (NRCS) shall provide the Conference with executive services. The Soils staff, NRCS, shall:

- Carry out administrative duties assigned by the Steering Committee.

- Distribute draft committee reports to participants

- Issue announcements and invitations.

- Prepare and distribute the program,

- Make arrangements for lodging, food, meeting rooms, and local transportation for official functions.

- Provide a recorder

- Assemble and distribute the proceedings.

- Provide publicity.

- Maintain the Conference mailing list.

- Maintain a record of all Conference proceedings; proceedings of Regional Conference meetings; and a copy of each Regional Conference's purpose, policies, and procedures,

Article VI. Steering Committee

Section 1.
The Conference shall have a Steering Committee. The Steering Committee shall assist in the planning and management of the Conference. The Steering Committee shall consist of.

- The NRCS Director, Soils; permanent chair.

- The U.S. Forest Service Soil Survey Leader.

- The Bureau of Land Management Senior Soil Scientist

- Four Agriculture Experiment Station Soil Survey Leaders, one from each respective Regional Conference. This normally is the State representative that was chair or vice chair of the previous Regional Conference.

~~- Four NRCS National Technical Center Heads of Soils Staffs~~

~~- A member from the NRCS National Headquarters Soils Staff~~

~~- Two NRCS Soil Survey Division Assistant Directors from the National Soil Survey Center as designated by the NRCS Director, Soils~~

- Six NRCS Soil Survey Staff Leaders, to include representatives of the National Headquarters, National Soil Survey Center. and Regional Soil Staffs as detennned by the Director. NRCS Soils Division

- The President Elect of the National Society of Consulting Soil Scientists, representing the private sector..

Section 2.
The Steering Committee shall select a vice chair for a 2 year term. The chair is responsible for all work of the Steering Committee. The vice chair acts for the chair in the chair's absence or disability or as assigned.

Section 3.
The Steering Committee shall formulate policy and procedure for the Conference

Section 4.
The Steering Committee shall plan, organize, and manage the Conference. The Steering Committee shall:

- Determine subjects to be discussed,

- Determine committees to be formed.

- Select committee chairs and obtain their approval and that of their agency for participation.

- Assign charges to the committee chairs

- Recommend committee members to committee chairs

- Determine individuals from the United States or other countries with soil science or related professional interest to be invited to participate.

- Determine the place and date of the Conference

- Organize the program and select presiding chairs for the sessions.

- Assemble in joint session at least once during each Conference to conduct business of the Conference.

Section 5.
Steering Committee work will normally be done by correspondence and telephone communication.

Section 6.
Fifty percent of the Steering Committee shall constitute a quorum for the transaction of business. Items shall be passed by a majority of members present or corresponding. The chair does not vote except in the case of ties.

Article VII. Meetings

Section 1.
A meeting of the Conference normally shall be held every 2 years in odd numbered years for the presentation and discussion of committee reports; exchange of ideas; and transaction of business. It shall consist of committee sessions and general sessions. Opportunity shall be provided for discussion of items members may wish to have brought before the Conference.

Section 2.
The time and place of meetings shall be determined by the Steering Committee.

Section 3.
The Steering Committee is responsible for planning, organizing, and managing the conference.

Section 4.
The Steering Committee shall meet immediately after the conference to summarize recommendations and propose actions to be taken.

Section 5.
Meetings of the Steering Committee, other than at the conference may be called with the approval of the Steering Committee.

Article VIII. Committees

Section 1.
The committees of the Conference shall be determined by the Steering Committee. Permanent or standing committees, ad hoc committees, and task force groups are considered to be committees for the Conference. The Steering Committee shall select committee chairs.

Section 2.
Committee members shall be selected by the committee chairs. Committee members shall be selected after considering Steering Committee recommendations, Regional Conference recommendations, individual interests, technical proficiency, and continuity of the work. They are not limited to members of the National Cooperative Soil Survey.

Section 3.
Each committee commonly conducts its work by correspondence among committee members. Committee chairs shall provide their committee members with the charges as assigned by the Steering Committee and procedure for committee operation.

Section 4.
Each committee chair shall send copies of a draft committee report to the Steering Committee prior to the Conference.

Section 5.
Each committee shall report at the Conference

Article IX. Amendments

The bylaws may be amended by ballot with a majority vote of the permanent members. An amendment shall, unless otherwise provided therein be effective immediately upon adoption and shall remain in effect until changed.

APPENDIX A

FEDERAL AGENCIES HAVING MOU'S WITH NRCS in the NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Agricultural Stabilization and Conservation Service, U.S.D.A.

Bureau of Indian Affairs, U.S.D.I.

Bureau of Land Management, U.S.D.I.

Bureau of Reclamation, U.S.D.I.

Economics and Statistics Service, U.S.D.A

U.S. Environmental Protection Agency

Federal Crop Insurance Corporation, U.S.D.A.

Forest Service, U.S.D.A.

National Bureau of Standards, U.S.D.C.

National Oceanic and Atmospheric Administration, U.S.D.C.

National Park Service, U.S.D.I.

Office of Territorial Affairs, U.S.D.I.

Extension Service, U.S.D.A.

Cooperative State Research Service, U.S.D.A

Tennessee Valley Authority (quasi Federal)

U.S. Fish and wildlife Service, U.S.D.I.

U.S. Food and Drug Administration, U.S.D.H.H.S.

U.S. Geological survey, U.S.D.I.

U.S. Army Corps of Engineers, U.S.D.O.D.

Defense Mapping Agency, U.S. D.O.D.

NATIONAL SOIL SURVEY CONFERENCE
San Diego, California
July 10-14, 1995
COMMITTEE 3. HYDRIC SOILS
FINAL REPORT August 11, 1995

TABLE OF CONTENTS

BACKGROUND TO CHARGES

Changes in the Definition of Hydric Soils

There have been several relatively minor variations in the definition **of Hydric Soils as it has** been stated in the publication *Hydric Soils of the United States*, and most of the variations are related to whether or not drained soils *can* be considered hydric'. The current definition of hydric soils is shown below.

> "A hydric soil is a soil that ***formed under*** con&ions ***of***[2] saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" From the Federal Register (35681) **7/13/94**

Despite the variations, the definition has been vague and imprecise. There is, for example, no explanation for what constitutes "the upper part."

"Criteria" as the Objective Basis for Identifying Hydric Soils

Because of the vagueness of the definition of hydric soils, additional CRITERIA were included which were more specific and detailed, and which provided some objective basis for evaluating whether or not a particular soil was hydric. For example, the 1991 version of *Hydric Soils of the United States* clearly stated that,

"The following CRITERIA reflect those soils that meet this definition" [ofhydric soils]....

CRITERIA for Hydric Soils (April 1991)

1. **All Histosols except Folists, or**
2. **Soils in Aquic suborders, Aquic** [illegible]

4. **Soils that are frequently flooded for long duration (>7 consecutive days) or very long duration (>30 consecutive days) during the growing season.**

These criteria have been modified from time to time during the last 10 years. Nevertheless, they continued to **provide,** in the thinking of most soil scientists, an objective standard or basis for stating more precisely, what was or was not a hydric soil.

During this same period, knowledgeable soil scientists have sought to use soil morphological features (ie FIELD INDICATORS) in making hydric soil determinations, Most have tried to select and use those morphological features or combinations of features which, in their professional judgement, best reflected the ***CRITERIA***. That is, many soil scientists have viewed those ***CRITERIA*** as **the objective basis** for determining whether or not a soil was hydric.

The National Technical Committee on Hydric Soils (NTCHS), has recently explained that the published ***CRITERIA*** were intended primarily to assist in computer queries of the NRCS Soil Survey database of the soil interpretation records (SIR) in order tc generate a list of Hydric Soil series. But It is also clear that nearly all soil scientists and wetland delineators have also regarded the published ***CRITERIA*** as definitive for the purposes of evaluating what was or was not a hydric soil. (Even at the time of writing this report, one established **pedological** researcher explained to the Chairman, that he was presently under the impression that the CRITERIA were the objective basis for determining if a soil was hydric.)

The Origin of Field Indicators of Hydric Soils

The 1987 Corps of Engineers Wetlands Delineation Manual adopted the ***definition*** of Hydric Soils as proposed by USDA, as well as the ***CRITERIA*** which attended the definition. In addition, lists of "indicators" for sandy and non-sandy soils were published in the COE manual which were accompanied by the interpretational **overstatement that *"any one of the following indicates that hydric soils are present."*** These lists **of *INDICATORS*** included such features as organic soils or ***histic epipedons,*** which might have been reasonably reliable indicators. The list **also** included items or features such as ***aquic moisture regime, soils with bright mottles and/or low matrix chroma, iron manganese concretions,*** or ***organic pans***, which by themselves, were probably not reliable indicators and were open to significant abuse by delineators lacking training in soil science.

When the 1989 interagency ***Federal Manual for Identifying and Delineating Jurisdictional Wetlands*** was published, it also included lists of FIELD INDICATORS. This document more wisely and prudently stated that "any one of the following ***may*** indicate that hydric soils are present." Thus, the indicators were to be joined with professional judgement in making decisions about hydric soils. The list of indicators, however, still included many which would not be considered to be reliable or definitive.

The Present Situation

During the last year, the NTCHS **recognized that there has** been disagreement and confusion concerning the purpose of the published CRITERIA. Some on the committee believed that the CRITERIA not only shouldn't be used as the objective or definitive statement **of what** is or isn't a Hydric Soil, but that they were never intended to be used that way in the past. Rather, in their place, ***the proposed*** *FIELD INDICATORS* of Hydric Soils in the United States are the appropriate basis for determining whether or not a soil is Hydric (minutes of the August 1994 meeting of the NTCHS in Boulder, CO). This opinion was codified when it was published in the Federal Register (Jan. 26, 1995) stating:

> "The CRITERIA are selected soil properties that are documented in *Soil Taxonomy* and were designed primarily to generate a list of hydric soils from the national database of soil interpretations records. CRITERIA 1, 3, and 4 serve as both database CRITERIA and as indicators for identification **of hydric soils. CRITERIA 2 serves only to retrieve soils from the database."**

During this time, soil scientists (principally **from** the NRCS, but also other federal agencies) have been working to develop lists **of** *FIELD INDICATORS* for hydric soils which are more precise and detailed (and thus hopefully more useful) than those previously published in the Corps **of** Engineers Manual or in the Interagency **Manual. The NTCHS** has endorsed the use of these specific soil morphological *FIELD INDICATORS* in lieu of the ***CRITERIA***. At present, an interagency team composed of NTCHS members Wade Hurt, Chris Smith, Blake Parker, and Steve **Sprecker** have been charged with developing a set of field indicators for hydric soils which will be adopted by the four agencies as the basis for making wetland determinations.

The Fundamental Question

The basic question is: On **what basis, or using what objective or measurable standards, are the morphological** *FIELD* ***INDICATORS*** **being developed?** The absence of such objective or measurable standards or any true operational definition for hydric soils was acknowledged by the NTCHS at the August 1994 meeting. A subcommittee was established by the NTCHS to consider technical issues related to hydric soils, and is being chaired by Steve Faulkner.

The premise behind the development **of** *FIELD INDICATORS* is that observable soil morphological features can be used to infer conditions (hydrological or **biogeochemical)** which cannot be observed or which might not be present at the lime the observation is made. This is a sound premise, but it implies that there are particular conditions which are recognized as being Hydric, and which are subsequently *INDICATED* by the *FIELD INDICATORS*. The question thus still remains, **what are those conditions (objective and measurable) which the FIELD INDICATORS supposedly indicate?**

CHARGE 3. RECOMMEND THE LEVEL OF DOCUMENTATION NECESSARY FOR HYDRIC SOIL INDICATORS.

1. Assuming that we can develop a set of methods which can he used to develop a list of appropriate indicators (charge #2 above), how thoroughly must we document the relationship between the objective criteria and the indicators?
2. Should there he some sort of reliability scale which can be applied to the lists of indicators signifying some as good or stronger indicators than others?

CHARGE 4. REVIEW THE AMOUNT OF REGIONALIZATION REQUIRED IN HYDRIC SOIL INDICATORS.

There has been discussion of developing a National List of FIELD INDICATORS for hydric soils. There has also been talk of permitting regions to select from the national list to develop a list more appropriate to their particular setting. Earlier drafts of the lists which were circulated for testing divided them according to temperature regimes. Are there other factors which could affect the appropriateness of various indicators? Parent materials? Physiography?

1. Should there he a national list of indicators?
2. To what degree do you think the field indicators should be regionalized?
By temperature regime7 State7 MLRA? NRCS Regions? Counties7

Synthesis of Committee Responses to Questionnaire

It was recommended that the term "technical standard" be used for those physically based soil properties or parameters which demonstrate that a soil meets the hydric soil definition, and that the term "criteria" be reserved for that group of conditions listed in the NTCHS publication which are used to search the SIR database and to generate a list of hydric soil series.

There was general agreement that the identification and delineation of hydric soils is best done using specified soil morphological properties (whether stated as specific field indicators (FIs) or as a simple application certain taxonomic classes From of *Soil Taxonomy*.) In either case, the technical standard (TS), would represent the objective basis for determining which field indicators (or possibly taxonomic classes) best identity hydric soils.

Points of Disagreement - There were a few issues which presented points of significant disagreement among those responding to the questionnaire. Three are listed below.

1. "Anaerobic" as part of the definition of Hydric Soils - Many of the Histosols of Alaska may be saturated, but may not in fact be anaerobic or reducing. Concern was expressed over the implications of the present language in the hydric soil definition on the delineation of hydric soils in Alaska, and there was some argument for the removal of the requirement that a hydric soil be anaerobic. This would obviously be a rather dramatic departure from the past, and appears mainly to be a problem in Alaska (It has been pointed out that the published CRITERIA do not require that Histosols be anaerobic. But the statements included in the CRITERIA or the present FIELD INDICATORS is quite different from the definition itself One would only conclude that in such cases, the CRITERIA OR FIs identify soils as wetlands which do not fit the definition.)

2. Use of Soil *Taxonomy*. Strongly contrasting views were expressed concerning the degree to which *Soil Taxonomy* should be utilized in the technical standard for hydric soils (and perhaps the criteria also). Most (especially representatives of Federal agencies) were of the opinion that Soil *Taxonomy* should be completely expunged from the whole discussion of Hydric Soils, Others thought that the recently developed concept of "aquic conditions" should be included in total or in part, in the technical standard or the criteria. One individual even advocated that Soil *Taxonomy* be the entire basis for determining whether or not a soil is hydric.

3. Need for a technical standard. While nearly all of the respondents were in favor of developing or identifying some sort of technical standard, there were one or two who indicated complete contentment with the present arrangement of having field indicators without a technical standard to provide an objective basis for determining that a soil meets the hydric soil definition.

Technical Standard - Following the opinion of the vast majority of respondants, it was concluded that a technical standard for hydric soils should be developed In this way, various soil morphological features can be evaluated and ultimately utilized in the determination of hydric soils. There was general agreement among those responding that the technical standard should include or address 1) hydrological parameters, 2) water chemistry, 3) some specified time period.

1. Hydrological parameters

While there were suggestions to consider such approaches as volumetric water content or degree of wetness in order to consider nearly saturated soils at tensions above 0, most favored identifying the free water surface (water table) at some depth within the soil, which is of course the easiest determination to make. Several specific suggestions were made which bore some semblance to the previously published criteria, relating the depth of the free water surface to soil permeability or soil texture. The rationale underlying these approaches appears to be that the capillary fringe would extend essentially to the soil surface, and thus, essentially all of the soil pores (except for some large macropores) would be filled with water.

2. Chemical parameters

While a few advocated using no chemical parameters (using hydrology alone), most favored some sort of chemical measurement to document that anaerobic or reducing conditions were present. There were two approaches.

The approach most strongly advocated was to measure dissolved oxygen. Advocates of this approach cited the definition of hydric soils itself (anaerobic in the upper part), as well as difficulties and uncertainties associated with redox measurements using Pt electrodes. The thresholds proposed for dissolved oxygen generally fell between 0.2mg/L and 2mg/L, citing published research from Indiana and North Carolina.

The second approach focused on the development of conditions sufficiently reducing to produce ferrous iron. Advocates of this approach cited the emphasis in soil morphology in general, and Soil *Taxonomy* in particular, on redox induced segregations of Fe oxyhydroxides as

Follow-up Questionnaire

Based upon the initial responses of the committee, a second questionnaire was developed to further refine the previous discussion, but still retaining the focus on hydrological and chemical parameters and on the issue of time of observation and duration.

Hydrological Parameters - **Those responding overwhelmingly supported the approach of observing the depth of the free water surface (rather than some other measurement ofwetness), and nearly all wanted to focus on a depth of <12" (<30cm). There also appeared to be general consensus that a two (or more) class approach was preferred (such as <12" or loamy and clayey soils and <6" for sandy soils; or <12" if permeability <20in/hr and <6" of permeability >20in/hr.)**

Most of those responding thought that the free water surface should be within the specified depth for a period of 2 weeks or 1 month (about half and half split).

Chemical Parameters - **When presented with choosing between dissolved oxygen measurements and indications of iron reduction, the respondents to this follow up questionnaire were divided, with slightly more preferring to require conditions for iron reduction. One of the items raised was the problem that often dissolved oxygen meters cannot accurately measure oxygen levels in the range where it is most important (0.1-0.5mg/L). Problems with estimating iron reduction from pe (or Eh) and pH measurements were also acknowledged. Therefore, most preferred using a-a-dipyradyl, although its limitations were also conceded, and questions** *were* **raised about what portion of the soil should be required to show a positive test.**

The respondents generally thought that the soil should meet the chemical parameters for a period equal to or shorter than that for the hydrological conditions (mostly 2 weeks and a few favored 1 week.) A couple of individuals thought that if you could demonstrate that reducing conditions were2006792t du2r96698 -0.2196697s 2.08913,520767 90 0 267.12 431s cod (were300247TT0 12.9675j -0.26159c 2.0394 Tw 0.90

2. *The* following statement provides an attempt to synthesize and consolidate the opinions of the members of committee #3 concerning what hydrological and chemical parameters should be met by a hydric soil. A hydric soil should have a water table within the upper 12" or the upper 6" (depth dependent on PSD or permeability) for a period of approximately 2 weeks to 4 weeks within the growing season (specific period being yet not specified, but probably best determined using soil temperatures of the upper 12"), and that during that period of saturation, the upper 12" or the upper 6" ofthat soil should be anaerobic (as evidenced by iron reduction or very low dissolved oxygen <0.2mg/L) for a period of at least 1 week to 2 weeks.

3. Considerably more work is needed to formulate a comprehensive statement specifying the TECHNICAL STANDARD for hedric soils.

4. Because of the rapid pace of development and the advanced stage of progress in refuting the FIELD INDICATORS, the FIELD INDICATORS will, in all likelihood, be implemented and adopted without a TECHNICAL STANDARD for hydric soils having been first approved.

RECOMMENDATIONS

1. We acknowledge that Policies and mandates have required the development and implementation of *the Field Indicators of Hydric Soils in the United Stores* within a relatively short period of time. Thus, while we understand that the Field Indicators are soil morphological features related to iron reduction and organic matter accumulation and thus generally indicative of wet soil conditions, we also recognize that the Field Indicators have not been developed in correlation with a technical standard which would more fully explain the definition of Hydric Soils. In particular, the degree of wetness or anaerobiosis reflected by these Indicators is not fully understood, especially some of those which are related to organic matter features. Continued documentation on their correlation with measurable soil properites is recommended.

2. A TECHNICAL STANDARD for hydric soils should be developed to clarify the definition of Hydric Soils and to provide a more objective and measurable way to evaluate when the definition of hydric soils has been met. The Technical Standard should focus on 1) the height, duration, and seasonal occurrence of the free water surface within the upper 30cm of the soil, and 2) chemical parameters indicative of anaerobic conditions such as the level of dissolved oxygen or iron reduction.

3. It is clear that the Field Indicators will continue to be used before a technical standard can be developed and approved. Therefore, the National Cooperative Soil Survey Conference should

6. The Field Indicators should provide a focal point for research activities. so that their significance may be fully understood and interpret&

LIST OF CONTRIBUTING COMMITTEE MEMBERS

Martin	Rabenhorst	Univ. Maryland (Chairman)
Terry	Brock	Forest Serv. Alaska
Mary	Collins	Univ. Florida
Craig	Ditzler	NRCS NSSC Lincoln. NE
Christine	Evans	univ. of NH
Steve	Faulkner	LA State Univ.
Richard	Griffith	Prairie View A&M Univ.
Herb	Huddleston	Oregon State Univ.
Wayne	Hudnall	LA State Univ.
Wade	Hurt	USFWS St. Petersburg, FL
Joe	Moore	NRCS Ancorage, Alaska
Russ	Pringle	NRCS Washington, DC
Jim	Richardson	ND State Univ.
Phil	Scoles	Scoles Assoc. Portland, OR
Chris	Smith	NRCS Chester, PA
Michael	Vepraskas	NC State Univ.
Michael	Whited	NRCS MNTC Lincoln, NE
DeWayne	Williams	NRCS SNTC Ft. Worth, TX

ERODED SOILS COMMITTEE REPORT
NATIONAL SOIL SURVEY CONFERENCE
SAN DIEGO, CA.
JULY 10-14, 1995

Eroded Soils Committee-Bob Ahrens, Mark Bradford, Cindy Cambardella, Ed Ciolkosz. Tom Collins, Jim Ford. Ben Hajek, Karl Hipple, Mark Kuzila, John Laflen, R.D. Lentz, Darl Lund, Ken Olson, Kendall Pfeiffer, Mickey Ransom, Neil Smeck, Rick Sojka, William Volk, Ted Zobeck, T.E. Fenton, Chair

The charges given to our commitlee are listed below (I-VI):

I. Review what **has been done wlth thls Issue** up **tlll now (status** report)
II. Suggest **dlagnostlc criterla** of accelerated eroslon
III. Suggest taxonomlc placement of eroded phases
IV. Suggest a **quantificatlon** of accelerated *eroslon (possible* **geologic** vs. accelerated)
V. Suggest llnkage wlth eroslon models
VI. Suggest what we need **to do next**
VII. **Recommendatlon**

I. Revlew what has been done wlth thls Issue up tlll now (status report).

The mapping of erosion phases began **with** the establishment of the Soil Erosion **Service** In the **1930's.** Two systems of mapping were used until the **1950's** when the **soil survey activities** were **consolidated** *under* tha **Soil** Conservation **Service.** The **basis** for mapping erosbn phases **and** the **definition** of **erosion classes** are given in the Soil Survey Manual (Soil Survey **Division** Staff. 1993). The **definitions** of **erosion classes** are based on the amount of original A horizon remaining **which** raqulres a comparison **with** a **similar soil** that has **not** been eroded. There have been past and recent research **efforts** lo document **the effects** of erosion on **productivity** and I suggest that for these **committee charges we accept the fact that accelerated** erosion does have a **significant** effect on productlvii of many **soils.**

With the **implementation of** the new classification system (Soil Taxonomy and **Approximations) that emphasizes** soil properties presently **observable** *or* measurable, differences between the **field mapping** process and the **classification** and **correlation** of the units **mapped grew** greater. In March of **1992, a** *conference* on the Classifiiatbn and Correlation of Eroded **Mollisols** was held in **Des Moines, Iowa. Data** and technical papers were presented and discussed at that **conference. Lockridge** (1992) **reported that** 20836,526 acres of eroded Mollisols had been mapped In 32 stales of the US. Leading **states** are bwa. Illinois, Kansas, Missouri, Nebraska, and Oklahoma. The acres of eroded Mollisols correlated **as** taxadjuncts totals 5669,081 acres as of 1992 **(Lockridge, 1992).** As of **1992,** 663, 604 acres of severely eroded Mollisols had been correlated as taxadjuncts. Nebraska had 428.718 acres and **Iowa 125,681 acres. These two states have** approximately 84% of the acres of the 6 states that had correlated severely eroded Mollisols. The use **of** the term **taxadjunct** to **describe** the eroded **units** has been **criticized** because **it** implies there are not **significant differences** between the **taxadjunct** and the series to **which it** was a taxadjunct Taxadjuncts are defined as soils that cannot be **classified** in a series recognized In the **classification** system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they **differ** in ways too small to **be of** consequence in **Interpreting** their use and behavior. At the Des Moines conference, **it** was **decided** that erosion phases also presented problems in other orders in addition to Mollisols. **ls01Af**

problwconases adiscussed. Thented

2. Humans Influence soil degradation and/or formation.

3. There is a need lo find alternatives olher than taxadjuncts for handling eroded Mollisols

4. The laxonomic system should reflect the genetic thread to Mollisols

5. 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.

6. We will classily soils on the basis of properties of the soil.

There was a general agreement that some way should be found to maintain the genetic thread principle so that soils formed under similar conditions that had been changed as a result of accelerated erosion could be linked by classification and naming as they had been in field mapping. It was also agreed at this conference that the problems discussed were not unique to Mollisols and other soils whose classification was thought to be affected by accelerated erosion should be included in future attempts to resolve the (tall grass prairie) were all Mollisols. One hundred years from now (current erosion rates) they will probably be dominantly Alfisols. To ignore the fact that the activities of man have turned these Mollisols into Alfisols is ludicrous. The genetic thread concept is interesting but has little lo do with reality. All soils are continually influenced by the soil formation factors (this includes the activities of man) and genetically subject to subsequent changes in classification. Eroded phases of non-existent classifications simple cloud the issue. What is wrong with a Mollisol-Alfisol, eroded complex? At least at the phase level this provides a method for documenting the degradation of the soil resource without compromising our classification system. This is probably enough personal bias for the moment,

Respondent 6b. We do have some accelerated erosion in Arizona but it does not present a taxonomic conflict. We follow the intent of Taxonomy and classify the soils based on current observed properties. We have a parallel situation with soils that exhibit all properties of a Mollisol except they don't quite meet the soil moisture requirements. We do not force them into a dry phase of Mollisols. They simply fall into other orders depending on subsurface properties. No big deal.

In my opinion, Soil Taxonomy should not have to accommodate eroded Mollisols. This effort to change our current system to accommodate a very poor midwest correlation decision of the 60's and 70's is not acceptable. I recommend the affected states correct the correlation problem and not change the system lo hiie or justify it. Eroded Mollisols are no longer Mollisois and will not be again.

Respondent 6c. We do have accelerated erosion in Idaho. I don't have any actual numbers of acres In each erosbn class but the biggest share of the cropland in tdaho will be in emsbn classes 1, 2, or 3. We have very small acreage that would be in erosion class 4. In some cases the erosbn has been severe enough that it has changed the classification of the soils. We have really not let this bother us too much and have gone ahead and classified the soil that is there and then put the appropriate erosion phase on the mapping unit using our best estimates. We have not let this become a problem in Idaho as in most cases I don't think we can be absolutely sure that the soil was before man's influence. Where we have tried to make the determination that something is now an eroded Mollisol such as they do in the Midwest we have usually found in areas that are not farmed there is not that much different taxonomically than where it is farmed. For example, it may have had a thin noncalcareous surface horizon before farming but now the soil is calcareous to the surface. Even in the Palouse regbn it appears that where we see the ridgetops that are Alfisols and tack a mollic epipedon that these soils may never have been Mollisols but only Mollic intergrades of Alfisols.

Respondent 6d. Oregon has not mapped or identified eroded phases of soils. However, recently, we have identified thin surface phases of existing soil series h mapping. This has been done in the Great Basin MLRA 23. In the Lake County, Southern Part soil survey, thin and thick surface phase map units account for about 250,000 acres. The series Include Booth, Bullump. Carryback. Fbke, Freznik, Hager, Harcany, Hart, Lasere. and Ninemile. After mapping is completed In the remainder of this MLRA in Oregon, I would anticipate about an additional 400,000 acres of thii and thick phase map units.

The soils having thin and lhii surface phases identify significant change in range site species and composition. The mapping units are typically identified as a complex; le. Booth complex, 2 to 15 percent slopes. The soil part having a thicker A horizon (7 to 25 inches thick) are characterized by having Wyoming or mountain big sagebrush in the plant community. The soil pad having a thin A horizon (less than 7 inches thick) are dominated by bw sagebrush in the plant community. In the past, individuals soil series were recognized for each of the range sites. The soils having the thicker A horizon are almost always Typic Mollisols or thin A horizons are either Mollisols or Aridisols. Only within the past 10 years have we identified thin/thick surface phases in mapping. Cur range conservationists would prefer us to

I should point out that on soils for which this phasing of soil series has occurred, a root limiting layer (claypan, duripan. high % rock fragments) exists immediately bebw the A horizon. This "pan" restricts permeability and thus in the spring during snowmelt the A horizon saturates and runoff occurs. We continue to advocate the use of phases rather than series for identifying these situation, but we realize that many of our pedons of thin surface Mollisols classify as Aridisols.

Erosion on steep forested timberlands is recognized as a concern, and classification of pedons is affected, In these situation the use, management, and productivity of the soils has not been identified as significantly changed. The eroded areas are considered as similar inclusions. The soils are typically Umbrepts with thick epipedons (15 to 25 inches thick). During harvesting and site preparation for planting, the A horizons are disturbed. Depending on the degree of disturbance, Umbrepts can be changed to Ochrepts. Series have not been recognized for this change to the epipedon thickness, eroded phases have not been recognized. Perhaps in the future with emphasis being placed on soil quality, this loss of the A horizon will be recognized as being more of a concern.

In our wheat fallow cropland area of the state (Palouse Region) erosion is a major concern. I know that significant loss of the A horizon has occurred In areas. Again as with the forested soils, these soils have thii mollic epipedons, but I am not sure as to whether erosion has been great enough to change classification. Because much of this area of the state was mapped In the 60's and 70's the documentation of erosion and its impact on classification is not easily determined.

In summary, erosion does affect the classification of soils in Oregon. Eroded phases of soil map units have not been used in the past and are presently not being used. This surface phases are being used in rangeland areas to identify where range sites have changed, probably due to past erosion. Classification changes are at the order level and affect Mollisols and Aridisols.

Respondent 6e. In Utah, we are not aware of this being a problem at this point in time. We do however, want our people to classify what they now are looking at, rather than what they thought was there some time h the past. However, if it was know that an area was being severely or rapidly eroded we would want to know about ii and have it discussed in the map unit (s).

Respondent 6f. Washington has several thousands of acres of Spodosols in the Cascade Mountain Range which are formed in residual/colluvial materials covers with mantles of aerially deposited volcanic ash. These soils have a weakly developed albic horizon, usually bebw 0 or thin A horizons, overlying a spodk horizon. The albii horizons are not thkk (generally 1 to 1.5 inches) and most am continuous. These soils have been mapped and classified as Spodosols (Haplocryods, Humkryods. and Haplorthods). These soils are extremely productive and are used mainly for timber productbn, but addii uses are recreation and watershed.

Surface disturbance. not necessarily soil erosbn, from logging practkes mixes these weakly developed albk horizons with the underlying spodic horizon effectively obliterating the diagnostk afbk horizon. In some oases however, erosbn due to disturbance by forest management practices does in fact remove the albk horizon. Long term forest management practices on these soils does not significantly change because the remaining andic soil material is also extremely productive. However, taxonomically these Spodosols now classify as Andisols or Andii intergrades.

These soils have been mapped and classified as Humicryods, Hapbcryods, and Haplorthods. Documentation supporting the classification has been collected in undisturbed sites and soil mapping reflects the undisturbed concept (albic over spodic sequence). The non-Spodosol concept (albii over spodic sequence) has been well documented by ocular observation. Washington has elected to accommodate the disturbed sites, Andisols, by including soils without albic/spodic sequences as major induskns in the soil map unit. Real time soil taxonomy on these landscapes Is much different than the soil survey maps indicate. In areas that have been clearcut. the existence of true Spodosols is, in my opinion, highly unlikely.

Respondent 6g. Accelerated erosion does occur in Wyoming and is mostly on cropland soils. It is, however. of very small extent. In most cases it has been handled by classifying the soil according to the properties as described in the fields without consideration of genetic threads.

Erosion classes have rarely been used probably for a number of reasons, The acreage is usually of very small extent. The eroded areas occur as the less extensive component of a complex map unit The eroded soils occur on small knobs and small steep hillsides. The land use is not particularly intensive and the roils are not highly productive. It is sometimes easier to classify the soil Into the observed taxonomk class than to determine if the soil is dominantly the result of natural or accelerated erosion or both. Even when we know that the soil has been subject to accelerated erosion, il is difficult to quantify the amount of surface layer loss attributed to accelerated erosion vs natural erosion. The soils of the area may have so little expression of soil development, ie. Entisols. thin solum soils with thin surface layers and/or thin cambk horizon, that erosion losses can not be easily determined.

The dominant soils that would have been affected by accelerated erosion cropland in order of extent are probably:

1) Aridisols with a molsture regime borderline to the ustk regime whkh may have lost all or part of an argillic or cambk horizon in addition to the surface layer; the taxonomk class identified would be an Entisol or a class with a cambk horizon depending on the amount of soil lost, or if only small amount of soil was lost, no change in class.

2) Ustk and arldk Entisols-difficult to assess the amount of soil lost due to the lack of developed horizons bekw the surface layer;

3) Dry-ustic Alfisols and Mollisols whkh may have lost all or part of an argillic or cambic horizon h addition to the surface layer; the taxonornlo class identified would be: Alfisol from a Mollisol if significant amount of mollk eplpedon was lost; Aifisol to Inceptisol if arglllk horizon was lost; or if only small amount of soil was bst, no change in class.

Respondent 8. I agree with the fand ecosystem approach to soil genesis and that it b important b consider human disturbance as a soil forming factor. It's also important to keep a historical thread in soil genesis with regard to the native vegetation under which the soil developed. However in my opinion, taxonomk dassfficatiin must be based only on soil properties that exist on the landscape today. Tryin b trace historical genetic threads can be extremely complicated since, In many cases. one can only speculate about what the native vegetation may have been for a given pedogenic unit. In cases where significant erosion has taken place, the more labile forms of organic matter are preferentially bst, leaving only forms of CM that don't contribute much to the soils ability to sustainably supply nutrients and available water. It's a tough call to decide that an eroded Mollisol can still be considered a Mollisol since the kinds and relative proportions of variius OM forms present have been drastically altered n addition to other changes, such as a thinner mollk epipedon.

Chair Comments The National Soils Handbook seems to give different guidance than what is practiced in some states based on some of the above responses. Part 627.07(c)(2) states 'Eroskn Is identified even if genetic soil horizons have been removed throughout most of the area and the soil Is a different series than it was before erosion occurred. If the original soil taxon is no longer identifiable except in isolated spots, the reference taxon is changed and the soil properties that exist after erosion are considered as characteristic of the taxon. The unit is designated as a phase of eroded soil of the taxon as currently classified, or ii may be designated as a complex of eroded and uneroded taxa. Examples are Udorthents-Alpha complex, eroded and Alpha, eroded-Bela complex."

Perhaps I should have included the complete Midwest report but we did reach agreement on a number of points. There was general acceptance that the land ecosystem concept proposed by Jenny (1980) was the best scientific approach to understanding soil genesis. Jenny slates that soil, vegetation, and animals (including man) constitute the land ecosystem and this ecological troika and its environment are chosen as the scene for the evaluation of soil genesis in lime and space. The alteration of soil and landscapes by cultivation and accelerated erosion seem to fit nicely into this concept. Dr. Smith (1986) staled 'The best grouping should determine the definition, not the definition the grouping". As soil scientists who are a part of a large community of ecological and earth scientists we have a responsibility to interpret and communicate our knowledge of that part of the ecosystem that is our specialty. A guiding principle was stated by Dr. Smith (1983): "Taxonomy is not simply a process of applying definitions; it requires some thought about the objects that are grouped. Does the grouping that results permit the greatest number Of the most important statements for the purposes of the classification about the objects that are grouped? For Soil Taxonomy, these statements concern the interpretations about responses to use and management of the soils. Genesis plays its role indirectly."

A main factor in the Mollisol definition is that the 1 O-inch requirement for mollic epipedon thickness for soils with a solum of 30 inches or more is not a magic number and in itself was subjective. A relationship between color and organic matter content is not without error. Many subsoils of Mollisols have 4/3 colors but have an organic matter content of greater than 1 percent. No consideration is given to bulk density difference that can result in significant changes In Surface thickness even without erosbn. Dr. Smith indicated that the thick dark surface horizon of soils was the best common denominator for grouping the grassland soils of the Great Plains. He dii state that subsurface horizons would be preferred for definition at the higher categories because these would be the last horizons to be removed by erosbn. However, since that time there has been additional research and criteria that indicate different genetic pathways of genesis in the Mollisols of the Midwest as compared to Alfisols that are more significant from both a management and genetic point of view than one inch change of surface thickness resulting In a change al the highest category in the system. Thus, the genetic thread principle is a factor in understanding

Riecken and Tembhare (1976) examined Bray I available phosphorus in biosequences. They reported that prairie soils in each biosequence were lower in AP than were forest soils, regardless of drainage sequence. Smeck (1972) concluded that in studies of pedogenetic processes, knowledge of transformations and translocation of soil phosphorus can be a valuable tool. Forms of phosphorus change as pH and other ionic concentrations change with profile development. In general, as pH decreases with increased horizon differentiation, relative soluble forms of phosphorus decrease and occluded forms increase. Therelore, relative amounts of phosphorus fractions can serve as a measure of soil development. Richardson and Riecken (1977) in a study of biosequences showed that native vegetation exerted a strong influence on soil acidity development. Exchangeable acidity in the B horizon increased progressively from prairie through transition to forest-derived soils. Exchangeable aluminum was even more sensitive to biosequence influences with only small amounts in prairie soils, intermediate amounts in transition soils, and highest amounts in the forested members of the biosequences.

Smeck (1982) states that the biological P cycle is driven by the essential role P plays in energy transport in biological systems. Pedological P transformations are driven by the formation of secondary minerals. Although the biological cycle is more dynamic than the sluggish pedologic pathway, long-term evolution of P forms in soil ecosystems controlled by the latter which continually moves P into a sink consisting primarily of occluded P. P content is related to stage of development. Hobson (1983) reported that within stable members of a biisequence. the secondary inorganic phosphorus fraction, Fe-P, Al-P, reductant-soluble P, and occluded P fractions in the 25 to 100 cm zone were in the order forest>transition>prairie. The eroded soils had more Ca-P and active P than their stable counterparts. Also, eroded soils had less secondary P in the control section than did the stable counterparts. Ca-P contribution to the active P fraction decreased from prairie to transition to forest-derived soils. Hobson concluded that the inactive phosphorus fractions were useful for separating eroded from non-eroded soils. Hobson studied humic acid and fulvic acid carbon contents of Alfisols and Mollisols. Alfisols had bwer H/F rat&s than did the Mollisols. H/F ratios were shown to be good Indicators of soils In these two orders. Kononova (1966) repotted similar results for Russian soils.

Sawyerr (1987) reported on preliminary results of data from soil included in an erosion-productivity study. For Mollisols that were moderatety eroded, 85% of 39 pedons

The following properties will aid in the identification of eroded conditions for all soils as compared lo their uneroded counterparts. The surface horizon refers to the Ap horizon or the upper 18 cm (7 inches) of the soil after mixing.

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 below the surface horizon.

6. Decreased solum thickness.

7. Shallower depth to the base of a subsurface diagnostic horizon.

6. Higher clay content in surface horizon.

9. Depth distribution of clay in profile. (Depth to clay maximum decreases with increasing erosion)

10. Shallower depth to carbonates.

11. Concentratbn of coarse fragments, if present, in or on surface horizon.

12. Soil chemical subsoil properties similar to unemded sites.

13. Presence of gullies.

14. Deterioration of structure in surface horizon.

It has also been suggested that the criteria to define erosion should be those listed in the Soil Survey Manual (1993). Class 1 erosbn would not be consider to be an eroded condition since as defined in the Manual, the thkkness of the surface horizon h within the normal range ot variability of the uneroded soil. Classes 3 and 4 would definitely be eroded and class 2 would require additional field testing for some soils. Since the 1930's field soils scientist have successfully soil. In most moderately eroded soils,ordinary tillage implements reach through the remaining A horizon or well below the depth of the original plowed layer. Most moderately eroded soils have class 2 erosion,

Severely eroded: Severely eroded phases commonly have been eroded lo the extent that the plow layer consists essentially of material from underlying horizons. Patches in which the plow layer is a mixture of the original A horizon and underlying horizons may be present within some delineations. Shallow gullies, or a few deep ones, are common in some places. Erosion has changed the soil so much that (1) the eroded soil is suited only to uses significantly less intensive than the uneroded soil, such as use for pasture instead of crops; (2) the eroded soil needs intensive management immediately or over a long period to be suitable for the same uses as the uneroded soil; (3) productivity is reduced significantly; or (4) limitations for some major engineering interpretations are greater than on the uneroded soil. Most severely eroded soils have class 3 erosion.

Committee 2 formed at the Des Moines Conference proposed the following addition to Soil Taxonomy for eroded Mollisols:

Soils that have an Ap horkon or the upper 16 cm of soil, after mixing that (1) meet all of the requirements of a mollic epipedon except thickness; and (2) do not have Andic soil properties; and (3) have two or more of the following:

1. In crushed and smoothed moist samples, the oobr changes abruptly at the bwer boundary of the Ap horizon. The underlying horkon k not an E, AE, E/B, or WE horizon. The combined difference in value and chroma is 2 or more or there is a difference in hue between the two horizons.

2. There is a clay decrease from the Ap horizon to a subjacent cambic or argillic horizon.

3. Has a lower organic carbon content as compared to a non-eroded horkon.

4. Structure has deteriorated as compared to a non-eroded horizon.

5. Has ten percent or more discernable masses of soil material that have mlor 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.

RESPONSES FROM COMMITTEE MEMBERS

Respondent 1. I believe most of my comments have already been provided to your with some of them incorporated. where appropriate, in this draft. Point 13 could be rills and gullies. On p. 5, point 3, May need to qualify that the long-term vegetation was similar for both.

Respondent 3. I have no mrnment to add, other than I would use the term rock fragments not coarse fragments.

Respondent 4. Consider adding criteria to recognize wind-eroded soils. These soils typically experience a decrease in clay content In the surface as the clay and silt Is winnowed out of the soil. Small dunes or hummocks may be present on moderately eroded phases. Severely eroded phases commonly have dunes along fencelines or as coppice dunes on rangeland

Respondent 5. I would not include number 6. decreased solum thickness as a criterion. Solum thickness is arbitrary and left to the discretion of the person describing the soil. Diagnostic horizons and depth to carbonates are measurable properties. Criteria 3 and 4 require comparison to other pedons. This probably violates number 6 on page 2. "We classify soils on the basis of properties of the soil." In number in the same section wc should try to avoid a criterion that uses horizon designations. Wc could restate the second sentence to say, "The underlying horizon does not have albic materials."

Respondent 6f. These soils Andisols and Spodosols (Washington) are identified by diagnostic criteria of accelerated erosion #4. My concern is that this resultant change in diagnostic criteria and therefore taxonomic change, is picked up by criteria 4. whether or not the taxonomic change is always/sometimes or partially/completely due to accelerated erosion.

Respondent 6f. These soils (Idaho and Washington soils with varying amounts of andic soil material) are identified by diagnostic criteria of accelerated erosion #4. However, it seems to me that because of the unique nature of andic soil material, it may be more appropriate to add a diagnostic criteria such as "decrease in thickness of andic soil materials necessary to qualify as Andisol and /or andic intergrade.

Respondent 6f. There are several diagnostic criteria that aid in identifying these changes (in eroded Mollisols of Washington and Idaho). They are No's. 2, 4, and 8.

Respondent 7. In my opinion. many of the criteria listed on page 3 (#1-14) are not adequate. Most require that the soil scientist speculate on the ● naturaP or 'non-eroded state of the soil profile. The associated decision-making process is too subjective, and Introduces considerable error Mo a soil classification procedure that, if anything, needs greater objectivity. Even the determination that accelerated erosion has occurred, is a subjective judgement. It rnight be best Just to describe the soil as it is and not try to interpret what it might have been. But, if one wishes lo include a genetic link, and in some cases where the occurrence of accelerated erosion is utterly irrefutable, I would prefer using criteria that require no subjective interpretations to classify soils.

Consider a non-eroded Mollisol and its <u>known</u> eroded counterpart (an Alfisol). Suppose a soil scientist determines that the subsoil characteristics and environmental factors for the two soils are identical, regardless of surface horizon characteristics. Then the Alfisol could be assigned a subgroup name indicating that the Alfisol developed under conditions that normally result in Mollisol formation. For example, one might coin a new subgroup name "Atypic Mollic", "Eroded Mollic" or simply use the "Mollic" subgroup name already available for many Alfisols: eg. The eroded soil could be assigned to a new series, named NewSoil and classlied as an "Atypic Mollic Hapludalf".

Respondent 8. I have a difficult time understanding how we are going to be able to clearly define criteria of 'accelerated erosion" when we have nothing to compare the current status of the soil to. If we consider human disturbance as an accelerated form of weathering, then soils that are severely eroded as a result of human activity have simple evolved more published In a series of papers In the Journal of Soil and Water Conservation. Surface layer properties that have a major effect on productivity were erosion phase, porosity. bulk density, aggregation. organic carbon, infiltration, texture and coarse fragments. A related project which supports some of the criteria was a southern region project S-174 entitled "Erosion Mechanisms". Olson et al. (1994) reviewed methods currently used to evaluate the effects of soil erosion on soil properties and crop yields on cultivated soils. The Soil Survey Handbook Part 627.07(c)(1) states "eroded phases of a soil are based on significant differences in land use suitability, conservation needs, input requirements, or yields resulting from accelerated erosion... Phase of eroded soil are based on a comparison between the suitability for use and management needs of the eroded soil and those of the uneroded soil. The phase of the eroded soil is identified on the basis of the properties of the soil that remains. An estimate of the amount of soil lost is described.... The classes given in Chapter 3 01 the Soil Survey Manual are useful, but phase separations are made on the basis of relative differences in use and management as a result of erosion and not on the basis of class definition."

III. Suggest taxonomlc placement of eroded phases.

The taxonomic placement is probably the most difficult change. In the Midwest, as a result of our 1992 meeting the consensus was that the genetic thread principle should be maintained ie. the soil properties which result from soil genetic processesor affect soil genesis are selected as diierentiating characteristics. This approach has been followed in the Midwest since the 1930's through the use of erosion phases in the mapping of Mollisols and Alfisols. However, for Mollisols. the Soil Taxonomy definition excludes tolls that have less than 10 Inches of upon a soil. The soil may then be a new order if the deposit is deep enough. Soils that become sandier in the surface with lime may not pose a significant problem for correlation. Please check with conelators in western stales regarding the severity of the problem.

Respondent 6c. First of all, I feel that we should be classifying the soil that we observe rather than trying lo guess what it was in the past. Soil Taxonomy is used to classify soils based on soil diagnostic horizons and properties and not 'genetic links" or genetic horizons. In the Midwest, are they always sure when they map an eroded phase of a Mollisol that it truly was a Mollisol before farming? We must remember that even before farming, there were prairie fire and drought that sometimes left the soil surface exposed to wind and water erosion. In some cases some of these so called eroded Mollisols may never have been more than a mollic intergrade of an Alfisol.

I do not feel that we should be making changes in Soil Taxonomy to accommodate eroded phases of soils. 1 really have a problem with the proposed additions to Soil Taxonomy proposed by Committee at the Des Moines Conference. These are not diagnostic horizons or features that we can uniformity use to classify soils in Soil Taxonomy. Soil erosion classes or phases are interpretations and management and interpretations should landscape. If the soil coverage is great enough lo be Included In the map unit then the soil should bo described and classified as it occurs, regardless of its perceived erosion regime. For purposes of classification, soil scientists should not be required to estimate "potential" soil profile characteristics under "more normal" erosive regimes. If the soil does not meet the criteria for Mollisol. it shouldn't be classified as such. Interpretation

However, In open drainage systems, only a minimal amount of the erosional sediments will remain In the system. Comparative study of profiles still seems to be the most practical means of determining the amount of erosion that has occurred in an area.

V. Suggest linkage with erosion models.

John Laflen is a member of this committee and has been a major player in the development of RUSLE and WEPP. Erosion models should support the concept of accelerated erosion since the models simulate the erosion process. Has anyone used these models in relationship to erosion classes and if not should we do some simulations?

<u>RESPONSES FROM COMMITTEE MEMBERS</u>

Respondent 1. I have used erosion classes and compared them to USLE for both a small 10 ha watershed (Soil Sci. Soc. Am. J. 54:1393-1771: Soil Sci. 153:69-81. The erosion classes and corresponding erosion phases (based on topsoil loss) underestimate the extent of erosion since both topsoil and subsoil were eroded from the side slopes. Also, gully erosion may have occurred during the 130 years of cultivation which was not accounted for by USLE.

Respondent 4. I am currently working on the development of the ARS Wind Erosion Prediction System (WEPS). We also have a revision of the Wind Erosbn Equation almost finished. We have not used these models In relationship to erosion classes.

3. They provide the best grouping of similar kinds of soils for Interpretations.

4. They provide a measure of soil change over time.

5. They maintain the genetic thread principle and provide a logical explanalion of soil landscape relationships and soil classification.

6. They document the need for erosion control programs.

7. Their recognition does not require additional soil series and maintains the concept of existing soil series.

6. Their use maintain continuity in communication and education relative to past research and experience.

9. Their use maintains and supports past and current means of communicating soil changes and the need for conservation practices related to land use.

10. Their use emphasizes the land ecosystem approach to soil genesis.

The arguments against the recognition of erosion are:

1. Changes in Soil Taxonomy are required.

2. Some-of the criteria may not be observable or measurable in a single pedon ie. reference pedons from the same area, landscape and ecosystem evaluations would be needed.

3. Could result in a more complicated key to use Soil Taxonomy.

RESPONSES FROM COMMITTEE MEMBERS

Respondent 1. I believe that accelerated erosbn should be recognized in Soil Taxonomy In the other diagnostic horizons section. Severely eroded pedons can be placed in other categorbs with thin A horizons and the past erosion will be understated or go without recognttbn. Severely eroded sites should be identified and will require diierent management. Any attempt to group with less eroded soils developed under different vegetation will mislead future users.

Respondent 7. Other arguments against the recognitbn of erosion:

4. Introduces a subjective judgement into taxonomy that should not be there.
5. The best measure of soil change over time is lo property describe and classify the soils that presently occur on the landscape, so that they may be accurately compared to future conditions.
6. Politics may be a fact of life, but I believe the soil classification system should be based on taxonomic principles, not manipulated as a tool for extracting governmental financial support. The argument in favor or recognizing erosion (p.6, #6) should be considered last, if at all.

Chair. An additbnal current topic of concern is soil quality. A SSSA committee defines soil quality as "The capacity of a specific kind of soil to lunctbn, within natural or managed ecosystem boundaries. to sustain plant and animal productivity, maintain or enhance water and air quality. and support human health and habitation." The committee goes on to state that by encompassing productivity, environmental quality. and health as major functions of soil, this definition requires that values be placed on specific soil functions as they relate to the overall sustainability of aiternate land-use decisions. It seems lo me that our understanding of soil erosbn and its effect on the soil and landscape are directly linked lo this definitbn of soil quality.

Another area of interest is soil specific management or precisionlarming. A better understanding of all soil properties and their variability as they affect crop production and contribute to the environmental late of fertilizer and other compounds and chemicals applied lo the soil should receive high priority in our research effort. This is especially true for organic matter content which is critical in relation lo physical and chemical properties of the soil and chemical reactions within the soil. New techniques such as the electromagnetic induction meter and improved methods of combining soil properties using pedotranster functions should stimulate us lo provide groupings that help make the most precise and most important interpretations.

It seems to me that the advantages of recognizing erosion phases greatly exceed the problems of not recognizing them.

GENERAL COMMENTS

Respondent 4. Water erosion has been such a dominant topic with the NCSS in the past. it seems the problems of wind-eroded soils are just blown off. In the Western U.S.A., wind erosion is a significant process and should be recognized.

Chair. Perhaps we could solve the problem of erosion by allowing those states that want to map erosbn phases win a new term related lo erosion to replace taxadjunct.

Summary of Items discussed In San Diego

There is a major problem In providing a logical explanation of erosbn and sedlmentation and related management problems if erosion phases are not used. Also. the Increased emphasis on soil quality, precision farming, gbbal climatic change, and increased study of the carbon cycle support the need for genetic relationships In the classification system.

A change to new series because of surface horizon differences ignores other subsurface properties.

Anthropic could be added lo the family category for eroded soils and still maintain present series and phase names.

Use regional indicators to separate soils of diierent genesis. An example would be subsoil phosphorus characteristics lo separate eroded Mollisols from Alfisols.

Organic carbon fractions may be a key lo separate diierent genetic pathways. Humic add and fulvic differences between Mollisols and Alfisols have been repotted in the literature.

It is too complicated lo add all new diagnostic criteria to recognize what has been handled as phase separations.

Another alternative k lo use another term In place of taxadjunct to identify those soils modified by accelerated erosbn. Erodadjunct Is a suggested term.

It is important lo recognize man's influence on soils and landscapes. A new international committee on anthropogenic (ICOMANTH) soils has been formed. Dr. Ray Bryant of Cornell University is the chair. II was questioned if eroded soils should be a part of this new committee. It is my understanding that they may also include eroded soils under their committee. However, I believe the consensus was that in general the international committee is dealing with more drastically disturbed conditions than the change caused by accelerated erosion.

VII. **Recommendation**

Since a consensus was not reached by this committee, **the 1996 Regional Committees that have an interest in the topic of eroded soils should have a committee that addresses that problem for the region and prepares a report of their recommendations. The 1997 National Work Planning Conference should attempt to consolidate the regional reports into a coherent recommendation. In the North Central Region, most agree that the genetic thread should be maintained ie. that we need to recognize erosion phases. Many people do not seem to understand that there are existing properties** in the eroded soils that help identify the relationship discussed. Therelore, the proposed classification is not based entirely on supposition but is based on existing soil properties. This approach has provided the most homogenous groupings for interpretative purposes in the midwest for Mollisols, Alfisols, and their intergrades

Some **additional information**

In the North Central Region, In response to the priorities for research established by Agriculture Experiment Station Directors, much effort was directed to better understanding the process of erosion, the consequence of soil erosion on productivity, methods of improving yields of eroded soils, and soil quality. These are problems that we continue to study in the North Central Region.

Some of the publications resulting from these efforts are listed below:

Andraski, B.J. and B. Lower-y. 1992. Erosion effects on soil water storage, plant water uptake, and corn growth. Soil Sci. Soc. Am. J. 56:1911-1919.

Cihacek, L.J. and J.B. Swan. 1994. Effect of erosbn on soil chemical properties in the north central region of the United States. J. Soil and Water Cons. 49 (3)259-265.

Er-Raji, M. and L.J. Cihacek. 1994. Erosion effeds on selected agronomic parameters of hard red spring wheat across a landscape. North Dakota Farm Research 50(3):26-30.

Jones, R.L. and K.R. Olson. 1990. Use of fly ash as a time marker in sedimentation studies. Soil Sci. Soc. Am. J. 54:855-859.

Kazemi, Masoud. L.C. Dumenil, and T.E. Fenton. 1990. Effects of accelerated erosion on corn yields of bessdertved and till-derived soils in Iowa. Final report for Soil Conservation Service, Agreement No. 68-6114-0-8, Des Moines, IA.

Kreznor. W.R., K.R. Olson, D.L. Johnson, and R.L. Jones. 1990. Quantitiiation of postsettlement depositiin is an northwestern Illinois sediment basin. Soil Sci. Soc. Am. J. 54: 1393-1401.

Kreznor, W.R., K.R. Olson, Wayne Banwart, and D.L. Johnson. 1989. Soil, landscape. and erosion relationships In a northwest Illinois watershed. 53: 1763-1771.

Krernor. W.R., K.R. Olson. and D.L. Johnson. 1992. Field evaluation of methods to estimate soil erosion, Soil Science 153: 69-81.

Lal, Rattan. 1967 Etlects of soil erosion on crop productivity. CRC Critical Reviews in Plant Sciences 5:303-367.

Larson, W.E.. T.E. Fenlon. E.L. Skidmore, and CM. Benbrook. 1985. Effects of soil eroslon on soil properties as related to crop productivity and classification. In R.F. Follett and B.A. Stewart ed. Soil Erosion and Productivity. ASA-CSSA-SSSA, Madison, WI.

Lowery, Birl, James Swan, Tom Schumacher, and Alice Jones. 1995. Physical properties of selected soils by erosion class. J. Soil and Waler Cons. 50(3)306-311.

Lowery. Birl and William Larson. 1995. Symposium: Erosion impact on soil productivity. Soil Sci. Soc. Am J. 59:647-648.

Mokma, D.L., T.E. Fenton, and K.R. Olson. 1995. Effect of erosion on morphology and classification of soils in North Central United States. In press. J. Soil and Water Cons.

Olson, K.R., L.D. Norton, T.E. Fenlon, and R. Lai. 1994. Quantiiicalion of soil loss from eroded soil phases. J. Soil and Water Cons. 49(6)591-596.

Olson, K.R., R. Lal, and L.D. Norton. 1994. Evaluation of methods to study soil erosion-productivity relationships. J. Soil and Water Cons. 49(6)586-590.

Olson, K.R. and S.G. Carmer. 1990. Corn yield and plant population differences between eroded phases of Illinois soils. J. Soil and Water Cons. 5:562-566.

Olson. K.R. and E. Nbeyimana. 1988. Effects of soil erosbn on corn yields of seven Illinois soils. J. Prod. Agric. 1:13-19.

Olson, K.R., R.G. Darmody, J.S. Steiner, and AH. Beavers. 1988. X-ray technique to evaluate pedon and erosion variability of an Ava map unit. Soil [illegible].

Ofson.Ti -0.20995Tc 01.647 Tc 0 Tr 0.9 0 0 1 150.24 3633.6Tm (K.R.and) A.H. Beavers. 1987. A method to

soil variables In eastern Iowa. MS. Thesis. Iowa State University.

Kononova. M. M. 1966. Soil Organic Matter. Second Edition. Pergamon Press, Oxford,

Kreznor. W.R., K.R. Olson, W.L. Banwart, and D.L. Johnson. 1989. Soil-landscape-erosion relationships in a northwest Illinois walershed. Soil Sci. Soc. Am. J. 53:1763-1771.

Lance, J.C., S.C. McIntyre, J.W. Nameyand S.S. Rousseva. 1986. Measuring sediment movement at low erosion rates using cesium-137. Soil Sci. Soc. Am. J. 50:1303-1309.

Lockridge, Earl D. 1992. Mollisols - Problems in classification of eroded areas. In Classification and Correlation of Eroded Mollisols, Soil Survey Quality Assurance Staff.

Mausbach. Maurice J. 1969. Inorganic phosphorus fractions of some Iowa soil profiles. MS. Thesis, Iowa State University.

Olson, K.R., L.D. Norton, T.E. Fenton, and R. Lal. Guantiiication of soil loss from eroded phases. J. Soil and Water Cons. 49(6) 591596.

Olson, K.R., R. Lal. and L.D. Norton. 1994. Evaluation of methods to study soil erosion-productivity relationships. J. Soil and Waler Cons. 49 (6) 586590.

Richardson, J.L. and F.F. Riecken. 1977. Differences in exohangeabte aluminum and soil acidity In loess soils in Iowa. Soil Scl. Soc. Am. Proc., Vol. 41: 588-593.

Riecken, F.F. and B. R. Tembhare. 1976. Effect of prairie and forest vegetation on phosphorus status of Iowa soil profiles. Proc. 5th Midwest Prairie Conf. Iowa State University. Ames, Iowa.

Ritchie, J.C. and J.R. McHenry. 1985. A comparison of three methods for measuring recent rates of sediment accumulation. Water Resource Bulletin 4:99-103.

Sawyerr, P.A. 1987. The effect of accelerated erosion on the classification of Mollisols. M.S. Thesis. Iowa State University.

Smeck, N.E. 1973. Phosphorus: An indicator of pedogenetic weathering processes. Soil Sci., 115:199-206.

Smeck, N.E. 1985. Phosphorus dynamics in soils and landscapes. Geoderma, 36:185-199.

Smith, G.D. 1983. Historical development of Soil Taxonomy-Background. In: L.P. Wilding, N.E. Smeck, and G.F. Hall (Editors) Pedogenesis and Soil Taxonomy. I. Concepts and Interactions. Elsevier, New York.

Smith, G.D. 1986. The Guy Smith Interviews: Rationale for concepts in Soil Taxonomy. SMSS Technical Monograph No. 11. Soil Management Support Services, U.S. Dept. of Agric., Soil Consewatbn Service, and Cornell University, Department of Agronomy.

Soil Science Society of America. 1987. Glossary of soil science terms. Madison, WI.

Soil Survey Division Staff. 1993. Soil survey manual. U.S. Department of Agriculture Handbook No. 18.

Soileau. J.M., B.F. Hajek, and J.T. Touchton. 1990. Soil erosion and deposition evidence in a small watershed using fallout Cesium137. Soil Sci. Soc. Am. J. 54:1712-1719.

HOLLISOL PROPOSAL

SUBMITTED BY ROBERT J. AHRENS
June 5, 1995

RJA

Background

There is a long history of grouping together soils that formed under grass. The previous soil classification system in the U.S. used a suborder entitled "Dark Colored Soils of the Semiarid, Subhumid, and Humid Grasslands.' With this long tradition of grouping the grassland soils, it is not surprising that Soil Taxonomy has maintained this emphasis and separated these soils at the order level as Mollisols. The properties of these soils include a dark colored surface, the mollic epipedon, and a base saturation of more than 50 percent by NH_4OAc in all subhorizons below the mollic epipedon and within the control section.

Soils at the order level are differentiated on the basis of properties resulting from the major processes of soil formation. The dominant genetic process'of Mollisols is considered to be the formation of the mollic epipedon as a result of underground decomposition of plant residues in the presence of appreciable calcium. Large areas of Mollisols occur in the midwestern U.S. It is likely that many of these soils are polygenetic and formed under more than one set of soil forming factors. Some of the. loess-derived Mollisols may have developed under periods of woodland vegetation as well as under grasses. Each set of soil forming factors has left an imprint on the soil. Woodland type vegetation appears more conducive to the formation of argillic horizons, while grassland vegetation is more conducive to the formation of mollic epipedons. If a given set of processes has been dominant for a significant amount of time, they will leave their marks in the form of distinctive horizons or features. The marks are always the result of genesis in the past which may be recent or distant. The formation of most soils, therefore, is.. inferred. Because the genesis of soils happened in the past and must be inferred, genesis does not appear in the definitions of the taxa but lies behind them. The genetic processes and marks can be greatly influenced by man. Soils are leveled, deeply plowed, mismanaged; mined, and removed by man. Man has a great influence on the soil and must be considered as a soil forming factor.

Problem

Because of man's influence, using the soil surface as a diagnostic horizon has caused problems. This is especially true of the mollic epipedon because it can be eroded or otherwise altered by man's influence. As yet no one has proposed a characteristic other than the mollic epipedon t h a

RJE

allowed only if the epipedon is underlain directly by a lithic or paralithic contact, a petrocalcic horizon, or a duripan. Thickness requirement between 18 cm (7 in) and 25 cm (10 in) are determined by the presence and thickness of underlying horizons and the texture of the epipedon.

Many sloping Mollisols have a mollic epipedon near the minimum thickness. Slight to moderate erosion can reduce the thickness of the epipedon to less than 25 cm.

Proposal:
Reduce the minimum thickness requirement for mollic epipedons now requiring from 18 cm to 25 cm of thickness to 18 cm, regardless of solum-thickness.

Rational:
The bottom of argillic and cambic horizons are not well defined in Soil Taxonomy and the thickness of the solum commonly has little relation to the thickness of epipedons. The management of many soils with epipedons 7 to 10 inches thick would be similar regardless of solum depth.

Results:
1. Eroded Mollisols with epipedons 7 to 10 inches thick that meet the requirements of a mollic epipedon except for thickness would classify as Mollisols.
2. Base rich soils with 7 to 10 inch thick dark colored, epipedons would be classified the same regardless of solum depth.
3. Some mollic intergrades from other orders with high base status would be classified as Mollisols.

that is common to all the soils we would like to classify as Mollisols.

For years there has been discussion on the best way to name, classify, correlate, and interpret soils believed to be eroded Mollisols. According to the Map Unit Use File (MUUF) 21.7 million acres of soils have been correlated as eroded phases of soil series in the Mollisol order. About 5.7 million of the 21.7 million acres of soils have been correlated as a taxadjunct to a series in the Mollisol order. This acreage is largely in the Midwest. The perception by some is that this large acreage of taxadjuncts represents a breakdown in our system.

Proposal 1
The philosophy of Soil Taxonomy is that a soil should be classified on its own properties, and not on those that are assumed to have existed in the past, nor on the properties of the adjacent soils.

Often the soils correlated as taxadjuncts to series of the Mollisol order are classified to another order such as Alfisols or Inceptisols. At the same time it is commonly' recognized that these eroded Mollisol taxadjuncts have lower yields and different interpretations than the uneroded Mollisol counterparts. This violates the concept of the taxadjunct, which must have very similar interpretations and management as the named series. One solution to this problem would be to recognize man as a soil forming factor, classify the soil as is, and if necessary set up new soil series for these eroded Mollisols. These new series could still have eroded phases if this is desired. The Official Series Description could state that this series is an eroded counterpart to a series that is a Mollisol. The interpretations would then match the series and it would not be necessary to have all the taxadjuncts that currently exist. Some soil scientists are reluctant to accept this course of action because of a bias toward the old zonal concept or because they believe Soil Taxonomy is not making the best separations. If Soil Taxonomy is not making the best separations, then proposal 2 should be considered.

Proposal 2
The second proposal changes the thickness requirements of the mollic epipedon and is outlined below.

RJE

Mollic Epipedon Proposal

Background:
The thickness of the dark colored surface layer required to meet the mollic epipedon definition in Soil Taxonomy ranges from 10 cm (4 in) to more than 25 cm (10 in). These thicknesses are determined after the soil has been mixed to a depth of 18 cm. Thickness less than 18 cm (7 in) is

NATIONAL COOPERATIVE SOIL SURVEY

National Cooperative Soil Survey Conference Proceedings

Burlington, Vermont
July 11-16, 1993

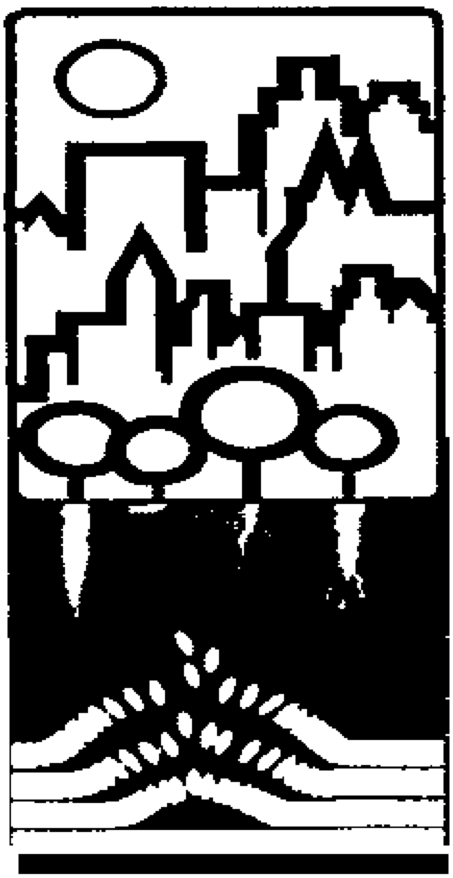
United States
Department of
Agriculture

Soil
Conservation
Service

Proceedings of National Cooperative Soil Survey Conference Burlington, Vermont July 11-16, 1993

NATIONAL COOPERATIVE **SOIL** SURVEY CONFERENCE

Burlington, Vermont
July 11-16, 1993



United States Department of Agriculture
Soil Conservation Service

5:00 PM - 7:00 PM Registration

AM **Chairperson** - Steve **Holzhey**

8:00 AM -- **9:00** AM **Registration**

9:00 AM - 9:15 AM *Welcome*
John Titchner
Stale Conservationist
USDA-SCS
Winooski, Vermont

9:15AM - 10:00 AM *Opening Remarks*
Chief (invited)
USDA- Soil Conservation Service
Washington, D.C.

10:00 AM **- 10:30** AM **Break**

10:30 AM **- 11:00AM** *Vermont Landscapes*
Dr. Larry **Forcier**
Dean, Division of **Agriculture, Natural Resources, and** Extension
University of **Vermont**

11:00 AM - 11:30 AM *SCS - Soil Survey Activities*
Dr. **Richard** Arnold
Director, Soil **Survey** Division
Washington, D.C.

11:30 AM **- 12:00** PM *North East Agricultural Experiment Station Report*
Dr. **Del** Fanning

12:00 PM - l:OOPM Lunch

PM **Chairperson** - Pete Avers

1:00 PM **- 1:30** PM *South Agricultural Experiment Station Report*
Dr. Dave **Pettry**

1:30 PM - 2:00 PM *West Agricultural Experiment Station Report*
Dr. Gene Kelly

2:00 PM - 2:30 PM North *Central Agricultural Experiment Station Report*
Dr. Ken Olson

2:30 PM - 3:00 PM *World Soil Resources Report*
Hari Eswaran, National Leader for World Soil Resources
USDA-SCS, Washington. **D.C.**

3:00 PM - 3:30 PM Break

3:30 PM - 4:00 PM *The Soil Management Collaborative Research support Program*
Dr. Roger Hanson
Director. **TROPSOILS**
North Carolina State University
Raleigh, North **Carolina**

4:00 PM - 4:30 PM *Framework for Evaluation of Sustainable Land Management*
Dr. **Julian Dumanski**
Agriculture Canada
Ottawa, Ontario

4:30 PM - 5:15 PM *A World Reference Base for Soil Classification*
Dr. **Alain Ruellan**
National Center of Agronomic **Studies** for Dry **Regions**
Montpellier, France
Following **this** presentation will **be** a discussion of helping lay **people** to **understand soil** morphology.

Tuesday - July 13

AM Chairperson - Jim Ware

8:00 AM - 8:30 AM *Report on Soil Survey Activities in Mexico*
Dr. Roberto **Nunez**
Vice President,
International Soil Science Society

8:30 AM - 9:00 AM *Report on Soil Survey Activities in Canada*
Richard **Coote**
Program Leader
Center for **Land** and Biologic Resource Research
Agriculture Canada

9:00 AM - 9:30 AM *Role of Soil Survey in the Commonwealth of Independent state.3*
Dr. Richard **Arnold**

9:30 AM - 10:00 AM Break

[illegible]

9:31a1o:oOA0.2264.00.5412 Tw 0 Tr 1 0 0 1 439061 499.44chard

12:00 PM. 1:00 PM Lunch

PM **Chairperson -** Maurice **Mausbach**

1:00 PM - 1:45 PM *EPA - EMAP*
Dr. Walter Heck
Associate Director,
EMAP Terrestrial

1:45 PM - 2:30 PM *Certification of Hydric Soil Delineators*
Dr. Tom Hall
American Society of Agronomy

2:30 PM - 3:00 PM *FOTG - SWAPA*
Obie Ashford
Head, Ecological Science and Pluming staff
NENTC, USDA -SCS,
Chester, PA

3:00 PM - 3:30 PM Break

3:30 PM - 4:15 PM ***The Role of Research in the Soil Survey Program Different Cooperators, Different Roles, Different Priorities***
Dr. Richard Guthrie
Assistant Dean of Agriculture
Auburn, University

4:15 PM - 5:00 PM *U.S. Forest* service *Report Ecological Approach to Soils Inventory*
Pete Avers, Soil Resource Program Manager
USDA-FS, Washington, D.C.

Fkld Tour

Thursday - July 15

AM Chairperson - Jim Culver

8:00 AM - 8:30 AM Soil *Interpretations and criteria used in Resource planning*
Maurice Mausbach

STANDMG **COMMITTEE REPORTS**

8:30 AM - 9:00 AM Standards Committee - General
Steve Holzhey

9:00 AM - 9:30 AM Map Unit Reliability
Ellis Knox

9:30 AM - 10:00 AM NSH -
Soil Survey Manual -
Soil Taxonomy
Bob Ahrens

10:00 AM - 10:30 AM Standards Committee - NCSS
Data Management Subcommittee
Dennis Lytle

10:30 AM - 11:00 AM BREAK

COMMITTEE WORK SESSIONS

11:00 AM - 12:00PM Committee 1
Vadose Zone
Chair: DeWayne Williams

Committee 2
Role of NCSS and the New Cooperators
Chair: G. Wade Hurt

Committee 3
Soil Survey by MLRA
Chair: Bob McLeese

Committee 4
The "Digital Soil Survey"
Chair: Dennis Lytle

Committee 5
Disturbed Lands
Chair: Tom Ammons

PARTICIPANTS IN THE
1993 NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE
BURLINGTON, VERMONT

DR. ANDRES AGUILAR, Universidad Autonoma Chapingo, P. 0. Box 45, 56230 Chapingo, Mexico

BOB AHRENS, Soil Scientist, USDA - SCS, Federal Building, Room 345 Lincoln, NE 68508-3866, (402) 437-5336

DR. TOM AMMONS, Associate Professor Soil Genesis, Department of Plant & Soil Sciences, College of Agriculture, University of Tennessee, Knoxville, TN 37901, (615) 974-8804

DR. RICHARD W. ARNOLD, Director, Soil Survey, USDA - SCS, P. 0. BOX 2890, Washington, D.C. 20013, (202) 720-1821

ANDREW ART, Center for Resource Economics, 1718 Connecticut Ave., N.W., Suite 300, Washington, D.C. 20009, (202) 667-6982

OBIE ASBFORD, Head, Ecological Sciences & Planning Staff, USDA - SCS, 160 East Seventh Street, Chester, PA 19013, (215) 499-3916

PETER AVERS, Soil Scientist, USDA - Forest Service, 201 14th Street N.W., 3rd Floor, South Auditors Bldg., Washington, D.C. 20250
(202) 205-0977

DICK BABCOCK, State Soil Scientist, USDA - SCS, 101 South Main Street, Temple, TX 76501-7682, (817) 774-1261

JOE BAGDON, Resource Conservationist, USDA - SCS, 451 West Street Amherst, MA 01002, (413) 253-4376

DR. JIM BAKER, Associate Professor Soil Genesis, Department of Agronomy, Virginia Polytechnic Institute, Blacksburg, VA 24061 (703) 231-6305

DON BEARDSHEAR, Teem Leader for Telecommunications Division, USDA - SCS, 2625 Redwing Road, Suite 110, Ft. Collins, CO 80525-2878, (303) 498-2112

DR. FRED BEINROTH, Professor, Department of Agronomy, College of Agriculture, University of Puerto Rico, Mayaguez, Puerto Rico 00708, (809) 833-2865

JERRY BERNARD, National Geologist, Engineering Division, USDA - SCS, P. 0. Box 2890, Washington, D.C. 20013, (202) 720-5356

EARL BLAKELY, Soil Scientist, USDA - SCS, Federal Center, Building 23, Room 60, Felix and Hemphill St., P. 0. Box 6567, Ft. Worth, TX 76116,
(817) 334-5224

JEFF BOOTB, National Mapping Requirements Program Manager, Environmental Protection Agency, Systems Development Center, 1500 Planning Research, TM-228, McLean, VA 22102, (703) 235-5591

DR. STAR **BOUL,** Professor of Soil Genesis and Classification, Soil Science Department, College of Agriculture, North Carolina State University, Raleigh, NC 27695, (919) 515-2655

KEN **BOYD,** NCD 1, **D58,** Defense Mapping Agency, Hydrographic Topographic Center, 4600 **Sangamore** Road, Bethesda, MD 20816-5003 (301) **227-2043**

MARK BRADFORD, Division of Water and Land Resources, Bureau of Indian Affairs, Department of Interior, 1849 C Street N.W., Code 218, Hail Stop 4559 **M1B,** Washington, D.C. 20240

JIM BROWN, State Soil Scientist, USDA - SCS, 339 Busch's Frontage Road, Annapolis, MD 21401, (410) 757-2872

DR. RAY BRYANT, Associate Professor of Soil Genesis and Classification, Department of Soil, Crop, and **Atmospheric** Sciences, Cornell University, Ithaca, NY 14583, (607) 255-1716

NS. NANCY BURT, Soil Scientist, USDA - Forest Service, P. **O.** Box 519 **Rutland, VT** 05201, (802) 773-0300

THOMAS CALHOUN, Assistant Director, Soil **survey,** USDA - SCS, P. 0. Box 2890, Washington, D.C. 20013, (202) 720-1824

DALE **CHILDS,** Asst. State Soil Scientist, USDA - SCS, 75 High Street Morgantown, WV 26505, (304) 291-4484

TOM COLLINS, Regional Soil Scientist, USDA - Forest Service, Federal Building, 324 25th Street, Ogden, UT 84401, (801) 625-5357

RICBARD **COOTE,** Program Leader, Agriculture Canada, Research Branch Center for Land & Biologic Resources Research, Ottowa, Ontario **K1A-OC6,** (613) 995-5011

JIN CULVER, National Leader, Soil Survey Quality Assurance, USDA - SCS, Federal Building, **Room** 345, 100 Centennial Mall North, Lincoln, NE **68508-3866,** (402) 437-5353

DR. LEE **DANIELS,** Asst. Professor Spoil Reclamation, Department of Agronomy, Virginia Polytechnic Inst., Blacksburg, VA 24061 (703) **231-6305**

LEW DANIELS, Soil Scientist, Soil Interpretations Staff, USDA - SCS, 160 East 7th street, Chester, PA 19013, (215) 499-3964

DR. R. **G.** DARMODY, Associate Professor of Pedology, Department of Agronomy, **W-**203 Turner Hall, 1102 South Goodwin, Urbana, IL 61801 (217) 333-3420

DR. **JULIAN DUMANSKI,** C.L.B.R.R., Agriculure Cbanda., ROBERT **ENGEL, USDA - SCS**, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE **68508-3866,** (402) 437-5353

DR. **HARI ESWARAN, Nat'l** Leader, World Soil Resources, **NHQ,** Soil Survey **Division,** USDA - SCS, P. **O.** Box 2890, Washington, D.C. 20013, (202) 690-0333

DR. **CHRIS** EVANS, Associate Professor of Pedology Natural Resources Department, College of Life Sciences **&** Agriculture, University of New Hampshire, Durham, NH 03824, (603) 862-1020

DR. DEL **FANNING,** Professor of Soil Classification, Department of Agronomy, College of Agriculture, University **of** Maryland, College Park, MD 20742, (301) 405-1306

DR. **TOM FENTON**, Professor Of Soil **Morphology** 6 **Genesis,** Department Of Agronomy, Iowa State University, Ames, **IA** 50011, (515) 294-6148

DR. LARRY **FORCIER, Dean, Division** of Agriculture **&** Natural **Resources,** University of Vermont, Burlington, VT 05405,
(802) 656-2908

DR. **DON FRANZMEYER,** Professor of Soil **Genesis,** Department of **Agronomy,** School of Agriculture, Purdue University, **West** Lafayette, IN 47907, (317) 494-4774

CHARLES FULTZ, State Soil Scientist, USDA - SCS, 700 West Capitol Avenue, Little Rock, AR 72201, (501) 324-5410

TIM **GERBER,** Soil Inventory **&** Evaluation Department, Ohio Department of Natural **Resources,** Building E, Fountain Square, Columbus, OH 43224, (614) 265-6680

JOSEPH U. GIBSON, U. S. Army Corps of Engineer, Topographic Engineering Center, ATTN: CETEC-TC-TC, Ft. **Belvoir,** VA 22060-5446

CHARLES GIRDNER, Soil Scientist, Ecological Sciences **&** Planning Staff, USDA - SCS, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE 68508-3866, (402) 437-5315

DR. R. C.

DR. G. F. BALL, Professor of Pedology, Department of Agronomy, College of Agriculture, Ohio State University, Columbus, OH 43210 (614) 292-2001

TOM HALL, Assistant Vice President, American Society of Agronomy 677 S. Segoe Road, Madison, WI 53711, (608) 273-8080

DR. ROWER HANSON, Director, Management Entity, TROPSOILS, P. 0. Box 7113, North Carolina State University, Raleigh, NC 27695-7133, (919) 515-3922

B. L. HARRIS, Specialist of Soil Genesis and Classification, Soil and Crop Sciences Department, College of Agriculture and Life Sciences, Texas A&M University, College Station, TX 77843 (409) 845-3041

BILL BATFIELD, State Soil Scientist, USDA - SCS, 75 High Street, Morgantown, WV 26505, (304) 291-4484

DR. WALT HECK, Associate Director, EMAP Terrestrial, 1509 Varisty Drive, Raleigh, NC 27606, (919) 515-3311

DENNIS HEIL, Head, Soil Interpretations Staff, USDA - SCS, Federal Building, Room 248, 511 N.W. Broadway, Portland, OR 97209-3489, (503) 326-2851

C. STEVEN HOLZHEY, Director, National Soil Survey Center, Federal Building, Room 345, 100 Centennial Wall North, Lincoln, NE 68508-3866, (402) 437-5353

DR. ART HORNSBY, Exteneio" Soils Specialist, Department of Soil Science, College of Agriculture, University of Florida, Gainesville, FL 32611, (904) 392-1804

WILLIAM D. XOSTETER, Soil Scientist, USDA - SCS, 6013 Lakeside Boulevard, Indianapolis, IN 46278, (317) 290-3203

DR. WAYNE HUDNEL, Associate Professor Soil Morphology, Department of Agronomy, Agricultural & Mechanical College, Louisiana State University, Baton Rouge, LA 70893, (504) 388-2110

DR. BERMAN HUDSON, National Soil Survey Center, USDA - SCS, Federal Bldg., Room 345, 100 Centennial Hall North, Lincoln, NE 68508-3866 (402) 437-5353

STEVE HUNDLEY, State Soil Scientist, USDA - SCS, Federal Building, Durham, NH 03824, (603) 868-7581

WADE HURT, State Soil Scientist, USDA - SCS, 401 S.E. 1st Street, Gainesville, FL 32601, (904) 377-1092

DAVID JONES, State Soil Scientist, USDA - SCS, 100 West Capitol Street, Jackson, MS 39269, (601) 965-5193

NORM KALLOCH, State Soil Scientist, USDA - SCS, 5 Godfrey Drive, Orono, ME 04473, (207) 866-7245

DR. EUGENE KELLEY, Assistant Professor, Department Of Agronomy, 22 Plant Sciene Building, Colorado State University, Ft. Collins, CO 80523, (303) 491-6881

JOHN KELLEY, Assistant State Soil Scientist, USDA - SCS, 4405 Bland Road, Suite 205, Raleigh, NC 27609, (919) 790-2905

RUSS KELSEA, Soil Scientist, Technology Information Systems Division, USDA, SCS, 2526 Redwing Road, Suite 110, Ft. Collins, CO 80526, (303) 489-1433

DR. JOE KLEISS, Associate Professor Soil Classification, Soil Science Department, College of Agriculture, North Carolina State University, Raleigh, NC 27695, (919) 515-2655

DR. ELLIS KNOX, National Leader for Soil Survey Investigations, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE 68508-3866, (402) 437-5353

KIP KOLESINSKAS, State Soil Scientist, USDA - SCS, 16 Professional Park Road, Storrs, CT 06268-1299, (203)

GEORGE MARTIN, Assistant State Soil Scientist, USDA - SCS, 665 Opelika Road, Auburn, AL 99508-4302, (205) 887-4540

DR. **MAURICE MAUSBACH,** National Leader, Technical Soil Servicea, USDA SCS, P. O Box 2890, Washington, D.C. 20013, (202) 720-1812

DWAYNE MAYS, USDA - SCS, Federal Building, Room 345, 100 Centennial Wall North, Lincoln, NE 68508-3866, (402) 437-5336

NATHAN MCCALEB, Soil Scientist, Ecological Sciences and Planning Staff, USDA - SCS, Federal Building, Room 345, 100 Centennial Mall North, Lincoln, NE 68508-3866, (402) 437-5315

ROBERT **MCLEESE,** USDA - SCS, 1902 Fox Drive, Champaign, IL 61820

DR. KBVIN **MCSWEENEY,** Associate Professor of Pedology, Soil Science Department, College of Agriculture, University of Wisconsin, Madison, WI 53706 (608) 262-0331

JOHN MEETZE, State Soil Scientist, USDA - SCS, 665 Opelika Road, Auburn, AL 99508-4302, (205) 887-4540

DR. BOB **MEURISSE,** Regional Soil Scientist, USDA - Forest Service, P. 0. Box 3623, Portland, OR 97208, (503) 326-3360

DICK MEYER, National Home Builders Association, 1201 15th Street N.W., Washington, D.C. 20005, (202) 822-0475

DR. RAY **MEYER,** Project Monitor, SMSS, S&T/AGR/RNR, Room 408B, Agency for International Development, Washington, D.C. 20523

FRED MINZENMEYER, Soil Scientist, Soil Geography and Interpretations Staff, USDA - SCS, Building 23, Room 60, Felix and Hemphill Street, P. O. Box 6567, Ft. Worth, TX 76116, (817) 334-5559

DR. **JOHN J. MORTVEDT,** Department of Agronomy, Colorado State Vnivereity, Ft. Collins, CO 80532

ROB NIELSEN, National Soil Survey Center, USDA - SCS, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE 68508-3866, (402) 437-5353

DARWIN **NEWTON,** State Soil Scientist, USDA - SCS, 801 Broadway, Nashville, TN 37203, (615) 736-5476

MAURICE NYQUIST, Chief, Data and Applications Branch, GIS - Division WASO, National Park Service, P. 0. Box 25287, Denver, CO 80225-0287, (303) 969-2590

CAROLYN OLSON, National Soil Survey Center, USDA - SCS, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE 68508-3866, (402) 437-5353

DR. KEN OLSON, Associate Professor of Soil Pedology, Department of Agronomy, W-203 Turner Hall, 1102 South Goodwin, Urbana, IL 61801, (217) 333-3420

ROBERT J. PEASE, GIS/Systems Analyst, U. S. Environmental Protection Agency, 1550 Wilson Blvd., Rosslyn, VA 22209,

DR. DAVID PETTRY, Professor of Agronomy, Department of Agronomy, College of Agriculture, Mississippi State University, Mississippi State, MS 39726, (601) 325-2459

JOHN A. PHILLIPS, Soil Scientist, Foreign Agricultural Service, Production Estimates & Crop Assessment Division, Room 6549-South, 14th & Independence Avenue S.W., Washington, D.C. 20250, (202) 690-0138

CHRISTIAN PIERS, Natural Resources Agro-Ecologist Agriculture and Rural Development, The World Bank, 1818 H. Street, N.W., Washington, D.C. 20433, (202) 473-0358

JOB PIMENTA, U.S. Army Corp of Engineers, ATTN: CETEC-TC-T, Ft. Belvoir, "A 22060-5546, (703) 355-2675

DR. MARTY RABENHORST, Associate Professor of Soil Pedology, Department of Agronomy, College of Agriculture, University of Maryland, College Park, MD 20742, (301) 405-1306

JERRY RAGUS, Resource Soil Scientist, USDA - Forest Service, 1720 Peach Tree Road N.W., Room 846, North Tower, Atlanta, GA 30367, (404) 347-7211

LARRY RATLIFF, National Soil Survey Center, USDA - SCS, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE, 68508-3866, (402) 437-5353

DEAR RECTOR, State Soil Scientist, USDA - SCS, 400 North 8th Street Richmond, "A 23240-9999, (804) 771-2463

WAYNE ROBBIE, Regional Soil Scientist, USDA - Forest Service, Federal Building, 517 Gold Ave., S.W., Albuquerque, NM 87102, (505) 842-3142

BILL ROTH, Soil Scientist, USDA - SCS, P. 0. Box 2890, Washington, D.C. 20013, (202) 720-1809

ROBERT ROURKE, Senior Soil Scientist, Plant, Soil, & Environmental Sciences, College of Applied Sciences and Agriculture, University of Maine, Orono, ME 04469, (207) 581-2946

DR. ALAIN RUELLAN, CNEARC, 1101 Avenue Agropolis, BP 5098, 34033 Nontpellier Cedex 01, France

JAVIER RUIZ, Soil Scientist, Soil Interpretations Staff, USDA - SCS Federal center, Building 23, Room 60, Felix and Hemphill Street, P. 0 .Box 6567, Ft. Worth, TX 76116, (817) 334-5224

DR. **MOYE RUTLEDGE,** Professor of Soil Classification, Department of Agronomy, Division of Agriculture, University of Arkansas, Fayettaville, AR 72701, (501) 575-2354

WALT RUSSELL, Regional Soil Scientist, USDA - Forest Service, 310 W. Wisconsin Ave., Room 500, Milwaukee, WI 53203, (414) 297-3328

PBIL **SCHOENBERGER,** National Soil Survey Center, USDA - SCS, Federal Building, Room 345, 100 Centennial Mall North, Lincoln, NE 68508-3866, (402) 437-5353

DR. JOBN **SENCENDIVER,** Professor of Soils, Division of Plant Science, Agricultural Science Building, West Virginia University Morgantow", WV 26506, (304) 293-4817

RAY SINCLAIR, National Soil Survey Center, USDA - SCS, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE, 68508-3866, (402) 437-5353

DR. **M. J.** SINGER, Professor of Soil Science, Department of Land, Air, and Water Resources, College of Agriculture and Environmental Sciences, University Of California, Davis, CA 95616, (916) 752-3607

CARTER STEERS, Assistant Head, National Cartographic Center, USDA - SCS, Federal Center, Building 23, Room 60, Felix and Hemphill Street, P. O. Box 6567, Ft. Worth, TX 76116, (817) 334-5292

EVERETT STUART, Assistant State Soil Scientist, USDA - SCS, 60 Quaker Lane, Warwick, RI 02886, (401) 828-1300

RON TAYLOR, State Soil Scientist, USDA - SCS, 1370 Hamilton Street, Somerset, NJ 08873, (908) 246-4110 ext. 170

JOHN TITCBNBR, State Conservationist, USDA - SCS, 69 Union Street Winooski, VT 05404, (802) 951-6795

DR. TOM **USSELMAN,** Mapping Science Committee, National Academy of Science, 2101 Constitution Avenue, Washington, D.C. 20418
(202) 334-3349

DAVE VAN **HOUTEN,** State Soil Scientist, USDA - SCS, 69 Union Street, Winooski, VT 05404, (802) 951-6795

DR. PETER **VENEMAN,** Professor of Soil Genesis, Plant & Soil Science Department, University of Massachusetts, Amherst, MA 01003 (413) 545-2243

COLIN VOIGT, Soil Scientist, Soil, water, and Air Branch, Department of Interior, BLN, Premier Bldg., Room 909, 18th & C St., N.W., Washington, D.C. 20240, (202) 653-9210

PETER WALDO, Sedimentation Geologist, USDA - SCS, 501 Felix Street, Bldg., 23, P. O. Box 6567, Ft. Worth, TX 76115, (817) 334-5242

DR. BILL WALTMAN, Soil Scientist, National Soil Survey Center, USDA - SCS, Federal Building, Room 345, 100 Centennial Wall North Lincoln, NE 68508-3866, (402) 437-5336

JIM WARE, Soil Scientist, USDA - SCS, P. O. Box 2890, Washington, D.C. 20013, (202) 720-1808

DR. LARRY WILDING, Professor of Soil Classification, Soil & Corp Sciences Department, College of Agriculture & Life Science, Texas A&M University, College Station, TX 77843, (409) 845-3041

DEWAYNE WILLIAMS, Soil Scientist, USDA - SCS, Federal Center, Building 23, Room 60, Felix and Hemphill Street, P. 0. Box 6567, Ft. Worth, TX 76116, (817) 334-5224

DR. GARY L. WILLIAMS, Inventory and Monitoring Program Coordinator, National Park Service, Department of Interior, 18th & C Street N.W., Room 3023, P. O. Box 37127 (Stop 470). Washington, D.C. 20013, (202) 208-5193

DR. JOHN WITTY, National Leader for Soil Classification, National Soil Survey center, USDA - SCS, Federal Building, Room 345, 100 Centennial Hall North, Lincoln, NE 68508-3866, (402) 437-5336

DR. BILL WRIGHT, Department Chair, Natural Resources Department, University of Rhode Island, Kingston, RI 02881, (401) 792-2495

JOHN ZACHARA, Chief Scientist, Pacific Northwest Lab., P. 0. Box 999, Nail Stop K3-61, Richland, WA 99352, (509) 375-2993

THE SOIL SURVEY OF THE UNITED STATES *

by Richard Arnold
Director. Soil Survey Division
SCS, Washington, DC

Slide Number

1. There is only one soil survey in the US; it is the National Cooperative Soil Survey. See it again - Nacional Conservacion de Suelos Servicio.

2. The vastness, beauty, and natural resources of this country are unsurpassed in the world. We are fortunate to have a role to play in the future of these resources.

3. The richness is bountiful. Careful and prudent management is a must.

4. In places the horizon stretches beyond view. Big sky and big land.

5. Perhaps the most dramatic change of the world's ecosystems

12. The consequences of our perceptions are that soil6 are segments of landscapes. The segments are potential mapping unit6 and our understanding of composition is associated with scale, We have relied on pedons to help us recognize the components in map uni ts,

13. Presto. The soil map - a classic. none according to well designed standards. Yet these change as our knowledge improves. Always our products and services must adapt to change. Quality is not a static concept.

14. If we understand map units so well, why do we spend so much time explaining them to others? Because we didn't create the variability and would like others to appreciate the difficulty in describing it.

15. Are soils segments of landscapes? So our experience across this nation has demonstrated.

17. Landscapes are the keepers of functional relationships that give credibility to the soil survey. Here are a few of the relationships we try to understand.

18. People want solutions to their own problems; suggestions to deal with their concerns. They trust us to provide the best science possible in support of our interpretations.

19. After more than 90 years of learning from our mistakes and beneflting from our successes, a new awakening is taking place. Aroused from the deep sleep of tradition; reaching out beyond the obvious for a new vision.

20. Okay, my friends. What is thls new awakening all about?

21. Well, we got together and talked about who we are and what we are about. Here is a brief listing of things we care about. Employees, colleagues, customers, volunteers, NCSS, and partners. We value global resources, research, innovation. creativity, professionalism, image, and ethics.

22. We are restating our mission to emphasize our role to provide leadership and services. and our vision is "quality soil resource information for science and society".

23. Strategic planning is not a easy process; however we have started to identify issues to guide our future and to help us monitor our performances.

24. We have a mix of issues: some are to help others; some are to strengthen our programs, and, likely, some are orientated towards survival.

25. Okay, okay you guys, so you can make 1 ists and show off; how are you going to get where you want to be?

26. We believe there are four ingredients of importance. One is to foster and maintain a strong scientific basis for our work. Another is to ensure that we have the competency to do soil survey.

27. A vital function is to make all our information more readily available, and all of the above so that results happen. Helping others help themselves. That is what we want.

28. Ever since the founding of this country certain rights have been self -evident. Of the people; by the people; for the people. Remember, you folks of the NCSS. nothing is more enduring than the integrity of your work.

29. Today there is the stark realization that the finite natural resources are plundered and abused by mankind - time and time again. But this time population seems to be running wild: out of control relative to the available resources.

30. The simple recognition is that no one can survive alone. It takes lots of helping hands just to get started; or restarted; or redirected.

31. The Soil Survey laboratory is a national treasure. A dynamic entlty of which the US can be proud. It is an international standard better; at least, up until now.

32. There are many sources of lnforaation in NASIS; our National Soil Information System. It needs help and cooperation from all of us.

33. October '94, is the target date for NAEIS version 1.0. It will truly change the future's understanding of soil relationships. It is complex and comprehensive: yet comforting.

34. Digitized spatial soil data - of course! The methods are in place. Financial resources are currently the most severe constraint to rapid implementation.

35. NATSGO. STATSGO, SSURGO. STATSGO is almost operational for the US. A budget initiative for digitizing additional SSURGO surveys is again in the "95, budget proposal.

36. Soil data layers facilitate providing interpretation6 for users; ourselves included,

37. Interpretations of interpretations of interpretations. It Is the analytical power of GIS that will sustain its application. Did you know that Technical Soil Services currently make-up about 1/3 of your budget expenditures? Fantastic.

38. We are examining new techniques to test the accuracy of our soil information and exploring new ways to specify the reliability of our Information.

39. It is not easy, but crucial to our credlbllity, and to user acceptance. *Fuzzy* set logic and probabilities are llkely here to stay.

40. Hydrologic Unit Areas, Watersheds, portions of MLRAs - new ways to organize our thoughts, process our information, and help people manage land.

41. Water quantity, water quality, ecosystems in harmony with quality environments. Integrating knowledge about stratigraphy, geomorphology, and hydrology are essential to good ecosystem management.

42. Total resource management means having the right inforsation to plan appropriate management systems and ensuring follow-through that results in harmonious humanized ecosystems.

43. Many of our ecosystems are fragile. Once disturbed they recover slowly. Soil resilience is a useful concept.

44. Most ecosystems ate multi-purpose ones; watershed protection, esthetics, recreation, and, oh yes, there is a moose making waves in the little lake.

45. Multiple purpose uses *are* not without conflict. The list of endangered species in the US is a long one. Much legislation and lots of litigation are encountered. Social issue6 are never easy ones.

46. In the US we have a little grace period remaining - something most of the world doesn't have. Beyond our boundaries is the rest of this interconnected one world. We are working to help others play a significant role; to share their experiences that we can only imagine. It's far more than just image building.

47. **When pedologlsts reach out they do it through their perceptions of the world. One important one is the estimation of soil temperature regimes. Important in Soil Taxonomy; important in ecosystems.**

48. Similar regions, of course. Useful in converting the FAO World Soil Map to Soil Taxonomy, of course. Helping all of us make necessary correlations

49. We want everyone to be a princess or a prince in the development of "productive nations in harmony with a quality global environment". The SCS vision can be enlarged to embrace the world. Believing it and doing something about it are still unknowns.

50. Earth system history, soil climate, carbon cycle and storage, and ecosystem responses are all components of the US Global Change Research Program.

51. Re-directed CO-02 funds enable the search for improved relationships in soil carbon, in soil climate, and in better understanding the world of permafrost: the Cryosol Zone.

52. As we adapt to other changes we've explored correlating and updating soil information along natural landscape boundaries rather than political boundaries. We envision a transition phase with Major Land Resource Area Soil Survey Managers rather than State Soil Scientists.

53. The juxtaposition of agriculture and urbanization is ever present. The finiteness of available arable land is still more critical in other countries than in the US, but we need to determine (or, at least, estimate1 the carrying capacity potentials of our land and water resources.

54. More people live in cities than have ever inhabited the earth since Adam and Eve. People in urban centers are very, very dependent on the sustaniability of natural resources; those open spaces beyond the "concrete jungle".

55. Yes. it is a wonderful world. We are so fortunate to be in touch with nature in all of its majesty. power, and mystery.

56. We recognize and realize the overwhelming need to transfer relevant technology that is not only right for the land, but is socially acceptable and politically feasible. Because the world's population won't even stabilize until late in the next century, we need to get good results today . . . and tomorrow.

57. The brutal fact is that physical science won't be able to stop the disasters. Institutional changes must occur so that people can accept and implement relevant technologies.

58. Cultural differences and traditions. illiteracy, poverty, and lack of access to information that promotes a quality life are far more frighting than barbed wire fences.

59. As somber as the degradation of the world's resources is we still believe in the dream of a "pot of gold" that symbolizes man's desire to have it better; to benefit from a shared benevolent existence.

60. We are a reflection of our attitudes and the activities, precepts. principles, and values that give rise to the wonderful world of pedology known a6 the National Cooperative Soil Survey. We like our reflection.

61. And I'm very honored to be the current "front man" for such an organization. It is unique and not replicated anywhere In the world, thanks to YOU.

National Cooperative Soil Survey Conference
Burlington, Vermont

Northeast Agricultural Experiment Stations Report

D. S. Fanning and M. C. Rabenhorst

Maine

Research activity related to Soil Survey:
1. Characterization studies of a soil series from five different locations
2. Water retention studies to support irrigation recommendations.

Cooperative activities **between** AES and SCS:
1. Progress reviews of active soil surveys.
2. Final reviews and final correlations of completed soil surveys.
3. Publication of water table studies.

Maryland

Research activity related to Soil Survey:
1. Genesis and characterization of soils and redoximorphic features in hydric and hydromorphic soils derived from red Triassic sedimentary rocks.
2. Evaluation of the relationship between sea level rise and carbon sequestration in coastal marsh soils.
3. Pedology and geomorphology of soils associated with Holocene marl in the Limestone Valley
4. Genesis and characterization of soils with spodic horizons in dunal landscapes associated with non-tidal wetlands on the lower Delmarva Peninsula.
5. Evaluating the relationship between soils, hydrology, and vegetation in selected landscapes of the Maryland Coastal Plain.

Cooperative activities between AES **and SCS:**
1. Soil characterization support of soil survey updates in Anne Arundel, Queen Annes, Washington, and Worcester Counties, Maryland.
2. Study to determine the impact of agricultural activity on Base Saturation in Queen Annes and Worcester, Counties.
3. Field testing of previous studies for using constructed wetlands for the treatment of acid mine drainage by optimizing sulfidization.
4. Evaluation of the effect of sea level rise on soil quality in coastal fringe areas.

Other: University of Maryland will be hosting the 1994 National Soil Judging Contest in April, 1994.

Northeast Agricultural Experiment Stations Report

New Hampshire

Research activity related to Soil Survey:
1. Hydrological monitoring of wet soils.
2. Gamma ray spectroscopy of Spodosols derived from the Conway Granite,
3. Genesis and classification of Monadnock soils with a focus on the presence of lithologic discontinuities and contrasting PSD families.
4. Efforts on the development of soil map units for use in gravel pit soils,

Cooperative activities between AES and SCS:
1. Monitoring of the water tables in wet soils.
2. Collection of transect data from the Mt. Major area, Belknap County, (Conway Granite grus.)

New Jersey

Dr. Lowell Douglas just recently retired from Rutgers University (June 30, 1993) where he has been working in the areas of Soil Mineralogy and Micromorphology.

New York

Research activity related to Soil Survey:
1. Simulation modeling of soil genesis processes in an Orthod
2. Application of RUSLE model to tropical conditions.
3. Carbon sequestration and cycling in soils of NY.
4. Development of a Soil Taxonomy expert system.

Cooperative activities between **AES and SCS:**
1. Soil survey digitizing (current project NY City watershed).
2. Seven active soil survey areas.

Other: Cornell University hosted the NE Regional Soil Judging Contest in October 1992, and will be hosting the NE Regional Soil Genesis field trip **in August 1993.**

Pennsylvania

Research activity related to Soil Survey:
1. **Completed the development of the Penn State** Soil Characterization Lab database system, and published a database manual, a new lab methods manual, and a lab methods comparison report. The systems works well and contains 800 pedons of PA data.
2. the following additional data have been added to database system: percolation rates (348 pedons); amorphous materials (35 pedons); acid soluble K (260 pedons); fixed

ammonium (31 pedons); total elemental analysis (35 pedons); oxalate, CBD and total Fe and Al (26 pedons); EPA total analysis (70 pedons).

3. A fluid flow parameter (hydraulic conductivity) will be added to the database soon. It will use one of the presently available models to calculate from soil characterization data the flow parameter (for all horizons of the pedon).

4. Published a report on fragipans in PA soils; also will present a paper at the 1993 SSSA meetings on bulk density relations of PA fragipans.

5. B horizon color (using the chromameter) in relation to iron oxide type, amount and crystal size is under study.

6. Color (using the chromameter) and organic C content of A horizons is being investigated (100 A horizons are being examined).

Rhode Island

Research activity related to Soil Survey:

1. New England regional soil morphology and seasonal high water table study conducted in cooperation with Univ. Mass, and the SCS in MA, CT, and RI.
2. Background levels of heavy metals in Rhode Island soils.

Cooperative activities **between AES and SCS:**

1. Soils and on-site sewage disposal workshops.
2. Hydric soils workshops for state regulatory offices.
3. RI on-site sewage disposal training and demonstration program.

Virginia

Research **activity related to Soil Survey:**

1. Characterization of saprolites in the Blue Ridge and Piedmont provinces.
2. Characterization and extent of soils formed on alluvial fans in the Great Valley of Virginia.
3. Soils formed from "cappings" in the Western Piedmont of Virginia.
4. Reclamation of prime agricultural lands after mineral sand mining in the Virginia Coastal Plains.
5. Study of a loess-mantled paleosol formed in residuum from granitic saprolite on the northern Virginia Piedmont.

Soil Survey Interpretation Activities:

1. Virginia Tech has six soil survey projects underway. These are in the Counties of Amherst, Buckingham, Floyd, Patrick, Surry, and in the Tidewater Cities of Hampton, Poquoson, and Portsmouth. Mapping progress in 1992 was 225,000 acres from nine field soil scientists.
2. The laboratory characterization program summaries include the following analyses for 1992: chemical characterizations (1300); physical analyses [PSA] (600+); Mineralogical analyses (400).

3. The Virginia Agronomic Land Use and Evaluation System (VALUES) has been developed and is being implemented. This program restructures and reorients soil test recommendations to include the best currently available scientific technology on water quality oriented nutrient management. It is based on soil productivity ratings formulated from yield data and soil survey characterization information for each individual soil identified in Virginia.

Cooperative activities between AES and SCS:

1. A study to evaluate the productivity of shale and sandstone derived soils, at altitudes >3,000 ft, for forest production in the western Virginia counties of Bath, Highland, and Alleghany has been initiated.
2. The study of Mollisols on alluvial landscapes with watershed originating in the mountains of western Virginia has been expanded to include some counties east of the Blue Ridge.

Other: The undergraduate enrollment in the Department of Crop and soil Environmental Sciences has continued to increase. Much of this enrollment increase is in the Environmental Science degree program offered and administered by our SCES department.

West Virginia

Research activity related to Soil Survey:

1. Evaluation of Southern West Virginia minesoils for wastewater disposal
2. Study of redoximorphic features of wet minesoils.
3. Studies of the morphology, genesis and classification of acid minesoils.
4. Examination of the physical properties and erodibility of minesoils.

Cooperative activities between AES and SCS:

1. Examination of texture and base saturation of soils in Berkeley Co., West Virginia.

Northeast Agricultural Experiment Stations Report

States Not Responding to Request for Information

Delaware
Connecticut
Massachusetts
Vermont

South Agricultural Experiment Station Report
To The
National Cooperative Soil Survey Conference

David E. Pettry

JOINT SESSION OF THE SOUTII AND NORTIIEAST COOPERATIVE SOIL SURVEY CONFERENCE

The joint conference was held in Asbville, North Carolina June 14-19, 1992. Conference discussions and a field trip provided an excellent forum for sharing ideas and new technologies. Task forces on (a) Soil Survey and Management of Forest Soils, and (b) Soil Temperature and Moisture Regimes received broad input from the two regions which generated discussions and recommendations that the areas be considered at the national level. A panel discussion reported on the Support for Soil Survey and Resource Inventories. Six joint committees addressed the following topics and issues of mutual couccrn:

- Soils of the Northeastern United States
- Soils of the Southern States and Puerto Rico
- Classification, Mapping and Interpreting Disturbed Lands
- National Cooperative Soil Survey and Private Sector Cooperation
- Representative Taxa for Modeling
- **Extrapedonal Investigations**

PEDOLOGIC RESEARCH IN THE SOUTII

Field and laboratory support were provided for cooperative soil survey, classification, interpretation, and correlation activities in the South. Laboratory characterization included physical, chemical, mineralogical, and hydrologic analyses. Research activities and undergraduate/graduate education programs in soil science at Agricultural Experiment Station were conducted at tbe following locations:

STATE	EXPERIMENT STA.	PEDOLOGISTS
Arkansas	University of Arkansas	Dr. E. Moye Rutledge
Alabama	Auburn University	Dr. Ben F. Hajek
Florida	University of Florida	Dr. Mary E. Collins
Georgia	University of Georgia	Dr. Larry T. West
Kentucky	University of Kentucky	Dr. A. D. Karathanasis
Louisiana	Louisiana State University	Dr. Wayne H. Hudnall
Mississippi	Mississippi State University	Dr. David E. Pettry
North Carolina	North Carolina State University	Dr. Stanley W. Buol
Oklahoma	Oklahoma State University	Dr. Brian J. Carter
Puerto Rico	University of Puerto Rico	Dr. Fred H. Beinroth
South Carolina	Clemson University	Dr. Bill R. Smith
Tennessee	University of Tennessee	Dr. John T. Ammons
Texas	Texas A & M University	Dr. Larry P. Wilding, Dr. C. T. Hallmark

Water and Chemical Transport in Soils

The importance of water and chemical movement in soils is reflected by several research efforts to identify soil properties impacting transport, and describing and quantifying water movement. Recognition that as much as 90 percent of water percolation may occur in 5 percent of the total soil pores has stimulated research on macro-porosity and channel flow. Preliminary models of a soil classification based on selected soil properties which describe water and chemical transport through soils have been developed. These systems are based primarily on surface texture, clay, mineralogy, soil structure, and horizonation.

On-site domestic wastewater movement in natural soils is being studied. The effects of soil morphology and perched seasonal water tables are being quantified for an array of soils.

Fragipan Soils

Soils containing fragipan horizons comprise major acreage in the South. Extensive studies have been conducted on fragipan soils in the region during the past 50 years, and research is currently being directed at the genesis, morphology, and properties of these soils. Fragipan horizons occur in diverse parent materials of various ages in the region. Recognition of soils containing both plinthite and fragipans stimulated research to better understand the genesis and properties of these complex soils.

Efforts to redefine fragipans and/or reclassify soils containing fragipans should utilize data of past studies in concert with current research in the South.

Wetlands

Public concern over jurisdictional wetlands and hydric soils has become one of the most significant issues over the past three decades in the South. Demands for research to document and quantify soil-water-air relationships have been emphatic. Research on hydric soils, aquic conditions-morphological indicators, hydrology, and soil morphology-water level/duration relationships arc in progress in several southern states. Efforts are being directed to quantify redox potentials, extractable iron and manganese and other soil attributes, and discern relationships to prevailing moisture conditions and soil morphological features.

Introduction of newly defined redoximorphic features in the fifth edition of Keys to Soil Toxonomy has resulted in confusion and subjective evaluation in leu of objectivity backed by research. Many soils in the South formed in sediments of pre-existing soils spanning several ecological and climatic periods. Episodic erosion and sedimentation superimposed on complex fluvatile geologic strata create major problems in accurately describing the redoximorphic features in a consistent manner. The extensive occurrence of paleosols with relic color features adds to the confusion. Long-term research efforts are needed to establish factual relationships.

Cracking Soils

Field and laboratory studies in several southern states are addressing clayey, montmorillonitic, cracking soils which are not classified are Vertisols. Cracks, slickensides, and hydrologic features are being quantified and related to clay content and mineralogy. Interstate studies and temporal studies indicate the need to reclassify several soil series of extensive acreage to Vertisols.

Field and micromorphology investigations are underway to quantify structure/porosity/hydrology of Vertisols. Relationships of macropore flow and soil morphology, and spatial variability in water flux of Vertisols are being studied. Structural dynamics of Vertisol surface horizons are also being investigated for different land use systems.

Eolian Sediments

Relative soil development of modern soils and paleosols developed in loess is being investigated. Morphology, physical and chemical characteristics, and mineralogy of paleosols developed in loessial deposits in upland and terrace positions are being characterized.

Mined Soils and Drastically Disturbed Soils

Mining activities to extract coal, lignite, bauxite, phosphate, clays, sands and gravel have severely impacted significant lands in the South. Research efforts to map, characterize, classify, and interpret these drastically disturbed soils are in progress in several southern states. Techniques and strategies to return productive potential to these soils and minimize adverse environmental impacts are being developed.

Soil Surveys by Major Land Resource Areas (MLRA'S)

Interstate field studies and planning have been conducted to complete and update soil surveys in MLRA 134 (Southern Mississippi Valley Silty Uplands) and MLRA 131 (Southern Mississippi Valley Alluvium). The proposed effort would provide a coordinated, joined, and digitized soil survey at common scales for similar map units. It would also refine the placement of the boundaries of the Major Land Resource Areas and align their relation with other natural resource boundaries. The Major Land Resource Areas comprise about 42 million acres in 150 counties of 7 states. Coordinated research efforts could be directed at common soil-geologic-hydrologic areas.

International Research Activities

Pedologists in the Southern Region have been actively involved in research, educational, and technology transfer activities relating to soil survey, classification, and interpretation in Africa, Asia, Australia, Caribbean Basin, Central America, Europe, and South America. International student enrollment in soil science graduate programs is increasing in the Southern Regional Land Grant Universities, and it comprises a major component.

ISSUES AND CONCERNS

The National Academy of Sciences is in the process of selecting a 24-member panel on the Wetlands study. It is highly desirable to have pedologist represented on this panel.

A report on the National Wetlands Monitoring Program would be timely.

It is imperative that the NCSS (Soil Scientists) have a presence at the 1994 ICSS in Acapulco, Mexico on July 12-18, 1994. Many good pm-conference and post-conference field trips in the U.S. and Mexico are associated with the meetings.

A good SSSA meeting is planned for Cincinnati, Ohio on Nov. 7-11, 1993. A Soils/Geomorphology pm-conference field trip is planned for the Cincinnati area from November 5-7. An excellent series of technical papers and symposia are planned for topics such as: Wetlands, Fuzz-Set Theory in Soil Interpretation, History of Soil Survey in the U.S., Soil Formation/Landforms, Global Warming, Global Positioning Systems.

The NCSS needs an exhibit on the new Keys to Soil Toxonomy with an accompanying explanation of rational for changes.

It is desirable to know the courses the USDA Examining Center uses for rating soil scientists. Academic programs and curricular are changing to address the needs of society. It is important to know the courses and subject matter being used so curricula can be adjusted properly.

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.

QUESTIONNAIRE CIRCULATED TO PARTICIPANTS:

1. Principle research activities at present:
2. Principle sources of funding for your research:
3. Number of graduate students : MS and PhD
4. Principle teaching Activities:
5. What changes have you maae in your curriculum or courses in recent years that you feel meet the changing needs of the soil science community ?

ACTIVITIES RELATED TO NCSS:

6. Involvement in Soil Survey activities:
7. What limits the extent of your involvement in NCSS:
8. Other general comments ?

SUMMARY OF QUESTIONNAIRE

" It's a Great time to be a Pedologist. As humans strive to understand the planet, pedologists are increasingly given the opportunity to interact with other disciplines and view soils on holistic global scales".

Curtis Monger (NMSU)

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 CO,, 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 0 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), 51 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. <u>New Chairman WRCC-93</u>.

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.

North Central Soil Survey Conference

Report to the National Cooperative Soil Survey Conference

July 10 - 16, 1993

by

Ken R. Olson

Introduction

This report summarizes the **1992** North Central Soil Survey Conference which was held in St. Paul, Minnesota on June 15-18, 1992. Details of that conference have been published in the proceedings and copies are available from Robert McLeese.

Technical Sessions

Committee 1 - Soil **Surveys in the** 1990's - Larry Tornes

Committee 1 developed two 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 as policy prior to NSH being 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 advanced 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's 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 map 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 he 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.

Field Trip

Typical (?) Minnesota weather (in the So's with wind and rain) provided a refreshing but pleasant field trip on June 17, 1992 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 Sherhurne 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 lung Term Ecological Research (LTER) site. P. Bates described the Cedar Creek Natural History Area and the opportunities it provides the environmental hiology research community.

NCR-3 Activities

Committee members continue to serve on Standing Committee on NCSS (National Cooperative Soil Survey) Standards, Soil Taxonomy Committee, National Soil Survey Data Base, National Cooperative Soil Survey Technical Advisory Committee and Eroded Mollisol committee.

The North Central Regional Soil Map and legend is still being worked on with additional writing assignments to be made to committee members.

A Summary of Responses to the 1992 North Central
Soil Survey Conference Survey Questions

Question 1: Should we continue to hold the Bi-Annual NC Soil Survey Conference?

YES: 49
NO: 1 (wanted an Annual Regional SS Conference)

Question 2: Should we continue the joint USDA, SCS and Ag. Exp. Station meeting format?

YES: so
NO: 0

Question 3: Please rate the current structure of the NCSSC (5 = excellent, and 1 = poor).

Rating	=	Responses
1	=	0
2	=	4
2.5	=	1 (?)
3	=	14
3.5	=	1 (?)
4	=	23
5	=	4
(No answer	=	3)

Mean = 3.5
Median = 4.0

Question 4: Is the current meeting format effective?

YES: 38
NO: 8
SOMEWHAT: 1 (?)
No answer: 3

Question 5: Should a full day be devoted to a field trip?

YES: 43
NO: 4
No answer: 3

Question 6: Should more meeting time he devoted to committee work?

YES: 32
NO: 13
No answer: 5

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

SOIL SCIENCE AND CHALLENGES OF GLOBAL AGRICULTURAL AND ENVIRONMENTAL CONCERNS

Hari Eswaran

(National Leader, World Soil Resources, Soil Conservation Service, P.O. Box 2890, Washington D.C. 20013, USA)

INTRODUCTION

With only seven years to go before the end of the century, the global society is awaiting a paradigm shift in addressing global problems. The 'Earth Summit', which was recently convened in Rio de Janeiro, was among other things, an admission by world leaders that major adjustments to current trends in land use was needed. This political impetus comes from environmental and not from agricultural concerns though the latter is equally disturbing and is the cause for some of the environmental problems. Irrespective of the motivating reasons of the political community, the result will probably be the paradigm shift we have awaited and which will necessarily force us to look at our Soil Science profession in a new light and require us to address new problems, develop new methods, and in general make radical changes in our research agenda.

The two driving forces in global concerns are sustainable agriculture and global climate change and both are major propellants of research and development due to the political awareness and support they have received. No other efforts in recent history have received the kinds or magnitude of support from the global community. The soil science purist will argue that as soils are the basis for both these concerns, a major endeavor must be based on soils. Despite the validity of this, recent trends show less emphasis to soil research by national decision makers and international donors. Consequently, only a small fraction of funding is going into soil research.

The thrust towards environmental sustainability was triggered by the report of the Bruntland Commission which for the first time emphasized the finite limits to global resources and alerted the general public to the fragile nature of the living planet.

The concept of sustainable agriculture becomes pertinent and takes on a new dimension when viewed in the context of limits to resource availability and use. If such limits do not exist or are perceived not to exist, exploitation with disregard to consequences is the result as has happened in the past. Sustainability hinges on the premise that arable agricultural land is finite. It also assumes that much of the land that is suitable for agriculture is already in use except for a few countries in Africa and South America. Of the 13.4 billion hectares of ice-free land on the world's surface, only about 25% is potentially arable. Of this potentially arable land, about 40% is suitable for productive agriculture and the remaining, largely in the inter-tropical regions, require high inputs and good management for sustained productivity.

The emerging crises are primarily related to the rising population competing for the limited land resource. Perhaps for the first time in the history of mankind, there will be insufficient land for agriculture expansion. For the first time, mankind is faced with the challenge of not only increasing productivity but also preserving the resource base to achieve inter-generational equity.

<u>THE ISSUES</u>

The Food and Agriculture Organization (FAO) has reported that in the tropics cultivated land per person fell from 0.28 hectares in 1971 to 0.22 hectares in 1986. This is evidence of the great pressure on available land. In Southeast Asia and the Near East the amount of land cultivated is already close to the amount of potential land suited for cultivation. With geometric increases in population, availability of land for agriculture becomes a critical resource issue in most of these countries.

Major issues which directly and indirectly require the attention of soil scientists are:

* <u>Limits of land resource</u>. Many countries have reached or

* ____________________

* ____________________

* ____________________

* <u>Research emphasis on past concerns rather than future problems.</u> With the increasing pressure on land there is a need for a greater emphasis on resource focused as opposed to commodity-focused research, and the need to provide an ecosystem emphasis in agronomic research and transfer. Additionally a holistic systems approach to agronomic research is required to address globally relevant problems through regional agro-ecological networks.

* <u>Global climate chance</u>. Future uncertainties about anticipated climate change, specifically as these changes affect sustainability of production, risks associated to production, and the impact of climate change on the quality of the resource base, must be adequately presented if they are to influence decisions and actions.

* <u>Policy options for decision makers</u>. Because there are insufficient policies based on meaningful research results, the role of scientists is clearly diminished. In addition there is frequently little effort by responsible and knowledgeable scientists to link national policies to global environmental concerns which are crucial to sustainable land management.

All lands have constraints, however minor they may be. However, there are some major constraints which are geographically widespread or are shared by many countries.

Some of these are:

a. Moisture stress
b. Soil acidity
c. Nutrient limitations
d. Compaction of soils
e. Problem soils (such as acid sulfate soils and peats)
f. Low organic matter content
g. Susceptibility to flooding
h. Susceptibility to land degradation
i. Lack of soil conservation policies

In many countries, misuse of land has or is resulting in stressed lands which are degraded and whose production potential is considerably reduced. Stressed ecosystems are those that are degraded or have reached a stage of degradation at which they cannot support their original biotic communities or cannot support agriculture in the absence of relatively high inputs. The stresses may be biotic and specifically, anthropically induced or abiotic.

From a land resource point of view, examples of stressed ecosystems are:

- acid soils
- degraded lands of the humid tropics
- steep lands
- heavy clay soils
- wetlands
- lands of the semi-arid tropics
- multiple stressed lands

For agricultural purposes, some ecosystems are naturally stressed. In the context of sustainable agriculture and technology to mitigate the effects of anticipated global climate change, there is an urgent need to better understand such ecosystems, develop methods to assess and monitor them, and evaluate technological options for their management. The subject must be addressed in a multi-disciplinary manner and involve environmentalists, ecologists, agriculturists, soil scientists, and others.

ASSESSMENT OF LAND RELATED CONSTRAINTS

FAO must be credited with spearheading modern land evaluation and the publication of the Framework for Land Evaluation (FAO, 1976) and subsequently, the publication 'Guidelines: Land Evaluation for Rainfed Agriculture' (FAO, 1984) marks the methodological breakthroughs. FAO developed the concept of land quality which is defined as "a complex attribute of land which acts in a manner distinct from the actions of other land qualities in its influence on the suitability of land for a specific kind of use." Land qualities are properties of land units that affect a specific land use in a particular manner.

Land qualities can be determined on the basis of land characteristics which are attributes of land that can be measured or estimated. These land attributes are also employed in establishing diagnostic factors. As defined by FAO (1984), a diagnostic factor may be a particular land characteristic or a function of several land characteristics, that has an understood influence on the output from, or input to, a specified kind of landuse.

For land evaluation for rainfed

For each of the 25 land qualities, the guidelines elaborate on the nature and effects, application to evaluations, and means for assessment. Nutrient availability, for example, can be assessed by chemical analyses or, more qualitatively, with the fertility capability classification (FCC) of Buol et al. (1975) as modified by Sanchez et al. (1982).

In the process of land evaluation, the land qualities are compared with the requirements of the specific landuse under consideration. If there is a mismatch and the land qualities are not in balance with the requirements, the system is stressed.

For a comprehensive discussion of the principles of land evaluation the reader is referred to the classic "framework" (FAO, 1976), the subsequent "guidelines" (FAO 1984), and a recent book by Davidson (1992) that is noteworthy for its breadth and depth.

INFORMATION AND KNOWLEDGE NEEDS AND SOURCES

The quality and accuracy of land evaluation and stress assessment depends on the availability of process knowledge of crop growth and development, and environmental characterization data. For most of the important crops of the tropics, the global aggregate of basic knowledge about crop physiology and growth requirements is adequate, although in many cases still widely dispersed. There thus exists reasonable qualitative knowledge of the environmental requirements of the crops to permit measurements needed to correct constraints to optimal production. Detailed assessments that must take cultivar-specific genetic characteristics into account, however, are still hampered by the lack of knowledge about these genetic coefficients.

Inadequate or incomplete environmental information, notably soil and weather characterization data, on the other hand, often constitutes the limiting factor in land appraisal, particularly when specific assessments at large scales are involved (Eswaran et al., 1992).

Reliable area- or site-specific primary data obviously provide the best database, but in their absence default procedures may produce satisfactory surrogate data. Where soil surveys employing Soil Taxonomy (Soil Survey Staff, 1975) classes are available, reasonable inferences about soil properties can be made from the name of the taxon that identifies a map unit.

For example, one of the soils at the ICRISAT farm is classified as a Lithic Rhodustalf; coarse-loamy, mixed, isohyperthermic. The following analysis indicates the properties and, by implication, constraints that can be derived from the various elements that compose this name.

Cateaory	Formative element	Defined or inferred accessory provertv
Order	alf	subsoil with high base saturation; no Al toxicity
Suborder	ust	ustic soil moisture regime: subsoil is dry for more than 90 cummulative days during the growing season
Great Group	rhod	red soil colors, high iron content may cause P fixation
Subgroup	lithic	lithic contact within 50 cm of the surface, limited rooting volume and moisture storing capacity
Family	coarse-loamy	less than 18% clay, low cation exchange capacity; suseptible to moisture stress
	mixed	less than 40% of any single kind of mineral other than quartz or feldspars; intermediate clay-related properties
	isohyperthermic	mean annual soil temperature is 22°C or more and difference between mean summer and mean winter temperatures is less than 5°C; year-round growing season

Many properties important to plant growth can thus be inferred from the name of the soil. Moreover, the name of a taxon, by virtue of its position in the key to orders, suborders, great groups and subgroups, also indicates what properties it cannot have. Thus, Alfisols cannot have the properties that are, at the order level, diagnostic for Histosols, Spodosols, Andisols, Oxisols, Vertisols, Aridisols, Ultisols, and Mollisols. Similarly, the parameters that differentiate Aqualfs and Boralfs from Ustalfs cannot be properties of Ustalfs. And, at the great group level, the differentiae for Durustalfs, Plinthustalfs, Natrustalfs, Kandiustalfs, Kanhaplustalfs, or Paleustalfs cannot be attributes of Rhodustalfs.

LAND DEGRADATION IN THE TROPICS

The Journal of Land Degradation and Rehabilitation defines land degradation "as the loss of utility or potential utility through reduction of or damage to physical, social or economic features and/or reduction of ecosystem diversity." Land degradation is a major threat to development and the Brundtland Commission (WCED,

1987) noted that "there is a growing realization in national and multinational institutions that not only many forms of economic development erode the environmental resources upon which they are based, but at the same time environmental degradation can undermine economic development."

In an effort to establish baseline data about the state of land degradation, the United Nations Environment Programme (UNEP) commissioned the International Soil Reference and Information Centre (ISRIC) to initiate a project entitled Global Assessment of Soil Degradation (GLASOD). The project recently published a World Map of the Status of Human-induced Soil Degradation. According- to the explanatory note that accompanies the maps (Oldeman et al., 1991), the percentage of land affected by soil degradation is as follows:

Africa	17%
Asia	18%
South America	14%
Central America	21%
Australasia	12%
WORLD	**15%**

The GLASOD project arrived at these estimates by evaluating land resources and degradation resulting from water erosion, wind erosion, chemical deterioration, and physical deterioration. It differentiates four degrees (light, moderate, strong, and extreme) and also indicates the causative factors (deforestation, overgrazing, agricultural mismanagement, overexploitation, and bioindustrial activities). At the scale of 1:10 M, the assessments are necessarily broad but, nonetheless constitute a first step towards a global evaluation of the nature and geographic extent of land degradation that indicate the magnitude of the problem.

The island of Puerto Rico, for example, carries the map symbol Wt2.3 f/g. This indicates loss of topsoil through water erosion (Wt), of a moderate degree and affecting 10 to 25 percent of the island (2.3). The causes are deforestation (f) and overgrazing (g). At the chosen scale, these estimates are a fair representation of the actual situation.

It should be mentioned that not all land degradation results from human activity. In many instances loss or reduction of land performance is induced by natural phenomena, notably catastrophic events such as volcanic activity and pedogenic processes leading to acidification, salt accumulation, and nutrient leaching. It must further be noted that not all human intervention is negative. In many cases soil management and erosion control have, in fact, improved land conditions, stabilized landscapes, and reversed degradation trends. But it must also be emphasized that although identifying the causes, nature and degree of severity of stressed ecosystems and developing techniques for control and rehabilitation is crucial, it may be an exercise in futility if political and socioeconomic conditions prevent their implementation.

SOIL RESILIENCE AND SUSTAINABLE LARD MANAGEMENT

In view of the preceding discussion,, it should be obvious that sustaining or enhancing the production levels of agroecosystems is a major challenge. The realization that stable food production levels is a conditio sine qua non for achieving food security for future generations has brought the concept of "sustainable agriculture" to the forefront. But although it is a prominent and fashionable topic among agriculturalists and environmentalists, a generally accepted definition has yet to emerge. However, employing ideas advanced by Conway (1987) and Conway and Barbier (1988), one can describe a sustainable agricultural system as one that maintains productivity, stability, resilience, and equitability over time.

Central to this paradigm are the concepts of sustainable land management (Dumanski et al., 1992a) and soil resilience (Brinkman, 1990). In a paper that addresses these two concepts in the context of AGENDA 21, Eswaran (1992) defined sustainable land management as:

"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."

In the same paper he defines soil resilience as:

"the ability of a system to revert to its original or near original performance or state that existed before the impressed forces altered it."

Both concepts are still new to the scientific community and efforts to formulate action programs continue to be rather tentative. Nevertheless, an international Workshop on 'Evaluation for Sustainable Land Management in the Developing World' held in Chiang Rai, Thailand, in 1991 (Dumanski et al., 1992b), and an international symposium on 'Soil Resilience and Sustainable Land Use' held in Budapest, Hungary, in 1992 helped to bring the topics into sharper focus. The awareness created will hopefully precipitate the concerted research programs that are needed to effectively address these critical issues.

AGRO-BIOPHYSICAL DOMAINS: An Alternative Approach to Land Evaluation

The Framework for Land Evaluation (FAO, 1976) constitutes a scale-independent methodology for evaluating land performance for a given agricultural use. The key process of the Framework is "matching," i.e., the comparison of landuse and land. Although it is emphasized that evaluations have to be made in terms that are relevant to the economic and social context of the area, the methodology is largely based on environmental characteristics of the land and crop requirements. One of the underlying principles is that "evaluation involves comparison of more than a single kind of use" (FAO, 1976). The Framework may thus be characterized as a resource-driven methodology that evaluates landuse alternatives for strategic planning.

Land evaluation, however, can also be approached from another perspective. One can begin with a specific landuse and analyze performance constraints in a given area or at a site. This reasoning led to the concept of agro-biophysioal domains which are defined as areas with the inherent suitability for a speoifio landuse. The domains can be subdivided into subdomains on the basis of actual production levels which are controlled by biophysical, sociocultural and economic factors. These factors are analyzed to identify the constraints and develop prescriptions for performance improvements. Actual and potential performance values are a function of environmental characteristics, management inputs, and output returns. The specificity of such assessments is obviously scale dependent and increases with decreasing domain areas.

Fig. 1, indicates a hierarchy of domains that should facilitate the assessment of the biophysical suitability of agricultural systems, actual and potential production levels, and the environmental effect of the managed system on the land resource from global to local levels. Also shown in the table is the approximate scale of the domains, the categoric level of the soil units in the domains, and the increasing specificity of land factors related to moisture availability.

At the domain level, the suitability of a specific crop can be evaluated using the methodology of the FAO Framework and Guidelines (FAO, 1976, 1984); the principles of which can be applied at all scales. The Agro-ecologic Zones (AEZ) Project of FAO employed this approach at a continental scale. Volume 1 of the AEZ report (FAO, 1978) contains a description of the methodology and the results for Africa. The maps delineate the generalized agro-climatic suitability assessment for the rainfed production of millet, sorghum, maize, wheat, soybean, sweet potato, white potato, cassava, and cotton. The areas represent, in fact, the small-scale agro-biophysical domains of these crops in Africa. At the next level of assessment, soil properties are taken into consideration to demarcate areas with high potential and to signal areas with constraints. Figs. la, and b, illustrate the sorghum and maize domains in Africa. This analysis only shows the potential for the land use. The crops may be grown in other areas, where. they may not be the most productive, or because of availability of management inputs such as irrigation. At a continental scale, the socio-economic conditions of the countries becomes an important consideration in the domain analysis. Such preliminary assessments are important for targeting research and developmental activities for international donors and research Centers.

The agro-biophysical domain approach differs from conventional land evaluation methodologies in that it is economics driven and seeks tactical solutions for enhancing agroecosystem performance, whereas land evaluation is usually resource based and of a more strategic nature.

IMPLICATIONS

Information technology such as relational databases, soil and crop simulation models, expert systems, and decision support systems have all contributed to transforming land resource evaluation from an art to a science. The greatest impact, however, came through advances in two areas: (1) the scientific and commercial development of geographical information systems (GIS) and companion digital terrain models (DTM), and (2) the development of crop and environmental simulation models and related rule-based systems.

A GIS is a set of tools that permit the collection, storage, retrieval, transformation, manipulation, and display of spatially referenced data. The capacity of GIS to explore a variety of "what if" type questions using different scenarios, is obviously of great importance to landuse planning and management. Similarly, the modeling of agrosystems has added new dimensions to land evaluation. Deterministic crop simulation models, for example, can predict the performance of a crop in a part of an agro-biophysical domain where it has not been grown. For a comprehensive review and discussion of land information systems and modeling of land resources, the reader is encouraged to consult Davidson (1992).

These and other relevant information technologies are merely tools, however. It cannot be overemphasized that the quality of the output they produce depends on the availability of adequate primary data. (Scarcity of such data caused what has been called the "parameter crisis"--too many models chasing too few data.) A serious problem in this regard is that government funding for soil survey or meteorological monitoring is often inadequate or being reduced. One reason for this may be that in the past soil survey and climatological information have not been efficiently used. The new information technology has changed this entirely as it can process huge amounts of data into useful information in very short periods of time. In our judgement, this should result in a renaissance of soil survey rather than a reduction.

The subject of spatial variability of land characteristics also requires attention. Stein et al. (1988) showed that this issue is best addressed by incorporation of soil survey data into geostatistical analysis with kriging. Another new development that warrants further study is the application of fuzzy set theory in land evaluation (Wang et al., 1990). According to Davidson (1992), still another avenue for research is the application of artificial neural networks which can deal with incomplete or inadequate data.

These scientific and technological advances, in conjunction with adequate primary environmental characterization data, facilitates an integrated approach to land resource issues that can play a key role in promoting the wise use of land resources that may help to prepare the groundwork for "the transition to sustainable life on Earth," as envisioned by AGENDA 21.

CHALLENGES AND OPPORTUNITIES

1. Identification and monitoring of parameters (including indicators) that control the enhancement of the quality of the land resource, and quantification of their impact in different agroenvironments.

2. Development of methodologies to evaluate the resilience of stressed ecosystems and implementation of preventive measures to retard degradation.

3. Identification of prime lands and application of modern technoloav to enhance and sustain their production and ensure their preservation for such uses.

4. Development of a conceptual, integrated framework for sustainable land management and its validation for different land use scenarios.

5. Development and utilization of systems-based analysis and strategy tools for assessing the impact of agricultural practices on the land resource and for developing environmentally sound land use options.

6. Development of methods and approaches to evaluate impact of land use changes on global climate and the converse, which is the impact of global climate change on soil resources.

7. New approaches to soil resource inventory and monitoring, utilizing recent computer technology, to make farm level resource information readily available to clients, particularly in developing countries.

8. Translating soil resource information and soil research findings into implementable policy options.

As the century draws to a close, soil scientists throughout the world can help catalyze the new global environmental paradigm. Feeding and clothing an expanding population and striving for zero-degree degradation of land resources is still the most viable and exciting option for the 21st. century. The knowledge of soil scientists is extremely relevant to the changing conditions of our world; but it will be insignificant if we fail to satisfy the critical needs of our governments and the people they represent. We can draw on the strength of our ancestors, revisit our capabilities as professionals and see beyond the obvious.

Let our vision be,

"PRODUCTIVE NATIONS IN HARMONY WITH A QUALITY ENVIRONMENT"

REFERENCES

Conway, G.R. 1987. Properties of agroecosystems. The Hague, Netherlands: Elsevier.

Conway, G.R., and Barbier, E.B. 1988. After the green revolution: sustainable and equitable agricultural development. Futures 20: 651-678.

Davidson, D.A. 1992. The evaluation of land resources. New York, N.Y., USA: John Wiley & Sons. 198 pp.

Dumanski, J., H. Eswaran, and M. Latham. 1992a. A proposal for an international framework for evaluating sustainable land management. In: Evaluation for sustainable land management in the developing world. (Eds. Dumanski, J., E. Pushparajah, M. Latham, and R. Meyers). Vol. 2: 25-45. Publ. IBSRAM, Bangkok, Thailand.

Dumanski, J, H. Eswaran, E. Pushparajah, and A. Smyth. (Eds.) 1992b. Evaluation for sustainable Land Management in the Developing World. IBSRAM Proceedings No. 12., Vol. I.

Eswaran, H. 1993. Soil resilience and sustainable land management. Proceedings of international symposium on soil resilience and sustainable land use, 28 Sep - 2 Oct 1992, Budapest, Hungary (In Press).

Eswaran, H., F.H. Beinroth, J. Kimble, T. Cook. 1992. Soil diversity in the tropics: Implications for agricultural development. In: (Eds. R. Lal and P.A. Sanchez.) Myths and Science of Soils of the Tropics. Publ. Soil Sci. Soc. Amer. Special Publ. No. 29: 1-16.

FAO 1976. A framework for land evaluation. FAO Soils Bulletin no. 32. Rome, Italy: FAO. 72 pp.

FAO 1978. Report of the agro-ecological zones project: volume 1, methodology and results for Africa. World Soils Resources Report 48. Rome, Italy: FAO. 158 pp.

FAO 1984. Guidelines: land evaluation for rainfed agriculture. FAO Soils Bulletin no. 52. Rome, Italy: FAO. 237 pp.

Oldeman, L.R., Hakkeling, R.T.A., and Sombroek, W.G. 1991. World map of the status of human-induced soil degradation: an explanatory note. Wageningen, Netherlands: International Soil Reference Centre. 34 pp.

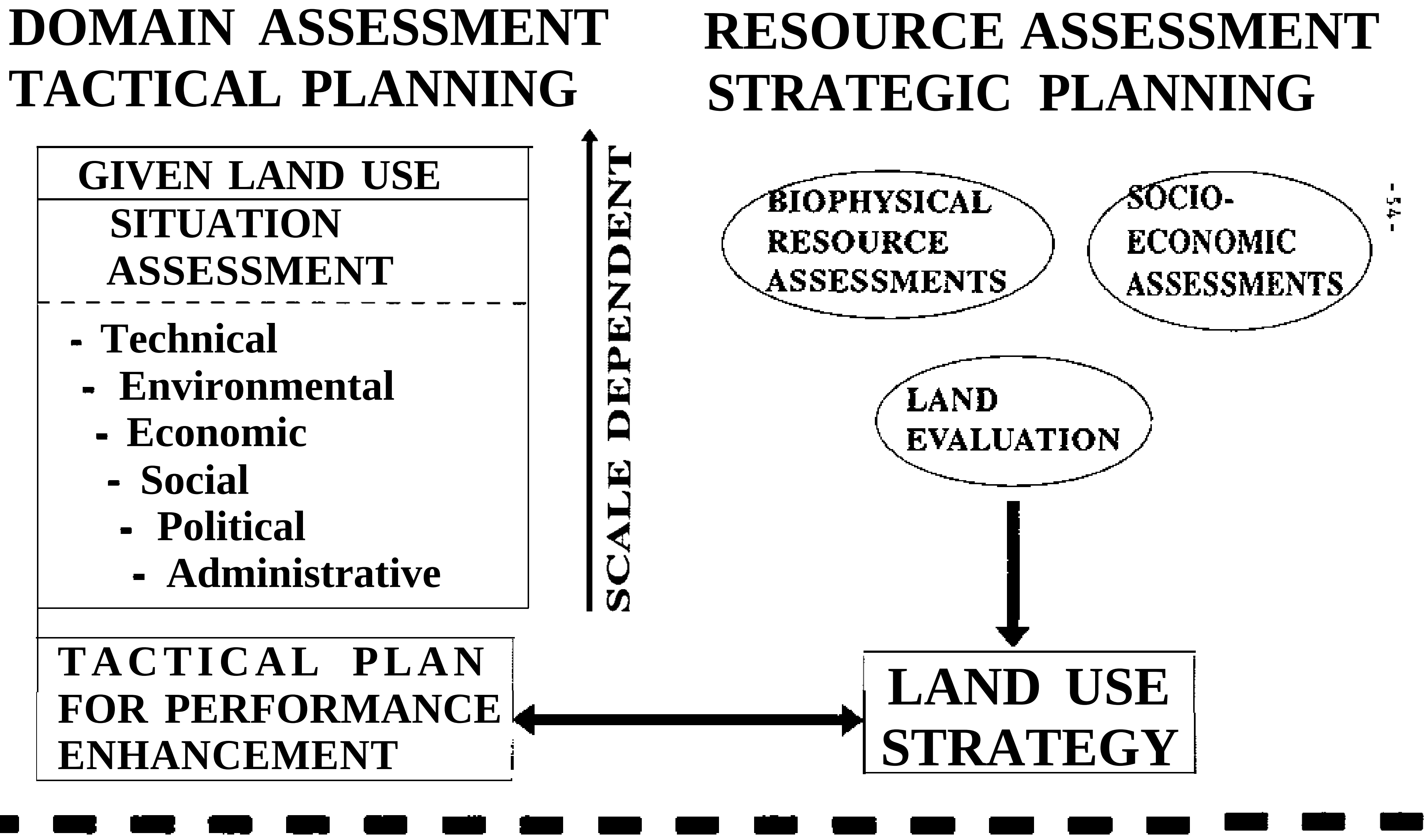
Soil Survey Staff 1975. Soil taxonomy - a basic system of soil classification for making and interpreting soil surveys. U.S. Department of Agriculture, Agriculture Handbook 436.

Washington, D.C., USA: U.S. Government Printing Office. 754 pp.

Wang, F., Brent Hall, G., and Subaryono 1990. Fuzzy information representation and processing in conventional GIS software: database design and application. International Journal of Geographical Information Systems 4: 261-83.

WCED (World Commission on Environment and Development). 1987. Our Common Future. Oxford, Oxford University Press.

Fig. 1. AGRO-DOMAIN ANALYSIS FOR SUSTAINABLE AGRICULTURE



THE SOIL MANAGEMENT COLLABORATIVE RESEARCH SUPPORT PROGRAM (CRSP)

Roger G. Hanson
Director, Management Entity
North Carolina State University
Box 7113, 209 Daniels Hall
Raleigh, NC 27695-7113

I. WHAT IS A CRSP

A CRSP is a Collaborative Research Support Program bringing together scientists in the United States and developing countries to address constraints of food security, sustainable agriculture, natural resource management and other factors to enhance the quality of life for small-scale farmers and their families. The CRSPs were created through the 1975 Title XII legislation and administered and funded under the U.S. Agency for International Development. The Soil Management CRSP, known as TropSoils, was created in 1981 and includes Cornell University, the University of Hawaii, North Carolina State University, and Texas A&M University. Recently, special international activities of the USDA--Agricultural Research Service, Economic Research Service, Soil Conservation Service and the Nitrogen Fixation by Tropical Agricultural Legumes (NifTAL) project of the University of Hawaii--have been merged into TropSoils.

II. SOILS AS THE SUSTAINABLE AGRICULTURE RESOURCES BASE

Natural resources, with soils as the foundation, are the long tern capital on which nations build and grow. Every country has an endowment of soil, water, mineral, plant, and animal resources. If the quality of life of its inhabitants is to be improved and sustained, it must be a good steward of these resources. Catastrophic consequences have beset those prior civilizations that allowed degradation of their natural resources beyond the levels necessary to sustain them. Similar processes are in progress today in many of the underdeveloped and developing countries.

Because capital inputs are strongly limiting in underdeveloped and developing countries, the nature, quality, and distribution of land resources strongly govern utilization of land for agricultural production. For this reason, the most efficient integration of indigenous cultivator knowledge into research programs is via a knowledge of the constraints and potentials of soil resources as perceived by farmers. Subsequent cataloging of this information with baseline soil characterization and classification systems provides the best avenue for rapid assimilation of new technology by farmers. This integrated approach to technology assimilation for transfer on a Land Management Unit basis also serves for extrapolation of this information to other developing regions having similar soils and socio-economic structures.

III. THE SOIL MANAGEMENT CRSP GOAL

The goal of the Soil Management CRSP is to develop and adapt improved soil-management technologies that are agronomically, ecologically and economically sound for developing countries in the tropics. To accomplish this goal, the Soil Management CRSP has focused its research thrusts on the major constraints to sound Natural Resource Management, &stainable Agriculture Production and Outreach. As the research process has progressed by generating appropriate technology for Natural Resource Management and Sustainable Agricultural Production, the Outreach thrust serves as the transfer activity working integratively on basic Land Management Units.

IV. THE SOIL MANAGEMENT CRSP GLOBAL PROGRAM

A. SUSTAINABLE AGRICULTURE PRODUCTION - The successful management of resources for agriculture to satisfy changing human needs while maintaining or enhancing the natural-resource base and avoiding environmental degradation.

1. Soil Acidity - Most soils in the humid tropics are very acid, low in exchangeable bases, and high in exchangeable aluminum. The acidity and toxicity of these soils constrains agricultural productivity in several ways. Sensitivity of plant species and cultivars to soil acidity and associated problems limits crop production. Technologies to ameliorate soil acidity are paramount on most tropical soils and has been a major activity in TropSoils research programs.

2. Nutrient Deficiencies and Losses - Soils in the humid tropics are often low or deficient in one or more primary and secondary plant nutrients. Low crop yields attributable to poor nutrition and accelerating soil degradation are major contributors to land abandonment and continuous rainforest destruction. Biological perspectives and nutrient cycling knowledge is necessary for sustainable systems.

3. Soil Physical Limitations - Soils of the tropics are characteristically highly weathered and, because of climate and other natural factors, are variable in organic matter. The overuse of traditional management systems often leads to soil physical degradation, land abandonment and rainforest encroachment.

4. Topographic Limitations - Landscape configurations impose special challenges in the development of appropriate soil-management technologies. Humid tropical soils of the steep lands are especially vulnerable to degradation as a result of water erosion. Selection of crops, cultivars, cropping sequences, and crop mixtures without considering landscape configurations often results in a loss of food and fuel production. Some landscape should best not be disturbed.

5. <u>Water Stress</u> - Moisture stress, natural or imposed, may result from either excessive or inadequate amounts of water. Selections of the best ecologically adaptable and socially acceptable combination of crops, plant species, cultivars, and cropping sequences and necessary production management must be decisions tempered with experience, financial constraints, and risk assessments.

B. NATURAL RESOURCE MANAGEMENT - The management, conservation, and enhancement of those natural resources which are most critical to meeting food, fiber, fuel and shelter requirements, as well as preserving genetic diversity and attenuating climatic change.

1. <u>Land-Clearino Pressure</u> - Population growth in the tropics places extreme pressure on the soil resources. As farm numbers increase, fallow periods are shorter, and vital nutrients are lost from the soil. Farmers must then clear more land to grow the same amount of food. Countries with high populations have little under-used land available.

2. <u>Landscape Restrictions</u> - Even on rolling and gently sloping tropical landscapes, wind and water erosion may be common. Without reliable information about natural processes, it is impossible to formulate sound management practices.

3. <u>Climate Variability</u> - In regions where rainfall or temperature are extreme, climate can be a major factor in soil management. Climate influences the physical, chemical and biological properties of soils, as well as the choice of crops and of cropping systems.

4. <u>Inadequate Resource Information</u> - Policies to achieve sustainable agriculture production must be based on an adequate technical assessment of natural resource inventory. Inventories of the soil and water resources along with the other natural resources are often incomplete or not available. Almost no reliable information exists on how forest conversion effects soi dynamics. Inventory of indigenous technologies should be included with physical inventories.

5. <u>Production--Demand Pressure</u> - Population growth, accompanied by increased demand for food, fiber, fuel and shelter materials, places extreme pressure on the soil resources. Larger and larger areas must be brought into production to meet the demands for food and exports. Soil resource inventories are needed to plan and develop sound long-term export crop policies.

C. OUTREACH - Those extrapolations, communications, training, networking, and decision-support activities which translate research into useful knowledge.

1. Number and Diversitv of Users - People throughout the developing world lack appropriate soil-management technologies. They are diverse in their needs, languages, and cultures. Extension and communication channels in developing countries are rudimentary; ethnic, cultural, and linguistic barriers are common.

2. Number and Diversitv of Soils - To be effective, soil-management practices must accommodate a range of conditions, including soil chemical and physical processes and crop and cultivar; climate and landscape; and social and economic conditions. While certain soil-management problems are common to many sites, solutions appropriate for one location may be inappropriate for another.

3. Lack of local Expertise, Information - The lack of trained soil scientists, agronomists, educators, and communicators in developing countries impedes the transfer and adoption of new agricultural technologies. Training and education provided by the Soil Management CRSP degree programs, workshops, and field projects contribute significantly to the base of soil-management expertise in the developing countries.

4. Information Knowledge Gap - Traditionally, research results become scientific knowledge through a lengthy process of consensus-building that includes peer review, publishing, public comment and application. In developing countries with degraded and degrading soils rapid application is important to stabilize the natural resource base while developing sustainable agriculture production. Decision Support Systems and Geographic Information Systems offer effective means to capture new technologies that can be integrated with indigenous technologies for transfer onto small watersheds or Land Management Units.

5. Lack of Skills & Research Capability - A constraint to Natural Resource Management and Sustainable Agriculture Production in developing countries is the shortage of trained professionals to implement appropriate policies and programs. The Soil Management CRSP has the Institutional strength to provide education, training, backstopping and broad based support to Natural Resource Management and Sustainable Agriculture Production.

V. SOIL MANAGEMENT CRSP OPERATIONAL, STRATEGY

While developing nations in the tropics share common constraints to Natural Resource Management, Sustainable Agriculture Production and Outreach, these constraints manifest themselves in varying ways from region to region. The operational strategy employed is to structure the operations along the following agroecological zones.

A. <u>Humid Tropics</u> - This is the portion of the tropics where there is *no* more than a three-month dry season and temperature is not a limiting factor to plant growth. The native vegetation is tropical rainforest. Soil Acidity and nutrient deficiencies are common chemical constraints to crop production.

B. <u>Semiarid Tropics</u> - This zone is characterized by a protracted dry season of six to nine months. Erratic precipitation, wind and water erosion, desertification, soil acidity and nutrient deficiency are major constraints to crop production.

C. <u>Savannas</u> - This portion of the tropics is characterized by a strong dry season of four to six months, savanna vegetation and predominantly acid soils with inherently low nutrient levels but generally good physical conditions. Temperature is not a limiting factor to plant growth.

D. <u>Temoerate Regions</u> - The temperate regions, the regions north and south of the 23° 27′ north and south parallels is common referenced as the temperate regions. These regions are characterized by definite cold and warm periods that control plant growth and soil physical, chemical and biological processes.

VI. THE MERGED PROGRAM COMPONENTS OF TROPSOILS

A. <u>USDA - Soil Conservation Services</u> - The USDA-SCS merger with TropSoils brings in the activities of the Soil Management Support Services (SMSS) program including support from the SCS characterization laboratory in Lincoln, Nebraska. The major areas of activities are: 1) utilization of soil resources information in policy formulation, economic planning and alternatives to global warming; 2) global soil database development to support modelling activities, farming systems and quantification of soil resources degradation; 3) soil and site characterization to enhance the process of technology transfer; 4) technical support to developing soil and environmental monitoring and strategies and resource management; and 5) outreach activities through organized workshops, field tours, training forums, publications and development of media aids. The USDa-SCS component and Texas A&M University have experiences in the development and application of the Geographic Information Systems (GIS) for Soil and Water Resources Inventories and Integrated Management of Agricultural Watershed in West Africa.

B. <u>USDA - Agricultural Research Services and Economic Research Services</u> - This merger brings those program components from the Technology for Soil Moisture Management (TSMM) program. The project provides technical assistance for improving investment decisions in the development of dryland and rainfed agriculture. The overall objective is to maintain and improve the soil and water resource base for short-term and long-term utilization and to improve output and income in crop and livestock production systems. The major thrust is to integrate agroclimatic, soil and water management, agronomic and economic data for assessment and analysis of economically, technically and environmentally viable agriculture systems and related policy and program planning options and improve scientist linkages between US, developing country and international scientists. Leadership in verification and quantification studies on short- long-term socio-economic impacts and improvements from process and development research can be provided through the expertise in this program.

C. Nitrogen Fixation for Tropical Agriculture Legumes - NifTAL (Nitrogen Fixation by Tropical Agricultural legumes) is a multi-disciplinary international development support program in tropical agriculture at the University of Hawaii. The NifTAL project was initiated in 1975 and received Microbiological Resource Center (MIRCEN) in 1982. NifTAL's MIRCEN status is an important commitment to the preservation of NifTAL's comprehensive rhizobia germplasm as an ecological resource. NifTAL's overall goal is to enhance tropical agricultural efficiency through the use of biological nitrogen fixation (BNF) by the legume-rhizobia symbiosis. NifTAL's aim is to enable developing country farmers to reduce their dependence on industrially produced nitrogen fertilizers needed to produce increased quantities of high protein crops for human and animal consumption. To achieve its goal through international cooperation, NifTAL has undertaken a wide range of activities to assist agricultural organizations of the developing countries that have research programs on BNF. These activities include research, networking, technology development, education and training, outreach and information services and rhizobia germplasm and anti-serum services. While NifTAL's mandates are focused exclusively on BNF, their implementation is based on a comprehensive agenda that include the following programs: 1) development of genetic technologies for improvement of *Rhizobium*/legumes symbiosis for crops and trees; 2) development of methods for monitoring microorganisms in the environment; 3) generations of environmental data bases for predicting symbiotic and saprophytic performance of rhizobia; 4) establishment of regional BNF resource centers; and 5) provisions of technical assistance to commercial inoculant producers. NifTAL's UNESCO-MIRCEN initiative has been especially valuable in computer communication networks, production and publication of communication materials, and supporting participation by nations of countries not eligible for USAID assistance in NifTAL's programs.

VII. PORTFOLIO OF SOIL MANAGEMENT PROGRAMS

Scientists in the Soil Management CRSP have developed collaborative research and educational activities in the following key program areas:

- low-input management systems
- soil characterization and classification
- soil variability and acidity
- green manures and nitrogen management
- integrated nutrient management
- soil-water-plant-nutrient relationship
- soil-water conservation and management
- develop improved Rhizobium/legume genetic technologies
- develop methods for monitoring microorganisms in the environment
- land reclamation and conservation technologies
- continuous cultivation of food crops
- agroforestry systems for soil/water/nutrient management
- improved sustainable pastures
- paddy-rice production
- integrated watershed management
- selection and use of indigenous plant species
- indigenous technologies and socioeconomic impacts
- decision support systems development
- generation of environmental rhizobia performance prediction data base
- establishment of regional BNF resource centers
- technical assistance to commercial inoculant producers
- establishment of international soil pedon description data base
- technical support to crop commodity research programs
- economic impact assessments
- graduate education and short-term training

The technologies generated by the Soil Management CRSP funnel into developed Decision Support and Geological Information Systems to systemize transfer and serve to identify gaps in the technology base.

Technical outreach materials as products of collaborative research have been provided upon request to over SO countries throughout the world. Results of this acceptance has resulted in many international scientists and students wanting to study at a TropSoils institution. Much of this success is based on research activities being jointly planned, implemented and evaluated. This mode of operation maintains long-term linkages between scientists and their interest in sustainable agriculture and environmentally sound natural resource management.

VIII. SUMMARY

The Soil Management CRSP program focus is on management of soil, water and nutrient resources for sustainable agricultural production that enhances the natural resource base. Research and outreach activities are jointly planned between researchers in U.S. institutions and scientists in host-country institutions. This develops networks and long-term linkages between scientists with the common goal of sound management of the world's soil and water resources.

The Soil Management CRSP has long-term experiences in intercropping and crop rotation that can increase ground cover, return organic material and fix nitrogen, as well as add income through forage and fodder crops. The importance of the role of animals through increased use of forages, manure production for nutrient cycling and animal traction are integrated with the total cropping system on the basis of Land Management Units. The Soil Management CRSP Land Management Unit approach integrates traditional commodity research with natural resource based agronomic and socio-economic research, on-farm testing of improved varieties in conjunction with improved cropping systems and cultural practices to maximum impact of improved commodity cultivars.

The socio-economic factor, understanding indigenous technologies, land and tree tenure, labor constraints and access to resources as they effect farmer decisions and the role of women in these decisions are fundamental to the Land Management Unit approach of the Soil Management CRSP. Farmer participation in testing and research and future planning have been found most important in the likelihood for adoption of appropriate technologies.

A FRAMEWORK *FOR* EVALUATION OF SUSTAINABLE LAND MANAGEMENT

J. Dumanski
Centre for Land and Biological Resources Research
Agriculture Canada
Ottawa, Canada

CHALLENGES AND OPPONTUNITIEB

Rising populations competing for limited land resources have focused attention on the need for increasing food production, while preserving the resource base and decreasing land degradation. This has prompted discussion on the sustainability of current land management systems.

Sustainable land management (SLM) has emerged as a global issue in securing enhanced productivity and performance of land resources, consistent with minimising adverse effects on the environment. To achieve this there is an urgent need to develop and implement appropriate technologies and policies for more effective land management which are sustainable over time. Significantly, SLM was high on the priority list of AGENDA 21 of the United Nations Conference on the Environment and Development, held in Rio de Janeiro, June, 1992. Also, Osten-Sacken (1992) has recently reported that the Consultative Group on International Agricultural Research (CGIAR) must address sustainable land use management as a matter of priority in the coming years.

THE NEED FOR A FRAMEWORK

Decisions as to whether or not a particular type of land use is sustainable in a given environment over a stated period of time can potentially be assessed using a framework approach. With this in mind, IBSRAM brought together a group of international agencies to develop a structured methodology for evaluating the sustainability of land management. The outcome was an International Workshop on ""Evaluation for Sustainable Land Management in the Developing World"", held at Chiang Rai, Thailand, September, 1991. One recommendation from this workshop was that an International Working Group be established to develop a Framework for Evaluation of Sustainable Land Management (FESLM) in partnership with the following institutions:

- Food and Agriculture Organization of the United Nations;
- International Fertilizer Development Centre;
- International Society of Soil Science;
- TROPSOILS Collaborative Research Management Program;
- Agriculture Canada.

More recently, this group has been expanded with the addition of:

- International Centre for Research in Agroforestry;

- Tropical Soils, Biology and Fertility Program.

The International Working Group has developed the following definition of SLM:

> Sustainable land management combines technologies, policies and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously:
> - maintain or enhance production/services (productivity);
> - reduce the level of production risk (stability);
> - protect the potential of natural resources and prevent degradation of soil and water quality (protection);
> - be economically viable (viability);
> - be socially acceptable (acceptability).

These five objectives of SLM - productivity, stability, protection, viability and acceptability - are the basic pillars and the foundation on which the Framework is being built.

WHAT IS THE FRAMEWORK

The Framework is designed to function as a logical pathway for analysis of the probability of sustainability. The pathway seeks to connect the form of land use under investigation with the multitude of environmental, economic and social conditions that collectively determine whether that form of land management is sustainable or will lead to sustainability. The Framework enables the evaluation of sustainability in a scientifically sound, logical, stepwise fashion, so as to develop a solution (assessment end point) in which one can have confidence.

The foundation for the Framework is provided by the five pillars of sustainable land management: productivity, stability, protection, viability, and acceptability. The Framework is designed as a hierarchy, consisting of five levels, which collectively lead one through the process of assessment, but in a manner that ensures that the most important (controlling) processes or constraints to sustainability are considered along the way. The land uses and the land management factors to be considered are defined in the first two levels of the Framework, whereas the diagnostic criteria to be used in the assessment, the causes and effects of each, and the indicators and thresholds for evaluating sustainability are defined in the lower three levels.

The levels of the Framework are summarized as follows:

Level 1: OBJECTIVE - identification of the land use system(s) to be evaluated.

Level 2: MEANS - specification of the land management practices employed in the land use system(s).

(Collectively the OBJECTIVE and MEANS statements describe WHAT will be evaluated)

Level 3: **EVALUATION FACTORS** - identification of all physical, biological, social and economic factors which potentially bear on the sustainability of the system.

Level 4: **DIAGNOSTIC CRITERIA** - establishment of cause and effect relationships between factors; collecting evidence of trends in these relationships on the site; projecting a pattern of these future trends. These are attained through analyses of available information, including modelling and expert systems, but it may also involve experimentation.

Level 5: **INDICATORS AND THRESHOLDS** - measurable or observable attributes which describe the rate and direction of change in one or more of the pillars of SLM and identify the status or condition of sustainability; measures beyond which the system can be judged to be to identify the issues of SLM, develop a strategy on how to deal with these issues and to develop indicators of SLM to be applied in the Framework and used for reporting on the status of natural resources. Twelve focus groups from 36 countries developed indicators for specific land uses in five of the major climate regions of the world. The major conclusions of this workshop were as follows:

- The groups recommended 3 - 5 indicators for each of the agronomic, environmental, economic and social dimensions of SLM. Given our current knowledge, no single indicator of SLM could be developed and the "basket" of indicators is the preferred approach.

- The indicators recommended by the focus groups reflected the performance of particular management practices and a specified land use in a defined environmental setting. This indicates that indicators cannot be separated from current land management practices, land uses and local environmental conditions.

- The above notwithstanding, a number of indicators consistently re-appeared from several of the focus groups. These were the following:

  Crop yield (trend and variability)
  Nutrient Balance
  Maintenance of Soil Cover
  Soil Quality/Quantity
  Water Quality/Quantity
  Net Farm Profitability
  Participation in Conservation Practices

These indicators possibly preview a set of generic indicators that could be developed as international standards for evaluation and monitoring of SLM.

TEE WAY AHEAD

Work on the FESLM was initiated only two years ago, but already much has been achieved. The international working group is in place, and it has developed the basis for investigation and research of SLM, as well as a definition and a prototype structure for the Framework. A discussion paper for application of the FESLM has been prepared, and will be published by FAO as part of their World Resource8 Series. A symposium on the FESLM will be held as part of the 15 Congress of the ISSS.

In addition to this, a series of case studies are being undertaken in different parts of the world to test the concepts of SLM and make improvements as necessary. The case studies will be in Australia, Canada, Africa and Asia. Results of these will be reported at international workshops currently being planned for Africa in 1995 and Europe in 1996. Case studies and related research on SLM in other parts of the world would be welcome to strengthen the concepts and the structure of the FESLM.

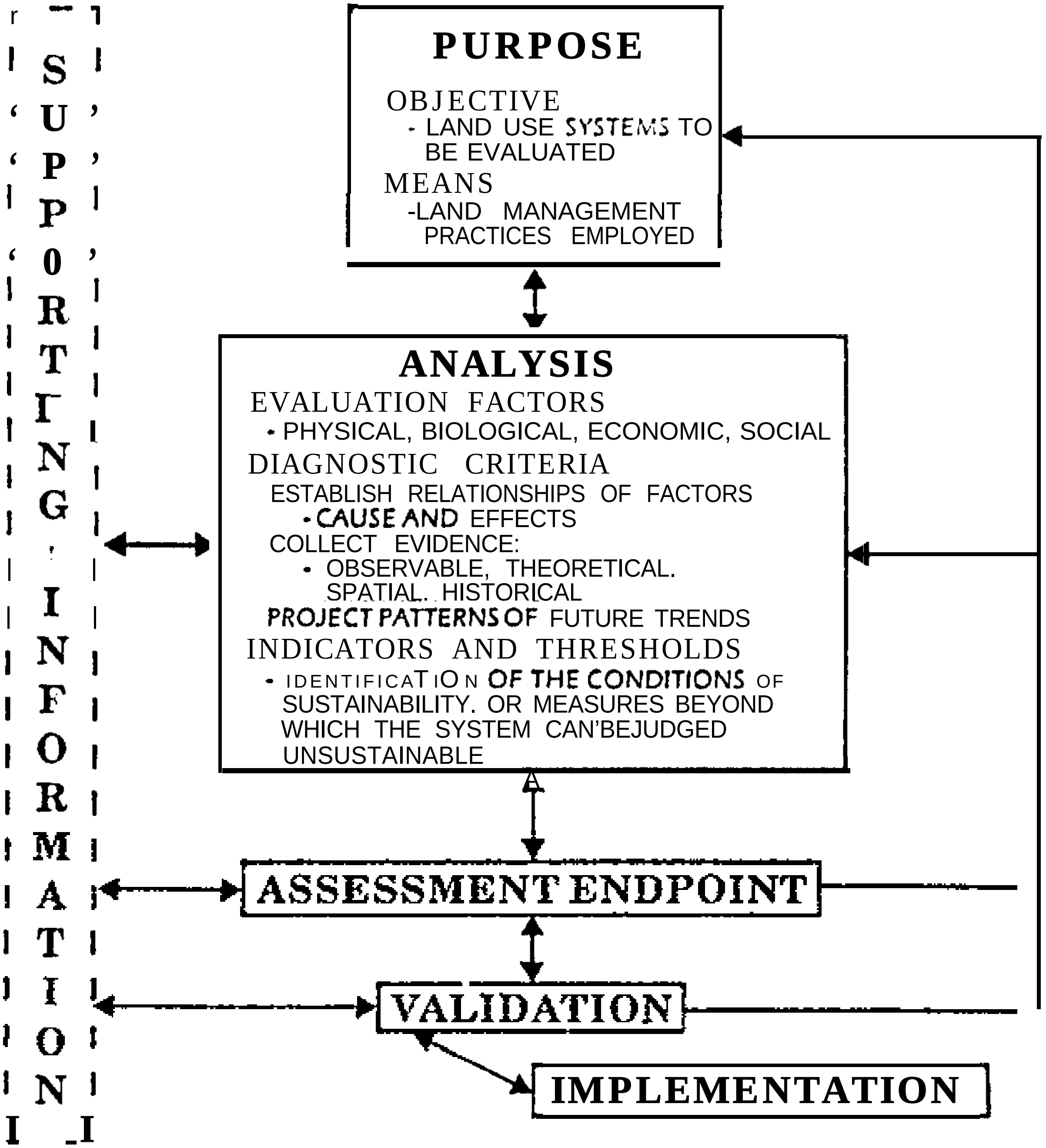
Although the international working group is leading the way, the search for sustainable systems of land management is everyone's responsibility. Sustainable land management involves harmonisinq environmental and ecological concerns with the economic realities of food and fibre production. The simple economic criteria of the past can no longer be used as yardsticks of future success. Although agriculture is producing more food on less land and with fewer people than ever before, there are few who would claim that our current production systems are sustainable. Last year, in Canada and in the U.S., government support programs accounted for about 50 percent of net farm income. Both consumers and producers are wondering if current support systems are the right approach. There is increasing evidence that society is demanding more from agriculture than simply putting food on the table. Increasingly, it is demanding that farmers become the custodians of rural resources, particularly soil, water and habitat.

The attainment of the objectives of SLM and the transition to a sustainable agriculture will require a long-term commitment, and there are no universal solutions. Technological and scientific advances will be instrumental in this, but political, economic and institutional structures will also have to be part of the solution.

REFERENCE

Osten-Sacken, A. von der. 1992. New directions for the CGIAR. Finance and Development, March issue. Washington, D.C. 26-31.

FRAMEWORK FOR EVALUATION OF SUSTAINABLE LAND MANAGEMENT



SOIL SURVEY ACTIVITIES IN CANADA *

D. Richard Coote
Program Leader
Centre for Land and Biological Resources Research
Research Branch,
Agriculture Canada,
Central Experimental Farm,
Ottawa, Ontario, K1A OC6

Historically, soil inventory (mapping) activities in Canada have been a joint Federal-Provincial responsibility. Teams of pedologists were employed in each Province by the Federal Government, and by the Provincial Governments. Depending on the Province, and on political considerations at the time, these teams worked more or less closely with each other. In some cases the teams were completely integrated, being indistinguishable to the outsider: in other cases they worked in different counties. Publication of reports was often a joint effort,and in other cases they were separate. In any case, responsibility for correlation, quality control and maintenance of the classification system was vested in the Federal program.

The last 5 years have seen some significant changes in the "Soil Survey" program in Canada - not the least of which is the official demise of the name "Soil Survey"! Regrettably, this name has become associated, at the upper levels of our bureaucracy, with "digging holes all over the country". This idea leads to concern over possible Federal-Provincial jurisdictional disputes, so we call ourselves "Land Resource Data and Applications" instead. The essential activities associated with "soil survey" continue, as does the use of this name by the public. The program, however, has a different emphasis than in former years.

The shifts in soil survey activities that have occurred across Canada over the last five years have made us generally more distinct as Federal or provincial teams, because the Federal pedologists are involved in more research than previously. At the same time, some provinces have more or less discontinued their soil survey programs. The movement of federal activities towards more research has been driven by reviews of our programs that have questioned the need for Federal employees to be doing large-scale soil surveys. These are often seen as the responsibility of the provincial governments under our loose constitutional framework. As federal employees, we have consequently reduced our involvement on field mapping in many provinces over the last five years. However, correlation and quality control activities, and the maintenance of the Canadian System of Soil Classification and the National Soil Database, have never been questioned as federal roles.

* Contribution No.: CLBRR 93-69

Being part of the Research Branch of Agriculture Canada, when reductions in field mapping have occurred our federal pedologists have been re-directed into greater support of our soil quality and management research activities. These are also carried out under the mandate of our Centre. Many provinces have also re-evaluated their soil survey activities, and in some cases have concluded that enough soil mapping has been done to meet their needs. Having very little involvement in research, these provinces have generally re-directed their soil survey staff to extension-type activities.

Our Centre remains unique in Canada, having a headquarters facility in Ottawa employing soil scientists mostly engaged in research, and having a "Unit" in every province (and even in the Yukon Territory), which interacts directly with provincial programs and attempts to address their priority needs. No other Agriculture Canada research establishment has such a wide mandate or distribution. Our budgets are constantly shrinking, as is our compliment of staff. Nevertheless, we are still very active in many elements of soil inventory, correlation, soil classification, and related topics, and these will be summarized below.

Figure 1. Staff involved in Soil Survey across Canada

Our current soil inventory program in Canada ranges from essentially no activity in Prince Edward Island, to mapping at the rate of over 3 million acres per year in Saskatchewan. Prince Edward Island has been mapped at 1:10,000, and no further mapping is considered necessary. Saskatchewan still has extensive areas in the agricultural region for which only reconnaissance scale (1:500,000 and 1:250,000) maps are available, and the objective is to have the entire agricultural portion of the province mapped at 1:100,000 or larger. Activity in the other provinces covers the spectrum between these two extremes, and is summarized in Table 1. In all provinces, we are responsible for correlation, whether it be for provincial or private soil mapping. Staff trained in correlation are available to provide this service in all provinces. Correlation at the national level is provided by two pedologists located in Ottawa. A major effort is now being directed towards upgrading older maps and databases, using stereoscopic area1 photography, digital terrain analysis and remote sensing to improve their accuracy and reliability.

Table 1. Federal-Provincial Soil Inventory:

Soil Survey Related Activities:

Table 2. Soil Survey Related Activities in Canada

Taxonomy: The Canadian System of Soil Classification is not a static object, but a dynamic system that continues to evolve as new concepts and information become available. We are presently developing a new Vertisolic Order, and reviewing the Cryosolic Order. Both of these activities are being done with considerable cooperation and assistance from the National Cooperative Soil Survey, so many of you will be more familiar with the details than am I. We consider the maintenance of the Canadian system to be a high priority, for it will fall into disuse if it is perceived to be out-of-date or incomplete. Our current activities include western (last year) and eastern (next year) tours to establish the nature and occurrence of Vertisols in Canada, and the International Correlation Meeting and Tour of Permafrost Affected Soils, that will take place in Alaska and the Northwest Territories of Canada in July of this year (1993).

National Mapping (Soil Landscapes of Canada): We are nearing completion of total coverage of Canada with 1:1 million Soil Landscapes maps based on available data (no new field mapping). This is a remarkable achievement when the size of the country, and the scarce resources in our program are considered! Our databases are complete for all but a small part of Northern Quebec, and only the northern map sheets of British Columbia, Ontario, Quebec and Newfoundland remain to be published. This success is due, in large part, to my colleagues Jack Shields and Charles Tarnocai, who have been responsible for the coordination and compilation of these huge databases for the provinces and the territories, respectively. Pedologists in the Units also compiled data for the provincial coverages and the Yukon. We are now using these maps and their databases for a wide range of interpretive projects, including erosion risk, ecological stratification, soil carbon, and soil quality assessment, to name just a few.

Figure 2. Soil Landscapes of Canada, 1993.

Canadian Soil Information System (CanSIS): This GIS based soil data management system was one of the first in the world when it was initiated in the early 1970s. We now operate with ARC/Info software, and we are in the process of converting from a VAX mainframe to UNIX workstations. The system contains 1,400 digitized maps, with another 1,300 in progress. Our Land Resource Units in each province have a variety of different GIS systems (ARC/Info, PAMAP, SPANS, TERRASOFT, CARIS) but data are exchanged without difficulty between the systems. Much of the time of our staff is involved with completion and editing of data files to accompany newly digitized maps. Support through Canada's Green Plan (a multi-departmental environmental initiative of the present government) is aiding the preparation of "seamless" coverage of digital soil data for the Prairie Provinces (Alberta, Saskatchewan and Manitoba) at a scale of 1:100,000. This effort combines soil survey upgrade activities in the three Land Resource Units in these provinces, as well as the GIS and soil inventory expertise elsewhere in the Centre.

Figure 3. Structure of Canadian Soil Information System (CanSIS)

Ecological Stratification: More than ever, we are being urged to report a range of activities and data on a "ecosystem" basis. To facilitate this, and with the support of Canada's State of the Environment Reporting program (Environment Canada), we are establishing a heirachial "framework" based on the Soil Landscapes of Canada and the Ecoregion Map of Canada. The SLC map polygons (1:1M) are grouped according to climate, landform and vegetation into Land Resource Areas (LRA - 1:2M scale), which in turn can be grouped into Ecoregions (1:7.5M scale), which can be further grouped into Ecoprovinces and Ecozones. This cooperative approach between the Canada Departments of Agriculture and Environment will provide a unique "nested" and georeferenced product at the national level. There are approximately 220 Ecoregions in Canada. The result will be a federally/provincially agreed geographical system for reporting most agricultural and environmental information. The "framework" is being correlated along the border with the U.S. to ensure continental consistency.

Figure 4. Ecological Regions of Canada

Pedological Processes and Soil Carbon: Current activities in pedological process are focused on soil carbon. In addition, process studies include temperature work on soils around the Mackenzie Valley pipeline. The objective of the soil carbon study is to determine the amounts and dynamics of soil carbon in Canadian soils. The results to date include 28 map sheets of soil carbon data to lm depth (or to the bottom of organic layers in organic soils), and an extensive database of related information. The data are geographically linked to the Soil Landscapes of Canada maps, and it was the soil carbon study that resulted in the soil landscape maps of the north being completed. The data are being correlated with US information along the border, and a combined North American map is proposed. Charles Tarnocai is working with John Kimble to complete this database, which will be of great value to "global warming" modellers.

Data Applications: The short-term objective of this project is to come up with a replacement for our old "Soil Capability for Agriculture" rating system. The old system is being used in ways that are beyond its original intent, principally by municipalities and consultants involved with land zoning disputes. The new system will use a greater portion of the existing land resource data base, will be more objective, and will be tuned to different climate conditions and cropping expectations. A first version is now available, which covers soil suitability for cereal-grains. My predecessor, Wayne Pettapiece, is the leader of this initiative.

G.I.S. Procedures: There is great interest in increasing our capabilities with GIS for many applications of land resource data. Digital terrain analysis and remote sensing are being used to obtain information that can be applied to existing maps and databases, thus increasing their resolution and accuracy. The results can also be applied to upgrading old surveys, which often omitted soil and landscape attributes that are of importance today. Regrettably, our current short-fall in funding and personnel has left this study with several vacant positions, and few resources.

Database Integration: This is another initiative that is being supported by the federal Department of the Environment (Environment Canada). The objective is to develop and demonstrate models and procedures for soil/land quality assessment that can be applied at the Land Resource Area level of the National Ecological Framework. The work is being done by the Manitoba Land Resource Unit, and will focus initially on the agricultural part of the Prairie Provinces.

Benchmark Soil Quality Monitoring Sites: Under this study, 22 sites have been selected in the major agricultural soils of each province, so that they represent "typical" agricultural land use across the country. The study is led by Chang Wang! in Ottawa, and each site is managed by the CLBRR Land Resource Unit staff in each province. Soils have been intensively sampled and analysed for all baseline information, either on a grid (20m square) or on a transect basis. Sites are about 5 ha (12ac) in area, and are farmed by the owners according to their own farm plan.

Figure 5. Benchmark Site Network.

Conclusion

"Soil Survey" is still alive and well in Canada, though we are sometimes a little cautious about admitting it! The pedology community in Canada has always valued the close and constructive relationship it has had with the National Cooperative Soil Survey, and looks forward to this continuing. We are especially pleased with, and grateful for, the interest that you have always shown in correlation activities. We have several such activities underway at present, and recently signed an agreement with you to formalize the completion and correlation of the Soil Carbon database for North America. During my relatively brief assignment as Leader of our Land Resource Data and Applications Program, I shall do all I can to maintain and strengthen the links between our respective programs.

Table 1. Federal/Provincial Soil Inventory

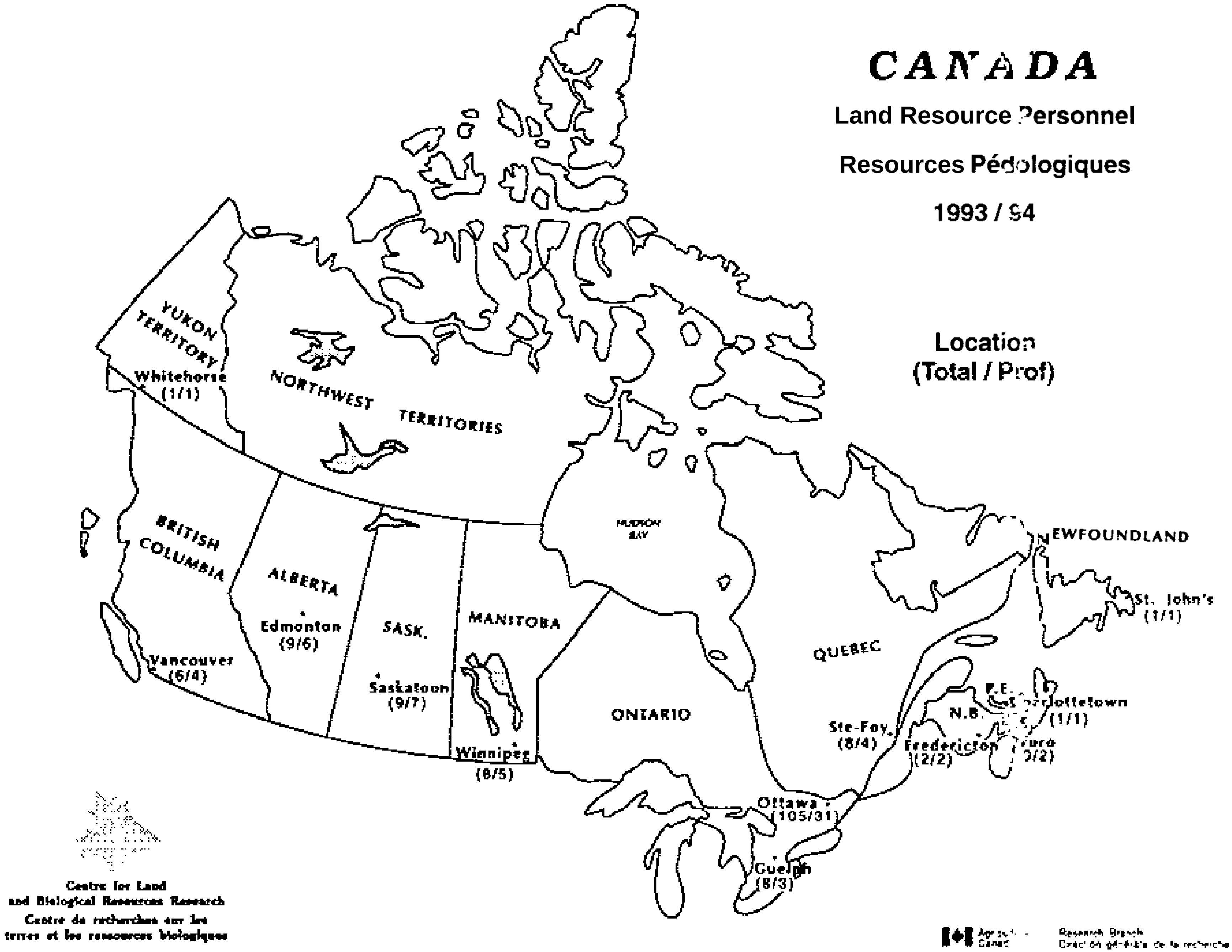
Province	Federal program			Provincial program		
	Ped	Tech		Ped	Tech	
Newfoundland	1	0	Correlation, forest site classification	4	2	Farm surveys and plans, land-use conflict areas
Nova Scotia	1	1	Correlation, data update	1	3	Farm surveys and plans
Pr. Edward Island	1	0	Data updata	0	0	None
New Brunswick	1	0	Correlation, completion of surveys, data update	1	1	Farm surveys and plans
Quebec	2	2	Correlation, survey at 1:50K in 3 counties	3	1	Survey in 4 other counties at 1:20K
Ontario	1	1	Correlation, completion of surveys, data update; survey methods upgrade	3	3	Completion of mapping, data update
Manitoba	2	2	Correlation, completion of surveys, data update; 1:100K database (Gr.Pln)	3	4	Continuation of surveys at 1:20K and 1:50K
Saskatchewan	4	1	Correlation, completion of surveys, data update; 1:100K database (Gr.Pln) Grassland National Park	10	4	Continuation of surveys at 1:100K
Alberta	2	•	Correlation, completion of surveys; data update; survey methods upgrade; 1:100K database (Gr.Pln)	4	3	Continuation of surveys at 1:50K and 1:100K, irrigation suitability map
British Columbia	0	1	None	2	0	Soil Landscapes
Yukon	1	0	Soil Landscapes	0	0	Parks, residential
H.Q. (Ottawa)	2	13	Correlation, national standards, map production			
Total	18	22		31	21	

Table 2. Soil Survey Related Activities in Canada

Study	Prof.	Tech	Activity
Taxonomy	1	0	Classification and description of Vertisols and Cryosols in Canada (in cooperation with NCSS)
National Mapping	1	5	Soil Landscapes of Canada - 1:1 M maps and databases
Canadian Soil Information System	3	17	National Soil Database, derived maps
Ecological Stratification	3	1	Ecozone. Land Resource Regions and Land Resource Areas, based on Soil Landscapes database (in cooperation with Environment Can,)
Pedoiogical Proc. and Soil Carbon	1	1	Northern soils, soil carbon database (in cooperation with NCSS)
Data Applications	,	0	Soil suitability (capability) rating system: application of models, interpretive algoriths
GIS procedures	1	0	Development of GIS procedures, remote sensing, digital terrain analysis (much potential, but understaffed)
Database Integration	1	1	Application of soil quality models to regional soil databases through application of GIS
Soil Quality Benchmark Sites	2	3	Network of 22 sites (1 O-l 2 ac) monitored for physicai, chemical and biological change over time, under “typical” farm management; sites for collaborative research on soil quality/degradation processes
Total	15	28	

Total Soil Survey	33	50	Direct and indirect Soil Survey related activities

Figure 1


CANADA
Land Resource Personnel
Resources Pédologiques
1993 / 94
Location
(Total / Prof)
YUKON TERRITORY
Whitehorse
(1/1)
NORTHWEST TERRITORIES
BRITISH COLUMBIA
Vancouver
(6/4)
ALBERTA
Edmonton
(9/6)
SASK.
Saskatoon
(9/7)
MANITOBA
Winnipeg
(8/5)
HUDSON BAY
ONTARIO
Ottawa
(105/31)
Guelph
(8/3)
QUEBEC
Ste-Foy
(8/4)
N.B.
Fredericton
(2/2)
P.E.I.
(1/1)
NEWFOUNDLAND
St. John's
(1/1)
Centre for Land and Biological Resources Research
Centre de recherches sur les terres et les ressources biologiques
Research Branch
Direction générale de la recherche

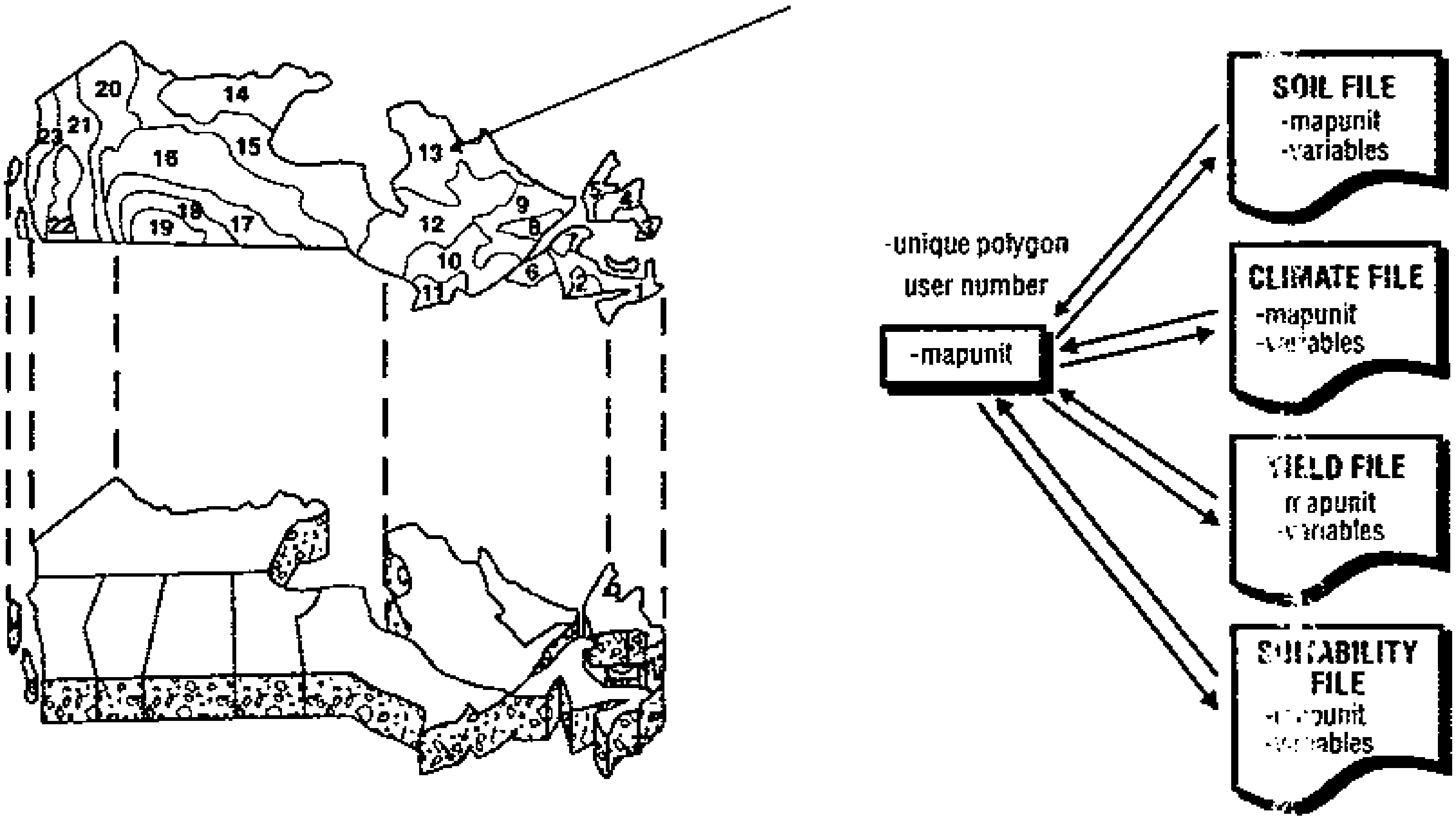
98

Figure 2

Canadian Soil Information System (CanSIS)

NATIONAL SOIL DATABASE (NSDB)

Soil Map of Canada (SMC) (1:5M) **Land Potential**

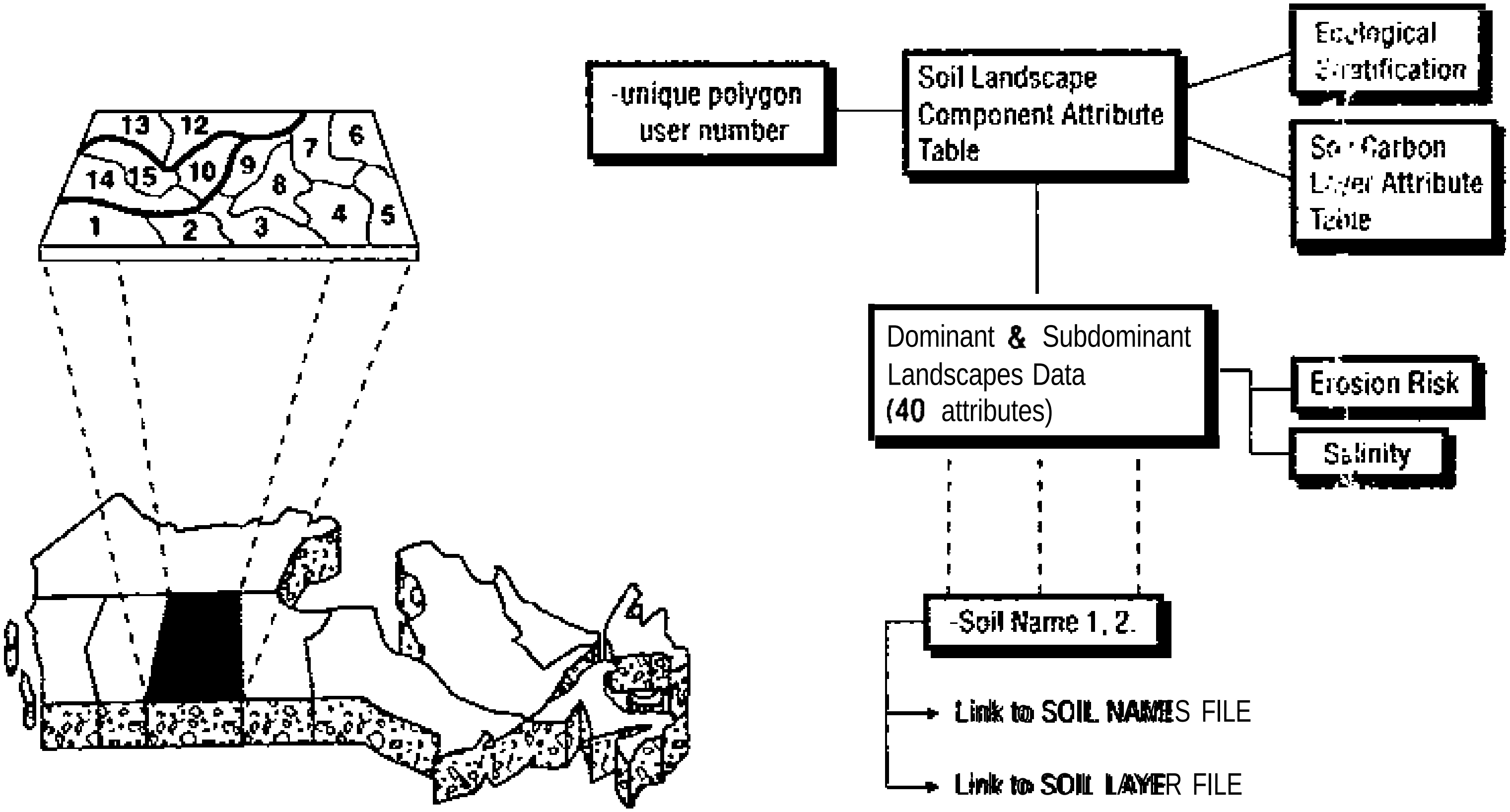


Canadian Soil Information System (CanSIS) ②

NATIONAL SOIL DATABASE (NSDB)

Soil Landscapes of Canada Maps (SLC) (1 :1M)

POLYGON ATTRIBUTE TABLE (PAT)



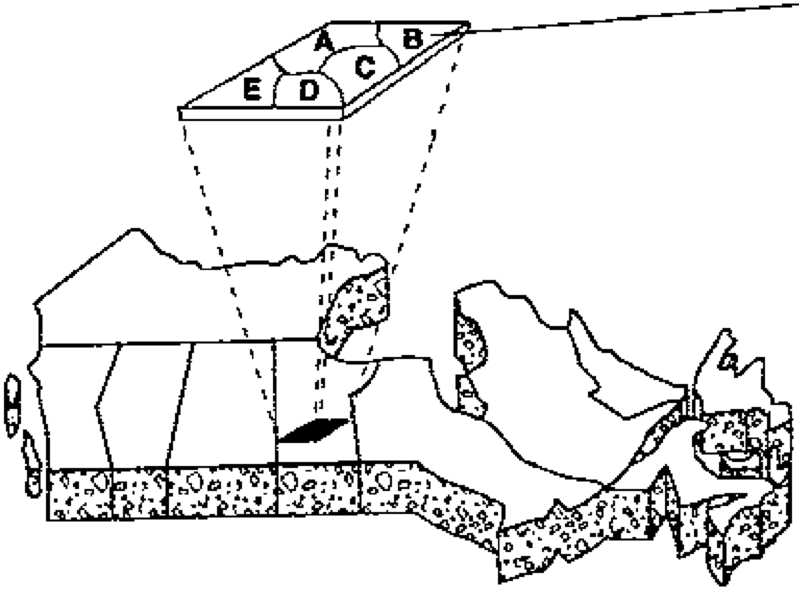
83

Figure 4

Canadian Soil Information System (CanSIS) ③

NATIONAL SOIL DATABASE (NSDB)

Detailed Soil Maps (DSM) (1 :10K→1:125K)



POLYGON ATTRIBUTE TABLE (PAT)

SOIL MAP UNIT FILE

-soil map unit name

-soil as designated by **soil code & modifier**

-soil extent

-slope %

-stoniness

-date

Link to

→ Provincial Soil Names File

→ Provincial Soil Layer File

83

Figure 5

General location of the benchmark sites

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE

Burlington, Vermont July 13

PANEL DISCUSSION

USE OF SOIL INFORMATION FOR WATER QUALITY ASSESSMENTS IN SMALL WATERSHEDS AND ON FIELDS

by

Dr. PETER VENEMAN, PROFESSOR,
UNIVERSITY OF MASSACHUSETTS

ERIC HESKETH, JOSEPH BAGDON, STEPHEN PLOTKIN,
USDA, SOIL CONSERVATION SERVICE, MASSACHUSETTS
(Joe Bagdon, Presenter)

BOB NIELSEN, SOIL SCIENTIST
USDA, SOIL CONSERVATION SERVICE, NATIONAL SOIL SURVEY CENTER

SOIL CHARACTERISTICS AFFECTING WATER QUALITY: SCIENCE BASE GENERAL OVERVIEW

Dr. Peter Veneman, University of Massachusetts

Soil is the recipient of many waste products and chemicals used in society. These waste products and chemicals include fertilizers, pesticides, other agrochemicals, and municipal and agricultural wastes intentionally applied to the soil, while others may enter the soil accidentally. The following general groups of soil pollutants may be recognized:

- inorganic pollutants: nitrates, metals.
- organic wastes: excess manure, sludge, domestic sewage, topsoil runoff.
- agricultural pesticides: herbicides, fungicides, insecticides.
- salts.
- anthropogenic wastes: acid deposition, industrial pollution.
- radionuclides.

This paper discusses the impact of the first three groupings on water quality in terms of edaphic effects. Figure 1 depicts the fate of soil applied chemicals. 1 (After N. Brady, 10th edition). The environmental fate of inorganic pollutants depends on soil properties, such as texture, organic matter content, structure, permeability, and soil moisture regime. The basic chemical properties of these pollutants also affects their fate in the environment. Soil nitrogen, even in the organic form, may ultimately mineralize to nitrates through the nitrification process. Nitrate, a negatively charged ion, easily leaches through the soil column and significant accumulations have been reported in the groundwater under cultivated fields. Since nitrate is not easily retained in the soil environment, efforts to reduce nitrate pollution should be focused on prevention rather than relying on retention in the soil. Lead and cadmium strongly bound to organic matter, while other metals may potentially move more quickly through the soil column depending on environmental conditions.

The fate of organic wastes is strongly dependent on soil and environmental conditions. Temperature and moisture conditions affect organic waste breakdown reactions. Most of these compounds will eventually be converted to the inorganic state including nitrates, phosphates, and heavy metals. The fate of these compounds generally follows the same pattern as described above.

Pesticides are any material (natural or manmade) that can be used to control undesired weeds, insects or microorganisms. Pesticides fate may be vaporization, sorption onto clay or humus particles, leaching, runoff, chemical and microbial alteration, and take up and possible detoxification by plants. Pesticide volatility varies from pesticide to pesticide, and different degrees of volatility may affect their effectiveness. From an environmental point of view, low volatility is desirable. Sorption is affected by edaphic factors such as organic matter, clay content, and the soil moisture condition. The chemical's characteristics, such as the size of the molecule, presence or absence of certain functional groups, and the ionic charge of the pesticide also affects their sorption rates.

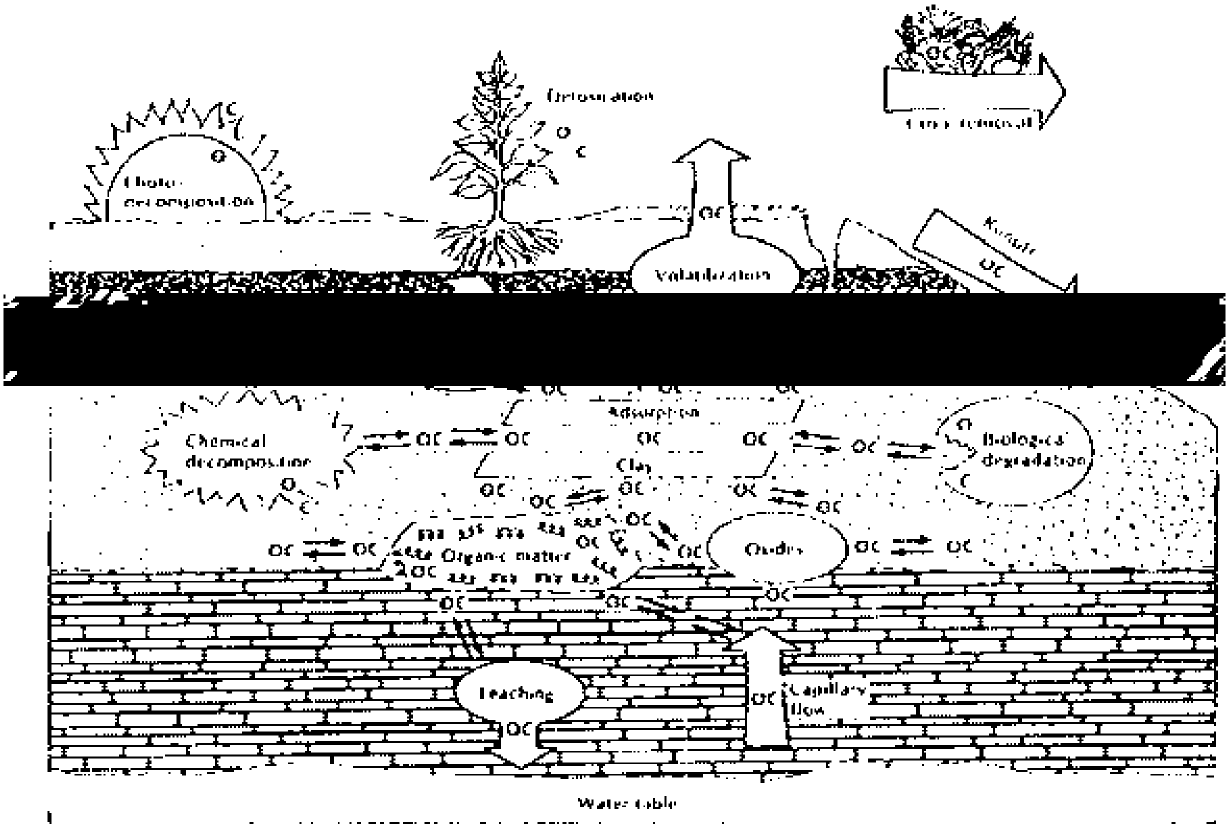


Figure 1. Fate of soil applied chemicals.
(After N. Brady, 10th edition).

The solubility and the sorption potential of the contaminante affects their leaching and runoff potential. Soil and general environmental conditions also affect the amount of the contaminant that leaches or that enters surface waters through erosion and runoff. For example, the following affect a contaminate's leachability and runoff potential.

- The amount of precipitation and irrigation water applied.
- The soil moisture conditions.
- The soil texture and structure.
- The soil organic matter content.
- The contaminant's chemical and physical properties.

Microbial processes are important parameters that effect the fate of soil contaminants. Amounts of microorganisms, soil moisture conditions, exposure to light (photodecomposition), degree of aeration, temperature, type of organic material to be degraded, and concentrations affect the rate of breakdown and the ultimate impact on the groundwater.

In summary, edaphic factors may result in different degrees of ground or surface water contamination depending on a host of sometimes unpredictable environmental, physical and chemical reactions. Soil factors that may have an effect during any or all the above discussed environmental fates are:

* texture
* organic matter content.
* permeability (hydraulic conductivity).
* structure.
* soil moisture condition.
* soil temperature.

Using Soils Information for Modeling Small Watersheds and Fields

Eric S. Hesketh Joseph K. Bagdon Stephen Plotkin
USDA Soil Conservation Service

Agricultural ecosystems are extremely complex and diverse. It is difficult therefore, to collect all the necessary descriptive information, assimilate these data, and make informed decisions strictly by brain power alone. To make life simpler we create "tools" to help us with our decisions. One very useful tool, especially in science, is the mathematical model. In this discussion, the use of the term, model, will describe a somewhat rigorous mathematical processing of information based upon the conceptual, empirical and/or physical relationships between the input parameters. Application of "models" or "modeling" in this sense can be simply described as a mathematical approach used to quantify complex systems.

One major advantage of modeling is speed. Simple computer models can provide answers in minutes or seconds. More complex models may take hours to process all the data. Development of input parameters for these models may require hours to weeks. In comparison, field studies and laboratory research, may take months to years. When resources are limited, modeling may be the only practical way to address spatially variable risk to the environment from the use of agrichemicals.

Advantages of modeling include:

* Input information based on measurable parameters.
* Output based on measurable parameters.
* Modeling based on current understanding of processes.
* There is less bias than "expert opinion".
* Modeling is less expensive than monitoring and/or field research.
* Modeling is very good at comparative analysis; e.g., No-till vs. Conventional till.
* Models are readily available from several sources.

There are also some disadvantages to modeling. Keeping in mind the limitations of computer modeling are **necessary** to apply properly the model's results.

Disadvantages of modeling include:

* Actual conditions may be more complex than the model can characterize; e.g., Channel erosion in GLEAMS; Only one "average" channel can be modeled. (Similar problems occur for slope, soil organic matter, and soil type.)
* Modeling assumptions may be incorrect.
* Requires expertise to develop valid input parameters.
* Simplification of processes compound error; e.g., Adsorption, equilibria, solute movement, evapotranspiration.
* Field results may be more than an order of magnitude different from model results.

* Model results may be misinterpreted in terms of accuracy and precision.
* Model output may be misapplied to situations that the model was not designed to simulate.

Major challenges in modeling include obtaining appropriate input and verifying the accuracy of the output. An acronym in the computer industry used to illustrate this is "GIGO", otherwise called "Garbage in, Garbage out." Quality input data are necessary to provide useful and accurate output. Keep in mind though, that the accuracy of input must be relative to both the accuracy of the model itself and to the intended use of the model results. For example, having hourly rainfall and temperature data, accurate to the third decimal place, would be too detailed to run RUSLE. Similarly, daily rainfall data accurate to the nearest inch, would not be sufficiently detailed to run GLEAMS.

Sensitivity of input parameters within the model also must be considered. GLEAMS, for instance, because of its daily time step, is somewhat insensitive to saturated hydraulic conductivity (Ksat) above 0.15 in/hr. Expenditures of resources to find the exact Ksat for a soil with a permeability range of 6 to 20 inches/hr would be wasteful. Conversely, being a tenth of an inch off for saturated porosity, field capacity or wilting point, would significantly effect the accuracy of the model output.

A confounding problem with model use, is the difference in input requirements for each model. One standardized set of data cannot run multiple models. Two models that simulate the same phenomenon may require similar or vastly different inputs. Table 1, lists several frequently used models and a partial list of soil input parameters they require.

It must be noted, however, that even an input parameter or group of input parameters like water retention, may be used differently by each model. For example, one model could require field capacity, saturated porosity, and wilting point, while another model might need the entire water retention curve. Other models may determine soil water retention based on "plant available water" or soil texture and bulk density.

What becomes frustrating is that state-of-the-art modeling frequently requires information that is not easily obtained. The result is that, in practice, the most usable models are the ones for which input data are readily available. A state-of-the-art model may give excellent field verified results. However, if that model requires data that are difficult to obtain, then the original advantages of modeling may be lost. A model that provides less accuracy and/or less precision, but uses data that are readily available or that can be obtained with modest effort, may have greater utility.

Table 1.

Soil inputs required for several popular models.

	GLEAMS	EPIC	DRAINMOD +	NLEAP +	WEPP +
Water Retention	*	*	*	*	*
K sat	*	*	*		*
Soil Texture	*	*			*
Erosional K	*	*			
Upflux		depth to WT	*		
Layer Depth	*	*	*	*	*
Bulk density		*		*	*
Detachment/Shear					*
% Rock Fragments		*		*	*
CEC/Base Saturation	*	*		*	*
pH/ $CaCO_3$	*	*		*	*
Specific Surface Area	*				*
Soil Albedo		*			*

Finding soils data for a particular environmental model can be problematic. Listed below are commonly available sources of soils data.

* **Soil** Surveys:
  - Interpretive data
    - Map Unit descriptions
    - Morphology.;
    - Land use
    - Available water (general range - usually estimated and not measured)
    - Texture as sieve size or phase
    - USLE K factor
    - pH
    - Permeability (general range - usually estimated and not measured)
    - Soil organic matter (general range)

* 3SD (State Soil Survey Database)
  - Similar information as soil surveys

* Field and laboratory analysis
  - Saturated hydraulic conductivity (Ksat)
  - Water retention
  - pH
  - Texture
  - Soil organic matter
  - Cation exchange capacity/Base saturation
  - $CaCO_3$

* Algorithms based on texture and structure (e.g., Baumer, van Genuchten, Rawls)
  - Erosional K
  - Ksat
  - Water retention
  - Upflux
  - Unsaturated hydraulic conductivity

Unfortunately, even if data exist, they might not be in the correct format. For example, the State Soil Survey Database has textural information recorded as sieve size ranges and not textural separates required by most models. This requires a fair amount of manual work to obtain discrete percentages for sand, silt and clay. This is somewhat easy to do for a few soils, but becomes a daunting task for a hundred or more soils. In addition, the quality of that information also may not be at the level necessary to run the particular model. The range of available water capacity is not specific enough to run GLEAMS, which needs discrete points for field capacity, wilting point and saturated porosity. Estimation of these parameters must be done with look-up tables provided with the model or found elsewhere, actual laboratory data, or by using mathematical formulas based on soil properties to derive the needed parameters. NASIS, the next step in SCS's soil database development, will correct some current deficiencies through the development of "Representative Values". These values will be listed as single points instead of ranges. This will greatly increase the usability of database information for modeling at the small watershed to field scales.

Soil's data need to be collected and made available for parameters that cannot be easily determined through field analysis. Data easily attained in the field, such as soil organic matter and pH, are equally important in modeling, but are tied closely to individual field management practices and vary widely. Therefore, spending significant time developing soil organic matter or pH values would not likely add to the utility of a soils database in terms of modeling. Additionally, a parameter such as soil organic matter, is so highly correlated with pesticide movement, that it must be treated as a sensitive variable. A range of values should be run to describe the variation of organic matter, and thus chemical movement, found within and between fields.

Using Soils **Data Appropriately**

Large scale modeling uses mostly "Averaged" or "representative" input parameters. Such homogenization of soil parameters can be useful to find gross trends over large spatial areas. As the focus of the modeling effort begins to delineate finer and finer detail, soil parameters themselves have to be treated with increasing detail. Caution then, must be used in extrapolating small scale occurrences from large scale modeling. Homogenizing may smooth effects caused by variations of critical parameters. These variations may be the overriding drivers of the modeled system. Frequently, it is the extremes and not the norms that cause the greatest concerns with regard to water quality.

Another problem with homogenizing soil parameters, is that doing so may produce a soil that does not exist, therefore the term "Frankensoil". The usefulness of an artificial soil depends on whether it accurately describes the soils from which it was derived. Table 2, shows an example of averaging soil parameters to develop "average" soil conditions.

Table 2.

Soil water retention parameters for individual and averaged soils.

	Clay Loam	Loamy Sand	Silty Clay	AVG.
Saturated Porosity	0.47	0.36	0.43	0.42
Field Capacity	0.42	0.15	0.36	0.31
Wilting Point	0.17	0.03	0.21	0.14

In this example, the average soil parameters do a poor job describing any of these soils. The **averaged** values might represent the water retention parameters of a silt loam. However, this soil would not well represent the clay loam, sandy loam or silty clay. This type of error can be introduced when Frankensoils are a composite of spatially related soils that have dissimilar parameters. A Frankensoil that represents a heterogeneous area or map unit that ranges from a silty clay to a loamy sand will be of questionable value. For example, we would expect to underestimate runoff in the clay loam but significantly overestimate runoff for the loamy sand based on drainable water (Saturated porosity - Field capacity). Likewise, even soils with similar textures may be poorly represented by "averaged" soils. This can be especially true when restrictive layers are present or the mineralogy of the soils is different.

Model users, therefor, must use soils data cautiously. Because of the individual sensitivities of each parameter for each model, homogenizing parameters should be done on a model by model basis.

Such flexibility is difficult due to the large number of available models.

A potential alternative to the Frankensoil approach is the use of Cluster Analysis. Cluster analysis provides objective and quantitative soil grouping. The uniqueness of this approach rests in its flexibility. The theory behind Cluster Analysis relies on quantifying dissimilarities between parameter values. Separating out groups or clusters is based on the magnitude of dissimilarity between soils.

Clustering methodology can be broken down into several simple steps:

1. Choose the model's most sensitive soil variables.
2. Develop a distance matrix between soil variables for a population of soils.
3. Group soils based on distances between variables.
   a. Soils with the least difference (distance) between variables are grouped (clustered) together.
   b. Soils with the greatest distance between variables are not clustered together.
4. Select a representative soil from each soil group (cluster) based on:
   a. Largest acreage to be modeled
   b. Most agriculturally important (can be crop dependent)
   c. Centroid of the cluster (soil most like other soils in group)
   d. Soil most likely to be cause for concern in group

Conclusion:

Modeling is a powerful and cost effective tool that can help us understand how management practices, soil types and climate, effect water quality. The power of modeling relies on the ability to describe accurately the study area. Attainment of relevant and accurate soils data is critical to the success of environmental fate modeling. Obtaining valid data useful for a particular model (e.g., saturated porosity, field capacity, wilting point, saturated hydraulic conductivity) is not an easy task due to the diversity of models and model inputs. Additionally, current soils database design does not provide data in the form required by mathematical environmental fate models. Models need single values instead of ranges. The Representative Value concept in NASIS is a positive step in linking soils data bases with model needs. Provisions also should be made to include actual field data. Broad default ranges should not replace actual field data.

Model developers and soil scientists must cooperate to determine the data needs of the future. By understanding the needs of computer models, soil scientists can develop more useful modeling data sets. Also, modelers who understand the limitations of data collection on a large scale, can develop better ways to use data already available.

SOILS DATABASE CONCEPTS FOR WATER QUALITY MODELS

BOB NIELSEN, USDA, Soil Conservation Service

Researchers and natural resource managers crafted models for research purposes and to study natural processes. Initially, these models required on site input measurements. A comparison of natural response conditions and model reponse conditions provided for model calibration and validation. These models are rapidly evolving from the research and development stages to the applied technology stage. The use of these models' encompasses agrochemical transport and fate assessment on fields, farms, small watersheds, and river basins. These models require a soil database that contains the necessary input soil parameters. Otherwise, soil data must be collected site by site, field by field, or watershed by watershed. Soil survey map unit attribute databases are available as inputs to water quality and other natural resource model applications. Yet, the specific soil data required by these models is not routinely gathered or reported in soil surveys or soil survey databases.

SOIL DATABASE APPLICATIONS TO WATER QUALITY ASSESSMENT MODELS:

Environmental system modelers and natural resource planners must use applicable soil map unit data and information. The accuracy and precision of the applied model is bolstered if the soil data inputs are relative to the area or resource. This is accomplished by encouraging the use of soil data that is suited to the area of concern.

Soil map spatial applicability, soil map unit design, and soil map unit attribute data have inherent constraints. These constraints must be recognized and addressed before using soil survey data as inputs in water quality models. The following introduce several of these constraints:

1. SIR (Soil Interpretative Record) data does not spatially or geographically represent any soil map unit or soil map unit component within a given geographical area. Soil series and phase SIR data and information represent only the conceptual bounds of any give soil series or soil series phase. A Map Unit Interpretative Record (MUIR) is a subset of the SIR information. It is the MUIR subset of the SIR data that represents a given geographic area and describes the attribute data for any given map unit component. The MUIR data is approperiate input for water quality models.

2. Users of water quality assessment models must match soil attribute data and map unit scale to the scale of the geographic area evaluated. Examples are given below:

   a. SSURGO (Soil Survey Geographic database) contains soil map unit and map unit component attribute data.

Published soil surveys and local soil survey database "Map Unit Interpretations Records (MUIR) data" contain this information. It is available for and applicable to "Small watershed and field" water quality assessment activities.

b. STATSGO (State Soil Geographic database) contains soil map unit and map unit component attribute data. This information is available for and applicable to "state, large watershed, and small river basin" water quality assessment activities.

c. NATSGO (National Soil Geographic database) mapping unit and map unit component attribute data is available for and applicable to "National and large river basin" water quality assessment activities.

Additionally, model information requirements, often, exceed the capabilities of current soil survey databases. i.e., Data input parameters such as organic phosphorus, total Nitrogen, specific gravity of soil separates, to name a few. These input parameter can be derived from basic soil properties; measured field by field or watershed by watershed; or are default values. Caution should be used when employing derivation algorithms to calculate water quality model input parameters. These algorithms are sensitive to the accuracy and precision of their soil properties inputs. Such derivation algorithms, also have inherent accuracy and precision errors that users must recognize and understand. Therefore, an understanding of the soil properties inputs and derivation constraints are essential in the development and application of soil input derivations.

SOIL DATA PRECISION:

Soil survey attribute data are accurate but lacks the precision required by many models to reflect the processes related to water quality assessments. Attribute data precision can be improved by the following:

a. Utilize measured data form state and national soil laboratories to improve the precision of the attribute data assigned to soil survey map units and map unit components. Access to a common database containing NSSL (National Soil Survey Laboratory) and NCSS laboratories' soil data will aid the implementation of this concept.

b. Develop and implement use and time dependent temporal soil attribute data and provide that information to modelers and natural resource planners.

c. Implement soil map unit and map unit component data spatial dependencies concepts that more precisely define soil map unit attribute properties. Thus, map unit attribute properties would represent the geographical area the map unit describes. Soil map unit and component attribute information obtained from the SIR may be too broad and may encompass broader concepts than occurs in the map unit. i.e., MUIR map unit component permeability retrieved from a SIR might be 0.6 to 6.0 in/hr.. Yet, the map unit component for that specific soil survey area might have a permeability range of 0.6 to 2.0 in/hr.. Conversely, soil map unit component property data of a specific area might encompass a broader range in attribute data than those retrieved from the SIR. Further, SIR data for a soil series or phase "of large geographical extent" has different relative precision and spatial relationship to a map unit component than does a series or phase "of very limited geographical extent".

d. Assign representative values to soil map unit and map unit component attribute data.

e. Soil attribute data, such as organic matter content, texture, or pH, could be gathered by trained field specialist or resource planners. This acquisition of data by trained field specialists could be periodically assimilated into soil databases during the update and maintenance process. Soil scientists would review this data and make the appropriate correlations and revisions to the soil attribute databases.

f. Develop techniques that reduce the need to homogenize watershed or field soil map units and attribute data into a composites of soil attribute data called a FRANKENSOIL.

SOIL ATTRIBUTE DATA PROGNOSIS:

Meeting present and future water quality model soil data needs will require a strong partnership between local and state units of government, CES (Cooperative Extension Service), Academia, and SCS SOILS DIVISION. This challenge is too great for any one of these entities to do alone. Yet, by working together and taking one piece at a time soil data input requirements for water quality and other natural resource assessments models can be met.

BLM SOIL SCIENCE HIGHLIGHTS: NCSS MEETING, BURLINGTON, VERMONT, JULY 13, 1993 (By: Scott Davis)

Jim Baca was confirmed as the new director of the BLM. He recently was a New Mexico Land Commissioner.
He views our challenge to be learning how to think about, organize and conduct our work on an ecosystem basis. He plans to promote innovation among our managers and interdisciplinary technical specialists. He seeks to reduce administrative costs and to reform mining, grazing, and timber practices while building an agency based upon collaboration and partnerships with outside interest groups.

Specific challenges for soil scientists in the BLM will be to explore non-traditional ways to use soils information. One goal will be to utilize ecotype provinces with all land ownerships and agencies while decribing a dominant soil, a unique soil, and/or a biologically sensitive soil linked to an ecological land unit. This will be key to developing multi-agency derived soil ecosystem units for monitoring benchmark conditions. Another challenge is to determine how to keep professional soil scientists in the BLM, bucking the trend of replacing technical soils expertise with general resource specialists. Extensive road systems once needed for extracting products from public lands. Many of these roads are no longer needed; carrying a high maintenance cost and creating damage and conflicts with other resources. Use of a properly designed winged subsoiler has been a cost-effective way to restore such damaged lands to a proper functioning condition.

The BLM Districts in western Oregon are using a Nitrogen budget driven model, based on the work done by Dr. Kimmins at the University of British Columbia, to rate assorted forest planning alternatives. The public domain lands will be utilizing WEPP (water erosion prediction program) to monitor ecosystem health, beginning in 1995. The BLM will soon complete the Soil Strategy developed at the Keystone, Colorado, meeting held in August of 1991. It will include direction on ecosystem management.

In January, 1993, the BLM published a Soil Data Element Dictionary which has been shared with the SCS and the USFS in an effort to tie soil data elements to ecological units. The Colorado SCS and the BLM have a formal Memorandum of Agreement for the purpose of exchanging automated spatial soils data for sharing of GIS data bases.

The BLM held a national riparian/watershed meeting in May of 1993 in Albuquerque. The big task was to account for the percentage of BLM riparian systems which are in "properly functioning condition" and to enable 75% of those areas to meet those conditions by the turn of the century. The workshop was accompanied by a tour of the Rio Puerco watershed to view the restoration work being done in partnership with the local communities.

Other research pertinent to the BLM is Utah State University's study of desert soil crusts/cryptograms---good or bad? Contact: Dr. Janis Boettinger. Another study which the BLM is cooperating in is one with the EPA/ARS to quantify sediment-salt relationships.

The BLM is moving toward ecosystem management while seeking to avoid specific programs and ownerships. By combining dollars and efforts among several resources, results on-the-ground can be attained at less cost. For success, the BLM will need to recognize site potential and capability to determine potential natural vegetation versus merely supporting prior land use. Without making proper interpretations of soil surveys and soils information, proper decisions in ecosystem mangement will be difficult. On many BLM sites dominated by pinyon pine and juniper the potential natural vegetation is not well understood. This can lead to improper assessments of range condition.

One of the least understood facets of soil science is currently being studied by a small cadre of researchers. That study involves arthropods, including soil insects, spiders, mites and centipedes. These tiny creatures (about the size of a period at the end of this sentence) turn insoluble cells into nutrients. If one wants to monitor changes in the environment, the worst thing one can do is to look at an organism that is very old. In contrast to a tree or plant, the arthropod community allows one to look at what is happening over a more appropriate time frame, as little as a few months. This is because of all the diversity. Dr. Moldenke at Oregon State University is studying forest soils and Dr. Moore at the University of Northern Colorado is working on range sites.

History of BLM and Soil Science

The BLM was formed after World War II. Soil scientists became part of the agency 20 years later, and expansion continued until 1980. This expansion of soil science occurred in response to the National Environmental Policy Act (NEPA) of 1969 and the challenge presented by the Natural Resources Defense Council that the BLM was not abiding to NEPA. The Federal Land Policy and Management Act (FLPMA), further supported the need for soil science expertise in the BLM.
Since 1980 a greater than 50% reduction in soil scientists in the BLM has occurred, resulting in less than 50 soil scientists today, down from a high of 116. Most soil scientists changed job roles, retired, or transferred to another organization. More than 80% of the cut-backs occurred in Colorado, California, and Utah.

Personnel changes during 1991-1992.

1. Glenn Bessinger is the new BLM Washington Office Soil Program leader. Prior to taking his new position in Denver, he worked in the Planning and Environmental Coordination Department with the BLM in Washington D.C. Colin Voigt moved from Soil Program leader to

the Planning and Environmental Coordination department.

2. Lee Barkow and Eric Janes assumed the duties of BLM Salinity Control Manager, which was moved to the BLM Denver Service Center. Keith Miller, past Salinity Manager, is working on the BLM rangeland monitoring task force.

3. Russ Krapf is now the soil scientist at the BLM Phoenix Training Center. Dan Tippy moved to Prineville, Oregon as a multi-staff supervisor.

4. Jim Pomerening, retired from the Oregon BLM after nearly 20 years of summer work mapping and correlating soils in Oregon.

5. George Staidl retired from the BLM. He worked on the Soil-Range team, which has been cut from the BLM.

BUREAU OF LAND MANAGEMENT(BLM) BOIL SURVEY ACTIVITIES

National Soil Survey Conference
July 11-16, 1993

STATUS OF SOIL SURVEYS

About 141 million acres of Public Land have Order 3 soil surveys completed on them. This represents about SO percent of the Public Land in the lower 48 states. The largest areas remaining to be surveyed are located in California, Oregon, Utah, and Nevada. total remaining acreage is about 34 million acres, not including Alaska. Soil survey of the immense acreage of Public Land I" Alaska has generally not been a high priority. Only a small percentage of our soil surveys have been digitized to date.

DENVER SERVICR CENTER ACTIVITIES

Some of the projects and activities our Denver Service Center is currently involved with include:

INTEGRATED SOIL-TERRAIN RESOURCE ANALYSIS

The Sagers Wash Watershed "ear Moab, Utah, has bee" proposed as a prototype watershed for reduction of salt input into the Colorado River. The Bureau of Land Management is using advance Geographic Information System (GIS) analytical techniques to assist with the development of a comprehensive watershed management plan. 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; vegetation, surface geology, and resource condition information.

ENBANCING SOIL SURVEYS - HENRY NOUNTAINS SOIL SURVEY, UTAH

Digital Elevation Model (DEW) and remote sensing imagery are being used with other supporting data (climate, geology, and vegetation) to more efficiently and accurately make and enhance Order 3 soil surveys for managing public lande and monitoring renewable resources. The Soil Landscape Analysis Project (SLAP) methodology incorporates a strong terrain analysis approach. It provides a soil digital layer that is incorporated into the Geographic Information System for soil interpretation and analysis. Experiences from soil surveys in Utah demonstrate the DEN products and remote sensing data are valuable tools for mapping soils in areas of rough terrain. Information and technology provided by this methodology is effectively used to enhance existing soil surveys and also for displaying and communicating soil information.

Soil Survey Enhancement provides additional interpretation capabilities for specific uses such as water quality, riparian area management, and reclamation needs on wildland surveys. The use of geologic and topographic data are strongly emphasized in the soil survey enhancement process on rangeland and wildland surveys.

RIPARIAN AREA SOIL SURVEY ENHANCEMENT

The emphasis on riparian area management undertaken by BLH since 1985 to ensure appropriate protection of these unique areas has highlighted the need for enhanced soils information. Most riparian areas are narrow, elongated stream areas and are not delineated on Order 3 soil surveys or are mapped as broad miscellaneous land types. Soil surveys on public land are being supplemented to identify these areas. Soils within these areas are most commonly highly variable requiring on-site soil investigation to determine basic soil properties and soil water relationships. The Riparian-Wetland Site Description Core Team has released a Draft Technical Reference TR 1737-l 1992, Riparian Area Management series entitled, "Procedures for Ecological Site Inventory - With Special Reference to Riparian - Wetland Sites".

BUREAU OF LAND MANAGEMENT
BOIL SURVEY PROGRESS REVIEW

STATE	PUBLIC LAND"	PUBLIC LAND MAPPED**	% PUBLIC LAND MAPPED
ARIZONA	12,428,584	10.500.000	84%
CALIFORNIA	17,204,689	4,262,500	25%
COLORADO	8.276.890	8,046,988	970
IDAHO	11,867,773	11,179,123	94%
MONTANA	8.070.658	6,100,000	76%
NEVADA	47.962.636	45,084,877	94%
NEW MEXICO	12,869,913	12,869,913	100%
NORTH DAKOTA	67,030	61,740	92%
OREGON	15.691.674	9,304,000	59%
SOUTH DAKOTA	279,595	270,946	97%
UTAH	22,141,908	17,077,184	77%
WASHINGTON	312,582	304,098	97%
WYOMING	18.404.034	16,190,000	88%
SUBTOTAL	175,577,966	141,251,369	80%
ALASKA	92.740.505	3,989,502	4 %
TOTAL	268,318,471	145,240,871	54%

* Acreage compiled from "Public Land Statistics - 1989"

** Acreage compiled from State program leads; Order 3 or higher soil surveys

Digital Soil Data - STATSGO and SSURGO

Dennis J. Lytle
USDA Soil Conservation Service
National Soil Survey Center, Lincoln NE

We have made a shift in how we in the National Cooperative Soil Survey (NCSS) do business from a process in which we used the soil data base to generate the "final product" manuscript tables for soil survey publications to one in which the data base is the final product that is being used to run erosion models such as RUSLE, WEQ and WEPP, and water quality models such as SPISP, AGNPS, NLEAP and SPAW, as well as many other engineering and climate change models, and also to generate manuscript tables for published soil survey reports.

This may seem like a subtle shift, but like a earthquake, this small shift is causing major waves. In the fonner process when the published soil survey report was the final product, we often manually edited the manuscript tables to fit local conditions without going back, often times because to SOIL 5 could not be adjusted, to edit the data base. It is akin to receiving your bank statement in the mail and taking a bottle of white-out to it! We have been concerned with this issue for at least 5 years now. The state soil survey data base (SSSD) is a result of these concerns. The new National Soil Information System (NASIS) is a result of these concerns.

The biggest issue we continue to struggle with is use-dependent soil properties. Most of the soil property data elements in MUIR are use-dependent. Clay percent may be the exception. We will have a team working on use-dependence in FY 94 to develop a comprehensive set of recommendations on the direction we should take. It is a critical issue because of the potential cost of adding and maintaining values for each data element under each use. The new NASIS structure will allow for the beginnings of such a system. At a minimum we must define the use(s) under which the current MUIR soil property data elements exist. The new NASIS structure also will allow us to store data by horizon. We know that there are vast differences in soil horizonation and properties and thus model results, where the same soil occurs under tree, shrub, grass or cropland, and within cropland between irrigated and nonirrigated, types of crops, cropping sequences and tillage operations. Current discussions center on defimng soil properties under a limited set of these conditions. We have no choice but to define our soil properties under these conditions if we are to use them in the previously mentioned models.

We must take the time to evaluate and update each states soil data base. Some states over the last 5 years have done a good job of editing and maintaining these data while others have not. This was pointed out in the answers we got back to the survey that each state recently responded to where we asked how much time would be required to edit and convert the data base to the new NASIS structure. Estimates range from 1 to 33 staff years with an average of 7.3 per state for this effort. Our future depends on being able to provide accurate soil data. We are shifting our priorities at the NSSC to work with each state in FY 1994 to develop and implement a plan to assure quality in the soil data base. Our long term efforts for data quality will continue to be centered on the MLRA approach for "Continuous Improvement of a Quality Product".

NASIS, mentioned earlier, is a mechanism that provides for the collection, storage, manipulation and dissemination of soil survey information within the framework of NCSS.

NASIS is also the umbrella project name under which the SCS Soil Survey Division is developing automated systems, and much of the talk lately has been about NASIS in this context, but the overall NASIS will continue to have both manual and automated processes.

An information system such as NASIS is not simply a collection of computer programs that operate on data tiles. It is a means to achieve organizational objectives by coordinating computer hardware, software, data, process logic, policy and operating procedures to implement organizational objectives.

Much of the work that has been done to date has involved mapping out the current system and then settling on the organizational objectives mentioned earlier. The 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 enhance and improve our NASIS into the year 2000 and beyond.

The first software to be released under the NASIS umbrella was the Pedon Description Program. It provides the foundation on which we will build. The next release or phase will deal with the storage, manipulation, and dissemination of soil survey infonnation. Currently we plan to have a first version of this software released in October 1994 with yearly releases after that. States may be able to start converting data to this new system several months earlier. This conversion will not be without a certain amount of pain, but it is good medicine. It will address many of the aches and pains we have with the current system. We intend to put out quality software even if it takes a little longer. It is an exciting time to be a part of Soil Survey. We are laying the groundwork for a whole new “automated” generation.

Another major part of our efforts recently have been in the development of standards for and access to digital soil data. Standards will enable us to share data as we move into this digital world. Standards development efforts got their first start with the NCSS Data Management Subcommittee that reported at the 1991 NCSS National Work Planning Conference. At about the same time the federal Office of Management and Budget fonned the Federal Geographic Data Committee (FGDC) and charged federal agencies with the task of developing standards initially for 10 thematic layers. Responsibility for the soils layer was assigned to the SCS. A FGDC Soil Subcommittee was formed to finalize these standards. I will talk to you later in more detail about the NCSS Data Management Subcommittee’s progress on these standards and how they fit with the FGDC efforts, but the FGDC has three major standards developments done or underway.

The first is the Spatial Data Transfer Standard (SDTS) which has become a Federal Information Processing Standard (FIPS), know as FIPS 173. This standard provides specifications for the organization and structure of digital spatial data transfer, definition of spatial features and attributes, and data transfer encoding. The purpose of the standard is to promote and facilitate the transfer of digital spatial data between dissimilar computer systems.

The second is the Metadata Standard. Metadata are “data about data.” They provide such information as the characteristics of a data set, the history of a data set, and organizations to contact to obtain a data set. Standardized metadata elements will provide a means to document data sets within and organization, to contribute catalogs of data IO help persons find and use existing data, and to aid users to understand the contents of data sets that they receive from others,.

The third is a Clearinghouse for all digital spatial data. The concept behind the Clearinghouse is one of easy access to digital spatial data. A prototype is being developed that initially uses high speed fiber optic communications over INTERNET and a Wide Area Information Server (WAIS) software. The FGDC tentatively envisions the Clearinghouse being implemented in three phases. The first phase would provide access to metadata. The second phase would provide on-line access to data sets and the third phase would provide a means to identify partners for data creation.

Linked to the Clearinghouse would be what the NASIS calls a National Soil Data Access Facility. This facility is currently envisioned as a centralized storage and retrieval system for anyone producing or requiring digital soil data. The Clearinghouse would provide public access to this National Soil Data Access Facility and SDTS and the Metadata standards would provide the standards for populating the databases.

Our efforts in Soil Survey Geographic Data Base (SSURGO) and State Soil Geographic Data Base (STATSGO) development have been tied to standards development. We have a draft definition of exactly what SSURGO is and committee 4 on the Digital Soil Survey will help us further define our standards. We are working with the SCS National Cartographic and GIS Center in Fort Worth to provide one document that lists our standards called the "Technical Specification for Soil GeoData Development" which should be complete in 1994.

We have digital data for the county level soil surveys, not all of it is SSURGO, for about 12 percent of the U.S. We have had major budget initiatives requesting about 20 million dollars in FY 1993 and 1994 and in 1995 we should have an FGDC/OMB cross agency budget initiative for digitizing soil surveys and creating this digital product.

STATSGO is complete for the U.S. We still are finalizing joins between some western states, and Alaska is still creating its attribute data. Our plans call for creating one uniform attribute data set for STATSGO in August 1993 and then distributing it on CD ROM. We also are working on the combination of STATSGO data to fonn a new NATSGO. Sharon Wahman is heading that effort. Our plans are to create a 1:1 million map first that could also be used for a regional general soil map publication. We will be working through the NTC's to accomplish this and look forward to publishing this regional general soil map as in the past through the experiment station committees.

In summary standards development for digital soil data will continue to require much effort and coordination. They will improve the quality of the soil survey. Computer systems (hardware and software) continue to improve. The challenge is to take advantage of the technology without loosing track of the science of soil and soil survey.

THE ROLE OF RESEARCH IN THE SOIL SURVEY PROGRAM - DIFFERENT COOPERATORS, DIFFERENT ROLES, DIFFERENT PRIORITIES

My invitation to participate in this National Soil Survey Conference was one of the most exciting pieces of mail to reach my box in a long time. Although I moved from the Soil Conservation Service side to the cooperator side a few years ago - and then away from the action arena into the research management arena, where often little happens unless we can stay out of the way of researchers - the excitement of soil classification and mapping and working with users of land has not diminished.

In a presentation made earlier in this conference, Dr. Del Fanning posed the question "Where are the soil scientists going"? As a parallel, perhaps the topic of my presentation should be retitled "Where is Research in the Soil Survey Program Going"? I would be much too presumptuous if I thought I had the answer, but I believe that soil scientists of the National Cooperative Soil Survey are already providing the answers. First, a few words about different cooperators.

The Soil Conservation Service, Land-Grant Universities (Agricultural Experiment Stations), the Forest Service, and the Bureau of Land Management have for many years been active cooperators in the National Cooperative Soil Survey. These agencies continue their participation, while other agencies and organizations have already become cooperators, either locally or nationally. Some of the new cooperators are likely to become increasingly active in support of research and/or application of soil survey information.

By: **Richard L. Guthrie**

Dr. Gene Kelly's report on principal funding sources for research in the Western Region lists the Environmental Protection Agency (EPA) as a major funding source for soil survey research. EPA is a relative newcomer as a cooperator, but is becoming a major partner, as demonstrated by the agency's participation in this conference.

Expect the Department of Energy (DOE) to become a major research cooperator in the future. DOE is seeking environmentally sustainable sources of energy and methods/sites for disposal of energy-related byproducts. Soil scientists, agronomists, and other scientists are being asked to conduct research on the feasibility of producing biomass for conversion to electricity and fuel. Identification of land suited to production of biomass but marginally suited to traditional agricultural crops is a high priority so that energy production does not compete for land with production of food, feed, forage and fiber.

Richard Duesterhaus, in his presentation to this conference, alerted us to seek out partners among heretofore unlikely cooperators such as international institutions and private groups, including both voluntary organizations, associations and commercial companies. Current issues locally and nationally have become global issues and U.S. science-based soil survey has no equal elsewhere in the world. As public concerns shift from food and fiber production to environmental issues, the soil survey program must look to the new cooperators for research support, just as other agricultural researchers are seeking new support. Clearly a different set of cooperators will change the role of research in the soil survey program. Now a few words about different roles.

Prior to the publication of a comprehensive soil classification in the 1938 Yearbook of Agriculture, research in support of soil survey focused on the processes of soil formation, relating kinds of soil and their distribution to soil forming factors. Most of the research was conducted by university collaborators and formed the core of much of the recorded basis for soil mapping. Marbut, Jenny and others developed and recorded concepts during this period that guided soil classification and mapping toward the current state of knowledge. They built on concepts put forward by predecessors, including Dokuchaiev and Sibertsev, whose works were not translated until the twentieth century.

The new classification system gave rise to a need for research that would help to distinguish between soil series, to characterize these taxonomic units and to relate their morphology to soil forming processes on landscapes. Catenas, toposequences, etc. were defined by research documenting detailed studies of landforms, sets of soil forming factors and spatial distribution.

The release of The Seventh Approximation and the refinements that resulted in Soil Taxonomy triggered a new role for research in the soil survey program. The placement of soil series in higher categories of the system required research on sets of properties and their ranges in order to confirm the correct classification. In many cases, overlapping ranges of properties required both field and laboratory investigations to determine quantitative measures of series limits to aid in correlation and classification. In are working as a member of a team that includes field soil scientists, applied researchers in other disciplines and extension specialists. Their role has shifted to that of consultant on projects designed to develop and test methodologies that use soils as environmental resources in addition to their traditional use as biological and physical resources for plant growth and infrastructure.

The capability to manage databases with computers has led to growth and development of geographic information systems as a way to provide a spatial dimension for natural resources data. Those of us familiar with soil surveys know the importance of soils information in these systems. The role of research in soil survey now is to respond to needs of these systems.

So what do we mean by different priorities for research in the soil survey program? Perhaps Richard Duesterhaus stated it as well as anyone when he listed several challenges for the future. First he challenged us to respond to "Science and the Environment". As a strongly science-based program, I believe that the soil survey program not only must, but will, respond to the new research priorities coming from this initiative. Second, Rich referred to "Managing the Soil Survey in an Automated World." The soil survey databases, geographical information systems, and ever-increasing capacity for data management are well prepared to respond to new research priorities requiring soils information.

It has, indeed, been a pleasure for me to address this group on the subject of different cooperators, roles and priorities for research in the soil survey proyram.

NATIONAL HIERARCHICAL FRAMEWORK OF ECOLOGICAL UNITS

ECOMAP, USDA Forest Service, Washington, D.C.

By: **Pete Avers**

October 7. 1993

Caring for the Land and Serving People

FS-6200-28b(3/92)

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 information at multiple geographic scales and across administrative and jurisdictional boundaries. implementation of the Framework will help integrate the principles of Ecosystem Management into national, regional and forest planning and assessment efforts. The required use of consistent terminology, common maps and standard data will improve communications internally and with 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 -

Caring for the Land and **Serving** People

FS-6200-28b(3/92)

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 management. 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, physiography. 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 to 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 information to determinethe 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 information resolution. These applications are summarized below. The hierarchical framework is largely a Forest Service effort, although there has been involvement by the U.S. 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 10,000's of square miles.
Subregions	Sections Subsections	RPA planning. Multi-forest, statewide and multi-agency analysis and assessment.	1,000's to 10's of square miles.
Landscape	Landtype Association	Forest or area-wide planning, and watershed analysis.	1,000's to 100's of acres.
Land Unit	Landtype Landtype Phase	Project and management area planning and analysis.	1 00's to less than 10 acres.

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 interaction 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 management. The basic objective of the hierarchical framework is to provide a systematic method for classifying and mapping areas of the Earth based on associations of ecological factors at different geographic scales. The framework is needed to improve our efforts in national, regional, and forest level planning; to achieve consistency in ecosystem management across National Forests and regions: to advance our understanding of the nature and distribution of ecosystems; and to facilitate interagency data sharing and planning. Furthermore, the framework will help us evaluate the inherent capabilities of land and water resources and the effects of management on them.

Ecological units delimit areas of different biological and physical potentials. Ecological unit maps can be coupled with inventories of existing vegetation, air quality, aquatic systems, wildlife, and human elements to characterize complexes of life and environment, or ecosystems. This information on ecosystems can be combined with our knowledge of various processes to facilitate a more ecological approach to resource planning, management, and research.

Note that ecological classification and mapping systerns are devised by humans to meet human needs and values. Ecosystems and their various components often change gradually, forming continua on the Earth's surface which cross administrative and political boundaries. Based on their understanding of ecological systems, humans decide on ecosystem boundaries by using physical, biological, and social considerations.

We recognize that the exact boundaries for each level envisioned in this process and developed in map format may not lit every analysis and management need. Developing boundaries of areas for analysis, however, will not change the boundariesof ecological units. In some cases, an ecological unit may be the analysis area. In other cases, watersheds, existing conditions, management emphasis, proximity to special features (e.g., research natural, wilderness, or urban areas) or other conditions may define an analysis area. In these cases, ecological units can be aggregated or divided if needed to focus on relevant issues and concerns.

BACKGROUND -- REGIONAL LAND CLASSIFICATIONS

Hierarchical systems using ecological principles for classifying land have been developed for geographical scales ranging from global to local. Using a bioclimatic approach at a global scale, several researchers have developed ecological land classifications: Holdridge (1967). Walter and Box (1976), Udvardy (1975). and Bailey (1989a,b). Wertz and Arnold (1972) developed land stratification concepts for regional and land unit scales. Other ecologically based classifications proposed at regional scales include those of Driscoll et al. (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

. . . .

[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.

have also been presented for ecological classification at subregional to local scales in the United States (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 water areas at **different** levels of resolution that have similar capabilities and potentials for management. Ecological Units are designed to exhibit similar patterns in: (1) potential natural communities, (2) soils, (3) hydrologic function, (4) landform and topography, (5) lithology, (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 of potential natural community, soil. landscape features, and climate; and **differing** from other ecologicaltypes in its ability to produce vegetation and respond to management' (FSM 2060.05). 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 individually and then combined, or multiple factors/components may be simultaneously evaluated to classify ecological types which are then used in ecological unit design (FSH 2090.1 I). 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 identify 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 cart 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 diierences 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 - subcontinental 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 influenced by equatorial air masses and there is no winter season. Domains are also characterized by broad differences in annual precipitation, evapotranspiration, potential natu-

ral 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 definite 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 (1966). 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 (1964). 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. 1985). 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 topography, 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 habitats (Platts 1979, Eben 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, lakes, 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. Uap tionof

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 conceptualized 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). Wiihin climatic regions, physiography or landforms modify macroclimate (Rowe 1984, Smalley 1986, Bailey 1987), and affect the movement of organisms, the flow and orientation of watersheds, and the frequency and spatial pattern of disturbance by fire and wind (Swanson et al. 1988). Within climatic-physiographic regions, water, plants, animals, soils, and topography interact to form ecosystems at Land Unit scales (Pregitzer and Barnes 1984). The challenge of ecosystem classification and mapping is to distinguish natural associations of ecological factors at different spatial scales, and to define ecological types and map ecological units that reflect these different levels of organization.

LIFE AND ENVIRONMENTAL INTERACTIONS Life forms and environment have interacted and codeveloped at all spatial and temporal scales. one modifying theotherthroughfeedback. Appreciating these interactions is integral to understanding ecosystems.

At a global scale, scientists have theorized that the evolution of cyanobacteria. followed by terrestrial plants capable of photosynthesis, carbon fixation and oxygen production converted the Earths atmosphere from a hydrogen to an oxygen base and still sustain it today. At a continental scale, the migration of species in response to climate change, and the interaction of their environmental tolerances and dispersal mechanisms with landform-controlled migration routes formed today's patterns in species' distributions. At a landscape scale, life forms, environment and disturbance regimes have interacted to form patterns and processes. For example, pyrophilic communities tend to occupy droughty soils in fire-prone landscape positions, produce volatile foliar substances. and accumulate litter, thereby increasing their susceptibility to burning. At yet finer scales, vegetation has induced soil development over time through carbon and nutrient cycling, enabling succession to proceed to communities with higher fertility requirements.

In each of these examples, life forms and environment have modified one another through feedback to form ecological patterns and processes. These types of relationships underscore the need to consider both biotic and environmental factors while classifying, mapping and managing ecological systems.

SPATIAL AND TEMPORAL VARIABILITY The structure and function of ecosystems change through space and time. Consequently, we need to address both spatial and temporal sources of variability while evaluating, classifying, mapping, or managing ecosystems (Delcourt et al. 1983, Forman and Godron 1986). At a Land Unit scale, for example, the fertility of particular locations changes through space because of differences in soil properties or hydrology, AND at Ecoregion scales, conditions vary from colder to warmer because of changes in macroclimate. These relatively stable conditions favor certain assemblages of plants and animals while excluding others because of biotic tolerances, and processes such as competition. These environmental conditions are classified as ecological types and mapped as ecological units.

Within ecological units, ecosystems may support vegetation that is young. mature, or old, and they may be composed of communities that are early, mid-, or late successional. These relatively dynamic conditions ALSO benefit certain plant and animal species and assemblages. Conditions that vary temporally are classified and mapped as existing vegetation, wildlife, water quality, and so forth.

These examples illustrate that ecological units do not contain all the information needed to classify, map and manage ecosystems. Ecological units address the spatial distributions of relatively stable associations of ecological factors that affect ecosystems. When combined with information on existing conditions, the National Hierarchy of Ecological Units provides a means of addressing spatial and temporal variations that affect the structural and functional anributes of ecosystems. Adding our knowledge of processes to this information will enable us to better evolve into ecosystem management.

USE OF ECOLOGICAL UNITS

Ecological units provide basic information for natural resource planning and management. Ecological unit maps may be used for activities such as delineating ecosystems, assessing resources, conducting environmental analyses, establishing desired future conditions, and managing and monitoring natural resources.

ECOSYSTEM MAPPING To map ecosystems, or places where life and environment interact, we need to combine two types of maps: maps of existing conditions that change readily through time, and maps of potential conditions that are relatively stable. Existing conditions change due to particular processes that operate within the bounds of biotic and environmental, or ecological, potentials. Existing conditions are inventoried as current vegetation, wildlife, water quality, and so forth. Potential conditions are inventoried as ecological units. When these maps are combined, biotic distributions and ecological processes can be evaluated and results can be extrapolated to similar ecosystems. The integration of multiple biotic and abiotic factors, then, provides the basis for defining and mapping ecosystems.

Fundamental base maps are key to mapping ecosystems and integrating resource inventories. These maps include the primary base map series showing topography, streams, lakes, ownership, political boundaries, cultural features, and other layers in the Cartographic Features File. On this base, the next set of layers could include ecological units, watersheds and inventories of aquatic systems at appropriate spatial scales. Next would be layers of information on existing vegetation, wildlife populations, fish distribution, demographics, cultural resources, economic data, and other information needed to delineate ecosystems to meet planning and analysis needs.

GIS will provide a tool for combining these separate themes of information, and representing the physical, biological, and social dimensions to define and map ecosystems. But scientists and managers using this technology must actually integrate information themes, comprehend processes, and formulate management strategies: These tasks will not be accomplished mechanically.

RESOURCE ASSESSMENTS The hierarchical framework of ecological units can provide a basis for assessing resource conditions at multiple scales. Broadly defined ecological units (eg. Ecoregions) can be used for general planning assessments of resource capability. Intermediate scale units (e.g., Landtype Associations) can be used to identify areas with similar natural disturbance regimes (e.g., mass wasting, flooding, fire potential). Narrowly defined Land Units can be used to assess site specific conditions including distributions of terrestrial and aquatic biota: forest growth, succession, and health: and various physical conditions (e.g., soil compaction and erosion potential, water quality).

High resolution information obtained for fine scale ecological units can be aggregated for some types of broader scale resource assessments. Resource production capability, for example, can be estimated based on potentials measured for landtype phases, and estimates can be aggregated to assess ranger district. national forest, regional, and national capabilities.

ENVIRONMENTAL ANALYSES Ecological units provide a means of analyzing the feasibility and effects of management alternatives. To discern the effects of management on ecosystems, we often need to examine conditions and processes occurring above and below the level under consideration (Rowe 1980). For example, the effects of timber harvesting are manifest not only at a land unit scale, but also at micro-site and landscape scales. Although the direct effects of management are assessed at the local ecosystem scale. indirect and cumulative effects take place at different points in space or time, often at higher spatial scales. Ecological units defined at different hierarchical levels will be useful in conducting multi-scaled analyses for managing ecosystems and documenting environmental effects (Jensen et al. 1991).

WATERSHED ANALYSIS The national hierarchy provides a basis for evaluating the linkages between terrestrial and aquatic systems. Because of the interdependence of geographical components, aquatic systems are linked or integrated with surrounding terrestrial systems through the processes of runoff, sedimentation, and migration of biotic and chemical elements, Furthermore, the context of water bodies affects their ecological significance. A lake embedded within a landscape containing few lakes, 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 (Frissell et al. 1966).

Overlays of hierarchical watershed boundaries on ecological mapping units are useful for most watershed analysis efforts. In this case, the watershed becomes the analysis 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 varioustreatments.

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 delineating land units at relevant analysis 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 health 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 information on the condition of ecosystems at different spatial scales. Through the ecological unit hierarchy, managers can obtain information about the geographic patterns in ecosystems. They are. thus. in a position lo design stratified sampling networks for inventory and monitoring. Representative ecological units can be sampled and information can then be extended to analogous 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 States at the subregion level of the national hierarchy into 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 filters, 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 results of human activities if we grow to understand the natural processes that species and ecosystems co-developed with, and then mimic those processes through ecosystem management.

Species may become rare, threatened or endangered because their habitat is being lost or degraded. because they are endemic to a particular area, or because they are at the edge of their natural range. In the **first** two instances, protection or recovery efforts are warranted. In the latter case, however, it may be futile to try to maintain biota in environments where they are pre-disposed to decline. At a minimum, populations at the edge of their range can be evaluated for genetic diversity, and recovery programs can be administered accordingly. Species and community distributions can often be related to ecological units, which can be useful in their inventory and protection.

The new emphasis on sustaining and restoring the integrity of ecosystems may aid in arresting the decline of biological diversity, and preempt the need for many future protection and recovery efforts. Developing basic information on the nature and distribution of ecosystems and their elements will enable us to better respond to issues like global warming, forest health, and biological diversity.

CONCLUSION

The hierarchical framework of ecological units was developed to improve our ability to implement ecosystem management. This framework. in combination with other information sources, is playing an Important role in national. regional. and forest planning efforts: the sharing of information between forests, stations, and regions: and inter-regional assessments of ecosystem conditions.

Regions and stations. with national guidance, are coordinating their design of ecological units at higher levels of the national hierarchy. Development of landscape and land unit maps is being coordinated by appropriate regional, station, forest and ranger district level staff As appropriate, new technologies (e.g., remote sensing, GIS, expert systems) should be used in both the design, testing and refinement of ecological unit maps.

The classification of ecological types and mapping of ecological units pose a challenge to integrate not only informatiorr, but also the concepts and tools traditionally used by various disciplines. The effort brings together the biological and physical sciences that have too often operated independently. Specialists like foresters, fishery and wildlife biologists, geologists. hydrologists, community ecologists and soil scientists will need to work together to develop and implement this new classification and mapping system. The results of these concerted efforts will then need to be applied in collaboration with planners. social scientists, economists, archaeologists and the many other specialties needed to achieve a truly ecological approach to the management of our nation's National Forests and Grasslands.

LITERATURE CITED

Albert, D.A.; Denton 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. Depanment of Agriculture, 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. Department 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 States. Washington DC: US. Department 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.

Gallant, A.L.: Whinier. T.R.: Larsen. D.P.; Omernik. J.M.; Hughes, R.M. 1989. Regionalization as a tool for managing environmental resources. U.S. 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: US. 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 Department of Lands and Forests. Resource Division Report 24.

Hix, D.M. 1988. Muitifactor 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. K.S; Ramm, C.W.; Hart J.B.; Cleland D.T. 1967. Landform mediated differences in successional pathways among upland forest 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. 1983. 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. 388 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: 9-22.

McNab, W.H. 1987. Rationale for a multifactor 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. 1987. 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 States. Annals of the Association of American Geographers 77:1 18.125.

O'Neill, R.V.; DeAngelis, D.L.; Waide, J.B.; Allen, T.F.H. 1966. A hierarchical concept of ecosystems. Princeton, N.J; Princeton University Press.

Platts, W.S. 1980. A plea for fishery habitat classification. Fisheries 5(1):2-6.

Platts, W.S. 1979. Including the fishery system in land planning. Ogden, UT: U.S. Department of Agriculture, Forest Service. Gen. Tech. Rep. INT-60. Intermountain Forest and Range Experiment Station. 37 p.

Pregitzer. K.S.; 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 18.20; 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 capability in midwestern and nonheastern U.S. national forests. In: Proceedings of the symposium, Ecological Land Classification: applications to identify 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. Department of Agriculture, 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.

Trewartha, 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 37:119-127.

U.S. Department of Agriculture. 1981. Land resource regions and major land resource areas of the United States. Washington, DC: Agricultural Handbook 296. U.S. Government Printing Office. 156 p.

Udvardy. M.D.F. 1975. A classification 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. Northern Region.

U.S. Department of Agriculture, Forest Service. 1993. Draft National Visibility Monitoring Strategy. Washington, DC.

U.S. Department of Agriculture. 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

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. MM-forest, statewide and multi-agency analysis ancl 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 to* smaller *geographical areas and more detailed ecological units if needed.*		Very *derailed project planning*

Table 2. Principal map unit design criteria of ecological units.

ECOLOGICAL UNIT	PRINCIPAL MAP UNIT DESIGN CRITERIA[1]
Domain	. Broad climatic zones or groups (e.g., dry, humid. tropical).
Division	• Regional climatic types (Koppen 1931. Trewartha 1968). • Vegetational affinities (e.g., prairie or forest). • Soil order.
Province	• Dominant potential natural vegetation (Kuchler 1964). . Highlands or mountains with complex vertical climate-vegetation-soil zonation.
Section	. Geomorphic province, geologic age, stratigaphy. lithology. . Regional climatic data. • Phases of soil orders, suborders or great groups. • Potential natural vegetation. • Potential natural communities (PNC) (FSH 2090).
Subsection	• Geomorphic process, surficial geology, fiihology. . Phases of soil orders, suborders or great groups. • Subregional climatic data. . PNC--formation or series.
Landtype Association	• Geomorphic process, geologic formation, surficial geology, and elevation. • Phases of soil subgroups. families, or series. • Local climate. . PNC--series, subseries, plant associations.
Landtype	• Landform and topography (elevation, aspect, slope gradient and position). • Phases of soil subgroups, families, or series. • Rock type, geomorphic process. • PNC--plant associations.
Landtype Phase	• Phases of soil families or series. . Landform and slope position. • PNC--plant associations or phases.

[1] It should be noted that the criteria listed are broad categories of environmental and landscape components. The actual classes of components chosen for designing map units depend on the objectives for the map.

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 miles
Division	1:30,000,000 to 1:7,500,000	100,000's of square miles
Province	1:15.000,000 to 1:5,000.000	10,000's of square miles
Section	1:7,500,000 to 1:3,500,000	1,000's Of square miles
Subsection	1:3,500,000 to 1:250,000	10's to low 1,000's of square miles
Landtype Association	1:250,000 to 1:60,000	high 100's to 1,000's of acres
Landtype	1:60,000 to 1:24,000	1 0'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, Water 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 WHEELER, Regional Ecologist, Region 2, Denver, CO.

JIM MAXWELL, Regional Hydrologist, Region 2, Denver, CO.

BARRY JOHNSTON, Plant Ecologist, Region 2, Delta, co.

WAYNE A. ROBBIE,

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, Inter-mountain 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 Northwest 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, Cowallis, 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 Agencies and Slates:

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 Environment, 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 Environment, University of Minnesota, Duluth, MN.

KURT S. PREGITZER, Professor of Forest Ecology, Michigan State 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.

SOIL INTERPRETATIONS AND CRITERIA USED IN RESOURCE PLANNING

Prepared by Maurice J. Mausbach
National Cooperative Work Planning Conference
Burhngton, Vermont, July 1993

INTRODUCTION: The Soil Conservation Service in the past five years has revised the structure of the Field Office Technical Guide to stress consideration of five resources, Soil, Water! Air, Plants, and Animals. In addition to consideration of five resources, we are also considering the interactions of among the 5 resources and the interactive effects of conservation practices on the resources. These changes emphasize the positive and negative effects of conservation practices on the soil as well as other resources. Thus in response to user needs we are developing soil interpretations for many of the conservation practices that alert land use managers to possible concerns or considerations when using the practice. I will briefly describe changes in the FOTG, to include the resource concerns, quality criteria for these concerns, conservation practice physical effects, the process for developing the interpretations, and present example interpretation matrixes.

FIVE RESOURCES; THEIR CONSIDERATIONS, CONCERNS, AND QUALITY CRITERIA:

Each of the five resources (Soil, Water, Air, Plants, and Animals) has resource considerations, each resource consideration has resource concerns, and each concern has a quality criterion. For example, the soil resource has 3 resource considerations:

- soil erosion
- soil condition
- deposition

To continue with the example, resource concerns for soil erosion are:

- sheet and rill
- wind
- ephemeral gully
- classic gully
- stream bank
- irrigation induced
- soil mass movement
- road banks and construction
- other

The resource concerns for soil condition are:

- soil tilth, crusting, water infiltration, organic material
- soil compaction
- excess chemical content (salinity, selenium, boron, heavy metals)
- excess animal wastes and other organics
- excess fertilizer
- excess pesticides
- other

An example quality criteria for soil tilth is:

"A condition of the soil with a suitable combination of mineral, air, water, and organic matter managed to avoid excess compression of soil particles, resulting in a favorable environment for microbial activity and chemical reactions." (Pennsylvania)

Similarly considerations and resource concerns are developed for the other 4 resources.

CONSERVATION PRACTICE PHYSICAL EFFECTS MATRIX

The physical effects of conservation practices are list in the FOTG for each resource concern. These physical effects are presented in matrix form in the FOTG. For example, the effect of the conservation tillage practice on the Water Quantity consideration and resource concern of water management for irrigated agriculture is:

"Slight to moderate interference with furrow irrigation because of increase residue"

The effect of conservation tillage practice on the Soil Erosion consideration and resource concern of sheet and rill erosion is:

"Significant decrease dependent on orientation and height of ridges and surface residue cover."

These statements are very general and are developed without reference to specific soil map units. Thus, the conservation tillage practice will most likely have different effects on each of the resource considerations and concerns. For example, increased residue on wet soils will delay, planting in Spring, reduce soil temperatures and effect seed germination, and reduce availability of some nutrients. These kinds of soil interpretations are necessary for land management specialists to adequately advise their clients.

SOIL INTERPRETATIONS FOR CONSERVATION PRACTICE PHYSICAL EFFECTS

The objective of theses soil interpretations are to integrate soil interpretations into the planning process as they relate to conservation practice physical effects, quality criteria, and practice standards for the 5 resources. The interpretations are being developed by interdisciplinary teams at the SCS National Technical Centers under the leadership of the Soil Survey Staffs. The approach is to develop a concept and procedure for some of the major conservation practices. The action steps are defined as:

- Identify critical practices
- Form interdisciplinary team
- Identify critical soil properties
- Develop criteria tables
- Identify and review available tools
- Develop new tools and algorithms as necessary
- Develop an example for user review
- Technical review from states and cooperators
- Train users

The following material represents products of C. L. Girdner's team at the Midwest National Technical Center and from DeWayne Williams' team at the South National Technical Center. The material is preliminary but represents the process of developing the interpretations and the proposed format of the interpretations. All of us are struggling with the format and content of the Interpretations and welcome your comments.

The critical soil properties and the portion of the pedon are identified in table 1. These properties can then be used to form groups of soils that would interpret similarly as shown in table 2, or could be used independently with specific soil components or phases to develop interpretations criteria.

Examples of the latter approach are given in tables 3 and 4, with only a few of the soil attributes shown. The process is to develop soil interpretations criteria for the mulch till conservation practice as related to each of the 5 resources. These criteria and accompanying resource concerns could be arrayed in a matrix format for ease of use. Please note that the resource concerns list the soil characteristic of concern together with possible problems that the concern may cause. For example, in table 4 the soil attribute, water table, gives a wetness concern that may result in fungi, molds, humidity, etc that may affect the plants. It is left to the user to determine if these concerns are positive or negative. The main purpose of the lists of concerns 5w 3 o flage orraisef theaw(artness)Tj -0.013

SOIL INTERPRETATIONS - CRITERIA
SOIL ATTRIBUTES

SOIL ATTRIBUTE	PORTION OF PEDON	SOIL ATTRIBUTE	PORTION OF PEDON
PERMEABILITY	1-40 IN.	CAPABILITY UNIT	WHOLE SOIL
AWC UDIC	1-40 IN.	K FACTOR	LAYER 1
AWC ARIDIC/USTIC	1-60 IN.	CEC	WHOLE SOIL
WEG	LAYER 1	ROCK FRAGS.	LAYER 1
WEQ I FACTOR	LAYER 1	PLASTIC. INDEX	WHOLE SOIL
TEXTURE	LAYER 1	SLOPE	
FLOODING		ORGANIC MATTER	1-20 IN.
SALINITY COMOD.	1-20 IN.	RKLS/T	WHOLE SOIL
SALINITY PASTURE	I-20 IN.	N VALUE	LAYER 1
SAR/ESP	I-20 IN.	CACO3	1-40 IN.
WATER TABLE	WHOLE SOIL	pH	I-20 IN.
PONDING	WHOLE SOIL	DEPTH TO ROCK	WHOLE SOIL
T FACTOR	WHOLE SOIL		

SOIL GROUPS USING ATTRIBUTES

SOIL ATTRIBUTE	VERY SIGNIF. GROUP 1	HIGH. SIGNIF. GROUP 2	SIGNIF. GROUP 3	SLIGHT. SIGNIF. GROUP 4
PERMEABILITY	> 6.0 IN/HR	2.0-6.0 IN/HR	<0.2 IN/HR	
AWC UDIC	< 2 IN.	2-4 IN.	4-6 IN.	----
AWC ARIDIC/USTIC	c 3 IN.	3-6 IN.	as IN.	----
WEG	1	12	3,4,4L	567
WEQ I FACTOR	250-310	160-220	86-134	<=56
TEXTURE	----	CLAYS SANDS	LS	SL,SIL,L,CL
FLOODING	FREQUENT	OCCASIONAL		RARE
SALINITY COMOD.	>16 MMHO	8-16 MMHO	4-8 MMHO	2-4 MMHO
SALINITY PASTURE	>30 MMHO	16-30 MMHO	am MMHO	2-a MMHO
SAR/ESP	>13/15	----	4-13/4-15	< 4
WATER TABLE	< 1 FT TO (+)	1-1.5,FT	1.5-3.0 FT	3-4 FT
T FACTOR	1	2	3	4

SOIL INTERPRETATIONS - CRITERIA
MULCH TILL CONSERVATJON PRACTICE

SOIL ATTRIBUTE	PORTION OF PEDON	<----- SLIGHT	PLANTS MODERATE	-----> SEVERE	RESOURCE CONCERN
WATER TABLE	WHOLE SOIL	> 3 FT	1.5-3 FT	< 1.5 FT	WETNESS, FUNGI MOLDS, HUMIDITY
SAR/ESP	< 20 IN.	< 4	4-13/4-15	> 13/15	GROWTH/VIGOR RESIDUE AMT.
AWC UDIC	1-40 IN.	> 8	4-8	< 4	DROUGHTY
ARIDIC/USTIC	1-W IN.	> 9	6-9	< 6	RESIDUE AMT.
CACO3	1-40 IN.	< 15	15-40	>40	GROWTH VIGOR NUTRIENT AVAIL.
pH	1-20 IN.	5.0-8.4	OTHERS	>9 c3.5	GROWTH VIGOR NUTRIENT AVAIL.

SOIL INTERPRETATIONS - CRITERIA

MULCH TILL CONSERVATION PRACTICE

SOIL ATTRIBUTE	PORTION OF PEDON	<------- SLIGHT	AIR MODERATE	-------> SEVERE	RESOURCE CONCERN
WATER TABLE	WHOLE SOIL	> 1 FT	< 1 FT		WETNESS, FUNGI

SOIL INTERPRETATIONS USING GROUPS

MULCH TILLAGE - SOIL EROSION CONCERN

SOIL ATTRIBUTE	VERY SIGNIF. GROUP I	HIGH. SIGNIF. GROUP 2	SIGNIF. GROUP 3	SLIGHT. SIGNIF. GROUP 4	RESOURCE CONCERN
PERMEABILITY	> 6.0 IN/HR	2.0-6.0 IN/HR	<0.2 IN/HR	------	
AWC UDIC	<2 IN.	2-4 IN.	4-6 IN.	------	RESID. AMTS
AWC ARIDIC/USTIC	< 3 IN.	3-6 IN.	6-9 IN.	------	RESID. AMTS
WEG	1	12	3,4,4L	567	
WEQ I FACTOR	250-310	160-220	86-134	<=56	
TEXTURE	-------	CLAYS SANDS	LS	SL,SIL,L,CL	
FLOODING	FREQUENT	OCCASIONAL	-----	RARE	
SALINITY COMOD.	>16 MMHO	8-16 MMHO	4.6 MMHO	2-4 MMHO	
SALINITY PASTURE	>30 MMHO	16-30 MMHO	E16 MMHO	2-8 MMHO	
SAWESP	>13/15	-----	4-13/4-15	< 4	
WATER TABLE	< 1 FT TO (+)	1-1.5 FT	1 S-3.0 FT	3-4 FT	RESID. AMTS EQUIP. LIMIT.
T FACTOR	1	2	3	4	

SOIL INTERPRETATIONS USING GROUPS - MULCH TILLAGE

CONCERN PLANT GROWTH, ESTABLISHMENT, AND HARVEST

SOIL ATTRIBUTE	VERY SIGNIF. GROUP 1	HIGH. SIGNIF. GROUP 2	SIGNIF. GROUP 3	SLIGHT. SIGNIF. GROUP 4	RESOURCE CONCERN
PERMEABILITY	> 6.0 IN/HR	2.0-6.0 IN/HR	<0.2 IN/HR	——	
AWC UDIC	< 2 IN.	2-4 IN.	4-6 IN.	------	DROUGHTY
AWC ARIDIC/USTIC	< 3 IN.	3-6 IN	6-9 IN.	------	DROUGHTY
WEG	1	12			
WEQ I FACTOR	250-310	160-220			
TEXTURE	—— ---	CLAYS SANDS			
FLOODING	FREQUENT	OCCASIONAL			
SALINITY COMOD.	>16 MMHO	6-16 MMHO			
SALINITY PASTURE	>30 MMHO	16-30 MMHO			
SAR/ESP	>13/15	-----			
WATER TABLE	< 1 FT TO (+)	f-1.5 Fr			
T FACTOR	1	2			

SOIL INTERPRETATIONS USING GROUPS - MULCH TILLAGE
CONCERN GROUND WATER - PESTICIDES

SOIL ATTRIBUTE	VERY SIGNIF. GROUP 1	HIGH. SIGNIF. GROUP 2	SIGNIF. GROUP3	SLIGHT. SIGNIF. GROUP 4	RESOURCE CONCERN
PERMEABILITY	> 6.0 IN/HR	2.0-6.0			
AWC UDIC	< 2 IN.			------	
AWC ARIDIC/USTIC	< 3 IN.			------	
WEG	1				
WEQ I FACTOR	250-310				
TEXTURE	-------				
FLOODING	FREQUENT		-----		
SALINITY COMOD.	>16 MMHO				
SALINITY PASTURE	>30 MMHO				
SAR/ESP	>13/15	-----			
WATER TABLE	< 1 FT TO (+)				
T FACTOR	1				

141

NATIONAL COOPERATIVE SOIL SURVEY STANDARDS COMMITTEE
REPORT TO THE NATIONAL **SOIL SURVEY CONFERENCE**
Burlington, Vermont, July 1993
Presented by C. Steven Holzhey

Committee Charges

The Steering Committee of the 1991 Nat. Soil Survey Conf. established this standing committee with the following charges:

1. Define what Standards are or what NCSS means by NCSS Standards,

2. Receive recommendations from other committees and be the clearinghouse for issues dealing with standards,

3. Establish subcommittees to deal with issues identified,

4. Consider establishing subcommittees to deal with the following areas which are issues of immediate importance:

a. NCSS Data Management Standards (spatial and attribute data),

b: Soil landscape terminology,

5. Develop a methodology for distributing Standards and make recommendations to the Steering Committee on disposition of issues raised, and,

6. The Standing Committee will report its activities at each National Conference.

Committee Formation

Each of the four Regional Soil Survey Work Groups of Agricultural Experiment Stations was asked to select a committee member and an alternate. The U.S. Forest Service, Bureau of Land Management, and Soil Conservation Service each selected a committee member. The chairman was selected by the Conference Steering Committee.

The committee members are: Mickey Ransom, Kansas State Univ.; David Hopkins (Alternate), North Dakota State Univ.; Tom Ammons, Univ. of Tennessee; Ed Ciolkosz, Pennsylvania State Univ.; Del Fanning (Alternate), Univ. of Maryland; Janis Boettinger, Utah State Univ.; Scott Davis, Bureau of Land Management; Pete Avers, Forest Service; and Steve Holzhey, chair, and Gary Muckel, Soil Conservation Service.

Activities

The attached list (Appendix A) is the first phase in developing a listing of standards and where they are documented. Gary Muckel developed the list from information in the new revision of the National Soil Survey Handbook of SCS, the new Soil Survey Manual revision, and other documents.

To this point the Committee has used this as a starting point to deliberate:

- what are the standards,

- how to provide the intended service and keep the workload manageable, and,

- what might needed to complete the array of NCSS standards.

The next phases are to:

- make the list into an annotated document that identifies standards, their purposes and where they are documented, and

- recommend action to fill in missing or vague standards.

Charge 1: Define NCSS Standards.

There is no sharp distinction among standards, procedures, and guidelines. There is some disagreement across NCSS about where to draw the line.

National Cooperative Soil Survey standards relate to:

- quality of products, and

- quality of communication.

Quality of products can be broadly broken into:

(1) quality of the information gathering processes, and

(2) quality of derivations and interpretations.

The Committee easily agreed that (1) above is within the scope of the charge, including such things as description, documentation, and map compilation. However, (2) above merges with activities outside NCSS, and the Committee will look at several individual examples before recommending how to make the distinction between standards, procedures, and guidelines relative to derivations and interpretations.

Quality of communication relates to consistent and effective uses of terminology, concepts, codes, including data dictionaries, Federal Data Transfer Standards, and descriptive terminology.

Charges 2 and 3

No issues have been referred to the Committee to date.

Chaige 4

Work is proceeding on the subjects of Charge 4. Noteworthy are the:

- Federal Geographic Data Committee, developing Federal Data Transfer Standards,

- Interagency Data Dictionary Committee,

- SCS Soil Survey effort to build and maintain a soil survey data dictionary,

- National Soil Survey Center project to improve landscape descriptors and put the improved system into automated descriptive software and data dictionary.

Although the Federal Data Transfer Standards encompass more than the NCSS, progress of that committee can be monitored by the NCSS Standards Committee, and input offered. Progress on the other fronts is also being followed.

Charge 5

The Committee plans to develop Appendix A into an annotated summary that identifies where standards are defined in NCSS documentation, their purposes, and where they are documented.

Methodologies for distribution of standards already exist, but as work progresses the Committee will compile issues and will recommend improvements if deemed necessary.

Committee Roles and Goals

It is important to note that technical oversight of NCSS activities affecting standards is not implied in the charges. There are at least 50 projects and teams in NCSS, or participated in by NCSS, that either generate standards or affect standards. They range from those already mentioned to liaison with ASTM, liaison with soil testing laboratories, capabilities in the National Soil Information System, and interpretive criteria.

The Committee interprets the charges to mean that it serves a clearinghouse and an advisory function in which it is:

- a receptacle for information about standards, associated issues, and actions,

- a clearinghouse for issues brought to its attention by the Steering Committee of the National Conference, or by others, and

- sometimes an action group that prepares or assigns subcommittees to work on key issues.

Immediate Goals

- Complete the summary of NCSS standards (In the process develop a position on derived information and interpretations.).

- Assure that the necessary NCSS standards do exist.

- Give special attention to the following areas, where deficiencies seem to have been identified:

(1) soil description standards with respect to information that is needed for specific functions of the soil survey or its customers,

(2) soil map unit documentation from the same perspective,

(3) documenting how mapping was done, including the thought process (should a standard define what the documentation would do for the user of the documentation, or the array of approaches that are acceptable?)

- Observe progress in the areas indicated by Charge 4.

APPENDIX A

NCSS STANDARDS

DRAFT 5/24/93 GMuckel fegi/gmuckel/standards4.doc

Definition:

National Cooperative Soil Survey Standards are common or shared procedures that enhance technology transfer, data sharing, and communications among soil survey participants.

Application:

Standards apply to these soil survey functions:
-soil description
-soil mapping
-soil map unit documentation
-soil laboratory characterization
-soil classification
-soil derivations ie soil erodibility K, tolerance T etc
-soil interpretation
-soil correlation
-soil map compilation
-soil map finishing
-soil map digitizing
-soil survey publication
-soil data base population and exchange

Reference for Standards by Soil Survey Function:

Soil description standards
- Designations for horizons and other layers (1)
- Boundaries of horizons and layers (1)
- Particle size distribution (1)
  - USDA soil separates
  - Soil Texture
  - Groupings of soil texture classes
- Terms for rock fragments (1)
- Soil Color (2)
- Soil structure (1)
  - shape
  - size
  - grade
- Soil concentrations (1)
- Soil consistence (1)
  - Rupture resistance classes
  - Plasticity
  - Stickiness
- Soil roots (1)
- Soil pores (1)
- Soil reaction classes (1)

Carbonate effervescent classes (1)
Salinity classes (1)
Drainage classes (1)

References:
(1) Chapter 3-Examination and Description of Soils, Soil Survey Manual
(2) Munsell Color Book-color notations

Soil mapping standards (specifications?)
General soil map (1)

References:
(1) National Soil Survey Handbook part 609

Reference for scale, minimum size of delineation, delineation of inclusions, natural boundaries and use and management separations:
Memorandum of Understanding for soil survey area

Soil map unit documentation standards
Required support data (1)
Documentation for a series
Minimum standard for a named map unit component
Minumum number of transects for a map unit
Descriptive legend
Identification legend
Convential and special symbols legend

References:
(1) National Soil Survey Handbook part 609.06 and 609.07

Soil laboratory characterization standards
Methods of soil sampling and soil analysis (1,2)

References:
(1) Soil Survey investigation Report 1
(2) Soil Survey Laboratory Methods Manual, SSIR 42

Soil classification standards
Classification of families and higher categories (1)
Classification into soil series level (2)

References:
(1) Soil Taxonomy and updates through Keys to Soil Taxonomy
(2) Official Series Description file (OSED)

Soil derivations
Capability class
Definition and assumptions (3)
Appication (2)
Corrosivity (1)
Erodibility Kf (1)
Erodibility Kw (1)

Hydrologic soil groups (1)
Soil loss tolerance T (1)
Wind Erodibility Group and Wind Erodibility Index (1)

References:
(1) National Soil Survey Handbook, part 618
(2) National Soil Survey Handbook, part 622
(3) Agricultural Handbook 210

Soil interpretation standards
National interpretation criteria (1)

(1) National Soil Survey Handbook, part 620

Soil map unit description and table standards
Available water capacity classes (2)
Flooding frequency and duration classes (3)
Landforms and geologic terms (1)
Linear extensibility classes (2)
Permeability classes (3)
Ponding frequency and duration classes (3)

References:
(1) National Soil Survey Handbook part 629
(2) National Soil Survey Handbook part 618
(3) National Soil Survey Handbook part 639 Soil Data Dictionary

Soil correlation standards
Correlation documentation (3)
Joining soils between surveys (2)
Naming soil map units (1)

References:
(1) National Soil Survey Handbook part 609.08
(2) National Soil Survey Handbook part 609.05
(3) National Soil Survey Handbook part 608 and 609.09

Soil map compilation standards
Map transfer requirements (1)

References:
(1) Photobase Map Compilation, April 1984, USDA, SCS

Soil map finishing standards
Map quality requirements (1)

Reference:
(1) Soil Map Finishing, April 1984, USDA, SCS

Soil map digitizing standards

Reference:

NCSS Soil Map Digitizing Handbook, USDA, SCS (Draft SCS 170-604)

SCS National Instruction No. 170-303, Technical Specifications for Line Segment Digitizing Soil Survey Maps Using the DLG-3 Optional Format, April 1990

Soil survey publication standards

Publication style (1)

References:

(1) GPO Style Manual

Guide for Authors of Soil Survey Manuscripts, NSH

Soil data base population and exchange

Data element names and definition (1)

References:

(1) NCSS data dictionary

Spatial Data Transfer Standards (SDTS) FIPS173

Procedures for Amending NCSS Standards:

Amendments to Soil Taxonomy are made through regional and Soil Science Society of America soil taxonomy committees.

Procedures to amend other NCSS standards are not presently defined,

Map Unit Reliability
A Customer's Point of View
Statement by Ellis G. Knox
10 June 1993

Two years ago, at the NCSS Conference at Bellevue, Washington, I presented a report on map unit reliability that stressed procedures for determination of the composition of map units and the variability within map units. I have come to realize that this emphasis on the parts of map units at the expense of a more holistic (integrated) view may give us who make soil maps an unwarranted sense of accomplishment. Perhaps a review of the needs of our customers, the people who want and need to learn something about the soil from our soil maps, from how we delineate and describe soil map units, would show that we need to give more integrated and comprehensive information about the map unit as a whole.

Reliability is a matter of giving the same results on successive trials and, more important for our purposes, consistency in producing satisfactory results. Map unit reliability that really counts toward the future vigor of the soil survey is a matter of customer satisfaction. Reliability of map units depends on:
(1) soundness of the basic concept of the map unit as an identifiable segment of the total landscape,
(2) accuracy of the delineation of that concept,
(3) accuracy of the information about the map unit, and
(4) from the customer's standpoint, the applicability and usefulness of the information provided.

Customers learn from a soil map that specific geographic areas are labelled by a map symbol. From the symbols they can identify the map units that are delineated in the field or other land unit of interest. They expect that whatever information we provide about these map units applies to the areas delineated. The information we do give our customers consists of the identification of components, the proportion of components, and the properties and features of individual components. In some cases, we provide a little information about the size and shape of component bodies and the landscape relationships of components. Even sophisticated customers who have been taught that there are variations within the map units have no good way to know which variation to expect in any given part of a map unit delineation.

To most of our customers, the niceties of map unit composition must seem incomprehensible and pointless. All they have to go on are the areas delineated on the map. Our customers, the users of soil maps, have no good way to get inside the delineation to apply the information provided about the components of the map unit.

Suppose that you are a customer in a bakery. Label information on the content of milk solids, wheat flour, salt, yeast, eggs, etc. simply does not substitute for clear identification of the bagels, the dinner rolls, and the sourdough French bread. Some few customers, with specialized needs and knowledge, do want and can use information about the composition of the products but most do not care about the composition and those who do care want it after the product has been clearly identified and described.

The disaggregation (to borrow an economics term) of map units began as early as 1951. The Soil Survey Manual of that year made a distinction between "taxonomic and mapping units" and recognized inclusions "up to about 15 percent" of soils other than those identified by the map unit name (p. 277). The 1951 Soil Survey Manual also recognized map units based on combined taxonomic units, namely soil associations, soil complexes, and undifferentiated soil groups (pp. 302-306).

In 1949, my first year of mapping, I asked Joe Fehrenbacher to show me the limits between two soil series. He refused on the grounds that what I needed to know was the centers and that toward the margins it didn't really matter which way I chose to throw a specific area of soil. In those days, soil series were thought of in terms of a central concept and classification at the series level did not really connect with soil classification in the higher categories (Riecken and Smith, 1949: Thorp and Smith, 1949). It was easy to blur the distinction between map units (delineated to fit the landscape) and classification units (the series that gave names to the map units). But when work on the Soil Taxonomy, a coordinated system of classification, put emphasis on the limits of classes all the way down to the series level, it was no longer possible for competent soil scientists to ignore the distinction.

Even before the Soil Taxonomy began to put sharp limits on soil series, many people were nervous about the Manual's 15 percent limit on map unit inclusions. I was told that the original author and reviewers tried to use a larger figure but that Dr. Kellogg insisted on 15 percent. My guess is that this claim for a high degree of map unit purity was not based on ignorance of soil variability. More probably, Dr. Kellogg recognized that details about minor variations are not needed and cannot be used by many customers so that for many purposes map units do have a high degree of reliability, even up to 85 percent. Further, he probably used the 15 percent limit on inclusions to pressure the soil survey to develop concepts and procedures to yield this degree of reliability.

This emphasis on whole map units rather than on map unit components is expressed in the publication on land-capability classification (Klingebiel and Montgomery, 1961). These authors assumed that from the customers' point of view the soil map unit is the most basic and detailed source of information.

> "Such interpretations [interpretations by individual kinds of soil on the map] provide the user with all the information that can be obtained from a soil map.... As with all interpretive groupings the capability classification begins with the individual soil-mapping units, which are building stones of the system.... The individual mapping units on soil maps show the location and extent of the different kinds of soil. One can make the greatest number of precise statements and predictions about the use and management of the individual mapping units shown on the soils map." (p. 1)

> "A soil mapping unit is a portion of the landscape that has similar characteristics and qualities and whose limits are fixed by precise definitions. Within the cartographic limitations and considering the purpose for which the map is made, the soil mapping unit is the unit about which the greatest number of precise statements can be made." (Table 1, p. 2)

These statements by Klingebiel and Montgomery were published ten years after complexes and associations were clearly identified as multi-taxa map units by the Soil Survey Manual. From my perspective, the applicability of their emphasis on the map unit for interpretations seems limited to consociations and, for broad, land-use interpretations like the capability classification, to complexes.

Acceleration of the soil survey in the sixties and seventies led to the beginnings of computer automation. The form SCS-SOI-5 and the Soil Interpretation Record provided a mechanism for recording the allowed ranges in estimated soil properties, features, and basic interpretations for soil series and for phases of soil series. This information, of course, was transferred to map units, specifically to map unit components. In effect this mechanism for standardization and automation of information about soil series facilitated treatment of map units, even consociations, by their parts. It favored an analytic over a synthetic approach to soil survey information. Analysis for the NASIS software development project maintained and reinforced the emphasis on map unit components. Allowance for a large number of components, which in effect softens the distinction between contrasting inclusions and other components, facilitates the trend.

The use of soil associations in third order soil surveys provided experience with map units that combine parts that could be delineated separately at a larger scale. For such compound map units, customer interest tends to shift from the whole map unit to major components.

For example, at 1:24,000 scale, third order soil associations in the eighties in Nevada were allowed up to three major components plus three inclusions. At this scale and with this number of components, for some purposes customers have need and are able to apply integrated information about the whole association. On the other hand, a major function of map unit descriptions for these associations is to provide information that helps customers identify major components on the ground for application of information at the component level. In contrast, map units of the State Soil Geographic (STATSGO) database project at a map scale of 1:250,000, with up to 24 components are little more than an aggregation of geographically associated components. Essentially the whole burden of information transfer is carried by the components.

Computer Assisted Writing (CAW) offered some potential to facilitate holistic descriptions of map units. My impression is that use of prewritten materials, the fill-in-the-blank approach, and the text rather than tabular format did little to provide comprehensive, integrated information for map units considered as a unit rather than as a sum of parts.

So, the Taxonomy by giving sharp limits to series and phases of series made it impossible for competent soil surveyors to ignore the distinction between classification and map units. This led to the quantification of the composition of map units in terms of classification units. The computer made it easy to focus on map unit components and facilitated our segmented approach to providing information about map units. We insiders in the soil survey business take pride and pleasure in being so analytical and quantitative. To us in the business, the various stages of clarification and development of our concepts about the composition of map units have seemed like great advances. But what does the customer want?

Actually, there should be two questions: What does the customer want? and What can the customer get from the maps we provide? Of course, there is a wide range of customers who come to the soil map with a wide variety of needs. Probably, very few customers are able to recognize landscape segments beyond the most obvious features. That is, while we can expect many customers to identify a conspicuous depressional wet spot or a rock outcrop, we probably cannot a few of the distinctions that we would have delineated on a more detailed map. Spatially, most customers have only what we give them on the soil map.

Some customers for some purposes are interested in the soil of a field or some other management parcel. If the technology is such that management decisions have to be applied uniformly across the pattern of soil variations, then it is the integrated effect of the various kinds of soil that needs to be considered. Information on the proportion of soil components and the properties of each component would be helpful, perhaps even necessary, but probably not sufficient for even an expert to determine the effect of the pattern of soils in combination.

Depending, of course, on the geographic scale of the pattern of soil variation, new technology for differential treatments within a field (soil-specific management) may make it possible to apply information for individual map unit components by matching treatments to the properties of the component soils. This will require information on the location of the components, that is, the creation of a new, more detaileld soil map.

Other users are interested in the soil at a specific site or a set of alternative sites. They are interested in a small area of soil maybe no more than 5 or 10 meters across, a place to put a house or a septic drain field. They need to learn about their chances. Application of fuzzy set mathematics may help translate information about composition of the map unit into customer satisfaction. Any expensive or critical land use decision about a site calls for an on-site inspection in preference to application of map unit information.

Still other customers are interested in areas larger than an individual field or farm, such as a hydrologic unit or county. They may have greater need for information on the integrated effect of a different map units than for information on the composition of map units.

None of this is to discount the importance of quantitative information about the proportion of components within map units and about the properties of soil components. Soil scientists need to pursue the development and testing of concepts and procedures for measuring the reliability of map units in terms of information about their components. Further, soil scientists need to give greater emphasis to measuring and presenting information about the size of component bodies. But the main point of this discussion is that map unit reliability in terms of quantitative information by components is not sufficient to fully satisfy the needs of our customers. This is because most customers lack the capability to determine the location of the component soils and, for uses that integrate the effects of different components, they need information about the interactions among the components. We need to enlarge our notion of map unit reliability to include the concept of consistency in producing satisfactory results for our customers.

References:

Klingebiel, A. A. and P. H. Montgomery. 1961. Land-Capability Classification. Agriculture Handbook No. 210. Soil Conservation Service, USDA, USGPO, Washington, DC

Riecken, F. F. and Guy D. Smith. 1949. Lower categories of soil classification: Family, series, type, and phase. Soil Science 67:107-115.

Soil Survey Staff. 1951. Soil Survey Manual. Agriculture Handbook No. 18. Soil Conservation Service, USDA, USGPO, Washington, DC

Thorp, James, and Guy D. Smith. 1949. Higher categories of soil classification: Order, suborder, and group soil groups. Soil Science 67:117-126.

NATIONAL WORK PLANNING CONFERENCE

Robert J. Ahrens
Acting National Leader, Soil Classification
July, 1993

Introduction

I appreciate the opportunity to attend the National Soil Survey Work Planning Conference. In this presentation I am going to give you a brief update on soil classification and the Soil Survey Manual with emphasis on revisions in Soil Taxonomy. If you have any questions I will try to answer them, and if you have any suggestions how we can better work together to improve Soil Taxonomy, I would appreciate receiving them.

Soil Classification Staff

As you know John Witty, National Leader for soil Classification, retired last April. His position has not been filled and current administrative constraints do not permit us to fill this position at this time. The remaining soil classification staff members are myself, Bob Engel, and our secretary, Margaret Hitz.

Soil *Survey Manual*

We have received the page proofs of the Soil *Survey Manual. Most* changes made to the proofs concentrated on Chapter 3, "Examination and Description of Soils" and the Appendices. Modifications were made to keep the Manual as current as possible. At the same time we realize that our technology is changing rapidly and other modifications will be required. Examples of changes include defining redoximorphic features as mottles that formed under saturated and reduced conditions. Other changes were made to clarify. An example is some of the class names were not mutually exclusive. Rock fragments were in the upper range of moderately cemented or more resistant to rupture. Moderately cemented had more than one operational definition. The class names were modified so that each has one operational definition. The Manual will go to press this fiscal year.

Soil Taxonomy

The 5th edition of *The Keys to* Soil Taxonomy was published in October. This edition contains numerous changes as a result of the work of three international committees; the International Committee on Aquic Moisture Regimes (ICOMAQ), the International Committee on Vertisols (ICOMERT) and the International Committee on Spodosols (ICOMOD). These changes require numerous soil series to be reclassified, and our staff will emphasize helping the states with this task during the next couple of years.

Our goal is to have the 6th edition of *The Keys to Soil Taxonomy* available for the 15th International Congress of Soil Science to be held in Mexico during July, 1994. The 6th edition of the "Keys" will include the recommendations from the International Committee on Aridisols (ICOMID). Important changes recommended by this committee include expanding the number of suborders from two (Argids and Orthids) to 7 (Cryids, Salids, Durids, Gypsids, Argids, Calcids, and Cambids).

We have also proposed some changes to the definitions of diagnostic horizons commonly associated with the Aridisols. The revised definitions recognize that many of these diagnostic horizons are not mutually exclusive. A petrocalcic horizon could also be a duripan, or a salic horizon could also be part of a gypsic horizon. This is reasonable since many of these horizons form under similar conditions. A proposed change to the calcic horizon would still require secondary carbonates, but not carbonate accumulations which are defined as more carbonates than the parent material. Competent pedologists should be able to identify a calcic horizon, even if they hold different opinions about its genetic processes.

During the past several years we have received a number of inquiries about republishing *Soil Taxonomy* in time for the International Congress of Soil Science. This would require considerable effort, and with our small staff we would not be able to accomplish this task on time. We do, however, intend to prepare a chapter for the 6th edition of the "Keys" that will provide the rationale for the major changes to Soil Taxonomy.

The International Committee on Families (ICOMFAM) has submitted their final report. Some of the proposed changes include:

Deleting chloritic family from Soil Taxonomy

Adding clay activity as stand-alone family criteria for mixed and siliceous classes of loamy, loamy-skeletal, clayey-skeletal, and clayey particle-size classes

Changing the name of montmorillonitic to smectic

Changing the definition of serpentinitic to include additional Mg-silicate minerals

We intend to send the committee's recommendations out for review before making anything final.

We currently have two active International committee's. The International Committee on Soil Moisture and Temperature Regimes (ICOMMOTR) was originally established in 1981 as the International Committee on Soil Moisture Regimes in the Tropics. In 1989 the focus of the committee was broadened to include temperature and not limit the committee's efforts to the tropics. Ron Patezold is directing this committee and three circular letters have issued to date.

The International Committee on the Classification of Anthropogenic Soils was recently established to define appropriate classes in ***Soil Taxonomy*** for soils that have their major properties derived from human activities. Soils that need to be considered include: deep plowed or ripped soils in which diagnostic horizons have been destroyed, eroded Mollisols, strip-mined land, paddy soils, etc. Ray Bryant is chairing this committee and the initial mailing list is being developed for distribution of the first circular letter.

There is the strong likelihood that an international committee will begin to look at permafrost-affected soils.

Standard Committee - NCSS Data Management Subcommittee

Dennis J. Lytle
USDA Soil Conservation Service
National Soil Survey Center, Lincoln NE

The NCSS Data Management Subcommittee has meet twice in fiscal year 1993. Once at the National Soil Survey Center in Lincoln, and once in Denver Co. They have focused on developing a minimum data set for soils. A draft of the data elements that would be included in this data set are included in Attachment A. They are working on data dictionary definitions for this data set and have a draft set of definitions. They will be working on a structure for this data set. They have been developing these as a part of the federal standards that are being developed thought the Federal Geographic Data Committee (FGDC). The schedule for developing these standards in included in Attachment B. The Federal Geographic Data Committee process because of FACTA does not allow nonfederal participation? thus it is extremely important that the NCSS Data Management Subcommittee remain active.

The process for standards development that is envisioned would be for SCS or others to develop drafts. These are then reviewed, sent back for modification and then concurred in by the Data Management Subcommittee. They would forward these to the NCSS Standards Subcommittee for approval and then they will go to the FGDC Soils Subcommittee for approval. Finally they would be proposed as a Federal Information Processing (FIPS) standard.

One of the most difficult parts of the standards development has been how to handle use dependance, reliability and method. In my last talk I discussed the fact that the National Soil Information System (NASIS) will provide a mechanism to store the soil data elements by land use. The catagories proposed for use in NASIS are the earth cover types (Attachment C) used in the SCS National Resources Inventory and these same types have been proposed for use at the broad level by the FGDC vegetation subcommittee. These types are trees cover, shrub cover, grass/herbaceous cover, crop cover, barren and artifical cover. Obviously these are too broad, but they are a start. Crop cover could further be subdivided by irrigated versus nonirrigated and then by cropping system and sequence. The combinations for cropland are large and we will probably have to settle on defining soil data element value ranges for a few selected senerios.
The NASIS structure will also allow us to store a method for each data element in NASIS. This will probably be one of the most important data quality indicators as we move into the automated world. We are also trying to tag each data element with reliability.

There is a tot of enthusiasm amoungst the members of the Data Management Subcommittee. We all feel that we can decrease the amount of resources we are spending on automation and increase the exchange of information with good standards. We all find it hard to dedicate the time needed to move the standards forward. USGS is probably having the most success redirecting people to work on standards because of leadership that is committed to automation. SCS will need to dedicate 3 staff years in fiscal 1994 and 1995 in order to meet the schedule in Attachment B.

National Soil Data Dictionary Meeting - Denver, Co. 1 1/16-19/92

Data Set For Soil Pedon

Team: Jim Keys R8, Tim Sullivan R2, Greg Miller - R3, Jan Carlson - SCS, Ken Harward SCS, George Teachman - SCS, Scott Davis - BLM, Bob Meurisse R6

Note: An • denotes a recommendation as a minimum data element.

• Bedrock Hardness
* Bedrock-Kind
Bedrock_Weathering
• Bedrock-Depth
• Boundary_Distinctness
• Boundary Topography
* Cementation
• Cementation-Agent
* Concentration_Color_Chroma
* Concentration_Color_Hue
• Concentration_Color_Value
* Concentration_Hardness
• Concentration-Kind
* Concentration_Location
• Concentration_Origin
• Concentration_Percent
* Concentratin_Shape
* Concentration_Size
• Date_Temporal_Data_Sampled
Default_Description
Describers_Name
• Diagnostic_Feature_Depth_Lower
* Diagnostic_Feature_Depth_Upper
* Diagnostic-Feature-Kind
* Diagnostic-Feature-Type
* Effervescence-Agent
* Effervescence_Class
• Effervescence_Continuity
* Effervescence_Location
* Horizon Color Chroma
* Horizon-Color-Hue
* Horizon-Color-Moisture-State
* Horizon-Color-Percent
* Horizon-Color-Physical_State
• Horizon-Color-Value
* Horizon_Depth_To_Bottom
• Horizon_Depth_To_Top
• Horizon_Designation_Suffixes
• Horizon_Designation_Master
* Horizon_Designation_Vertical Subdivision
• Horizon_Feature_Kind
Horizon Lateral-Area
Horizon-Note
• Horizon Note Formatted
• Horizon-Thickness
• Horizon-Thickness Average
• Horizon-Thickness-Maxirnum
• Horizon_Thickness_Minimum

Horizon_Volume_Total
Horizon_Wetness_State
Hydric_Condition
Hydric_Criteria
• Latitude-Degrees
• Latitude-Direction
• Latitude Minutes
• Latitude-Seconds
• Location_General
Location_Meridian_Plss
Location_Range_Plss
Location Section Details_Plss
Location-Section-PISS
Location_Township_Plss
• Longitude-Degrees
* Longitude-Direction
• Longitude-Minutes
• Longitude-Seconds
• Manner_Of_Failure
• Mottle_Color_Chroma
• Mottle Color Hue
• Mottle-Color-Moisture-State
* Mottle-Color-Value
• Mottle_Contrast
Mottle_Location
• Mottle-Percent
• Mottle-Shape
• Mottle-Size
Note-Identification
• Parent_Material_Deposition
• Parent-Material-Kind
• Parent-Material-Weathering
• Particle_Size_Control_Lower
• Particle_Size_Control_Upper
• Pedon_Purpose
• Pedon Type
• Plasticity
• Pore_Continuity_Vertical
• Pore-Location
• Pore_Quantity
* Pore-Shape
• Pore-Size
Property-Code Property_Code_Discription
Property-Domain
* PSF_ Color_ Chroma
• PSF_Color_Hue96. PSF_Color_Moisture_State
• PSF_Color_Value
• PSF_Continuity
• PSF_Distinctness
* PSF_Kind
• PSF_Location
• PSF_Percent
• Restriction Depth To_Top
• Restriction-Hardness
* Restriction-Kind
* Restriction-Thickness
• Restrictive_Feature

National Soil Data Dictionary Meeting - Denver, Co. 11/16-19/92

- Rock_Fragment_Kind
- Rock_Fragment_Shape
- Rock_Fragment_Size
- Rock_Fragment_Size_Flat
- Rock_Fragment_Size_Round
- Rock_Fragment_Volume
- Roots-Depth
- Roots-Location
- Roots-Quantity
- Roots-Size
- Rupture_Resistance_Plate
- Rupture_Resist_Block_Dry
- Rupture_Resist_Block_Moist
- Soil-Depth

Soil_Description_Note

- Soil_Moisture_Depth_To_Bottom
- Soil_Moisture_Depth_To_Top
- Soil-Moisture-Month
- Soil_ Moisture_ Status
- Soil_Name_As_Sampled
- Soil_Temperature_Depth_To_Bottom
- Soil_Temperature_Depth_To_Top
- Soil_Temperature_Maximum Daily

* Soil_Temperature_Minimum Daily

- Soil_Temperature_Mean_Monthly
- Soil_Temperature_Month
- Stickiness
- Structure-Grade
- Structure_Parts_To
- Structure-Shape
- Structure _Size
- Taxonomic_Classification_Name
- Taxonomic_Family_Other
- Taxonomic_Family_Temperature
- Taxonomic_Great_Group
- Taxonomic_Mineralogy * Taxonomic_Moisture_Class
- Taxonomic_Moisture_Subclass
- Taxonomic_Moisture_Regime
- Taxonomic Order
- Taxonomic-Particle _Size
- Taxonomic_Phases of Series

* Taxonomic_Reaction

- Taxonomic_Subgroup

* Taxonomic_Subgroup_Modifier

- Taxonomic_Suborder

* Taxonomic_Suborder_Modifier

-

National Soil Data Dictionary Meeting - Denver, Co. 1 l/16-19/92

Dataset for Soil Mapping Unit

Team: Jim Keys - R8, Tim Sullivan - R2, Greg Miller - R3, Jan Carlson - SCS, Ken Harward - SCS, George Teachman - SCS, Scott Davis - BLM, Bob Meurisse - R6

Note: All are considered a minimum dat set.

1. Assoicated_Soil
2. Component_Acres
3. Component-Kind
4. Component_Inclusion
5. Component_Inclusion Percent
6. Component_Location
7. Component_Major
8. Component-Map Symbol
9. Component_Minor

National Soil Data Dictionary Meeting - Denver, Co. 1 l/16-19/92

Dataset For Soil Interpretations

Team: Jim Keys R8, Tim Sullivan - R2, Greg Miller - R3, Jan Carlson - SCS, Ken Harward - SCS, George Teachman

National Soil Data Dictionary Meeting - Denver, Co. 1 l/16-19/92

52. Snow Avalance_Frequency (BLM)
53. Soil Compaction Hazard (BLM)
54. Soil Compaction Tolerance, Biological (BLM)
55. Soil_Erodibility_Factor_(rf)
56. Soil_Erodibility_Factor_(whol)
57. Soil Erodibility Factor, K (BLM)
58. Soil Erodibility Factor, Group, Wind (BLM)
59. Soil Erodibility Index, Wind (BLM)
60. Soil Location, Field Sample (BLM)
61. Soil Location, Field Sample, Narrative (BLM)
62. Soil Location, Survey Area (BLM)
63. Soil Location, Transect (BLM)
64. Soil Location, Transect, Narrative (BLM)
65. Soil Location, Type, Series (BLM)
66. Soil Location, Type, Series, Narrative (BLM)
67. Soil Location, Type, Survey Area (BLM)
68. Soil Location, Type, Survey Area, Narrative (BLM)
69. Soil Moisture Annual Pattern (BLM)
70. Soil Subsidence
71. Soil Surface Factor Rating (BLM)
72. t_Factor
73. Terracing (BLM)
74. Topsoil (BLM)
75. Total-Subsidence
76. Trenching (BLM)
77. Unified
78. Unified_Soil_Classification
79. Water-Table-Duration
80. Water-Table_Kind
81. Waterspreading Construction
82. Waterspresding Irrigability
83. Wind_Erodibility_Group
84. Wind_Erodibility_Index

Data Elements Relating to Soil **Inventory Status**

Team: Jim Keys - R8, Tim Sullivan - R2, Greg Miller - R3, Jan Carlson - SCS, Ken Harward - SCS, George Teachman - SCS, Scott Davis - BLM, Bob Meurisse - R6

Note: all data elements are considered a minimum.

1. Correlation-Date
2. County_Fips_Code
3. County-Name
4. Date_Survey_Area_Data_Edited
5. SSA_Country_Acres
6. SSA_Status
7. Soil_Survey_Area_Acres
8. Soil_Survey_Area_Comments
9. Soil_Survey_Area_Edit_Status
10. Soil_Survey_Area_Name
11. Soil_Survey_Area_Number
12. State_Fips_Code_Alpha
13. Survey_Area_Enter_Edit_Author

National Soil Data Dictionary Meeting - Denver, Co. 11/16-19/92

Data Elements Relating to Site

Team: Scott Davis - BLM, Denver, CO, Randy West - R10, Mark Jensen - R1 , Tom Collins - R4, Rick Biglar - SCS, NSSC, Lincoln, NE.

Site Characteristics (non-soil) include geology, gemorphology and vegetation data elements.

Note: An • identifies element as a minimum data set.

Location

- UTM (GPS/Topographic Map Call
- LAT/Long

One of the above are required for location

Township and Range legal description - This is optional field which may not be used by all cooperators.

Photograph Identification
*Key identification (Unique site identifications)

Stop number
Quadrangle sheet name
Polygon Number (GIS Spatial Link)
State and County

'Administrative boundry (Agency etc.,)
*Soil taxa

Climate

Sampling Specifications

*Observer Indentification
• Date
*Unit of Measure
?Sampling reliability
*Sampling purpose/method
?Plot size

Environmental (physical)

*Elevation
*Landform (geomorph)) awaiting work of geomorphology Workgroup
'Azimuth
*Slope (vertical & horizonal)
Slope horizonal
Slope distance to up break
Slope length total

Topo position

Slope kind (complex, simple...)

National Soil Data Dictionary Meeting - Denver, Co. 1 l/16-19/92

Geology

*Ground cover (surface rock, kind, size, slope)
Erosion kind & amount
Runoff
Micro/macro relief (kind, pattern)) awaiting work of geomorphology
Mean annual ppt. seasonal (winter, summer)
" " temp. "
Average snow pack "

Flooding

Duration
Frequency
Month

Ponding

Duration
Frequency
Month
Snow avalanches - freg.
*Parent Material - kind

Bedrock

Dip
*Kind
Hardness
Weathing
Fracturing
Strike

Geomorphic Surface ---\
Formative ----Awaiting work of geomorphology group
Active/Current ---/

Water Table

Depth
Duration
Kind
Depth to standing water

Disturbance and/or landuse (use dependence)

Kind
Intensity
Time
Frequency/internal

Environmental - vegetation (all x for potential natural vegetation PNV required)

'PNV taxa (from indicator species)
*Existing taxa (cover type, dominance type)
*Tree BA, DBH, Ht. Age, CCtot, CCszclass, Biomass

National Soil Data Dictionary Meeting - Denver, Co. 1 l/16-19/92

‘Shrubs - total cover, size class "
*Herbs - grass, forb, moss, fern "
‘Dead (standing) - same as “tree”
“Dead/down - size class, decomp class, cover %
‘Duff & litter depth
- Int fuel depth

Species

*Plant name
- Foliar Canopy Cover
* " " " by size class, by selected species
‘Ave. ht. by species
*Biomass by species

Note: Vegetation data elements were identified by the ecologists at a National meeting held in 1990.

(additional data needs)

Add timber stuff for woodland interps
Need water/aquatic data elements

Data Elements for Lab and Field Observations/Measurements

Team: Benny Brasher - NSSC, SCS, Lincoln, NE; Lloyd Mielke - ARS, WO; Bob Meurisse - R6.

Premise for sampling: If we are going to obtain the data, what is the minimum for “a soil?”

Criteria:

Develop a strategic long-range sampling plan for a physiographic province or other broad ecological region (MLRA, physiog. province, etc.) In most cases, it will encompass the range of soil series.

Must be accompanied by a profile description with “good” location information (Lat/Lng).

Include date of sample (yr/mo/day).

Include greater or less than 3 major determinations on greater or less than 2 to 3 master horizons.

Have enough lab and field measurements to classify the pedon to the family level to appear in a “permanent” data base.

Assemble all data by physiog., province, MLRA, or other broad region. Include NCSE, Univ., FS, etc.

National Soil Data Dictionary Meeting - Denver, Co. 11/16-19/92

Basic Data Elements (Measured/Predicted)

Assumption: All will include methods & Reliability

Physical:

- Bulk density (moist & dry)
- Particle size distribution CPSD)
  % Sand (five sizes for eng. particle size)
  % silt
  % clay
- Rock Fragments
  4-5mm, 20mm, 76mm, 76-254mm, 254-635mm
- Water Retention (calculate other points on curve)
  .1 or .3 Bar; 15 Bar
- Particle Density (to calc. pore vol.) weighted of greater than 2mm fraction
- (organic carbon)

Hydraulic Conductivity
- Infiltration

Chemical:

- Organic Carbon

- ph
- CaCo3 Equivalent

CeC- Exch. Bases

• EC and Satuation Paste water content (%) (Used to estimate soluble salts & osmotic potential)

Mechanical:

- Atterberg Limits (LL & PL)
- Soil strength • (method to be decided)

• Engineering particle size - calc. from PSD (not stored)

SCHEDULE FOR DEVELOPING STANDARDS FOR SOIL GEOGRAPHIC DATA

Background: OMB Bulletin No. 93-14 requires that "No later than ninety days after the date of issue of this Bulletin (May 20, 1993) the FGDC should submit to OMB a schedule for developing standards for geographic data, including those needed of each data category as described in 3(a)." In 3(a) under the subject of Digital Data Standards the bulletin says "OMB expects the agencies assigned lead responsibility by Circular A-16 for particular categories of digital data will work through the FGDC to complete data standards for those categories. Development of digital dat standards is essential to avoid unnecessary and wasteful duplication of effort across all levels of Government. The final standards should allow the easy integration of multiple data layers from different sources."

Standards for soil geographic data are subdivided into the following categories. Reference Model; Definitions, Terminology, Content (features, attributes, attribute values); Feature Delineation and Representation Rules; Data Collection Rules and Procedures; Geo-Referencing (geodetic and altimetric datums, projection transformations); Data Quality Descriptions; Metadata; and Data Exchange and Transfer.

Standards are clearly defined for some categories and uniformly applied by those agencies producing soil data. For other categories standards are not clearly defined and agreed upon, but there is usually a defacto standard that producers are applying. In general standards exist for creating analog soil geographic data, but are not agreed upon for digital soil geographic data. Standards are being developed by the FGDC Soil Subcommittee working through the National Cooperative Soil Survey (NCSS). The process and schedule the FGDC Soil Subcommittee is following in standards development is as follows.

For each category a draft is being or has been developed by the Soil Conservation Service. This first draft is then reviewed and revised by the NCSS Data Management Subcommittee. Their final draft is then reviewed by the NCSS Standards Committee before it is reviewed and approved by the FGDC Soils Subcommittee. The NCSS Data Management Subcommittee's initial efforts have concentrated on documenting and agreeing upon Definitions, Terminology and Content. The schedule for each standards category is as follows.

Reference **Model: Standards** for this category are not clearly defined and agreed upon, but the USGS Digital Line Graph Optional format is a defacto standard. Data are stored in a topological structure. Nearly all soil digital spatial data are stored in this format.

Schedule: Review and agree upon the standard - 1194 to 6/94.

Definitions, Terminology and Content: Standards for this catagory are being developed through the National Cooperative Soil Survey Data Management Subcommittee.

Schedule: Complete draft of standards - 10/93, NCSS Standards Subcommittee review - 10/93 to 2/94, FGDC Soil Subcommittee Review 2/94 to 4/94.

Feature Delineation and Representation Rules, and the Data Collection Rules and Procedures: Standards have been in place and applied for about 40 years. Standards are in numerous references, but two of the major ones are the Soil Survey Manual, and Soil Taxonomy. These standards have been developed and applied through the NCSS. Compliance with these standards is reviewed, usually in the field, by NCSS cooperators at least yearly in the process of completing a soil survey. Compliance with standards for soil description and classification outside of the NCSS is through peer review of papers on soil or soil related research. The NCSS Standards Committee is currently reconfirming the entire set of standards.

Georeferencing: Standards

Point Module IV
Earth Cover Determination
[Screen L. NRIIS Data Entry System]

The collection of earth cover information is a new element for the 1992 NRI data collection process. Both the information being determined and the procedure are different.

Earth *Cover* is the natural or artificial material that is observed to cover a portion of the earth's surface. It is determined (at least conceptually) as a vertical projection downward.

Earth cover is determined only for the year 1992. The procedure for making this determination for a 1992 NRI sample point is:

1) Construct a 2-acre circular area, centered around the point: the diameter of the circle will be 333 feet [Note: At a photo scale of 8 inches to the mile, the circle will have a one-half-inch diameter]. Do not free the point or move the circle for any reason: the circle may extend outside of the PSU.

2) Identify the major (Level I) earth cover categories which occur within this 2-acre area.

Level-I Categories

0 ***Crop Cover*** — vegetative cover of annual or perennial plants that are cultivated or harvested, or both, for the production of food, feed, oil. and flber other than wood: excluded are horticultural shrubs and trees, hay cover, and aquaculture areas: included are recently tilled and fallow portions of fields. as well as plant residue in any stage [summer fallow in rotation is considered as crop cover even though it may appear to be bare land]

o ***Grass/Herbaceous*** **Cover** — non-woody vegetative cover composed of annual or perenntal grasses, grasslike plants [sedges/ rushes). forbs, mosses, lichens, and ferns

0 Tree ***Cover*** — vegetative cover recognized as woody plants which usually have one perennial stem, a definitely formed crown of foliage, and a mature height of at least 4 meters; this category contains all trees, even those planted for the purpose or producing food, or omamentals, including Christmas trees

o **Shrub Cover — vegetative** cover composed of multi-stemmed woody plants and single-stemmed species that attain less than 4 meters in height at maturity: this category contains all shrubs and woody vines, even those planted for the purpose of producing food

o **Barren** — nonvegetative natural cover often having a limited capacity to support vegetation. with a surface of sand, rock, thin soil, or permanent ice or snow: this category also includes bare soil resulting from construction activities, extractive activities such as mining, or clear-cutting

o **Artificial *Cover*** — nonvegetative cover either made or modified by human activity and prohibiting or restricting vegetative growth and water penetration (for example, highways, rooftops)

o ***Water Cover — earth*** covered by water in a fluid state

4. To what extent should we classify the regolith? Oliver Rice developed a guide for describing earth material between the base of soil and bedrock. The committee was asked to evaluate the guide. (Appendix A and B)

5. Should a major thrust be made to the map the vadose zone?

6. If so, should soil scientist map it?

7. Could the type of investigations done for soil survey provide the needed data?

8. If not, what changes in soil survey techniques would be needed?

9. If soil scientist don't map the vadose zone, who should map it?

10. Who should fund the mapping of the vadose zone?

11. How do geologists fit into this type of project?

12. Should information we know or acquire about the vadose zone be presented?

13. How should information about the vadose zone be presented?

14. Should or could information about the vadose zone be tied to series descriptions?

15. Should information about the vadose zone be in a separate data base and tied to geomorphic or other boundaries within a major land resource area?

CHARGE 1 - To evaluate the need for information on the vadose zone not only for SCS, but for EPA, OSM, USGS, and others.

It seemed basic to have an understanding of what constitutes the vadose zone. At least to decide if all materials between the surface and ground water should be included. The majority of committee members responding stated that the entire unsaturated zone should be included in this discussion. It was felt by some that we should confine our efforts to the earthy materials below the solum, but above hard bedrock. One respondent stated that we may need to go into the saturated zone to collect some data.

All agree that there is a definite need for information on the unsaturated zone. Many did not think that vadose zone was the proper term. It was pointed out that the vadose zone is actually a moving target depending on the rise and fall of seasonal water tables. Some terms suggested are non-soil regolith, subdapic zone, and deep regolith. The NCSS should make a major effort to collect data on the earthy material below the solum, but above hard bedrock.

The NCSS should actively pursue a working agreement with geologists to link soil survey, regolith, and geology. This linkage should provide the pathway to characterize the vadose zone. In all likelihood this attempted linkage will point out that adequate information is lacking on the regolith.

CHARGE 2 - To evaluate the kinds of information needed by these groups, and to determine if the types of investigations done for the data needed.

Needs identified by the committee are:

1. Predict ability to absorb or otherwise "decontaminate" waters injected below the soil, landfills, or other urban waste disposal sites.
2. Planning of pipelines, roads and other such projects could benefit from a deeper evaluation of soil materials.
3. Provide a better link between pedology and geology.
4. Identify layers or zones containing sulfide bearing materials in relation to environmental regulations dealing with "earth moving" activities.
5. Aquifer sensitivity and vulnerability.
6. Impact of agriculture practices on ground water and chemical make up of the vadose zone.
7. Water, chemicals, and microbes transmission properties of the vadose zone.
8. Are there seasonal or temporal characteristics that affect the transmission of water, chemicals, and microbes?
9. Do vadose zone materials further contaminate leaching water? For example, what are background phosphorous levels?
10. Occurrence of aquitards and perched water tables within the vadose zone.

The major need for collecting information on the vadose zone center on water quality. This was expressed by nearly all respondents.

A rather long list of attribute data was identified as needed. The South-Northeast Cooperative Soil Survey Conference, Committee 6, chaired by W.J. Edmonds, put together a comprehensive list of potential properties. The conference participants considered the approach used be NCSS to describe and characterize soils to have a high potential for describing and characterizing the regolith. These properties are considered to be important attributes that could be used as a first approximation. They are included in Appendix C.

Because Committee 6 of the South Northeast Cooperative Soil Survey Conference limited the discussion to exclude hard bedrock, additional potential properties of bedrock need to be added such as features, faults, and karst areas. Additional discussions with USGS and other geologists are needed.

Existing soil survey techniques that emphasize landscapes should provide excellent methods for characterizing the upper part of the vadose zone in many areas. However, these techniques would need to be modified and coordinated with geologic methodologies for properties of the lower part of the vadose zones.

A multi-agency and multi-discipline task force is needed to work out a link between soil survey maps and geology maps. This linkage would identify terminology that must be defined and understood. It is also anticipated that such a linkage would further identify that little is known about the regolith. As used here, the regolith is the unconsolidated material between the bottom of the soil and hard bedrock.

Demonstration projects involving multi-discipline and multi-agency could be a good way to work out feasibility and methodology. It does not seem feasible to mount an all out effort to map the vadose zone throughout the country; however, we need to develop the expertise and be prepared to map or collect the data for specific localities where needs have been identified.

The guide developed by Oliver Rice, while assigned to the Northeast National Technical Center, for describing earth materials between the base of soil and bedrock along with the potential properties outlined by Committee 6 of the South-Northeast Cooperative Soil Survey Conference should provide the necessary outline for multi-agency/ multi-discipline task force discussions. A copy of the guide developed by Rice is attached (Appendix A and B).

CHARGE 3 - If soil survey techniques are appropriate for collecting information on the vadose zone, how should the information be presented?

Information collected on the vadose zone should be presented as a GIS layer linked to STATSGO map units. Hopefully, STATSGO is tied to geometric units which are in turn tied to geological units. STATSGO will also provide us a link with SSURGO. It is important that the attribute data of these layers be linked and that it be presented geographically.

CHARGE 4 - Who should be responsible for collecting information on the vadose zone (who should be funded to support these projects)?

The NCSS should assume the leadership role for the non-soil regolith and take the initiative to organize a multi-agency/multi-discipline task force to work out a link between soil survey maps and geology maps, in addition to the items presented with charge 2. OMB has sponsored a committee, Federal Government Data Coordinating Committee, with responsibility for developing standards for linking geographical data collected by the Federal Government. It has been suggested that we stand a good chance of getting a soil-geology linkage project funded from this means. Funding for pilot projects should be pursued by the task force from such as USDA, COE, EPA, USGS, DOE, OSM and Transportation.

CHARGE 5 - Where should this information be stored and how?

The information should be stored as a layer in GIS, so that it can be linked to other data bases. Attribute files need to be accessible by software models such as GLEAMS. A database needs to be designed for the storage, analysis and retrieval of the information collected. The format of NASIS might be a good starting point.

RECOMMENDATIONS:

1. NCSS assume the leadership role for characterizing the regolith.

2. NCSS take the initiative to organize a multi-agency/multi-discipline task force to work out a link between soil survey maps and geology maps with special emphasis on the vadose zone.

3. NCSS recommends that SCS assign a member of the Soil Investigations Staff to develop demonstration projects involving multi-agency/multi-discipline personnel to work out feasibility and methodology of characterizing the regolith to address water quality issues and other interpretations.

4. That a report be given at the next conference of progress on the demonstration projects and the efforts to link soil survey maps and geology maps.

COMMITTEE 1 MEMBERSHIP

Aziz Amoozegar
Jerry Bernard
Stan Boul
Del Fanning
Leon Follmer
Don Franzmeier
Robert C. Graham
Dennis Heil
Tom Iivari
Bruce Johnson
Jim Kearney
Steven Lacy
Maurice Mausbach
Steve Monteith
John Moore
Bob Neilson
Carolyn Olson
Carol Reed
John Schmidt
Philip Schoenberger
Russell Shepherd
Ray Sinclair
Ed Stearns
Lyle Steffen
Mike Vepraskas
Peter Waldo
DeWayne Williams, Chair

APPENDIX A

DRAFT - 12/88 OWR

GUIDE FOR DESCRIBING EARTHY MATERIAL BETWEEN BASE OF SOIL AND BEDROCK 1/

INTRODUCTION

The current emphasis in SCS to develop procedures to evaluate water quality effects of soil and crop management practices has placed a demand on soil data that is not fully supplied with our current soil data bases. A major limitation is that our current inventories describe soils to a maximum depth of approximately 2 meters, patterned after instructions that are now obsolete. We really need information on all unconsolidated material between the surface and "bedrock."

Water quality assessments are not the only urgent need for this information. Another need for a real inventory of soil resources. In order to plan for permanent agriculture we need an inventory of all unconsolidated sediments, not simply the top meter or two. With such an inventory, we could begin to develop a more rational meaning for soil loss tolerance.

We are in a position of needing to reevaluate our definition of soil survey as a resource inventory and to make additional soil quality standards and to make our only defined one (T value of USLE) realistic.

Surficial geology maps provide some information for some areas, but are not well linked to soils data and use a different set of terminology. It would be highly desirable to describe the whole section from soil surface to bedrock using one set of conventions. It seems logical to use soil science terminology and conventions because many models are designed to operate using soil survey data.

Current instructions for describing the upper 2 meters of soil are generally adequate for describing the soil material to bedrock, but standard layer and property class limits may not be commensurate with the in-exactness with which the deeper layers have been examined or the impression we want to give readers of the detail with which we or geologists have examined the material. It is because of these concerns that many have chosen not to record anything about the material below about 2 meters, even though much more is known than is recorded. Another reason is time constraints, although the principle excuse used has been that this portion of the regolith "belonged" to the geologists. The soils memorandum on which this belief was based was cancelled years ago.

1/ Bedrock or other material that would become soil material through weathering very slowly, or be made soil material with difficulty with machinery.

APPENDIX A

It is now necessary that we record an appropriate description of the material, one which contains a minimum set of information in all cases, but that may be highly detailed for specific uses. In some areas good information is available in surficial geology surveys, however, in all cases that I know of it needs to be converted to soil survey terminology to be useful with soil data bases, and to be useful at more than a qualitative level, additional estimates of physical and chemical properties must be gathered. We need to use geologists in updating soil surveys. As soil surveys are updated, the unconsolidated material should be characterized by the NSSL.

This guide is for describing these materials. Guides and procedures to sample, analyze, and characterize these layers need to be incorporated into our standard characterization procedures and guides are needed for including the information into standard soil surveys. Unless these data are included in the minimum set of data to be included in the next generation of soil surveys, it is not likely to happen.

This is not a suggestion to attempt to survey the substratum at the same intensity as the surface layers (the solum). The suggestion is that we set a minimum standard for what we ought to know at various depths and that the solum and substratum be described using a uniform system of terminology. This may require additional laboratory data and greater cooperation and collaboration with geologists.

The guidelines for describing the unconsolidated layers consist of two parts. The minimum set of soil material attributes to record, and the description detail and depth increments of each layer.

Minimum Set of Soil Material Attributes

To arrive at the suggested minimum set of soil material attributes, we made an estimate of what would be the commonly required data needed to estimate with computer models the crop producing life of a soil and the underlying soil material, and the ability of the soil and regolith beneath it to attenuate and transmit potential pollutants moving in the soil water. In this draft, we have selected items only from those currently listed in the National Soils Handbook - Soil Survey Manual. The detail (exactness) with which these are recorded is defined for the minimum requirements, as opposed to the maximum requirements such as for special studies or research which might be more extensive and detailed than for a standard description. Suggestions are made for grouping attribute descriptions (classes) and increasing thickness of layers described so as to simplify the description as depth increases. In future drafts we might include items not normally recorded in soil descriptions provided field procedures are available that have acceptable time and equipment requirements. In general, however, any new subsoil attributes approved for inclusion in soil descriptions would also be included in descriptions of the substratum.

APPENDIX A

List of Attributes to Include in Description

a. **Layer depth and thickness**
b. **Reaction**
c. **Texture**
d. **Lithology**
e. **Rock fragment content**
f. **Soil or material structure**
g. **Cementation, induration, etc.**
h. **Estimate of consolidation - compactness, bulk density**
i. **Other items highly significant to water movement** such as surface coatings, tubular pores, pore fillings etc.

Characterization Data by NSSL Laboratory

a. Basic physical and chemical properties

Guide for Description Detail

As a guide to selecting the desirable degree of detail as depth increases, use the following table.

a. **The thickness of the layer described is to be determined by selecting the thickest layer that is relatively uniform with respect to most of the attributes classes listed for that depth interval.** The general philosophy in deciding on the appropriate thickness is that it is permissible to be less specific (more general) as depth increases. This reflects the assumption that a given range in properties at a great depth has less of an influence than the sane range nearer the surface.

b. Aggregate classes of some attributes are suggested for use at greater depth. Not all attributes have classes that are aggregates of more specific classes. As we gain experience, we may find it desirable to devise aggregate classes for all attributes. Another alternative, which I prefer, is to expand the range of attribute classes that can be included in one layer. This should be interpreted to mean that it is not desirable to create new classes that will be used only for the deeper soil material layers. I argue with myself about this, reasoning that it would be desirable to have classes that we would always recognize as having a more general meaning.

c. For each depth interval, there probably should be a minimum thickness to describe. Within the solun, it is generally taken to be 10 cm. As a trial, we might try 20 cm. for interval 1, 40 cm. for interval 2, and 100 cm. for interval 3.

NEEDSTBLE

GUIDE FOR DESCRIPTION DETAIL - table (updated 12/88)

attributes	depth interval 1	depth interval 2	depth interval 3
	----------depth intervals----------		
characterization intensity	2-5 m	5-20 m	20+ m
attributes to select layer thickness	items c,d,f,g,and h attribute classes listed below	items c,d,f,g,and h attribute classes listed below	items c,d,f,g,and h attribute classes listed below
reaction	manual classes	acid,neutral,alka-line,calcareous	acid,neutral,alka-line,calcareous
texture	manual classes	11 particle size classes or 5 general texture classes	7 particle size classes or 3 general texture classes
lithology	taxonomy mineralogy classes or manual parent material classes	manual parent material classes, geologic unit and material	geologic unit and material
rock fragment content	4 manual classes	4 manual classes or 11 family particle size classes	geologic unit and material
soil or material structure	manual classes, substitute material structure for soil structure	manual classes, substitute material structure for soil structure	geologic unit and material
cementation,in-duration,etc.	manual classes of concentrations, ce-menting, consistence	manual classes of concentrations, ce-menting, consistence	geologic unit and material
consolidation and bulk density	NSH (603.12) range of moist bulk density	NSH (603.12) range of moist bulk density	NSH (603.12) range of moist bulk density
surface coats, pores, etc.	manual classes	manual classes	geologic unit and material

APPENDIX B

Potential properties for describing layers of the regolith:

- Designation for layers

  Designations for layers below the soil have not been developed. The conference felt that this work should be done in concert with participants from other disciplines, such as engineers, hydrologists, and geologists.

- Depth to and thickness of layers

  Depth to and thickness of layers are site specific. The practical lower limit for depth of observations should be defined, because depths to hard rock in the Atlantic Coastal Plain can be hundreds or thousands of feet, Committee 4 of the 1990 Northeast Cooperative Soil Survey Conference suggested 2 to 5 m, 5 to 20 m, and > 20 m.

  Practical methods of observing the regolith are suggested; i.e., use the hand auger for the 2 to 5 m zone, and use drilling for the zone > 20 m.

  Practical density of observations in a mapping context could also be developed for the 2 to 5 m, 5 to 10 m, and > 20 m zones.

  - Matrix color

  - USDA-particle-size distribution

  - mottle color (s)

  - structure - Guidelines for describing structure should be developed in concert with other disciplines.

  - Consistence (dry, moist, wet) - Guidelines for describing consistence should be developed in concert with other disciplines and should include strength of materials.

  - Roots - Should include root casts, including those that are calcified and silicified.

  - Pores - Guidelines for describing macropores in the field should be used to the level of a 10x hand lens. Percent pore space estimated using bulk density and particle density should be considered.

    - Plinthite

    - Pressure surfaces with or without shear failure

    - Relict-rock fissures filled with iron, aluminum, or manganese oxides; organic matter; salts; carbonates; quartz; etc.

    - Concentrations

- Mica - expansive classes of mica could be needed.
- Rock fragments
- Brittleness - brittleness should be quantified.
- Selected chemical properties:
  - Salinity
  - Sodicity
  - Gypsum
  - Sulfides
  - Reaction (pH)
  - Boundary of layers

- Free water occurrence; i.e., variations in water table surface
  - Particle-size distribution
  - USDA-particle-size class
  - Fraction > 250 mm, 250-75 mm
  - Percent passing sieve numbers 4, 10, 40, and 200
  - Clay
  - Particle-size-superseding characteristics (sapric material, coprogenous earth, cinders, marl, muck, etc.)

- Fabric-related analysis
  - Moist-bulk density
  - Shrink-swell potential
  - Saturated-hydraulic conductivity (K^{SAT})
  - Unsaturated flow 0 (h) and K (zero)

- Engineer classification
  - Unified
  - AASHTO

- Chemical properties
  - $CaCO_3$ equivalent
  - Cation-exchange capacity
  - Gypsum
  - Organic matter
  - Reaction (pH)
  - Salinity
  - Sodium adsorption ratio
  - Sulfur content
  - Total Fe_2O_3 and Al_2O_3 content as a measure of ore potential

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE
Burlington, Vermont, July 12-16, 1993

By: Wade Hurt

REPORT OF COMMITTEE 2
ROLE OF NCSS AND THE "NEW COOPERATOR"

MEMBERS:

Wade Hurt, Chair

Thomas Calhoun
Maury Mausbach
John Meetze
J.C. Baker
Jim Brown
Wayne Robbie
Ken Olsen
Richard Arnold
Christian Pieri
Tom Usselman
Steve Holzhey
Pete Avers
John Phillips
Andrew Art
Joe Kleiss
Dave Jones
Charles Fultz
Steve Hundley
Harvey Luce
Moye Rutledge

BACKGROUND:

In 1990, at the Northeast Cooperative Soil Survey Conference a committee concerned with the relationships between NCSS, SCS, and public sector soil scientist recommended that "Private sector people (soil scientists) should be part of the NCSS." and that "A MOU between each private sector organization and the NCSS should (exist)...'

Again, in 1992, at the Joint South and Northeast Cooperative Soil Survey Conference a committee addressed the same relationship and recommended to "Develop a national MOU between SCS, as lead agency for NCSS, and national professional organizations of private soil scientists."

Concurrently, the state of New Hampshire and New Hampshire SCS was (and is currently) trying to formalize the relationship between NCSS and New Hampshire. Other states apparently have had some concerns over the desired kinds and extent of soil survey services provided by agencies and institutions as compared with the desired kinds and extent of soil survey services provided by the private sector.

FOR THESE REASOND AS WELL AS OTHER REASONS THIS COMMITTEE TO ADDRESS NCSS AND COOPERATORS WAS ESTABLISHED.

COMMITTEE CHARGE 1:

Review the list of cooperators in the NCSS and make recommendations on new cooperators and their role in NCSS.

DISCUSSION:

What is NCSS? The NCSS is a nationwide partnership of federal, regional, state, and local agencies and institutions. This partnership works together to cooperatively investigate, inventory, document, classify, and interpret soils and disseminate, publish, and promote use of information about soils of the United States and its trust territories.

NCSS provides guidance in all phases of soil survey production and use.

What NCSS is not. The NCSS is not a legal entity. It cannot sign MOUs; it does not "define"; it does not regulate. The real authority behind the NCSS is the cooperating agencies and institutions. These agencies and institutions sign MOUs; not NCSS.

RECOMMENDATIONS:

1. This committee recommends that no action be taken to create within NCSS the ability to sign MOUs or in any other way "formalize" NCSS.

2. This committee recommends that the SCS, acting for NCSS, pursue the development and signing of MOUs with the Corps of Engineers, NASA, World Bank, Department of Defence, and other applicable agency and institutional users of soils information.

3. This committee recommends that the NCSS, pursue a dialog with and invite to the NCSS Conference representatives of national organizations of consultant soil scientists, agribusinesses, etc. and that the NCSS encourage states to develop MOUs with state associations that represent private consultants.

COMMITTEE CHARGE 3.

Review the need for and make recommendations on an NCSS code of ethics.

DISCUSSION:

If the above recommendations of this committee are adhered to, NCSS will not be formalized and there will be no need for a non-enforceable and unusable code of ethics.

RECOMMENDATIONS:

This committee recommends that the NCSS not develop a code of ethics.

COMMITTEE CHARGE 4.

Provide any insight to the role of NCSS in the future.

DISCUSSION:

The future of NCSS is limitless.

The soil survey of the future should be led and directed by NCSS just as the soil survey of the past and present have been and are being led and directed by NCSS. NCSS should continue to improve existing soil survey techniques through research and development. The NCSS should develop guidelines and procedures for site specific soil surveys (agricultural, building site, recreational, sanitary facility, waste management, water management, woodland, wildlife, etc.).

Perhaps even more exciting to NCSS is the arena of soil survey use. Specifically, NCSS should develop guidelines and procedures for soil survey use in conjunction with geographical information system and other pseudo intelligent systems.

Draft part 655 of the National Soils Handbook proposes to establish in the National Soil Survey Users Council is one example. NCSS should question the need for such a council.

RECOMMENDATIONS:

1. This committee recommends that the NCSS develop guidelines and procedures for soil survey use in conjunction with geographical information system and other pseudo intelligent systems.

2. This committee recommends that the NCSS develop guidelines and procedures for site specific, Order 1, soil surveys and that the kind and extent of surveys by NCSS representatives be differentiated from those of private consultants.

3. This committee recommends that SCS's proposed National Soil Survey Users Council be replaced with NCSS sponsored user conferences.

NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE
Burlington, Vermont, July 12-16, 1993

REPORT OF COMMITTEE 2
ROLE OF NCSS AND THE "NEW COOPERATOR"

MEMBERS:

Wade Hurt, Chair

Thomas Calhoun
Maury Mausbach
John Meetze
J.C. Baker
Jim Brown
Wayne Robbie
Ken Olsen
Richard Arnold
Christian Pieri
Tom Usselman
Steve Holzhey
Pete Avers
John Phillips
Andrew Art
Joe Kleiss
Dave Jones
Charles Fultz
Steve Hundley
Harvey Luce
Moye Rutledge

BACKGROUND:

In 1990, at the Northeast Cooperative Soil Survey Conference a committee concerned with the relationships between NCSS, SCS, and public sector soil scientist recommended that "Private sector people (soil scientists) should be part of the NCSS." and that "A MOU between each private sector organization and the NCSS should (exist)..."

Again, in 1992, at the Joint South and Northeast Cooperative Soil Survey Conference a committee addressed the same relationship and recommended to "Develop a national MOU between SCS, as lead agency for NCSS, and national professional organizations of private soil scientists."

Concurrently, the state of New Hampshire and New Hampshire SCS was (and is currently) trying to formalize the relationship between NCSS and New Hampshire. Other states apparently have had some concerns over the desired kinds and extent of soil survey services provided by agencies and institutions as compared with the desired kinds and extent of soil survey services provided by the private sector.

FOR THESE REASOND AS WELL AS OTHER REASONS THIS COMMITTEE TO ADDRESS NCSS AND COOPERATORS WAS ESTABLISHED.

COMMITTEE CHARGE 1:

Review the list of cooperators in the NCSS and make recommendations on new cooperators and their role in NCSS.

DISCUSSION:

What is NCSS? The NCSS is a nationwide partnership of federal, regional, state, and local agencies and institutions. This partnership works together to cooperatively investigate, inventory, document, classify, and interpret soils and disseminate, publish, and promote use of information about soils of the United States and its trust territories.

NCSS provides guidance in all phases of soil survey production and use.

What NCSS is not. The NCSS is not a legal entity. It cannot sign MOUs; it does not "define"; it does not regulate. The real authority behind the NCSS is the cooperating agencies and institutions. These agencies and institutions sign MOUs; not NCSS.

RECOMMENDATIONS:

1. This committee recommends that no action be taken to create within NCSS the ability to sign MOUs or in any other way "formalize" NCSS.

2. This committee recommends that the SCS, acting for NCSS, pursue the development and signing of MOUs with the Corps of Engineers, NASA, World Bank, Department of Defence, and other applicable agency and institutional users of soils information.

3. This committee recommends that the NCSS, pursue a dialog with and invite to the NCSS Conference representatives of national organizations of consultant soil scientists, agribusinesses, etc. and that the NCSS encourage states to develop MOUs with state associations that represent private consultants.

4. This committee recommends that the SCS and other NCSS agencies and institutions review existing MOUs to insure that the best interest of NCSS are being served.

COMMITTEE CHARGE 2.

Define the NCSS role in endorsing states procedures and laws that involve soil survey,

DISCUSSION:

The NCSS currently has no method of endorsing procedures or laws. In addition, there is no need for NCSS to provide special endorsement to its procedures and standards. Because NCSS guidelines, procedures, and standards such as National Soils Handbook, Soil Survey Manual, and Soil Taxonomy exist, they are already endorsed by NCSS.

Federal laws and regulations are endorsed, executed, and enforced by federal agencies. State laws and regulations are endorsed, executed, and enforced by state agencies. Even if NCSS could endorse state laws and regulations there is no need. Of course any state or federal agency involved with the endorsement, execution, and enforcement of laws and regulations concerning soil survey should be a member of NCSS and should sign all applicable MOUs as a representative of NCSS.

RECOMMENDATIONS:

1. This committee recommends that the NCSS not accept any additional role in endorsing state procedures and standards that involve soil survey.

2. This committee recommends that the NCSS not accept any additional role in endorsing state laws and regulations that involve soil survey.

COMMITTEE CHARGE 3.

Review the need for and make recommendations on an NCSS code of ethics.

DISCUSSION:

If the above recommendations of this committee are adhered to, NCSS will not be formalized and there will be no need for a non-enforceable and unusable code of ethics.

RECOMMENDATIONS:

This committee recommends that the NCSS not develop a code of ethics.

COMMITTEE CHARGE 4.

Provide any insight to the role of NCSS in the future.

DISCUSSION:

The future of NCSS is limitless.

The soil survey of the future should be led and directed by NCSS just as the soil survey of the past and present have been and are being led and directed by NCSS. NCSS should continue to improve existing soil survey techniques through research and development. The NCSS should develop guidelines and procedures for site specific soil surveys (agricultural, building site, recreational, sanitary facility, waste management, water management, woodland, wildlife, etc.).

Perhaps even more exciting to NCSS is the arena of soil survey use. Specifically, NCSS should develop guidelines and procedures for soil survey use in conjunction with geographical information system and other pseudo intelligent systems.

Draft part 655 of the National Soils Handbook proposes to establish in the National Soil Survey Users Council is one example. NCSS should question the need for such a council.

RECOMMENDATIONS:

1. This committee recommends that the NCSS develop guidelines and procedures for soil survey use in conjunction with geographical information system and other pseudo intelligent systems.

2. This committee recommends that the NCSS develop guidelines and procedures for site specific, Order 1, soil surveys and that the kind and extent of surveys by NCSS representatives be differentiated from those of private consultants.

3. This committee recommends that SCS's proposed National Soil Survey Users Council be replaced with NCSS sponsored user conferences.

Soil Survey by MLRA: *Positioning the NCSS for the 21st Century*

A Report to the 1993 NCSS Conference

BY

K. McSweeney, University of Wisconsin
J. Bell, University of Minnesota
R. McLeese, SCS, Illinois
S. Indorante, SCS, Illinois
C. Love, SCS, Illinois

The following charges were addressed by the committee:

Charge 1: Recommend how user of soil survey information can be most effectively informed about and involved in survey by MLRA.

Charge 2: Define the goals for making soil survey independent of political boundaries.

Charge 3: Provide guidance on how these soil survey projects should be organized and who should organize them.

Charge 4: Recommend how the information gathered in these projects should be presented.

Charge 5: Recommend how these projects can be conducted efficiently.

Charge 6: Evaluate the merit and feasibility of adopting new field procedures and technological aids for soil surveys by MLRA.

A draft report was prepared by the Committee and sent to 32 individuals throughout the country for review and comment.

Comments were incorporated into the report and the following recommendations were presented to the participants of the conference during 4 breakout sessions.

Charge 1

1. Clients/Users need to be actively engaged in planning and implementation, so that their needs for soil survey information are adequately addressed and progressively improved.

2. Principles of scientific and technical quality, preeminence of client needs and flexibility to accommodate special local/regional priorities'must be constructively promoted.

3. NCSS coordinators should conduct meetings with users in the early stages of the planning process in order to identify and inform users about the operational and philosophical rationale for soil survey by MLRA and to seek their input.

4. SCS should assume leadership at the national level for establishing dialogue among all NCSS cooperators, other agencies, professional and scientific organizations, and natural resource advocacy groups to inform them about the MLRA concept and to seek their input.

5. The Total Quality Management (TQM) approach should be considered for implementation and continued support of soil survey by MLRA.

6. An internal committee should be convened for each MLRA to establish an implementation timetable and monitor progress towards the goals.

Charge 2

1. The major impetus for updating and maintaining soil survey by MLRA is as follows:

   (a) bring existing county soil surveys to current NCSS standards,

   (b) improve the quality and dissemination of soil survey information to an increasingly diverse and sophisticated users,

   (c) provide soil survey information in flexible formats that meet local, regional, and national needs and is suitable for integration with other resource inventories.

2. The objective of MLRA soil survey activities is to provide a refined and enhanced product, on a controlled base, and in digital format. Significant improvements (goals) expected are as follows:

   (a) A uniform map scale and mapping intensity for the MLRA.

   (b) Soil maps that join across political boundaries--line for line, symbol for symbol, map unit name for map unit name, and interpretation for interpretation.

   (c) A common standard of documentation.

(d) Consistent description of landscapes, land forms, and slope positions.

(e) Adequate documentation to make reliable quantitative statements of map unit composition.

(f) New soil property data and interpretations designed to meet current and projected user needs.

(g) Better description of composition and patter of soils in map units.

(h) More precise statements about the expected reliability of maps and interpretations.

(i) A coordinated soils data base.

(j) A digital soils data layer meeting national map accuracy standards and suitable for use in GIS environment.

(k) Eliminate duplication and waste in developing soil data bases.

(l) Facilitate the transfer of soil data layers between different computer systems.

Charge 3

1. The key organizational principle for future soil survey is to establish the MLRA as the soil survey area.

2. Reorganize soil survey to best support MLRA concept - establish MLRA project offices.

3. Develop innovative/creative staffing plans (flexible work schedules, locations).

4. An MLRA Project Leader manages activities in the MLRA and supervises "subset" Project Leaders. His/her responsibility and authority should cross state lines.

5. One correlator would be responsible for MLRA correlation activities. One data set manager would be responsible for database management activities.

6. MLRA activities between states and agencies will be coordinated by an MLRA Steering Committee and technical subcommittees.

Charge 4

1. A report for the entire MLRA should be compiled, edited, and considered for publication. A 1:250,000 soil map, legend, descriptions, and general interpretations would be published.

2. Publications of subsets of the MLRA will be optional depending on user needs.

3. Manuscript and maps will be available in hard copy and digital format.

4. Users should be consulted about their preferences for information delivery.

5. It is essential to have support staff to help users obtain optional benefit from new formats of soil survey information delivery.

Charge

1. Soil survey evaluations must be completed form each survey in the MLRA.

2. Initial work in an MLRA should be directed towards legend development, investigation, and data gathering to build on the effort of the evaluation process.

3. Strong emphasis should be placed on working with all users to assure that the update addresses user needs.

4. Sufficient work should be done on major landforms and parent materials to assure proper legend development.

5. Investigative work in the first year or two of the project will be the key to establishing a sound, stable legend - project leaders must be allowed time for preliminary investigations!

6. The MLRA office must be a "high-tech" facility with GRASS-GIS, basic soils lab, map and reference library, etc.- a quality work environment.

7. We must use new technology in the update process - GIS, remote sensing, EM technology etc. must be incorporated into the technical and operational aspects of the soil survey.

8. Regional research projects need to be initiated.

9. Emphasis should be placed on extent of soils, suites of soils, most extensive soils, benchmark soils, data gaps.

10. Standardized methods for collecting and analyzing transect data as a regional basis needs to be adopted.

11. Identification and measurement of "Critical Soil Properties" and development of more quantitative presentations of interpretations require special attention.

12. Special support should be provided to investigate soil-geomorphic relationships.

13. NCSS should establish a special committee to explore the opportunities to develop research initiatives in support of soil survey.

14. The MLRA boundary must be evaluated and refined early on in the update process.

15. Steering committees and technical subcommittees must be empowered and given adequate time "To get the job done".

16. Users should be expected to share in the cost of updating and digitizing soil surveys.

17. MLRAs should be prioritized nationally and funded accordingly - funding by MLRA.

18. Local, state, private funds dedicated to soil survey should be matched with federal dollars.

19. We should establish a 25 year (or less) timetable for a digital soil survey for the USA.

Charge 6

1. We should view the MLRA process as an opportunity to update our soil mapping techniques and incorporate the following tools into the way we do business - GIS and allied technologies, geostatistical and mutlivariate statistical modeling, digital terrain modeling, digital orthos, GPR, EM, GPS, etc.

2. If our final product is to be in digital format we need to re-evaluate how we collect minimize the needless conversion from paper to digital format.

3. GIS should be viewed as a potential analytical tool and not just a system to produce pretty maps.

4. Pitfalls of using GIS and allied technologies need to be carefully considered (ie error propagation through map overlay, scale difference, goe-referencing).

5. An NCSS committee should be established to investigate and provide specific recommendations about the use of GIS and allied technologies.

Top Ten (10) Recommendations

In each breakout session the recommendations were reviewed and discussed. The list was added to and cut. Through a nominal group voting process the top ten (10) recommendations were identified. They are as follows:

1. REORGANIZE SOIL SURVEY TO BEST SUPPORT MLRA CONCEPT - ESTABLISH MLRA OFFICES (44pts/10votes)

2. FUNDING
   - .Users should be expected to share in cost
   - .MLRA's should be prioritized nationally and funded accordingly
   - .Local/state/private funds dedicated to soil survey should be matched by federal dollars (27/11)

3. MLRA PROJECT LEADER MANAGES ACTIVITIES IN MLRA AND SUPERVISES "SUBSET" PROJECT LEADERS (23/6)

4. VIEW UPDATE PROCESS AS OPPORTUNITY TO UPDATE SOIL SURVEY TECHNIQUES GIS - Geostatistical and miltivariate statistitical modeling etc. (21/7)

5. INITIAL WORK DIRECTED TOWARDS LEGEND DEVELOPMENT INVESTIGATION, DATA GATHERING (20/4)

6. COMPLETE EVALUATIONS FOR EACH SURVEY AREA TO DOCUMENT NEED FOR UPDATE AND TO ESTIMATE WORKLOAD (19/6)

7. OBJECTIVE/GOALS (18/6)

8. EMPOWER STEERING COMMITTEES AND TECHNICAL SUBCOMMITTEES "TO GET THE JOB DONE" (15/5)

9. NCSS COORDINATORS CONDUCT MEETINGS EARLY ON IN THE: PLANING PROCESS TO IDENTIFY AND SEEK USER INPUT AND TO INFORM USER OF CONCEPT/PHILOSOPHY (14/4)

10. USERS SHOULD BE CONSULTED ABOUT PREFERENCE FOR SOIL INFORMATION DELIVERY (10/3)

Final Recommendations

The following final recommendations (by functional area) were **offered** to the entire conference for consideration:

LEADERSHIP

1. Develop a model organizational structure for MLRA soil survey.
2. Adopt and promote TQM philosophy
3. Refine OBJECTIVE/GOAL statements for MLRA soil survey and disseminate as soon as possible.

MARKETING

4. Develop soil survey marketing plan to include strategy for marketing or promoting MLRA concept.
5. Soil survey by MLRA concept needs to remain flexible enough to allow for soil survey by other geographic area (physiographic area, watershed, soil region).

FUNDING!

6. Develop soil survey funding strategy that identifies new partners and funding sources, establishes criteria to prioritize MLRA's and proposes a new funding formula.

TECHNOLOGY

7. Establish an NCSS committee to provide recommendations about the use of GIS and allied technologies in soil survey update activities.
8. Establish an NCSS committee to explore the opportunities to develop research initiatives in support of soil survey.

/DATA COLLECTION

9. Finalize work on the "Soil Survey by Geographic Area" guidebook and disseminate ASAP. Address tactical, operational and project functions and activities.

RIM:lr:SSMLRAltr.doc

The Digital Soil Survey

Report of National Cooperative
Soil Survey Committee 4
BY: Dennis Lytle

INTRODUCTION:

Members of this committee were Javier Ruiz SCS, Fort Worth Texas; Bob Meurise, USFS, Portland Oregon; Bob Pease, USEPA, Arlington Virginia; Bill Wright, University of Rhode Island.; Elissa Levine, NASA, Beltsville Maryland; and Tom Fenton Iowa State University. Dennis Lytle SCS, Lincoln Nebraska was chair. The committee completed most of its work though written correspondence. Input was also obtained from participants at the conference.

CHARGES:

1. State what the Federal government is requiring of us now in digitizing soil surveys.

2. Provide an analysis of how digitizing affect the NCSS soil survey process. For example, what's the basic cartographic unit mapping (topoquad, MLRA, County, State)?

3. Recommend what the products of the digital soil survey should be and how they should be distributed. What is the record copy of the survey? What are the cooperators needs? How should they be archived?

4. Recommend an infrastructure that NCSS should develop in order to share and distribute digital soils data.

RECOMMENDATIONS:

1. Review standards for digitizing soil surveys in light of base materials that are available and the accuracy of these base materials and the ability of current computer digitizing hardware and software equipments ability to meet the standard. The standards for digitizing may need to be relaxed standards in certain cases.

2. Digital soil survey data needs to be easily available through Internet and on-line for easy query and retrieval. Data should also be available on CD ROM. Data should be archived on an USGS 7.5 minute basis. The cartographic unit should be the USGS 7.5 minute quadrangle. The SCS should consider moving the archive and distribution of digital soil data to USGS or National Agriculture Library where systems currently exist, or establish a easily accessible method to the data such as a 1 800 number similar to the 1 800 USA MAPS that USGS has. Could be 1 800 SOIL MAP.

3. [illegible]

NCSS Conference 1993
Report of Committee on Disturbed Soils

J.T. Ammons
Soil Survey Leader-TAES

Objectives: To review concepts, applications, and research on what is known about disturbed soils and to formulate a working definition of drastically disturbed soils.

Recommendations: Steering committee recommendations from the Burlington, Vermont Conference held July 11-16, 1993.

1. **Develop a definition of drastically disturbed soils to separate these soils from eroded or plowed soils.** This **definition is to include soils that have been completely** removed or reoriented essentially resetting the pedogenic clock at time zero.

2. **Classification of disturbed soils** should **follow the protocol of** Soil Taxonomy. New suborders should be defined in the Entisol and Inceptisol orders. A proposal to Soil Taxonomy should be formulated for review after the available scientific literature is reviewed. This is currently underway at the University of Tennessee.

3. An inventory of drastically disturbed soils by state should be completed. Information on approximate acreages and nature of disturbances should be recorded.

4. This committee should continue as a function of the NCSS until the duties of the **newly** formed international committee on disturbed soils is defined.

5. Dr. J.T. Ammons will be responsible for coordinating information exchange on drastically disturbed soil for the NCSS. The University of Tennessee will act as a clearinghouse for these activities.

Committee **Discussion**

The committee discussion covered essentially all forms of disturbed soils. It was the consensus that this committee's work should focus on drastically disturbed soils, separating severely eroded or plowed soils. The committee felt that these soils could be classified under the current keys of soil taxonomy.

Most of the disturbed soils research involving drastically disturbed soils has centered around surface mining for coal. The attached list of literature citations reflects as much and this list provides a starting point for the study of disturbed soil properties. It is the intent of the committee to develop a proposal for Soil Taxonomy that will cover all drastically disturbed soils. Disturbed soils created from landfills, civil works projects, dredge and fill, and highway construction will be considered along with disturbed soils created from various mining activities.

Additional discussion centering around urban lands and those agricultural lands that have been plowed to a depth of two meters or more should be considered if the pedogenic clock has been reset to time zero.

Standard soil profile descriptions and other soil inventory procedures currently followed by the NCSS will be followed to reduce duplication of terminology used by fieid soil scientists.

The committee requested that once the current literature is reviewed, a proposal be compiled in draft for review. once all comments are made, this proposal should be forwarded to the International Committee on disturbed soils for additional review and comment, The proposal will become the working document for comments and input from various agencies and researchers.

National Soil Survey WPC
Disturbed Soil Classification Reference List

Ammons, J.T. and E.F. Perry. 1979. The Relationship of Overburden Analysis to Minesoil Properties in Post-Mining Land Use Reclamation. Symp. Sur. Coal Mine Reclamation. McGraw-Hill. p.170-176.

Ammons, J.T., E. F. Perry, and R.M. Smith. 1979. "Soil Water and Root Development on Characterized Classes of Minesoils." Final Report. USDA-SEA by Agreement Number 684-15-16. West Virginia University, Division of Plant Sciences. Morgantown, WV.

Ammons, J.T. 1979. Minesoil Properties, Root Growth, and Land Use Implications. Ph.D. diss. West Virginia Univ., Morgantown (Diss. Abstr. 40:2936B).

Ammons, J.T. and P.A. Shelton. 1985. Disturbed Soil Classification-Divide Section. Tennessee Tombigbee Waterway. Better Reclamation with Trees Symposium. SIU-C, Amax Coal Co. and Purdue University. pp. 127-143.

Ammons, J.T., T.A. Keeney, and R.M. Smith. 1985. Minesoil Properties Affecting Rootgrowth. Better Reclamation with Trees Symposium. SIU-C. AMAX Coal Co. and Purdue University. pp. 111-126.

Ammons, J.T. and J.C. Sencindiver. 1990. Minesoil Mapping at the Family Level Using a Proposed Classification System, J. Soil and Water Conservation 45:567-571,

Anderson, D.W. 1977. Early Stages of Soil Formation on Glacial Till Mine Spoils in a Semi-Arid Climate. Geoderma 19:11-19.

Barfield, B.J., R.I. Barnhisel, J.L. Powell, M.C. Hirschi, and I.D. Moore. 1984. Erodibilities and eroded size distribution of western Kentucky mine spoils and reconstructed topsoil. Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation. Univ. of KY, PP. 179-189.

Barnhisel, R.I. 1992. Mitigation and Management of Acid Minesoils. In Acid Forming Material FF. Munshower and S.E. Fisher (eds.) Reclamation Research Publication No. 9202 Montana State Univ. Office of Surface Mining. pp.47-62.

Barnhisel, R.I. and H.F. Massey. 1969. Chemical, Mineralogical, and Physical Properties of Eastern Kentucky Acid-Forming Coal Spoil Materials. Soil Sci. 108:367-372.

Barnhisel, R.I., J.L. Powell, and D.H. Hines. 1987. Changes in chemical and physical properties of two soils in the process of surface mining. Am. Soc. Surf. Mining and Reclamation 4:87-97.

Barnhisel, R.I. and A.R. Rotramel. 1974. Weathering of clay minerals by simulated acid coal spoil-bank solutions. Soil Sci. 188-22-27.

Barnhisel, R.I., G. Wilmhoff, and J.L. Powell. 1979. Characterization of soil properties of reconstructed prime and non prime land in western Kentucky. 1979 Symposium on Surface Mining Hydrology, Sedimentology and Reclamation. Univ. of KY, Lexington, KY. Dec. 4-7, pp.119-122.

Bearden, E.D. 1984. A Comparison of Variability of Undisturbed and Surface Mined Soils in Freestone County, Texas. Texas A&M University. M.S. Thesis.

Bertsch, P.M., V.P. Evangelou, J.H. Grove, and R.I. Barnhisel. 1983. The importance of soil mineralogical components in a release from acid soil environments. Proceedings of Acid Rain in Kentucky Workshop on Acid Deposition. IMMR, Univ. of KY pp.37-48.

Beverage, W.W. and T.D. Yoakum. 1980. Soil Survey of Harrison and Taylor Counties, West Virginia, USDA-SCS in coop. with WV Agri. and For. Exp. Sta.

Chickester, F.W. and V. L. Hauser. 1991. Change in Chemical Properties of Constructed Minesoils Developing Under Forage Grass Management. Soil Sci. Soc. Am. J. 55(2):451-459.

Cole. C.P. 1976. Overburden and Minesoil Properties in Relation to Original Soil Profiles, with Special Attention to Soil Structure. M.S. Thesis. West Virginia University. Morgantown, WV.

Ciolkoz, E.J. 1983. Characteristics, Interpretations, and Uses of Pennsylvania Minesoils. Pennsylvania Agricultural Experiment Station. Progress Report 381. University Park, PA. pp.88.

Ciolkosz, E.J., R.C. Cronce, R.L. Cunningham, and G.W. Petersen. 1985. Characteristics, genesis, and classificationof Pennsylvania minesoils. Soil Sci. 139:232-238.

DeMent, J.A., S. Cooney, and J. Denman. 1992. Development of a prime farmland minesoil in selectively cast overburden in northeast Texas. p. 177-182. In Dunker, R.E., R.I. Barnhisel, and R.G. Darmody (eds.) 1992. Proceedings of the 1992 National Symposium on Prime Farmland Reclamation. Dept. of Agronomy, University of Illinois, Urbana, Illinois 61801.

Daniels, W.L. and D.F. Amos. 1982. Chemical Characteristics of Some Southwest Virginia Minesoils. Proc. 1982 Symp. Sur. Min. Hydr., Sed., and Rec. Lexington, KY.

Daniels, W.L. and D.F. Amos. 1981. Mapping, Characterization and Genesis of Mine Soils on a Reclamation Research Area in Wise County, Virginia. Symp. Sur. Min. Hydr., Sed., and Rec. Lexington, Ky.

Delp, C.H. 1978. Classification of Mine Spoils. Soil Survey Horizons. 19:11-13.

Delp, C.J. 1975. Soil Morphological Characteristics, Genesis, and Classification of West Virginia Coal Mine Refuse. M.S. Thesis. West Virginia University, Morgantown.

Estepp, R., R.J. Baumley, R.A. Becker, E.A. Kesecker, J.P. Ross, K.N. Sponaugle, D.G. Sprankle, D.G. Van Houten, L. Wright, Jr., and T.D. Yoakum. 1989. Soil Survey of Grand and Hardy Counties, West Virginia. USDA, Soil Conservation Service in cooperation with USDA, Forest Service and West Virginia University Agriculture and Forestry Experiment Station.

Fanning, D.S. 1991. Human Influenced and Distrubed Soils: Overview with Emphasis

0" Classification. Proceedines of the Conference of Human-Influenced and Disturbed Soils, Univ. of N.H. Durham. p.3.

Gorman, J.L. and L.E. Espy. 1975. Soil Survey of Fayette and Raleigh Counties, West Virginia. USDA-SCS in coop. with WV Agri. and For. Exp. Sta.

Grube, W.E., Jr., R.M. Smith, R.N. Singh, and A.A. Sobek. 1973. Characterization of Coal Overburden Materials and Minesoils in Advance of Surface Mining. In Proceedings of the Research and Applied Technology Symposium on Mined-Land Reclamation, Bituminous Coal Research, Inc. Monroeville, PA. p.134-152.

Grube, W.E.. Jr., R.M. Smith, J.C. Sencindiver, and A.A. Sobek. 1974. Overburden Properties and Young Soils in Mined Lands. In Second Reclamation and Applied Technology Symposium on Mined-Land Reclamation. National Coal Association, Washington, D.C. pp.145-149.

Grube, W.E., Jr., E.M. Jencks, R.N. Singh, R.M. Smith, and H.A. Wilson. 1971. Minesoil Potentials for Water Quality and Controlled Erosion. US EPA Report, 14010 EJE.

Grube, W.E., Jr., R.M. Smith, and J.T. Ammons. 1982. Mineralogical Alterations that Affect Pedogenesis in Minesoils from Bituminous Coal Overburdens. Chapter 12. In Acid Sulfate Weathering. SSSA Spec. Pub. No. 10. Madison, WI. p.209-223.

Hanson, R.G., M. Tucker, A.D. Calib, and C.J. Johannsen. 1984. Reclamation of Disturbed Soil by Amending the Minesoil and Placement of Glacial Till Over Minesoil. Commun. Soil Sci. Plant and Soil Vol. 15. p. 419-435.

Hatzell, H.H. 198.5. Geostatistical Analysis of the Spatial Variability of Leveled Lignite Mine Spoil in East Texas. Doctoral Dissertation, Texas A&M University.

Heald, M.T., G.E. Arnold, and R.M. Smith. 1974. Sandstone Weathering on Surface Mine Spoil. Green Lands Quarterly. 4(3):19-20.

Hendley, S. 1991. Recognition of Distrubed Soil Map Units by the National Cooperative Soil Survey. Proceedines of the Conference of Human-Influenced and Disturbed Soils. Univ. of N.H. Durham. p.43.

Hons, F.M. 1978. Chemical and Physical Properties of Lignite Spoils and Their Influence Upon Successful Reclamation. Doctoral Dissertation, Texas A&M University.

Hower, J.M., R.I. Barnhisel, and T.C. Hopkins. 1992. Physical and Chemical Properties of Potential Topsoil Substitutes in Kentucky Oil Shale Mining Reclamation. J. Envir. Quality 21:502-5083.

Indorante, S.J. and I.J. Jansen. 1984. Perceiving and Defining Soils on Disturbed Lands. Soil Sci. Amer. J. 48:1334-1337.

Indorante, S.J. and I. J. Jansen. 1981. Soil Variability on Surface-Mined and Undisturbed Land in Southern Illinois. Soil Sci. Soc. Amer. J. 45:564-568.

Indorante, S.J., D.R. Grantham, R.E. Dunker, and R.C. Darmody. 1992. Mapping and classification of minesoils: past, present. and future. p.233-241. In Dunker, R.E.. R.I. Barnhisel. and R.C. Darmody (Ed.) 1992. Proceedings of the 1992 National Sympsoium on Prime Farmland Reclamation. Department of Agronomy, University of Illinois, Urbana, Illinois 61801.

Joost, R.E., F.J. Olsen, and J.H. Jones. 1987. Revegetation and Minesoil Development of Coal Refuse Amended With Sewage Sludge and Limestone. J. Environ. Qual. 16, p.65-68.

Kaiser, W.R. 1974. Texas Lignite: Near Surface and Deep-basin Resource. Bureau of Economic Geology Report of Investigation, No. 79. University of Texas, Austin.

Levin, M.J. 1991. Soil Mapping in an Urban Environment. Proceedings of the Conference of Human-Influenced and Disturbed Soils. Univ. of N.H. Durham. p.37.

Lyle, E.S. Jr. 1980. Minesoil Classification. In D.G. Simpson and W.P. Plass (ed.). Proceedings of Seminar on the Role of Overburden Analysis in Surface Mining. Wheeling, WV. Bureau of Mines Info Cir. 8863. U.S. Dept. of Interior. Washington, DC. p. 38-51.

McSweeney, K. and I.J. Jansen. 1984. Soil structure and associated rooting in minespoils. Soil Sci. Soc. Am.J. 48:607-612.

Olson, K.R. 1992. Assessment of reclaimed farmland disturbed by surface mining in Illinois. p.173-176. In Dunker, R.E., R.I. Barnhisel, and R.G. Darmody (Eds.) 1992. Proceedings of the 1992 National Symposium on Prime Farmland Reclamation. Department of Agronomy, University of Illinois, Urbana, Illinois 61801.

Pederson, T.A., A.S. Ragouski, and R. Pennack, Jr. 1980. Physical Characteristics of Some Minesoils. Soil Sci. Soc. Am. J. Vol 44(2):321-328.

Perry, E.F. 1978. Minesoil Properties That Influence Fish and Wildlife Habitats. In Samuel, D.E., J.R. Stuffer. C.H. Hocutt, and W.T. Mason (ed.) Surface Mining and Fish/Wildlife Needs in Eastern United States. FWS/OBS-78/81. Biological Services Program, US Dept. of Interior. p.223-231.

Pettry, D.E., W.F. Miller, and J.W. Darden. 1980. Reclamation of the Knob Surface Mine, Alabama, Using Selected Overburden Material. Symp. Min. Hyd., Sed., and Rec. University of Kentucky. Lexington. KY. pp.285-291.

Plass, W.T. and W.G. Vogel. 1973. Chemical Properties and Particle-Size Distribution of 39 Surface-Mine Spoils in Southern West Virginia. US Forest Service Northeastern Exp. Station. Res. Paper NE-276. pp 8.

Pyle, R.E., W.W. Beverage, T. Yoakum, D.P. Amick, W.F. Hatfield, and D.E.

Am. P. Vol. 52, No.3.

Roberts, J..A., W.L. Daniels, J.C. Bell, and J.A. Burger. 1988. Early Stages of Mine Soils Genesis in a Southwest Virginia Spoil Lithosequence Sequence. Soil Sci. Soc. Am. P. Vol. 52. No.3.

Rubel, N., P.C. Jenny, and H.K. Plunkett. 1981. Soil Survey of Belmont County. Ohio. USDA-SCS in coop. with Ohio DNR. Div. of Lands and Soil and Ohio Ag. Research and Development Center.

Schafer. W.M. 1979. Variability of Mine Soils and Natural Soils in Southeastern Montana. Soil Sci. Soc. Am. J. 14:1207-1212.

Schafer, W.M. 1979. Variability of Minesoils and Natural Soils in Southwestern Montana. Soil Sci. Soc. Am. J. Vol. 43(6):1207-1212.

Schafer, W.M., G.A. Nielson, and W.D. Nettleton. 1980. Minesoil Genesis and Morphology in a Spoil Chronosequence in Montana. Soil Sci. Soc. Amer. J. 44(4):802-807.

Sencindiver, J.C., J.T. Ammons, and C.H. Delp. 1978. Minesoil Classification - A Proposed Suborder. 11th Int. Soil Sci. Cong. Abstr. Edmonton, CN. p.30.

Sencindiver, J.C., B.L. Wolf, and N.C. Thurman. 1985. Characterization and Classification of Minesoils in Southern West Virginia. Agron. Abstr. p.197.

Sencindiver, J.C., J.T. Ammons, and R.M. Smith. 1979. Overburden and Minesoil Potentials for Land Use. Proc. WV Acad. Sci. 51(3):138-146.

Sencindiver, J.C. 1977. Classification and Genesis of Minesoils. Ph.D. Diss. West Virginia Univ., Morgantown (Diss. Abstr. 38:1495B)

Short, J.R., D.S. Fanning, M.S. McIntosh, J.E. Foss, and J.C. Patterson. 1986. Soils of the Mall in Washington, D.C.: I. Statistical summary of properties. Soil Sci. Soc. Am. J. 50:699-705.

Short, J.R., D.S. Fanning, M.S. McIntosh, J.E. Foss, and J.C. Patterson. 1986. Soils of the Mall in Washington, D.C.: II. Genesis, classification, and mapping. Soil Sci. Soc. Am. J. 50:705-710.

Short, J.R. 1983. Characterization and classification of highly man-influenced soils on the Mall in Washington, D.C. M.S. Thesis, University of Maryland, College Park.

Simmons, F.W., R.G. Darmody. R.E. Dunker, and J.M. Lang. 1992, Physical properties of deep tilled surface mine soils. p.71-76. In Dunker, R.E., R.I. Barnhisel, and R.G. Darmody (Eds.) 1992. Proceedings of the 1992 National Sympsoium on Prime Farmland Reclamation. Department of Agronomy, University of Illinois, Urbana, Illinois 61801.

Smith, R.M., A.A. Sobek, T. Arkle, J.C. Sencindiver, and J.R. Freeman. 1976. Extensive Overburden Potentials for Soil and Water Quality EPA-60012-76-184. USEPA. Cincinnati, OH.

Smith, R.M. 1976. Minesoil Properties and Classification Study. Green Lands Quarterly. 6(1):11.

Smith, R.M. 1971. Properties of Coal Overburden That Influence Revegetation and Economic Use of Mine Soils. p.5-6. In D.M. Bondurant (ed.) Proceedings of the Revegetation and Economic Use of Surface-Mined Land and Mine Refuse Symposium. West Virginia Univ. Morgantown, WV.

Smith, R.M., E.H. Tryon, and E.H. Tyner. 1971. Soil Development on Mine Spoil. West Virginia Agric. Exp. Stn. Bull. 604T.

Smith, R.M. and A.A. Sobek. 1978. Physical and Chemical Properties of Overburdens, Spoils, Wastes, and New Soils. p.149-172. In F.W. Schaller and P. Sutton (eds.) Reclamation of Drastically Disturbed Lands. ASA Madison, WI.

Smith, R.M., W.E. Grube, Jr., T. Arkle and A.A. Sobek. 1974. Mine Spoil Potentials for Soil and Water Quality. EPA- 670-12-74-070. USEPA. Cincinnati, OH.

Smith, R.M., W.E. Grube, Jr., J.C. Sencindiver, R.N. Singh, and A.A. Sobek. 1974. Properties, Processes and Energetics of Minesoils. Transactions of the 10th International Congress of Soil Science (Moscow, U.S.S.R.). IV:406-411.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith. 1978. Field and Laboratory Methods Applicable to Overburdens and Minesoils. EPA-600/2-78-054. National Tech. information Service. Springfield, VA.

Sobek, A.A. and R.M. Smith. 1971. Properties of Barren Minespoil. Proc. WV Acad. Sci. 43:161-169.

Sobek. A.A., R.M. Smith, and T. Arkle, Jr. 1976. Planning Criteria and Use of Highly Disturbed Soils. In Hillands (Ed.). Proceedings of an International Symposium. Morgantown, WV. p. 535-539.

Strain, M.R. 1991. Proposed Classification of Highly Human-Influenced Soils. Proceedings of the Conference of Human-Influenced and Disturbed Soils, Univ. of N.H. Durham. p.31.

Sweeney. R.L. 1979. Soil Genesis on Relatively Young Surface Mined Land in Southern West Virginia. M.S. Thesis. Virginia Polytechnic Institute and State University. Blacksburg, VA.

Thomas, D. and I. Jansen. 1985. Soil Development in Coal Mine Spoils. J. Soil and water cons. 40:439-442.

Thurman, N.C. and J.C. Sencindiver. 1986. Properties, Classification, and Interpretation of Minesoils at Two Sites in West Virginia. Soil Sci. Soc. Amer. J. 50(1):181-185.

Thurman, N.C., J.C. Sencindiver, J.T. Ammons, and D.C. Adamo. 1985. Physical Properties of Minesoils and Their Effects on Root Growth. p. 194-208. In C.A. Kilar (ed.), Proc. of the 7th Better Reclamation with Trees Conf. Southern Ill. Univ.

Tonkonogov, V.D. and L.L. Shishov. 1990. Classification of Anthropologenically

Transformed Soils. Pochnovedeniye. No. 1:72-79.

Topalanchick, Alex R., Claude L. Marra, and Frank A. Doonan. 1989. Soil Survey of Pleasants and Tyler Counties, West Virginia. USDA, Soil Conservation Service in cooperation with West Virginia Agricultural and Forestry Experiment Station.

Tyner, E.H. and R.M. Smith. 1945. The reclamation of the strip-mined coal lands of West Virginia with forage species. Soil Sci. Soc. Amer. Proc. 9:429-436.

EXERPTS OF MINUTES OF THE STEERING COMMITTEE OF THE 1993 NATIONAL COOPERATIVE SOIL SURVEY CONFERENCE AT BURLINGTON VERMONT

The meeting was called to order by Dr. Richard W. Arnold at the at 1:00 pm on July 16, 1993.

Steering Committee members present were:
Richard Arnold, Director, Soil Survey Division, SCS
Pete Avers, USFS Soil Scientist
Tom Ammons, South Experiment Station Representative
Tom Calhoun, Asst. Dir. Soil Survey Division, SCS
Jim Culver, National Leader SSQA, SCS
Del Fanning, North East Experiment Station Representative
Dennis Heil, Head-Soils Staff, WNTC, SCS
Steve Holzhey, Asst. Dir. Soil Survey Division, SCS
Karl Langlois, Head-Soils Staff, NENTC, SCS
Nathan McCaleb, Soil Scientist, MNTC, SCS
Ken Olson, North Central Experiment Station Representative
DeWayne Williams, acting Head-Soils Staff, SNTC, SCS

A quorum was present.

I. The first order of business was to decide on the disposition of the recommendations from the committees that reported at this years conference.

COMMITTEE 1 The Vadose Zone
chair - DeWayne Williams

Committee Recommendations:

1. NCSS assume the leadership role for characterizing the regolith.

2. NCSS take the initiative to organize a multi-agency, multi-discipline task force to work out a link between soil survey maps and geology maps, with special emphasis on the vadose zone.

3. NCSS assign a member of the SCS Soils Investigations Staff to develop two or three pilot projects involving multi-agency, multi-discipline personnel to work out the feasibility and methodology of characterizing the regolith for the purposes of addressing water quality and other issues.

4. NCSS recommends that reports on the progress of recommendations 3 and 4 be made at the next NCSS conference.

5. Disband this committee.

Steering Committee Actions:

Recommendation 1: Accepted
Recommendation 2: Chair and establish this task force as a National NCSS task force to report at the next conference.
Recommendation 3: This item will be referred to SCS soil survey leadership for action.
Recommendation 4: Accepted
Recommendation 5: Accepted

COMMITTEE 2 Role of NCSS and the New Cooperator
chair - G. Wade Hurt

Committee Recommendations

1. No action be taken to create within NCSS the ability to sign MOUs or in any other way "formalize" NCSS.

2. SCS acting for NCSS, pursue the development and Signing of MOUs with the Corps of Engineers, NASA, World Bank, Department of Defence, and other applicable agency and institutional users of soils information.

3. NCSS pursue a dialog with and invite to the NCSS Conference, representatives of national organizations of consultant soil scientists, agribusinesses, etc. and that the NCSS encourage states to develop MOUs with state associations that represent private consultants.

4. SCS and other NCSS agencies and institutions review existing MOUs to insure that the best interests of NCSS are being served.

5. NCSS not accept any additional role in endorsing state procedures and standards that involve soil survey.

6. NCSS not accept any additional role in endorsing State laws and regulations that involve soil survey.

7. NCSS not develop a "Code of Ethics"

8. NCSS develop guidelines and procedures for soil survey use in conjunction with geographical information system and other pseudo-intelligent systems.

9. NCSS develop guidelines and procedures for site specific, Order 1, soil surveys and that the kind and extent of surveys by NCSS representatives be differentiated from those of private consultants.

10. SCS's proposed National Soil Survey Users Council be replaced with NCSS sponsored user conferences.

Steering Committee Action:

Recommendation 1: The SCS Soil Survey Division on behalf of NCSS is to explore the mechanism for signing intents to cooperate with private institutions, but not formalize NCSS in any other way.

Recommendation 2: SCS acting for NCSS will pursue the development and signing of the mentioned MOUs to encourage participation in NCSS.

Recommendation 3: SCS acting for NCSS will create a dialog with and pursue developing agreements with state associations that represent private consulting soil scientists and other appropriate groups.

Recommendation 4: Accepted.

Recommendation 5: Accepted.

Recommendation 6: No action taken since NCSS does not now have that role.

Recommendation 7: Accepted.

Recommendation 8: Accepted.

Recommendation 9: This work on order 1 guidelines is currently in progress by SCS. The second part of this recommendation is to be forwarded to the NCSS Regional conferences for their consideration as they put their committees together.

COMMITTEE 3 Soil Survey by MLRA
chair - Keven McSweeney/Bob McLeese

Committee Recommendations

1. Develop a model organization structure for MLRA soil surveys.

2. Adopt and promote TQM philosophy for conducting MLRA surveys.

3. Refine the objective/goal statements for MLRA soil surveys and disseminate as soon as possible.

4. Develop a soil survey marketing plan to include strategy for marketing and promoting mlra concepts.

5. Soil survey by MLRA concept needs to remain flexible enough to allow for soil survey by other geographic area (physiographic area, watershed, soil region, etc.).

6. Develop a soil survey funding strategy that identifies new partners and funding sources, establishes criteria to prioritize MLRA's, and proposes a new funding formula.

7. Establish an NCSS committee to provide recommendations about the use of GIS and allied technologies in soil survey update activities.

8. Finalize work on the "Soil Survey by Geographic Area" guidebook and disseminate ASAP. Address tactical, operational and project functions and activities.

Steering Committee Actions:

The steering committee accepted the entire set of recommendations. Many of these concern work that is already in progress and work that must be addressed as MLRA soil survey projects are established by SCS. These recommendations will be forwarded to the appropriate SCS Soil Survey Program team that will deal with the MLRA projects.

COMMITTEE 4 The Digital Soil Survey
chair - Dennis Lytle

Committee Recommendations:

1. Review standards in light of
   - o Base materials
   - o equipment capabilities

   may need to relax standards in certain cases.

2. Need to make data easily available
   - o internet online or CD ROM
   - o central archive on 7.5' base
   - o cartographic unit should be 7.5'

3. Concentrate on GIS as a tool up front to help with making soil survey.

4. Site observations should be made available
   - o USGS for examples

5. Digital soil survey should contain as much or more than published soil survey report and be based on user needs.

6. Need to deal with the issue of changing base maps (ortho or 7.5') and the new base not matching the digitized lines.

7. Digital product is more user friendly, but is also more subject to abuse, so education of users is important.

8. Needs to be made available as a teaching tool
   - IDRISI
   - STATSGO

9. Consider moving SCS archive and distribution to USGS or National Ag. Library.

10. Disband committee

Steering Committee Action:

These deliberations were made in the form of issues that need to be considered as the digital soil survey program is further developed. The Steering Committee accepted the report and it will be used to focus future developmental efforts in this area.

COMMITTEE 5 Disturbed Lands
chair - Tom Ammons

Committee Recommendations:

1. Develop a definition of Drastically Disturbed Soils to separate those that are eroded or plowed.
2. Classification of drastically disturbed soils should follow the protocol within Soil Taxonony. New suborders should be defined in the Enitsol and Inceptisol Orders. (This procedure should be attempted after available literature is consulted. The University of Tennessee is currently involved in this effort.)

3. An inventory of drastically disturbed soils should be conducted on a state by state basis. An inventory form should be sent to each state to obtain approximate acreage and type of disturbance.

4. This committee should continue until it can be established how it will function with the newly established international committee. If this committee's activities fit, then it should continue as part of the international group. If not, this committee should continue as part of the National Cooperative Soil Survey Conference.

5. A person should be assigned coordinating responsibilities for this activity for the National Cooperative Soil Survey. This person should serve as a clearing house for these activities.

Steering Committee Actions:

Recommendation 1:	The existing committee is assigned the task of developing this definition.
Recommendation 2:	Accepted.
Recommendation 3:	Referred back to the committee as an additional charge.
Recommendation 4:	Accepted.
Recommendation 5:	Dr. Ammons has agreed to serve.

NATIONAL COOPERATIVE SOIL SURVEY

National Cooperative Soil Survey Conference Proceedings

Seattle, Washington
July 22-26, 1991

United States Department of Agriculture

Soil Conservation Service

Proceedings of National Cooperative Soil Survey Conference

Seattle, Washington

July 22-26, 1991

National Cooperative Soil Survey Conference

Seattle, Washington
July 22-26, 1991

1

Monday - July 22

10.00 AM 12:00 PM	Registration
12:00 PM - 1:00 PM	Lunch
1:00 PM - 1:15 PM	Welcome Lynn Brown State Conservationist USDA-SCS Spokane. Washington
1:15 PM - 2.00 PM	Opening Remarks and Report on SCS Soil Survey Activities Richard Arnold Director. Soil Survey Division USDA-SCS Washington. DC
2:00 PM - 2:30 PM	Soils of Washington State Dr. Bruce E. Frazier Assistant Professor Washington State University Pullman, Washington
2:30 PM 3:00 PM	Northeast Agricultural Experiment Station Report Dr. John Sencindiver Professor West Virginia University West Virginia
3:00 PM 3:30 PM	BREAK
3:30 PM 4:00 PM	South Agricultural Experiment Station Report Dr. Fred Beinroth Professor University of Puerto Rico Mayaguez, Puerto Rico
4:00 PM 4:30 PM	West Agricultural Experiment Station Report Dr. Paul McDaniel University of Idaho Moscow, Idaho

4:30 PM - 5:00 PM — **Mid West Agricultural Experiment Station Report**
Dr. Tom Fenton
Iowa State University
Professor
Ames, Iowa

Tuesday - July 23

8:00 AM 12:00 PM — **Total Quality Management Workshop**
Rex Tracy and Jim Ware
National Headquarters
USDA-SCS, Washington, DC

(coffee available at 9:30)

12:00 PM 1:00 PM — LUNCH

1:00 PM 4:30 PM — Total Quality Management Workshop

Wednesday - July 24

8:00 AM - 8:30 AM — Report on Soil Survey Activities in Canada
Dr. Gerry M. Coen
LRRC Soil Survey Unit
Agriculture Canada
Edmorton, Alberta

8:30 AM - 10:00 AM — AEGIS Demonstration
Dr. Fred Beinroth
Professor
University of Puerto Rico
Mayaguez, Puerto Rico

CRASS-STATSGO Demonstration
Dennis Lytle
National Soil Survey Center
USDA-SCS, Lincoln. Nebraska

10:30 AM - 5:00 PM — TOUR - Forest Soils, GPS Demonstration, and Pedon Data Program Demonstration

(Box lunches should be purchased at time of registration)

Thursday - July 25

Poster Presentations

8:00 AM - 8:45 AM — National Soils Information System Concepts
Dave Anderson
National Soil Survey Center
USDA-SCS, Lincoln, Nebraska

8:45 AM 9:30 AM — Hydric Soils Committee Report
Dr. Maurice Mausbach
National Headquarters
USDA-SCS

9.30 AM 10:00 AM

10:00 AM 10:30 AM

10:30 AM - 11:15 AM

11:15 AM - 11:45 AM

11:45 AM 12:30 PM

12:30 PM - 1:00 PM

1:00 PM 1:45 PM

1 45 PM - 2 30 PM **International Activities**
Hari Eswaran
National Leader for World Soil Resources
USDA-SCS. Washington, DC

COMMITTEE MEETINGS

2:30 PM 3:30 PM **Committee 1**
NSH-NCSS Manual
Committee 2
Soil Survey Data Dictionary
Committee 3
Map Unit Reliability-Data Variability

3 30 PM 4:30 PM **Committee 1**
NSH-NCSS Manual
Committee 2
Soil Survey Data Dictionary
Committee 3
Map Unit Reliability-Data Variability

4:30 PM 5:30 PM **Task Force 1**
Status of Land Mapped in the U.S
Task Force 2
Past Conference Reports

Friday July 26

6:00 AM 8:30 AM **Report on Soil Survey Activities in Mexico**
Andres Aguilar
Universidad Autonoma Chapingo
Chapingo, Mexico

8:30 AM 9:00 AM **Report - NSH-NCSS Manual Committee**
Sy Ekart. Soil Scientist
USDA-SCS, NSSC Lincoln, NE

9:00 AM 9:30 AM **Report Soil Survey Data Dictionary Committee**
Dave Anderson. National Leader for Soil Survey Data Bases
USDA-SCS, NSSC Lincoln, NE

9:30 AM 10 00 AM **BREAK**

10 00 AM - 10 30 AM **Report Map Unit Reliability Data Variability Committee**
Ellis Knox. National Leader for Soil Survey Investigations
USDA-SCS. NSSC, Lincoln, NE

10 30 AM - 11:00 AM **Task Force Report Status of Land Mapped in the U.S.**
Cohn Voight. Soil Scientist
USDI-BLM, Washington, DC

11 00 AM - 11:30 AM **Task Force Report. Past Conference Reports**
Joe Nichols, Head. Soil Interpretations Staff. SNTC
USDA-SCS. Fort Worth, TX

11 30 AM 12:00 PM Closing Remarks
Richard Arnold

12 00 PM **ADJOURN**

The Steering Committee will meet at 1:00 PM.

Providing Quality Soil Survey Information To Our Customers

PARTICIPANTS IN THE 1991 NATIONAL SOIL SURVEY CONFERENCE

Dr. Andres Aguilar, Universidad Autonoma Chapingo, 56230 Chapingo, Mexico

David L. Anderson, Database Development Team Leader, Technology Information Systems Division, USDA-Soil Conservation Service, Fort Collins, CO, 303 498-1968

Dr. Richard W. Arnold, Director, Soil Survey Division, USDA-Soil Conservation Service, Washington, DC, 202 720-1819

Pete Avers, Soil Resource Program Manager, USDA-Forest Service, Watershed and Air Management, Washington, DC, 202 205-0977

Dr. Fredrick Beinroth, Professor of Soil Classification, Department of Agronomy and Soils, University of Puerto Rico, Mayaguez, PR, 809 832-4040

Lynn A. Brown, State Conservationist, USDA-Soil Conservation Service, Spokane, WA, 509 353-2337

Thomas E. Calhoun, Assistant Director, Soil Survey Division, USDA-Soil Conservation Service, Washington, DC 202 720-1824

James A. Carley, State Soil Scientist, USDA-Soil Conservation Service, Spokane, WA, 509 353-2339

Dr. Gerald Coen, Acting Unit Head, Agriculture Canada - Soil Survey, Edmonton, Alberta, Canada, 403 495-4243

Dr. Mary Collins, Professor of Soil Genesis and Classification, Department of Soil Science, University of Florida, Gainsville, FL, 904 392-3261

Gerald Crenwelge, Area Soil Scientist, USDA-Soil Conservation Service, Beaumont, TX

James R. Culver, National Leader, Soil Survey Quality Assurance Staff, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5353

Scott Davis, Soil Scientist, USDI-BLM, Colorado State, Lakewood, CO, 303 239-3721

Richard Dierking, Soil Scientist, West National Technical Center, USDA-Soil Conservation Service, Portland, OR, 503 326-2824

Jim Doolittle, Research Soil Scientist, Northeast National Technical Center, USDA-Soil Conservation Service, Chester PA 215 499-3964

Sy Ekart, Soil Scientist, USDA-Soil Conservation Service, Bismark, ND, 701 250-4435

Dr. Hari Eswaran, National Leader, World Soil Resources, Soil Survey Division, USDA-Soil Conservation Service, Washington, DC, 202 690-0333

Marjorie Faber, Soil Scientist, USDA-Soil Conservation Service, Windsor, CT, 203 688-4099

Dr. Tom E. Fenton, Professor of Soil Morphology and Genesis, Department of Agronomy, Iowa State University, Ames, IA, 515 294-1360

Dr. Bruce Frazier, Associate Professor of Soil Science and Remote Sensing, Department of Crop and Soil Sciences, Washington State University, Pullman, WA, 509 335-3564

Dr. Don W. Goss, Soil Scientist, Texas A&M University System, Temple, TX, 817 770-6600

Karl Hipple, Soil Scientist, USDA-Soil Conservation Service, Spokane, WA, 509 353-2339

Dennis Hollaran, Consulting Soil Scientist, Northwest Soil Consultants, Idleyld Park, OR, 503 496-3724

Dr. C. Steven Holzhey, Assistant Director, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5346

Dr. Berman D. Hudson, Supervisory Soil Scientist, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5353

Keith Huffman, State Soil Scientist, USDA-Soil Conservation Service, Columbus, OH, 614 469-6914

Steve Hundley, State Soil Scientist, USDA-Soil Conservation Service, Durham, NH, 603 868-7581

Carole Jett, State Soil Scientist, USDA-Soil Conservation Service, Davis, CA, 916 449-2870

Dr. Eugene Kelley, Assistant Professor, Department of Agronomy, Colorado State University, Ft. Collins, CO, 303 491-6501

Robert Klink, Soil Scientist, Bureau of Indian Affairs, Portland, OR, 503 231-6444

Dr. Ellis G. Knox, National Leader for Soil Survey Investigations, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5363

Dr. Harbanes Lal, Department of Agricultural Engineering, University of Florida, Gainsville, FL, 904 392-3261

Dr. Duane Lammers, Soil Scientist, U. S. Forest Service, Forest Sciences Laboratory, Corvallis, OR, 503 750-7258

Karl H. Lanqlois, Head, Soil Interpretations Staff, Northeast National Technical Center, USDA-Soil Conservation Service, Chester, PA, 215 499-3964

Garland Lipscomb, State Soil Scientist, USDA-Soil Conservation Service, Harrisburg, PA, 717 782-3889

Dennis J. Lytle, National Coordinator, Soil Geography, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5423

Clarence Maesner Head, Ecological Sciences Staff, West National Technical Center, USDA-Soil Conservation Service, Portland, OR

Dr.Maurice J. Mausbach. National Leader. Technical Soil Services, USDA-Soil Conservation Service, Washington, DC, 202 720-1812

Harold Maxwell, State Soil Scientist, USDA-Soil Conservation Service, Boise, ID, 208 334-1348

Nathan McCaleb, Soil Scientist, ESP Staff, Midwest National Technical Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5346

Dr. Paul McDaniels, Assistant Professor of Soil Morphology, Department of Plant, Soil and Entomological Sciences, University of Idaho, Moscow, ID, 208 885-6276

Dr. Bob Meurisse, Regional Soil Scientist, U. S. Forest Service, Portland, OR

Wesley Miller, Area Soil Scientist, USDA-Soil Conservation Service, Victoria, TX,

Gary Muckel, Soil Scientist, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5353

Joe D. Nichols, Head, Soil Interpretations Staff, South National Technical Center, USDA-Soil Conservation Service, Ft. Worth, TX, 817 334-5253

Jerry Ragus, Resource Soil Scientist, USDA-Forest Service, Atlanta, GA, FTS 257-7211

Dr. Pierre Robert, Assistant Proffessor of Soil Classification and Survey, Department of Soil Science, University of Minnesota, St. Paul, MN, 612 625-5000

William E. Roth, Soil Scientist, Soil Survey Division, USDA-Soil Conservation Service, Washington, DC, 202 720-1809

Dr. John C. Sencindiver, Associate Professor of Soils: Department of Plant and Soil Sciences, West Virginia University, Morgantown, WV, 304 293-4817

Benjamin Smallwood Soil Scientist, USDA-Soil Conservation Service, Washington, DC, 202 720-1813

Chris Smith, Soil Scientist, Northeast National Technical Center USDA-Soil Conservation Service, Chester, PA, 215 499-3964

Horace Smith, State Soil Scientist, USDA-Soil Conservation Service, Raleigh, NC, 919 790-2905

Lawson D. Spivey, Jr., Soil Scientist, Soil Survey Division, USDA-Soil Conservation Service, Washington, DC, 202 720-6371

Ben Stuckey, State Soil Scientist, USDA-Soil Conservation Service, Columbia, SC, 803 253-3896

Jim Thiele State Soil Scientist, USDA-Soil Conservation Service, Bismark, ND, 701 250-4435

Larry Tornes, State Soil Scientist, USDA-Soil Conservation Service, East Lansing, MI, 517 337-6680

Rex Tracy, TQM Specialist, USDA-Soil Conservation Service, Washington, DC, 202 720-3750

Colin W. Voigt, Soil Scientist, U.S. Department of Interior, Bureau of Land Management, Washington, DC, 202 653-9210

Dr. Bill Waltman, Soil Scientist, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5363

Bobby Ward, State Soil Scientist, USDA-Soil Conservation Service, Indianapolis, IN, 317 290-3203

James H.Ware, Soil Scientist, Soil Survey Division, USDA-Soil Conservation Service, Washington, DC, 202 720-1808

Dr. Larry Wilding, Professor of Soil Classification Department of Soil and Crop Sciences, Texas A&M University, College Station, TX, 409 845-3041

DeWayne Williams, Soil Scientist, South National Technical Technical Center, USDA-Soil Conservation Service, Ft. Worth, TX, 817 334-5253

Dr. John E. Witty, National Leader for Soil Classification, National Soil Survey Center, USDA-Soil Conservation Service, Lincoln, NE, 402 437-5363

National Cooperative Soil Survey Conference
(1991)

Welcome to the 1991 conference of the National Cooperative Soil Survey. It is indeed a privilege to have all of you in attendance and to know you represent many of your fellow soil scientists. The decade of the 90's presents untold opportunities for soil science and especially pedology - the art and science of soil classification, genesis, cartography and interpretation. Global change is more than a catchy phrase - it is beginning to guide our analysis and investigations and it challenges our data bases almost without mercy. Sustainability is a concept that I place in the category of visions. If we hear, if we believe, and if we take actions that are appropriate then we can be significant contributors to a sustainable global habitat.

Why is sustainability a vision? It is a vision because it looks beyond the obvious horizons. Yes, it looks beyond the obvious crystal ball trends and conditions as we perceive them today. Sustainability is probably the most difficult state of the global environment to attain. It forces us to re-visit the management practices we espouse today. Many of them are designed for short term benefits - not for harmony, efficiency, and a better quality of life for all people everywhere.

As soil scientists of the NCSS we want to provide quality products and services to all of our clients in so far as it is possible to do so. We will explore relationships between customers and suppliers this week because they are essential for continuing role as the "good hands" people of the earth.

I'd like to share some sights that illustrate why we must take a more proactive position throughout this decade. Our mission. Our mission is to help people better understand soils and to wisely use soil resources. Notice it is people oriented. It always has been. We accomplish our mission by doing four things. First, it is essential that we maintain a strong scientific basis for the relationships we use. Secondly, we provide the required expertise to do our kind of work. Third, we make our information available in all kinds of formats as may be useful to our clients. Fourth, we are back to people again, helping them understand and use soil information in their decision making.

What's going on in our world today? Rain forests and other forests are being cleared, burned and prepared for cropping.

Shallow, steep soils that once supported forests have become marginal areas of productivity. Droughts are here, of course, and famine and desolation and lots of heart break. In places there are new homes for new immigrants. A whole new beginning, yet very few people wonder why there weren't people there before. Aha, Mr. Minister of the Environment, what do you think of our efforts to correct the problems? I see you are still holding your nose. Thank you, Mr. Minister.

Markets and marketing for the potential customers. But look again, there are far too many of them. Everyone wants to belly up to the trough. Who is looking ahead to the consequences of the "me now" attitude? And the wildlife wanders away, not at all sure that we really have a message of hope. We really do care. Sometimes even before they gain a place on the endangered list. Cultural diversity, hard labor, illiterate; shackles of the mind more harmful than barbed wire barriers. Also the lure of cities drawing the helpless, the homeless, the poor like a magnet. The lure and prospect of "city gold". There are significant differences in beliefs, and values. Differences in concepts of pride and meaning, in integrity, and in the here after.

These shacks nestled along the river bank suggest that all homesites don't get the sane degree of planning. What do our rating guides for houses have to say about these situations? And here is a grass savannah in a 2500 mm rainfall area. What do you expect, what will you recommend? Will it be based on your udic, nesic experiences - like environmental mistakes made before?

Clients cone wrapped in all colors of skin. They have varied family arrangements and other differences that *aren't* important to us who are here to help. We must continue to study relationships in the field and learn from each other. Then we need to tell others; to inform them of soil property-soil behavior relationships that are relevant to their decisions. In the field there are improved plants, renewed interest in rotations and a concern about the land and its care. More and more different users come together to hear and see and learn about potential solutions for their concerns.

Traveling, teaching, sharing, learning - it is truly the age of information. We are part of a soil information system. It is world wide. But the information age isn't all that easy. Some is guarded jealously - and many dare not enter the guarded doors. After a long struggle, a climb to a high mountain pass we often discover that it is still going to be a difficult journey ahead. Attempts to have a common language, a voice of consensus, a choice for progress---is inevitably a slow process.

The far mountains, the clear waters, the solitude. Do you feel comfortable, refreshed, at peace, happy? This is Nature nearly unadulterated, with very, very people around. Comfortable, isn't it? Here we are, soil scientists in touch with nature unravelling the mysteries of how soils form, what their properties are and so forth. But there are whole segments of our society who have no knowledge, or even interest, in our world of soils. In the past, people have recorded their messages.. many seem to have been misunderstood. Some were hieroglyphics - and printed on rock to last forever.

Complexity in soils is really common. Tracing the patterns of mottles often looks like modern art gone haywire. How do we get the flexibility required for the future? First we have to recognize that even our sacred concepts do change with time. Listening, talking, hearing, sharing. These are client-supplier, customer alignment words. It's a first step, but so crucial.

Another shot of the wilderness? Not quite. Look again carefully, there's a group of people out there. Crazies, perhaps. Holy smoke. A Haplic Cryohumod. Searching, seeking, trying to understand more about our world and how it operates. Here is a mock-up of a laterite profile. Hard ferricrete and duricrust on top, gradually changing to the thin mottled zone, and changing abruptly to the pallid kaolinitic zone. In Australia, they have huge mines taking the kaolin from the lower beds. Are these soils? If so , from what geologic period, the Tertiary or before? It's a complex story this earth of ours has.

SOTER and NASOTER are world efforts and those of Canada and the U.S. to prepare a common map with a common legend and attribute file. Problems, you bet, but we have started. Soil processes need to be understood so that realistic models can be developed. These concepts are used in WEPP, the water erosion model. Now this should be familiar to us all. The nine landscape components including the concave-concave pattern of cove positions. The challenge of today is to link segments together and describe landscape interactions.

We have to learn more about cropping systems, conservation tillage, imitating nature yet providing for the needs of mankind. The experimental design shown here is powerful stuff if you want to scientifically demonstrate that many, many results are those related to differences of soils. Some people call this sequential testing

And to finish, let me recall the conclusions from a soil workshop several years ago. We know a lot, we show a lot yet there is much to be done. And today we go forward together.

Richard W. Arnold

Northeast Agricultural Experiment Station Report
to the
National Cooperative Soil Survey Conference
July 22-26, 1991

by

John Sencindiver and Bill Waltman

Introduction

This report summarizes the 1990 regional conference committees, the activities of the northeast experiment station coordination committee on soil survey, and research projects of experiment station/university faculty. The 1990 Northeast Cooperative Soil Survey Conference was held in Morgantown, WV on the West Virginia University campus on June 3-8, 1990. Details of that conference have been published in the proceedings, copies of which are available from Steve Holzhey, Karl Langlois or John Sencindiver.

Committees of the 1990 Northeastern Regional Soil Survey Conference

Committee 1: Drainage Class.
Committee 2: Soil-Water Contamination.
Committee 3: Geographic Information Systems.
Committee 4: Should Soil Survey Be Involved In Describing The Earthy Material Between Soil and Bedrock?
Committee 5: Including Private and Public Sector Soil Scientists that are not now a part of the NCSS.
Committee 6: How to Attract Students into Soil Survey.

NEC-50, Northeastern Regional Committee on Soil Survey.

MC-50 sponsors an annual soil genesis field trip primarily for graduate students and university faculty, but other persons are welcome to attend. In 1990 the trip was held in Maryland. The 1991 trip was held in Massachusetts, Rhode Island and Connecticut. Pennsylvania and West Virginia will host the 1992 trip.

Research in the Northeast

Connecticut (New Haven) - Composted manures are being evaluated in an effort to dispose of animal manures in an environmentally safe manner. Release of nitrogen from the compost is relatively slow, reducing potential losses to leaching as crops readily utilize the nitrogen as it become available.

Connecticut (Storrs) - Studies of the Pre-Sidedress Soil Nitrate Test, also known as the June Nitrate Test, are continuing. Existing and proposed criteria for Spodosols are being evaluated. Acid sulfate soils formed in dredged spoils from brackish waters are being studied.

Delaware (Newark and Georgetown) - Leaching, sorption, biodegradation and general fate of pesticides and organic contaminants in soils are being evaluated. The contribution of soybeans to nitrate contamination of groundwater is being assessed. Improved management practices for nutrients are being developed.

Maine (Orono) - Characterization of Maine soils continues, using soil mapping units as the sampling basis. Work continues on the definition of the spodic horizon.

Maryland (College Park) - Studies include (1) formation of iron sulfide in tidal marsh soil; (2) mineralogy and vanadium distribution in SWAN-gypsum; (3) colors of acid sulfate soils; (4) hydrology, morphology and mineralogy of soils in the Triassic Basin of Maryland; (5) spodic characteristics of soils in eastern Maryland; and (6) anthropic epipedons affected by oyster shell middens.

Massachusetts (Amherst) - Studies include the relationship between soil morphology and soil moisture regimes, relationship of hydric soils and hydrophytic vegetation, fragipan formation, spatial variability of organic matter content, phosphorus sorption in relation to wastewater renovation, wastewater treatment using peat technology, and an evaluation of the application of morphological data in hydric soil identification.

New York (Ithaca) - A Soil Information Systems Laboratory has been established at Cornell to serve as a focal point for soil survey digitizing. Several GIS-based projects have been established: (1) potential pesticide leaching, (2) soil impact assessment and amelioration of pipeline construction and (3) site assessment for landfill sighting. Other pedological studies include P-retention in Central American soils, iron oxides in Brazilian oxisols and soil temperature of New York soils.

Pennsylvania (University Park) - The Land Analysis Laboratory conducts research on soil landscapes and hydrology to improve the understanding of soil-water relationships, to discover new information about soils and to implement new techniques that utilize soil information in land-use planning and management. Numerous GIS-based projects are being conducted. Limited soil sampling ƒœ?ðü? ioine foroOther(research project, ie: radion)Tj 0 TwT*d (nvpestglat of the Ridge and Valley province, flood and river terrace soils in the Coastal Plain. Work continues on a project to incorporate water quality indexes and new soil productivity indexes into soil test recommendations. Pilot programs for yard waste composting have begun.

West Virginia (Morgantown) -'Research centers on reclamation of mined lands and disposal of wastes. Specific studies include land application of municipal wastewater sludges; evaluation of soils for wastewater disposal; abandoned mine land and coal refuse revegetation; mineralogy, genesis and classification of extremely acid minescils; use of fly ash to reclaim mined lands; and removal of metals from acid mine drainage by cattail wetlands.

Report on the 1990 SOUTHERN REGIONAL TECHNICAL WORK-PLANNING CONFERENCE of the NATIONAL COOPERATIVE SOIL SURVEY

Fred H. Beinroth
College of Agricultural Sciences
University of Puerto Rico

INTRODUCTION

For its 1990 Technical Work-Planning Conference, the Southern Region decided to go as far south as possible. As a geographical consequence, the SRTWPC was held in Puerto Rico from 18 to 22 June. This marked the first time that such a conference convened in Puerto Rico. It was hosted by the University of Puerto Rico (UPR) and the local Soil Conservation Service. Fred Beinroth, Professor of Soil Science at UPR, and Gilberto Acevedo, SCS Staff Soil Scientist for the Caribbean Area, served as chairman and vice-chairman, respectively. They and Joe D. Nichols, Head of the Soil Inter-pretation Staff at the South National Technical Center, also formed the Steering Committee of the Conference.

Perhaps as a result of the venue, the SRTWPC enjoyed a sizable attendance of about 80 soil scientists. The program showed another location effect. In a distinct departure from past practice, almost as many days were spent in the field as in conference since there were two days of field trips and two and one half days of technical sessions.

TECHNICAL SESSIONS

"Soil Survey in the Information Age: ADDRESSING CHANGING USER NEEDS" could have been the theme of the Conference as this motto captures the tenor of the meeting. This agenda is also reflected in the focus of the 1990 SRTWPC Committees:

- Communication in the National Cooperative Soil Survey,
- Soil Data Bases for Geographic Information Systems,
- Soil Data for Modeling,
- Soil Survey and Management of Forest Soils,
- Soil Water, and
- Minesoil Classification and Interpretation.

The first three of these committees were new while the others were carried over from the previous conference.

A detailed account of the work and recommendations of the six committees is contained in the Proceedings of the Southern Regional Technical Work-Planning Conference that was reproduced and distributed by the SCS South National Technical Center. In addition to the usual peripheral information, this 121-page report also contains the text of two excellent keynote addresses: Managing Tropical Forests in a Time of Climate Change by Ariel E. Lugo, an ecologist with the USDA Forest Service in Puerto Rico: and The Soil Resource: Challenges and Perspectives for the 1990's by E.C.A. Runge, Professor and Head of the Department of Soil and Crop Sciences of the Texas A&M University.

The following is a summary of the salient activities and recommendations of the 1990 SRTWPC committees that intends to provide an overview of what transpired at the meeting and entice the reader to consult the Proceedings for further information.

Committee I: COMMUNICATION IN THE NATIONAL COOPERATIVE SOIL SURVEY
Chair/Vice-chair: Glenn E. Kelly/Wayne Hudnall

The committee was charged to propose ways and means to improve the effectiveness of communication in the NCSS. They developed a comprehensive questionnaire that was sent to 105 individuals in the Southern Region, of which about half responded. On the basis of this survey, the committee concluded that communication in the NCSS is indeed in need of improvement and recommended that:

- the South National Technical Center assume a more active role and explore the use of electronic mail,
- the NCSS establish a committee on communication, and
- the committee be discontinued for now, although it may have to be re-established at a later time.

Committee II: SOIL DATA BASES **FOR GEOGRAPHIC INFORMATION** 6YSTEMS
Chair/Vice-chair: Mary E. Collins/Carter Steers

The committee was charged to assess the impact and requirements of GIS methodology for landuse planning and natural resource management relative to the soil survey data base with particular emphasis on (a) the detail, accuracy and consistency of primary and secondary soil data, (b) levels of generalization for interpretation at different scales, and (c) update procedures. They were also asked to recommend possible improvements.

The committee attracted a large number of very active members who recommended that:

- the responsibility for primary and secondary data end when given to the user,
- the user should be familiar with map scale, minimum delineation and survey reliability (a certainly desirable but perhaps unrealistic recommendation as we have no control over the user's pedologic expertise),
- the current update procedures be continued,
- the NCSS establish a policy for facilitating GIS soils data,
- the SCS support inputting soil survey data into a GIS,
- each state have a soil scientist responsible for GIS, and
- the committee be continued in view of the escalating prominence of GIS.

committee 111: BOIL DATA FOR MODELING
Chair/Vice-chair: Earl Blakely/Fred H. Beinroth

The committee had two charges:

1. Evaluate the adequacy of soil survey data for environmental and agricultural models and knowledge-based systems with regard to
   - accuracy and completeness,
   - spatial and temporal variability,
   - default procedures, and
   - implications for SCS operations; and
2. Recommend remedial action.

The committee advanced no less than eleven recommendations:

- Develop and test a methodology for recording variability and collect respective data,
- Encourage the accelerated use of the Computerized Soil Description System and Transect Program (SCS-232),
- Record map unit composition and landscape features,
- Describe soils to 2 m depth,
- Collect more precise water table data,
- Convert official pedon descriptions (OSEDS) into tabular format,
- Accelerate the development of the National Soil Characterization Data Base,
- Establish better communication with modelers to ensure that model requirements are more in tune with data availability,
- Focus data gathering efforts on a set of benchmark sites for model testing,
- Develop procedures for estimating missing soil data and model-required soil data not contained in the standard data base, and
- Continue the committee with emphasis on spatial variability.

Committee IV: SOIL SURVEY AND NANAGEHENT OF FOREST LANDS
Chair: Jim Keys

The committee was charged to develop criteria for specific interpretations of soil surveys for forest lands, and to recommend alternatives for presenting forestry interpretations in soil survey reports.

They recommended that:
- the work on woodland interpretations for specific practices be continued concentrating on criteria of regional application,
- innovative alternatives of presenting forestry interpretations be compiled, and
- the committee continue with emphasis on local interpretations.

Committee V: SOIL WATER--CLASSIFICATION AND INTERPRETATION
Chair/Vice-chair: Larry P. Wilding/Arville Touchet

The charge of this committee was, in essence, to recommend soil survey activities and policies that facilitate procurement and transmission of water-related soil properties pertinent to soil classification, behavior and management.

The committee's innovative approach to accomplishing this charge was to select key individuals with expertise in given subject matter areas to develop position papers, or extended abstracts, that outline topic pertinence, and soil survey needs to improve the database, information content and interpretation accuracy. The following topics were addressed by the indicated contributors:
- Monitoring soils wit and without aquic conditions in the Gulf Coast region - W.H. Hudnall and L.P. Wilding
- Guidelines for establishing wetland interpretations inferred from aquic moisture conditions - M.J. Mausbach and R.W. Fenwick
- Guidelines for assessing soil/water properties governing pesticide movement - D.W. Goss

- Macropores in soils: Quantification and affects on water and solute transport - L.T. West
- Septic tank filter field designs for soils with perched aquic conditions - E.M. Rutledge and B.J. Teppen
- Propose criteria for identification of soil moisture regimes - R. Paetzold

The above papers are included in the Conference Proceedings and add considerable scientific substance to the publication. From these position papers, the committee members developed the following recommendations:

- Establish regional and national log-term projects to study seasonally wet soils and wetlands,
- Calibrate macroporosity with hydraulic conductivity using soil morphology as an inference,
- Improve estimates of pesticide movement in soils by improving the database in the SOI-5 file,
- Develop more precise guidelines to link hydric soils with aquic soil conditions so wetland interpretations may be developed with greater accuracy,
- Improve guidelines for evaluation of soils for septic tank absorption fields,
- Establish a subcommittee to study the revision of soil moisture regimes to reflect mean soil matric potentials at specified depth(s),
- Place committee activities among the highest national and regional priorities for the next decade, and consequently
- Continue the soil water committee.

Committee VI: MINESOIL CLASSIFICATION AND INTERPRETATION
Chair/Vice-chair: John T. Amnons/Darwin L. Newton

Committee VI had two charges:

1. Determine what soil characteristics are changed by the mining process and how the resultant properties can be used in Soil

Taxonomy and soil survey interpretations for reclamation, revegetation, and maintenance.

2. Evaluate the applicability of differentiae developed in the NCSS for minesoils on the Southern Region.

The committee members disliked the name of their committee and recommended that it be changed to @*Drastically Altered Soils: Their Classification and Interpretation" which obviously implies a broader scope and a new committee mandate. The other recommendations were:

- split the committee in subcommittees for taxonomy and interpretation,
- Develop criteria for classification after complete review of the literature,
- Consider all land disturbance in developing the classi- fication, and
- Continue the committee.

It may be noted parenthetically that the committee members apparently practice what they preach: their report contained seventy-five literature citations.

FIELD TRIPS

The first of the two field trips was a half day outing on Tuesday, 19 June 1990, to the El Yunque Tropical Rainforest located in the Luquillo Range in northeastern Puerto Rico. In addition to the lush rainforest ecosystem, we saw a peculiar kind of Inceptisol that is unique to perudic and isothermic areas and which is charcaterized by intensive leaching and the probable formation of lepidocrocite. We also inspected a major landslide and, as might be expected in a rainforest, a tropical downpour left everybody soaking wet.

The second field trip took place at the end of the Conference and led from San Juan along the island's north coast to the city of Isabela in northwestern Puerto Rico. Along the way we saw Eutrudox developed in transported materials and pineapple plantations in a tropical karst landscape. Near Isabela we visited one of the agricultural experiment stations of the University of Puerto Rico where we inspected a Eutrustox and various tropical crops. After a picnic lunch the group proceeded south to the city of Mayaguez and then east into the volcanic uplands to see a typical Haplohumult and a coffee plantation and processing plant. On the continuation of our journey to the south, we inspected a spectacular saprolite exposure and the famed Nipe soil, an Acrudox developed on serpentinite. Further south we entered an area of Usterts and Calciustolls before arriving in La Parguera, a pleasant fishing village on the south coast where we spent the night. On Friday morning the group travelled along the south coast to the city of Ponce and then turned north to cross the central mountain range before arriving in San Juan where most participants departed the same day.

Warren Lynn of the SCS National Soil Survey Laboratory in Lincoln, NE, had prepared a 85-page tour guide that provided excellent environmental background information and comprehensive descriptive and analytical site and soil data.

CONCLUSION

On the basis of comments from participants, there is reason to consider the 1990 Southern Regional Technical Work-Planning Conference of the NCSS a complete success from a technical, social and scenic point of view. Compressing the indoor sessions to allow more time for field trips turned out to be wise decision as the excursions and the attendant social functions made the conference not only a professionally successful but also an otherwise enjoyable event. We would be delighted, therefore, if Puerto Rico were selected again to host the Southern Regional Technical Work-Planning Conference in the not too distant future.

Bureau of Indian Affairs as a Member of the National Cooperative Soil Survey (NCSS)

July 27-26, 1991
Seattle, Washington

Rohert 4. Klink

On behalf of the Indian tribes of the Northwest, Iwould like to take this opportunity to welcome all NCSS delegates to the Dlvmpic Peninsula and Puget Sound region. This is truly Indian Country! There are twenty five Indian Reservations and federally recognized Indian tribal governments in northwest. part of Washington state, and the region's Indian people are the cornerstone of cultural diversity of the Northwest.

Instead of naming all 25 Indian tribes, I would like to abbreviate the list to several that highlight the geography, vocabulary and history. Starting off the southwest corner of the Olympic Mountains and then proceeding north up the coast, our federal government recognizes the Quinalt, Quileute, and Makah tribal governments. The Makah Tribe has been key in the region's history, noted for first defending their homelands when the Spanish explorers approached and entered the Strait of Juan De Fuca in the sixteenth century.

Moving clockwise around Puget Sound, the Lummi Tribe occupies reservation land in the vicinity of Bellingham, the Swinomish and Tulalip are adjacent to the immediate south, the Muckleshoot and Nisqually Tribes are in the Tacoma-Olympia areas, and the Skokomish occupy the Hood Canal region in the rain shadow of the Olympic mountains. The land and waters of this state have supported the Indian culture for centuries.

In addition to the Olympic/Puget Sound tribes, there are five additional tribes with large land based reservations in eastern Washington. Of the total 53.5 Million acres of Indian Trust lands held by the federal government on behalf of individual Indians or Tribes, not quite 3 Million or over 5% lie in this state.

The Bureau of Indian Affairs staff in Washington state is typical of BIA staffing levels nationwide. There is one soil scientist located at both Yakima and Colville Agencies, and four soil and range conservationists at Agency locations in eastern Washington. However, under the principles of Indian Self-Determination, there has been five additional soil survey positions under the control of the Yakima Indian Nation.

I mention these staffing patterns to make several points; first, staffing directly by BIA itself is only a fraction of that of other land managing agencies. and second, Tribes have the lawful authority to determine for themselves how federal services will be rendered on there own reservation lands. A recently completed position analysis report has revealed that the Bureau is understaffed in the fields of professional soil and range management. This shortfall in staffing is at the one-third to one-quarter level when a per management acre basis is used. That is. where the Forest Service. Soil Conservation Service, or the Bureau of Land Management (our sister agency in the Department of Interior) may have one professional for every 300 thousand acres, a professional working in BIA maybe required to cover one million acres. Tribes have recognized these shortcomings and often when a federal program becomes a high priority, the principles of Self-Determination enable a tribe to accelerate staffing and funding. Such is the case at Yakima, where the tribal government has entered into a federal grant and contract to complete the soil survey end land classification. They have been managing the soil survey themselves for a number of years and the field work is essentially complete. They are now in the process of recruiting a competent soil scientist that can complete the written manuscript and finalize the mapping. Perhaps this employment opportunity may appeal to someone in this room or possibly you may know of someone seeking a position. The Tribe would feel comfortable with hiring an experienced soil scientist, probably out of retirement. If anyone is interested or know of someone, I have the Tribal address here with me this week.

When running down the Interior Department staff in the buisness of managing Indian Affairs, one would have to begin with Manual Lujan, the current Secretary. Immediately working for him and the chief Indian advocate of the U.S. government is the Assistant Secretary of the Interior-Indian Affairs, a position currently held by Eddie Brown, who is responsible for all major policy. planning and budgeting decisions. Patrick Hayes is his deputy in charge of all trust responsibility and economic development issues. Under that post is the Chief of the Division of Land and Water, currently held by Sam Miller. Mark Bradford occupies the position of Soil Conservationist at the Washinoton D. C. level, with responsibilities for cooperating with the Nation's soil survey effort. The BIA has no Soil Scientist position in the Division of Land and Water in Washington D. C. I feel privileged to be addressing this conference on behalf of the Bureau.

The Bureau of Indian Affairs has adopted the principles of Total Quality Management (TQM). As we will discover tommorrow, accurate mission statements are an important part of the TQM process. Unlike the Central Intelligence Agency or CIA (BIA comes immediately before the CIA in any government glossary, of course), BIA wants everyone to know who we are and what we do and has drafted a Mission Statement to guide our operations on a national basis:

> The Bureau of Indian Affairs' mission is to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of American Indians, Indian tribes and Alaska natives. We will accomplish this through the delivery of quality, services, maintaining government to government relationships within the spirit of Indian self-determination.

To carry out this national mission the Bureau maintains twelve mid-level offices to manage Indian Affirs on a regional (usually several states) level. They are refered to as Area Offices (Table 1), and each is allowed to further define their mission. I am currently employed through the Portland Area Office, which has responsibility for Indian lands in western Montana, Idaho, Oregon. Washington, and the Alaskan panhandle.

I have recently been transfered from the Phoenix Area which oversees Indian lands in Utah and Nevada. and parts of Arizona and California. Previously, I was employed by the Alhuqerque Area which covers Colorado and New Mexico.
I began my federal career with six years of Forest Service experience in the Northwest, and I am pleased to have the chance to return.

TABLE 1

LAND RESOURCES ON INDIAN TRUST RESERVATIONS

IN THE UNITED STATES BY AREA 1/

Area	Open Crazing (Acres)	Forest Grazing (Acres)	Dry Farmland & Irrig. (Acres)	Total Indian Trust Lard (Acres)
ABERDEEN	5,117,707	302,250	617,734	6,285,401
ALBUQUERQUE	2,421,024	1,532,829	58,069	4,598,046
ANADARKO	218,809	35,078	199,733	443,010
BILLINGS	4,439,047	332,930	1,010,450	6,190,523
EASTERN	17,143	-o-	30,815	244,561
JUNEAU 2/	141,460	-o-	40	1,271,384
MINNEAPOLIS	1,737	120	14,152	1,228,513
MUSKOGEE	529,906	89,522	45,491	723,105
NAVAJO	10,581,567	2,776,306	139,023	14,709,734
PHOENIX	8,849,605	2,197,568	503,269	12,535,003
PORTLAND	1,435,737	2,060,284	401,544	4,823,829
SACRAMENTO	103,039	41,652	6,599	472,328
TOTALS	33,856,781	9,368,539	3,026,919	53,525,437

1/ Figures current as of August 1987. Source, Natural Resources Information System. (Report No. 55-38X;

2/ Does not include Alaska Native Claims Settlement Act lands, which are in fee simple ownership. , The mission statement of the Portland Area has been proposed with additional definition as follows:

The mission of the Portland Area Office of the BIA is based -on the underlying principles and goals of:

-protection and advocacy of American Indian Sovereign rights:
-performance of the trust responsibility regarding American Indian trust resources;
-commitment to carry-out policies of tribal self-determination, self-governance, and government-to-government relations;
-development and enhancement of Bureau and tribal human resources.

The role of the Portland Area Office in carrying out this mission is to provide management, leadership, technical assistance and administrative support to field units in the delivery of services to tribes and individual Indians. This includes the develapment and enhancement of tribal/Bureau human resources by providing programs and opportunities for career development, professinnal growth, and improvement of skills which will ensure the maintenance and retention of a stable work force for the delivery of quality services to American Indian tribes and people.

Technical assistance from the Portland Area Office in the land management covers all aspects of forestry, hydrology. geology, range and soil conservation, as well as soil science. The mission statement that would he of most interest to this audience would be that of the Soil and Moisture Conservation (SMC) Unit which is as follows:

The Soil and Moisture Conservation Unit will provide leadership and quality technical assistance as required to facilitate sound defensible soil, water, and related land use decisions.

Through this mission, the Bureau is responsible for technical advice and assistance in fulfilling requirements and authorities pertaining to conservation, use, develoopment and management of soil, plant and water resources on all Indian lands (forestland, cropland, rangeland, wildland, and residential or recreational developments). The Soil Scientist provides technical direction for the implementation of land classification processes and related interpretations from a data base that supports decisions regarding agriculture, forestry, wildlife, environmental compliance, and water rights

The authority for an Indian SMC program begins with the Act of April 27, 1935 which mandates the protection of land resources from soil erosion or the wastage of moisture supplies, and survey and investigation to characterize the Nation's soil resource. Technical assistance from SMC is properly funded through the agriculture, forestry, water management, or irrigation accounts. In the case of tribal financing of irrigation development work, the cost of soil inventories (land classification and suitability determinations), will be charged to the Agriculture function by BIA national policy.

The Soil Scientist in BIA draws additional authority from P.L. 89-560 (September 7,1966) which requires the collection of soil and related data by government agencies to guide comaunitv planning and resource development.

The

TABLE 1

LAND ACREAGE RY USE ON INDIAN TRUST

RESERVATIONS IN THE UNITED STATES BY AREA[1]

Area	Open Grazing (Acres)	Forest/Grazing (Acres)	Drv Farmed and/or Irrigated (Acres)	Total Indian Trust (Acres)
ABERDEEN	5,117,707	302,250	617,734	6,285,401
ALBUQUERQUE	2,421,024	1,532,829	58,069	4,598,046
ANADARKO	218,809	35,078	199,733	443,010
BILLINGS	4,439,047	332,930	1,010,450	6,190,523
EASTERN	17,143	-0-	30,815	244,561
JUNEAU[2]	141,460	-0-	40	1,271,384
MINNEAPOLIS	1,737	120	14,152	1,228,513
MUSKOGEE	529,906	89,572	45,491	723,105
NAVAJO	10,581,567	2,776,306	139,023	14,709,734
PHOENIX	8,849,605	2,197,568	503,269	12,535,003
PORTLAND	1,435,737	2,060,284	401,544	4,823,829
SACRAMENTO	103,039	41,652	6,599	472,328
TOTALS	33,856,781	9,368,539	3,026,919	53,525,437

1 From the Natural Resources Information System. (Report No. 55-38-X), Subject to increases and losses annually.

2 Does not include lands held in fee simple, such as in Alaska.

SOIL SURVEY ACTIVITIES IN CANADA

Gerald Coen
Agriculture Canada
Land Resource Research Centre

On behalf of the Land Resource Research Centre and the Expert Committee on Soil Survey, I thank you for the opportunity to participate in this conference. We find the exchange of information vital to our continued progress. especially considering the magnitude of our common border. As most of you mappers Will recognize. when you approach a "soil line" from one side your concept of the distribution and make-up of the map unit is likely to be different than had you approached the line from the other side. It is only as you travel further and look back on the line from this enlarged perspective that you can complete the picture. So it is with soils on either side of our border. We need to look back on our concepts through your eyes.

INTRODUCTION

An attempt by all levels of government to reduce deficits has resulted in a review of most programs. Soil survey programs were no exception, and the result has been a shift in emphasis, throughout Canada, away from primary inventory and toward utilization of soil surveys in the decision making process. There is an ongoing effort to define and separate the roles of the federal and provincial governments.

THE FEDERAL SITUATION

Background

The Land Resource Research Centre is the federal research agency that has the responsibility for Soil Survey. The 1989-90 review of programs resulted in an evaluation of the LRRC with respect to:

1. federal-provincial roles and jurisdictions
2. research mandates

The outcome was strong support for the LRRC program. However, given present constraints we were requested to concentrate on national mandates and reduce the activities in support of provincial priorities. In practical terms we have reduced the amount of large scale field surveys, but maintained the responsibility for standards and procedures, and a national soils database. We also have increased our efforts toward utilization of soil survey information. an area we have neglected for some time, and to address soil conservation and soil quality monitoring issues.

The program review has led to the following program outline.

Present Program

The Land Resource Research Centre has reoriented around 3 major programs:

1. Land Resource Data and its Application
2. Sustainable Land Productivity
3. Environmental Quality.

In general terms Program 3 concentrates on the basic research necessary to define and detect environmental quality as it relates to the land resource. Program 1 concentrates on the nature and spatial distribution of these land resources (includes soil surveys). Program 2 provides the applied research that allows the application of the basic research to landscapes and land management decisions through such techniques as land evaluation.

Of the approximately SO professional staff about one-half are located in regional provincial offices while the remainder are at headquarters in Ottawa. About two-thirds of the regional professionals are assigned to Program 1 and one-third to Program 2 with a minor contribution to Program 3.

A more detailed description of Program 1 will help to define the soils survey activities in which we are involved.

Program 1: Land Resource Data and its Application

Our mandate is to ***address the requirement for current, relevant and accessible land resource data including guidelines and frameworks for its application and use.***

Sub-program 1.1 Soil Resource Information

This sub-program deals with soil correlation and standards, and soil taxonomy. It is also responsible for our efforts in soil inventory and management of the national soils database. We are increasing our emphasis in technology transfer and developing standard digital products to efficiently meet requests for data.

Sub-program 1.2 Ecological Interactions

This sub-program deals with agroecological stratification of our landscapes and with pedological processes that control the distribution of soils in the landscape.

Sub-program 1.3 Application of Land Information

This sub-program concentrates of the development of methods to use GIS procedures and related databases to make land management decisions. Efforts to improve efficiency will result in emphasis on developing interpretive algorithms.

Priority Issues

In the past we considered our business to be soil survey first and its use second. We are now saying that ***our business is soil resource information and its application. Our*** immediate priority issues arising from this refocussing are:

1. Development of an accessible, relevant national soils database.

2. Reviewing and testing interpretations.

3. Developing, with other natural resource agencies, a consolidated standard ecological framework.

4. Developing (GIS) procedures and protocols for the extrapolation ***of site*** data to geographical expressions.

Concluding Statement

We are in the process of a fairly major reorientation. There are strains, but on the whole we feel comfortable with the direction.

THE SITUATION IN THE PROVINCES

Provincial involvement in soil survey has not been uniform across Canada. In Quebec, Ontario and the Western Provinces there tended to be about a 50-50 split between provincial and federal contribution to mapping. In the Maritime provinces and Newfoundland the provincial soil survey effort tended to be smaller and concentrated on technology transfer whereas the federal effort was larger and directed to soil mapping. Provincial efforts supporting soil survey have decreased significantly in the last 5 years and shifted from soil mapping to technology transfer. It seems that soil maps have been a "free good" for most user agencies and in these times of fiscal restraint there is reluctance on the part of individual user agencies to identify funds to support a mapping program that may not be of direct benefit for several years. The consequence is a reduced emphasis on provincial field mapping programs throughout Canada.

SUMMARY

We appreciate the opportunity to be part of this National Cooperative Soil Survey Conference. The Canadian soil survey community has benefitted from our involvement in the ISCOM tours on Wetlands Spodosols, Aridisols and Vertisols. We appreciate the recent visit of Maurie Mausbach to Ottawa, and many other contacts relating to issues such as soil conservation and soil taxonomy. Considering the amount of Canada affected by cold soils we are excited about the ISCOM - permafrost soils workshop in 1993. Globalization is a topical word and in that context we are pleased to encourage and support increased cooperation between our countries.

Paper presented to:
National Cooperative Soil Survey Conference
Seattle, Washington
July 22 - 26, 1991

Representing:
Head, Land Resource Data and Application
Land Resource Research Centre
Research Branch, Agriculture Canada

OVERVIEW OF AGRICULTURAL AND ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEM (AEGIS)

H. Lal, Jean-Paul Calixte, J. W. Jones[1]
F. H. Beinroth, and Luis Perez-Alegria[2]

ABSTRACT

AEGIS - Agricultural and Environmental Geographical Information System is a user-oriented regional agricultural planning, information management, and decision support system. It integrates simulation models and an expert system with spatial databases. A Geographical Information System (GIS) provides the structure for organizing land and weather data and simulation results from crop models, analyzing spatial characteristics of the region, and displaying results in tables and maps. A prototype of the system is being developed for three areas in Puerto Rico. The organization of databases and the roles of crop models and expert systems are discussed and preliminary results are presented.

INTRODUCTION

Agriculture is evolutionary, responding to various physical, social, economic, and political forces. On a global scale, increases in human population are causing increases in demand for agricultural products. This is causing agriculture to expand into new areas.

[1] Postdoctoral Associate, Graduate Research Assistant, and Professor, Department of Agricultural Engineering, University of Florida, Gainesville, FL

[2] Professor, Department of Agronomy and Soils and Assistant Professor, Department of Agricultural Engineering, University of Puerto Rico, Mayaguez, Puerto Rico.

Forests and other natural systems are being replaced by more intensive land use practices, primarily by crops and managed animal systems. On a regional scale, changes in production are occurring not only in response to changes in global demand but also to meet local food needs and to improve the local economy. Land use modifications are leading to undesirable changes in the environmen!. These changes include degradation of the soil itself leading to non-sustainable production. There are many well-documented cases where agricultural practices in a region have led to surface and ground water contamination, soil loss, and salt accumulation in the soil.

Policy makers can influence changes in agricultural production in many ways, such as by placing restrictions on land use and practices, by providing financial incentives, by funding projects to make resources available, by creating transportation systems, etc. Policies to meet any particular goal may influence other factors. For example, a policy to cause an increase in production of a particular crop may improve the economic viability of farmers and increase food in the region, but it may also lead to surface and ground water contamination. Policy makers and planners are continuously confronted uith the problem of deciding viable land uses that would meet the economic requirements of a region and also conserve its natural resources for generations to come. This is not a simple task. It requires many kinds of data on soil, current land use, weather, and topography variations over space as well as information on regional economic and natural systems, Tools are needed to help policy makers and planners develop and evaluate policies that enhance agricultural production, economic stability, and protect the environment, These tools should have the capability to organize and manipulate large amounts of data, carry out analysis based upon historical or present records, and present the results to the user in an easily understandable format.

This paper describes a user-oriented GIS-based decision support system named AEGIS - Agricultural and Environmental Geographical Information System. AEGIS integrates the capabilities of crop and soil models with GIS and an expert system for land use planning and information management. In this system, GIS provides the structure for 1) organizing land and weather data and simulation results from crop and soil models, 2) analyzing spatial characteristics of the region, and 3) displaying results in tables and maps. A prototype of the system for three areas in Puerto Rico is being developed. The organization of databases, the roles of crop and soil models, and an expert system are discussed. The initial design considerations for this system were discussed by Lal et al.

AEGIS DESIGN

Overview

Several researchers have discussed the need for an integrated approach to technology assessment, environment impact analysis, and regional development planning (Clarke, 1989; Fedra and Reitsma, 1989; Osborne and Stoogenke, 1989; Barker, 1990). A model-based information management and decision support system that combines GIS and an expert system can provide such a tool. In such systems, simulation models can help in analyzing data, and expert systems can provide missing links and supervise the overall functioning of the system.

Crop growth simulation models are designed to predict crop growth, yield, and resource use as controlled by genotype, weather, soil, and management practices at a site (Wilkerson et al., 1983). Recently, several crop models have been combined with soil and weather databases to create a user-friendly, site-oriented Decision Support System for Agrotechnology Transfer (DSSAT) with standardized input and output (IBSNAT Project, 1989). This makes possible the use of several crop models with a single input dataset for evaluating different management alternatives. Models, such as Universal Soil Loss Equation (USLE), have also been developed to estimate soil loss under different crop and soil management practices (Wischmeier and Smith, 1978).

AEGIS makes use of DSSAT crop models and the USLE for evaluating crop production and environmental degradation simultaneously on regional scale with heterogeneous environmental and soil conditions. The user can generate thematic/interpretive maps and tables for crop yield parameters and environmental degradation factors and identify the most viable practices for the region.

Figure 1 presents a schematic of AEGIS including its components, databases, and its linkage with DSSAT. AEGIS consists of 1) a database management system for managing soil, weather, and production requirements databases for different crops; 2) a GIS for organizing, storing and presenting spatial'information; and 3) models for simulating crop production and environmental degradation factors. The DSSAT crop and soil simulation models generate databases of crop yields, runoff and nitrogen leached under a variety of management factors. An intelligent interface supervises the system, provides essential missing information, and dialogues with the user for collecting inputs and presenting reports and maps. AEGIS can be used for 1) estimating crop yield, runoff and soil loss for an individual mapping unit or for a soil group consisting of several mapping units, 2) displaying maps of these parameters, 3) preparing regional plans and reports, and 4) carrying out "if-then" type of analysis for policy decisions.

Database Design

The databases in AEGIS can be broadly classified into 1) spatial databases, 2) attribute databases, and 3) model results. The spatial databases are soil, landuse, and weather maps of the selected sites. The attribute databases store information about soil, landuse and weather characteristics for the region. These databases are generated from the USDA-KS soils information, historical weather records, regional expert knowledge, and crop, soil and environmental models. The model result datatiles (CROP_YLD and SOIL_LOS) contain information about management inputs such as crop variety, irrigation type, and planting date and their effects on crop yield, irrigation requirement, cumulative evapotranspiration, surface runoff, soil loss, and nitrogen leached for different crops.

The polygon attribute tables (MAP_PAT) store the spatial information and can be generated by digitizing regional maps using ARC/INFO (ESRI, 1989) or any other GIS software. The three layers of spatial data are combined to generate a composite overlay of the information (Figure 2).

AEGIS employs soil and weather datafiles in two formats: 1) DSSAT format for running crop simulation models for generating the crop-yield datafile, and 2) special indicators datafiles (SOIL_INDIC and WTH_INDIC) for evaluating the potential of each polygon for different crops based upon their specific requirements stored in the crop suitability (CROP-SUIT) datatile. The soil indicator datafile (SOIL_INDIC) contains parameters such as slope, depth to water table, concentration of some of the essential micro and macro elements (aluminum, phosphorus, potassium, and sulfur) in the upper 45 cm of the soil profile. These files are generated from soil classification and surface characteristics (PROFHEAD) and soil characterization by layers (PROFLAYR) datafiles based upon USDA-SCS soils information and available in DSSAT. The parameters not available in DSSAT soil datafiles are estimated from the original USDA-SCS soils data files. The data for the soils not available from either of these sources are being estimated by employing the approach developed by Beinroth (1990) based upon soil taxonomic analogies and expert knowledge. The historical weather records for 20 years are contained in AEGIS for running crop models and developing weather indicator datafiles (WTH_INDIC) for the three project sites. Daily records of precipitation, maximum and minimum temperature, and solar radiation are used by crop models. The weather indicator datafile stores monthly averages of these parameters. The weather data were obtained from EarthInfo, Inc. (1989.) The EarthInfo weather data do not include solar radiation required for DSSAT crop models. These values were generated using the method of Lopez and Soderstorm (1983).

The crop suitability

liming, are taken. This information is used to evaluate the suitability of a soil mapping unit for a particular crop for the factors not considered in crop models.

The crop yield datafiles are generated by running crop models for different soil mapping units for 20 years of historical weather records. The simulated outputs for each set of inputs are statistically analyzed for average value, 20 and 80 percentile levels. These percentile values indicate the probability of getting less than a certain value of the parameter being analyzed. For example, a 20 percentile value of yield indicates that 20 of the time, we could expect to get yield equal or less than the quoted yield value.

The soil loss datafile stores expected annual soil loss under different management practices (crop, variety, planting date, and irrigation type). The soil loss for each polygon is calculated using the USLE (Calixte et al., 1991). It estimates long term average values of the soil loss for the selected combinations of management practices. The rainfall factor (R) and soil erodibility factor (K) are estimated from the SCS tables for the Caribbean area (USDA-SCS, 1980). A representative value for slope/length factor (LS) for each mapping unit is drawn from SCS Natural Resource Inventory database. The values of the crop management factors *for* different growth stages depend *upon* the percentage ground cover and are estimated from the crop model output for each management combination for the polygons suitable for agriculture. Values for polygons not suitable for agriculture are estimated from the tables presented by Wischmeier and Smith (1978). Constant values of 0.80 and 1.00 were assumed for erosion control practice factor (P) for polygons suitable for agriculture and not suitable for agriculture respectively.

CURRENT AEGIS IMPLEMENTATION

Intelligent System Supervisor

A menu-driven interface (Figure 3) for AEGIS has been designed to **facilitate its** use by non-computer experts. At the start of AEGIS, a bar-menu connected with three pull-down menus lets the user select a crop, region, soil types and other environmental characteristics; perform production and environment analyses; and produce thematic/interpretative maps and tables with aggregate and other statistical values. The user can produce hard copies of the maps and tables created during different stages of the selection and analysis processes. The selection process lets the user un-select a portion of the selected data records and/or append additional records to already selected ones based upon previously selected criteria. The AEGIS menu system is also designed with a module that will let the user create a new set of databases for new environment and management conditions using DSSAT and other soil models (Figure 3).

Software and Hardware

We are using pc ARC/INFO (ESRI, 1989), a vector based GIS, and dBASE IV, a relational database management system (Ashton-Tate, 1988) for developing AEGIS. The user-interface and different databases are implemented in dBASE IV; and pc ARC/INFO is used for designing and presenting maps on the computer screen, aggregating spatial results, and producing them onto plotters and printers, Specific Details of AEGIS - Puerto Rico

A prototype version of AEGIS was demonstrated at the meeting in Seattle, Washington. It is being developed for three sites, namely Isabella, Mayaguez, and Lajas Valley of western Puerto Rico. These sites have been selected for their climatic and soil diversities. Sixty-seven soil series in the three areas belong to the orders of Alfisols, Entisols, Inceptisols, Mollisols, Oxisols, Ultisols, and Vertisols; and thus exemplify seven of the eleven orders recognized in the US system of soil classification. The climates in these three areas range from humid to subhumid and semi-arid tropical. We are using four locations to supply weather information for the three regional maps. Two weather locations for Lajas Valley region (Figure 4) were selected because a mountain belt dividing the region into two distinct climatic zones.

The soil, weather and landuse maps for the three locations are at the scale of 1:20,000. Each site covers an area of about 3,800 ha (9,400 acres). In total there are 84 mapping units which are mainly phases of soil series but also include 16 land types as limestone rock land and tidal flats. The agricultural suitability for these map units has been established and coded into AEGIS. The landuse map was developed using a LANDSAT satellite image for the south western part of Puerto Rico.

AEGIS is currently being built with two crops: drybeans and upland rice; and a combination of management practices (irrigation amounts, planting dates, cultivars). Figure 5 presents simulated average yield distribution for a short season drybean crop planted on January 15 under irrigation in the Mayaguez region. The areas marked “not cropped” on this map are mainly urban areas and considered not suitable for agriculture. Similar maps can be created for other locations and management practices. The AEGIS structure also permits incorporation of additional crops and management practices. This system, though not yet completed, demonstrates the value of an integrated approach for assessing the potential benefits of alternative land uses and agricultural practices on a regional basis. Once fully developed, AEGIS can be very effective and helpful for the Land Authority of Puerto Rico in evaluating alternative crops and their management practices in place of sugarcane, a crop that is becoming non-profitable on the island. The experiences with AEGIS from these three sites can also be adapted to other areas in the Caribbean basin.

REFERENCES

Ashton-Tate. 1988. Getting Started with dBASE IV - DOS Version. Ashton-Tate, Torrance, CA, 20 p.

Barker, G. R. 1990. Sustainable development in GIS as a component in statewide decision support systems. GIS'90 Symposium, Vancouver, British Columbia, 8 p.

Beinroth, F. H. 1990. Estimating missing soil data: How to cope with an incomplete database. Agrotechnology Transfer 11: 10-11.

Calixte, J.P., H. Lal, J.W. Jones, F.H. Beinroth, and L.R. Perez-Alegria. 1991. A model based Decision Support System for regional agricultural planning. Proceedings of Conference on New Directions in Sustainable Agriculture. July 14-19, Caribbean Food Crops Society, *Roseau*, Dominica.

Clarke, M. 1989. GIS and model based analysis towards effective decision support system. School of Geography, University of Leeds, Leeds, United Kingdom, 15 p.

EarthInfo, Inc. 1988. Climatedata user's manual. U S WEST Optical Publishing, Denver, CO, 116 p.

ESRI. 1988. PC ARC/!NFO Starter Kit. Environmental Systems Research Institute, Inc. Redlands, CA.

Fedra, K. and R. F. Reitsma. 1989. Decision support and geographical information system. Proceedings of the GIS Summer Institute, Amsterdam, The Netherlands.

IBSNAT Project. 1989. Decision Support System for Agrotechnology Transfer (DSSAT)--User's Guide. IBSNAT Project, University of Hawaii, Honolulu, HI, 317 p.

Lal, H., J. W. Jones, F. H. Beinroth and R. M. Peart. 1990. Regional agricultural planning information and decision support system. Proceedings of the Conference on Application of GIS, Simulation Models and Knowledge-Based Systems for Landuse Management, Nov. 12-14, VPI and State University, Blacksburg, VA, pp 51-60.

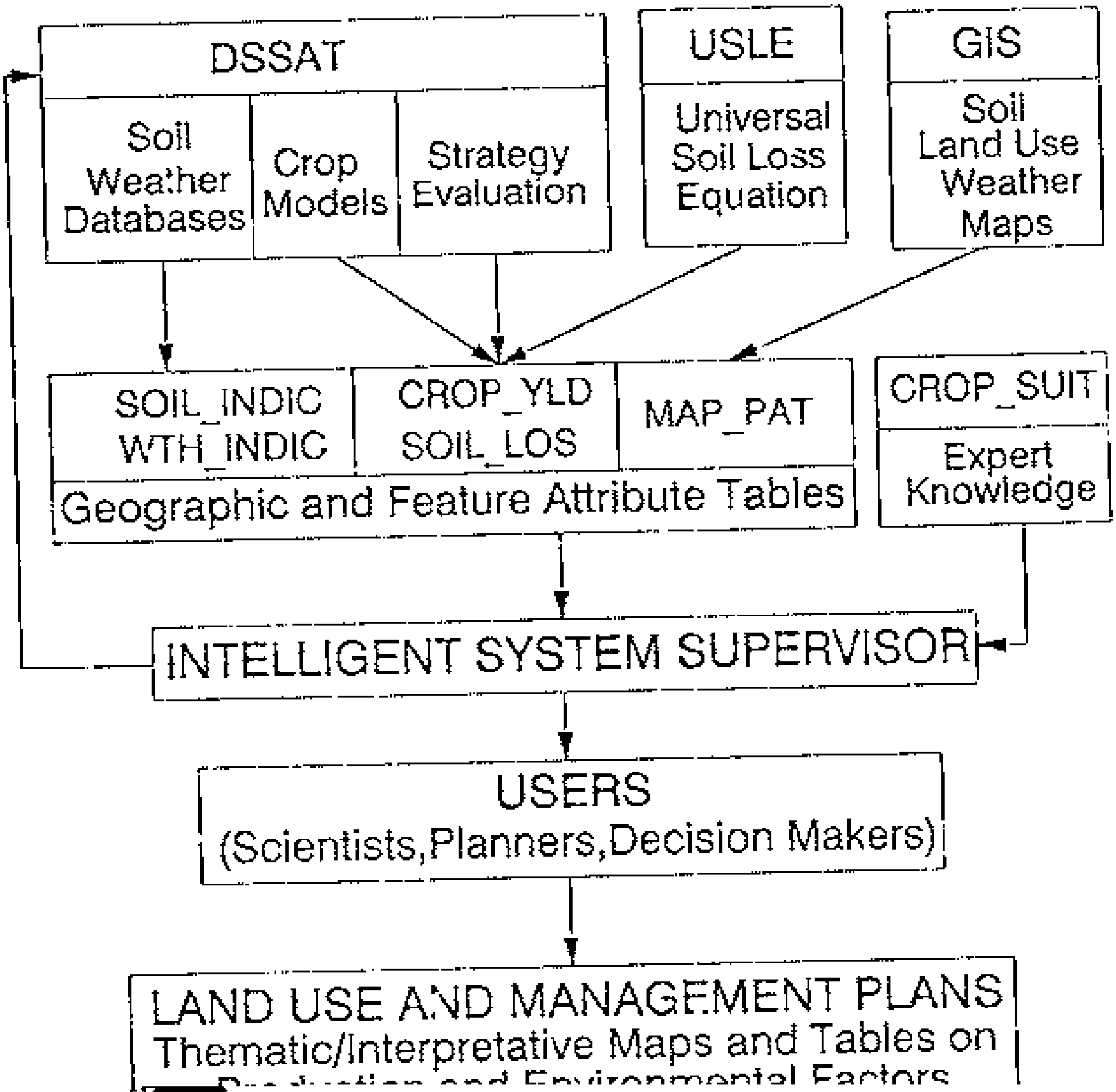
Lopez, A. M. and K. G. Soderstorm. 1983. Insolation in Puerto Rico. In Solar Engineering--1983. Ed. L. M. Murphy. The American Society of Mechanical Engineers, New York, NY, 70-75.

Osborne, S. and M. Stoogenke. 1989. Integration of a temporal element into a natural resource decision support system. GIS/LIS'89 Proceedings, Orlando, FL, 221-227.

Wilkerson, G. G., J. W. Jones, K. J. Boote, K. T. Ingram, and J. W. Mishoe. 1983. Modeling soybean growth for management. Transactions of the American Society of Agricultural Engineers 26:63-73.

Wischmeier, W. H. and D. D. Smith. 1978. Predicting rainfall erosion losses. USDA Agricultural Handbook No. 537, 58 p.

USDA-SCS. 1980. Universal Soil Loss Equation -- Technical Notes, Caribbean Area. USDA-SCS, GPO Box 4868, San Juan, PR.


DSSAT
Soil Weather Databases
Crop Models
Strategy Evaluation
USLE
Universal Soil Loss Equation
GIS
Soil Land Use Weather Maps
SOIL_INDIC WTH_INDIC
CROP_YLD SOIL_LOS
MAP_PAT
Geographic and Feature Attribute Tables
CROP_SUIT
Expert Knowledge
INTELLIGENT SYSTEM SUPERVISOR
USERS
(Scientists,Planners,Decision Makers)
LAND USE AND MANAGEMENT PLANS
Thematic/Interpretative Maps and Tables on

[redacted]

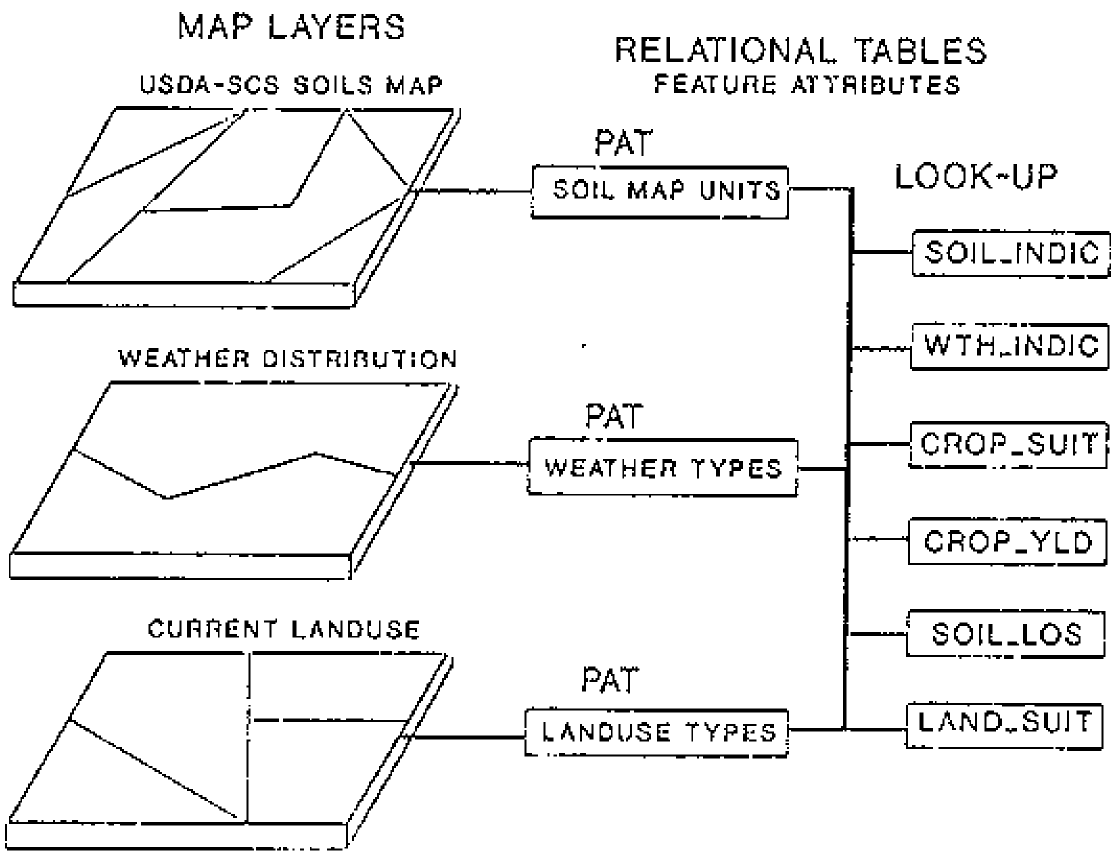


Figure 2. Coverages in AEGIS

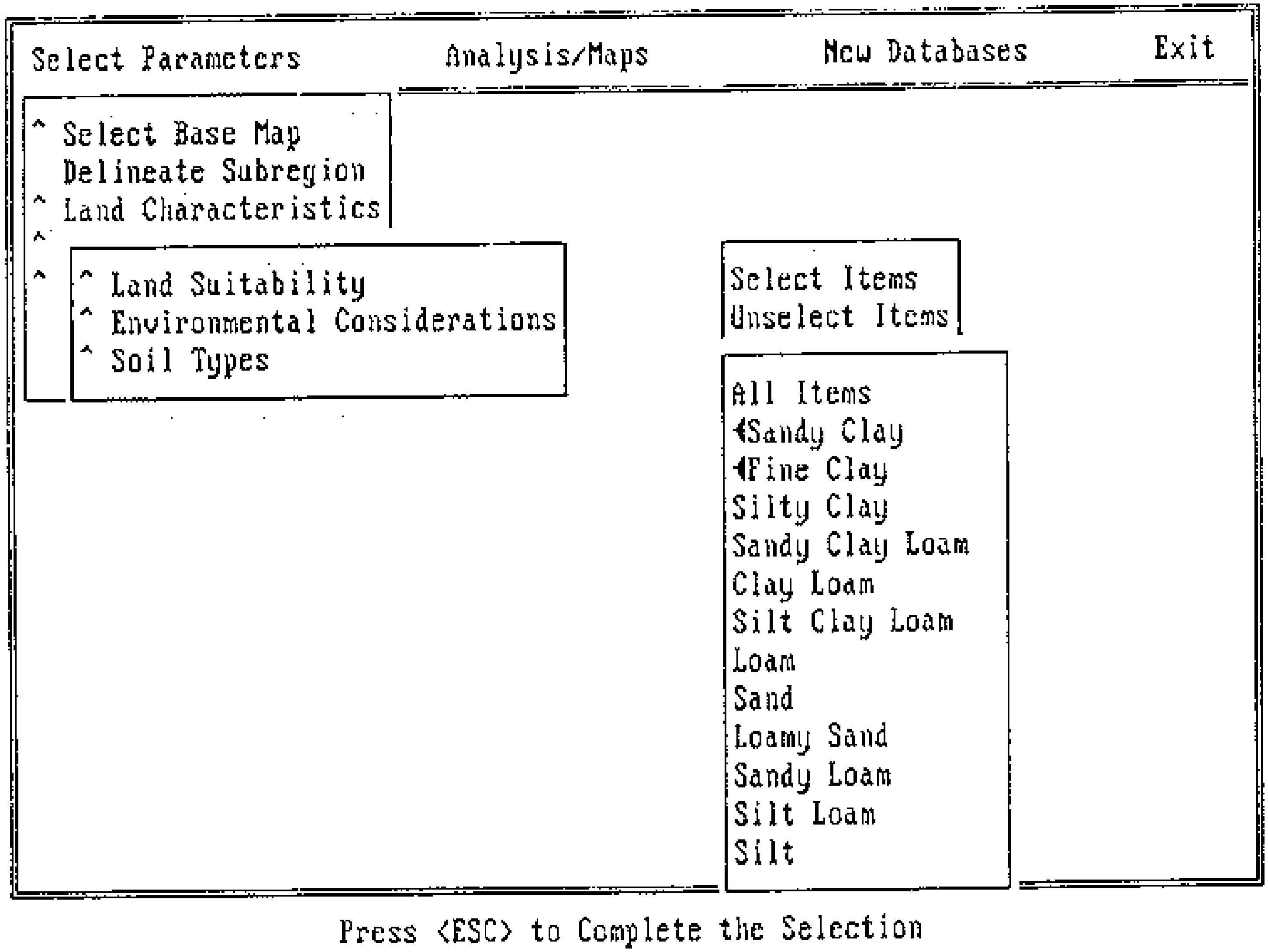
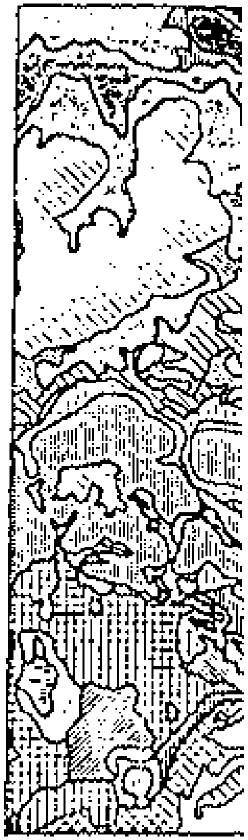


Figure 3. AECIS User Interface Menu System

LAJAS \



Depar

Fi

Average Yield f

Mayaguez Jan 1

Figure 5. Average Simulated

NATIONAL SOILS INFORMATION SYSTEM (NASIS) AN OVERVIEW

David L. Anderson, Daniel Ernstrom, Richard Stahler
July, 1991

Background Summary

The primary focus of the National Cooperative Soil Survey has been the production of static, printed soil survey reports. This focus is shifting to maintaining and providing a dynamic resource of soils information that can serve diverse, individualized needs.

This change in focus is driven by: 1) an increasing demand for reliable and dependable soils data and their interpretations, and 2) advances in automation and information processing technology that will help relieve many of the prior constraints on the management, organization, and the usability of large and complex sets of data that are characteristic of soils information.

STRATEGY FOR SOIL SURVEY INFORMATION MANAGEMENT

The Soils Division National Leaders, other soil scientists, users of soils information, and professional information system developers have done intensive analysis to define the requirements of a soils information system that will 1) improve our ability to manage current soils information, and 2) meet the expanding demands for soils information in the future. The analysis resulted in the basic concepts and framework for an integrated National Soils Information System.

An information system is not simply a collection of computer programs that operate on data files. It is a means to achieve organizational objectives by coordinating computer hardware, software, data, process logic, policy and operating procedures, to implement organizational objectives.

The fundamental purpose of the National Soils Information System (NASIS) is to enhance and improve the collection, storage, manipulation, and dissemination of soil survey information in a manner that is most suitable for making informed decisions about the soils resource. NASIS will support the soil survey of the future in three important areas:

- support of field operations to efficiently gather new information in compliance with standards

- application of expert knowledge to make information usable for an increasing variety of purposes, and

- making the information readily available to meet the needs of a wide variety of users.

Guiding principles

The following general principles have guided the definition of requirements for the soils information system:

- Demand for valid and reliable soils information is increasing.

* We must be able to update with new/current data.

* The data must represent as near as possible the accurate characteristics of delineated soil areas.

* Differences in detail and reliability/validity and currency of the data should be communicated to users.

* Hany new needs for soil survey information can not be met by traditional text oriented information management.

- Hany users of soils information require detailed and specific information. Much of this detail though known by the soil scientist, is not made available to users. All soil6 information should be organized and made available where appropriate.

- Data processing technology can provide solutions for managing soils information. The use of this technology is inevitable.

NASIS Requirements

The analysis process has resulted in a document called a Draft Requirements Statement (DRS) for the Soils Interpretation and Information Dissemination module (SIID), that defines the requirements for NASIS in detail. Following is a summary of the requirements as outlined in the DRS.

<u>Enable the collectors of soil information to efficiently record their actual observations,</u>

An important and major requirement of NASIS is to provide for efficient, systematic recording of the actual soil characteristics observed by soil scientists. NASIS must preserve the integrity, continuity, and entirety of soils information, and must convey to the user accurate information that is consistent with the observations and scientific judgment of the collector/recorder.

To accomplish these requirements the following specific objectives must be met:

- remove system limits imposed on information, such as the number of entries for some items i. e. soil layers, map unit components, crop yields.

- provide for the entry of the actual data values, where known, as well as the generation of current data classes.

- provide a system that insures integrity between actual data and interpretations.

- provide for the recording of actual data, without constraining it to fit within a taxonomic class.

- provide for the recording and management of data affected by external occurrences such as management practices or flooding.

Flexible Input

Future versions of NASIS should provide capability to tailor the system for localized needs. This will allow the data collector to easily record those observations which are pertinent to the local conditions as well as the needs for the survey being made.

Availability of detailed primary soil property data

Primary data is defined as the site specific data collected as pedon descriptions, transects, laboratory analysis, and field notes. It is an objective of NASIS to make maximum use of primary data. The organization and storage of these data will allow their aggregation to form Component Data Records and Official Series Data Records.

Although much primary information is collected and may be used in the context of the soil survey, most of this detail is not made available to the users in soil survey reports.

It is an objective of NASIS to be able to provide as much detailed information as has been recorded. The level of information provided (either detailed of generalized) should be determined by the users need, availability of data, and the detail appropriate for the intended use. In the future NASIS should provide a dynamic information system that will enable many different output formats and levels of detail. The user view, and level of detail represented by the conventional soil survey report will be only one of many output formats.

Soil survey projects should emphasis the collection and recording of primary data.

The ability to observe, record, interpret, and report spatially referenced soil properties is essential for future soil surveys. It will be essential to geographically reference all recorded observations to take full advantage of Geographic Information System (GIS) technology.

pvnamic Update

There are four areas where the system must be able to be routinely updated:

1. Addition or modification of new, approved soil attributes.

2. Addition or modification of interpretive criteria.

3. Addition or modification of soil map units or components of map units.

4. Customization of data queries and reports.

In the first case, it is imperative that the system not become outdated as technology and soil science advances. As research continues in all aspects of soil science and as new technologies are implemented, new characteristics of soils will be required. When this occurs, the soil database will need to be modified to provide for the recording, management, and output of the new data. This is a considerable problem with rigid data systems. It can be especially problematic in the situation where the soils database will be distributed to over 3000 field offices. NASIS should provide for the routine addition or modification to the structure and content of the database to accommodate change. This will be possible because of the generic nature of the data structure for the system being developed.

The second case involves the flexibility of the system in meeting individualized user need6 for interpretations. These needs for soil6 information are highly variable. In addition, local soil condition6 and interpretive need6 vary between regions of the country. For these reasons, NASIS must provide for the routine addition or modification of interpretive criteria that will allow user6 of the system to develop suitable interpretations for their location, condition or application.

The third case is one that allows 'continuous update of the soils data contained within the system. The collection of soils data is a continual process. However, we normally associate the data collection effort with a project soil survey where progressive mapping is going on. In areas of existing mapping, detailed investigations are often made to verify soil maps, or to provide more detail data for a special project. Often, information about soils is collected as part of the normal SCS planning process. These events should be used as opportunities for adding to and improving our soils database. NASIS should provide the capability to incorporate additional information as it is collected and validated through the normal correlation and quality assurance processes. The information within NASIS would thereby continually improve as more and more is learned about the soils resource. As data is added to the system and is validated, it should become available immediately to users of NASIS.

The fourth case is one brought about by the variable ways data is being looked at or accessed. As users have more diverse needs for data contained within the soils information svstem. it is necessary to be able to customize queries for accessing the data as well as presenting the data in many different formats and styles of reports.

Integrated System

One of the requirements of NASIS is to provide access to all data collected and recorded during the soil survey process. For this to be possible, the system must be integrated. What this means is that beginning with data collection and continuing through information dissemination, all the information that has been recorded, pertaining to a particular soil, should be accessible through the system.

Databases currently being maintained include the National Soils Characterization Database, the SOI-6 and Map Unit Use File (MWF), the SOI-5, and the Map Unit Interpretations Record (MUIR) in the State Soil Survey Database (SSSD). These databases contain site specific data as well as data about spatial entities. Site specific data include observations made about pedons or individual sites such as lab characterization data and estimates of soil properties at individual sites. Spatial entity data include observations about map units and components of map units such as estimates of map unit extent and map unit composition. It is intended that NASIS will combine the necessary functionality of existing data sets into one integrated system, remove redundancy, and eliminate the current problems of keeping independent data sets current and consistent. At the same time, NASIS would provide access to all data previously contained in each of the separate data sets.

There is another aspect of integration that future versions of NASIS will provide. Much information exists pertaining to soils that is not part of the normal data collected as part of the soil survey. There is also information collected during the normal soil survey process that does not become part of the soils database. Examples of these are, soils data resulting from analysis performed by university laboratories and stored in their databases as a result of research projects, state highway department laboratory analysis data, and data collected by other agencies. Where appropriate, this data can be added to NASIS. Where data from these sources are not physically stored in NASIS, the system may provide a capability to reference the additional sources of information. These references could be linked to known locations, or existing soils in the database.

User Defined Output

It is an objective of NASIS to provide for the standardization of content of the data but allow flexibility in the output format (diverse user views).

Users have different applications for soils data which require different levels of generalization. NASIS will provide the capability to aggregate the basic, most detailed component data records, or interpretations of those data records at any level of generalization less detailed than the Component Data Record.

In addition to different levels of generalization, users have needs for different groupings of soil map units based on their specific applications for the data.

One of the primary objectives of NASIS is to manage the most detailed information available and use the computer to interpret the detail, generalize, and regroup the detailed data based on criteria Supplied by the user. As more primary data are added through the update process, the definition and proliferation of Map Unit Components and their corresponding Component Data Records will change. As this happens, any data aggregated and stored at a more general level will become outdated. Therefore, NASIS must be able to aggregate as often as needed, as new detailed data are added. This will result in consistency at all levels of generalization.

A practical result of this will be the ability to generate both geographic and attribute databases, such as STATSGO and NATSGO, from the detailed database. Updating of the generalized databases would become automatic as new detailed data is added or as older surveys are updated.

This capability will allow the viewing of information at various user specified levels of generalization. For example, it will be possible to view data generalized at the soil survey area(s), MLRA(s), or state(s) i.e., show me the range in characteristics for all soils named Alpha for a given MLRA, a given state, or a given MLRA within a state. In this example the generalized view is not obtained from a stored generalized (aggregated) database, but rather is regenerated from the most detailed information available at the local soil survey level.

Btatements or measures of dependability or reliability of the data

NASIS will contain data and information based on varying degrees of knowledge and supporting documentation. Some information stored within NASIS will be the best estimate that can be made based on a limited amount of information. In other instances information will have been substantiated by much supporting data and investigations. NASIS should provide a method for communicating the methods used to collect the information to users. The users could then determine the suitability of the data to meet their needs.

Variability

In addition to understanding how data was collected, users have the need to know the variability of the soils they are dealing with. Future versions of NASIS should provide for the inclusion of information which describes the variability of soils that can occur within and between map units and their components.

Conclusion

The Soil Conservation Service is committed to providing the best information possible to its clients so they may make informed land use decisions. These decisions can help us to make the best use of our soil and related natural resources while protecting and maintaining them for use by future generations.

The most vital resource for accomplishing this goal is the information and data collected and managed by the agency about our natural resources. NASIS is intended to be an integral part of an overall Natural Resource Information System that ties our knowledge of the various aspects of the natural resources together.

NASIS is a system being designed to respond to user needs for soils information, and to provide the capabilities to use that information to the fullest extent.

HYDRIC SOILS COMMITTEE REPORT

BY
Maurice J. Mausbach

Introduction: The hydric soil definition and criteria are a continuing issue especially with public interest in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands. The administration is very interested in the scientific basis for the hydric soil definition and criteria. In this report, I will discuss these issues; the organization and activities of the National Technical Committee for Hydric soils (NTCHS); and some issues on the Federal Wetlands Manual.

Background: The NTCHS began as an ad hoc interagency group with the charge to develop a definition and criteria for hydric soils. The initial objective being to assist the Fish and Wildlife Service (FWS) in mapping wetlands for the National Wetlands Inventory. Dr. Richard Guthrie organized the group with assistance from FWS. A few years later, the group was recognized by the SCS Deputy Chief for Technology and the Corps of Engineers (CE); Environmenta; Protection Agency (EPA), and FWS were invited to assign permanent members to the committee. Dr. Guthrie also invited experts from the university community to join the committee.

In 1985 congress passed the Food Security Act (FSA) which cited the hydric soil criteria as part of the definition of wetlands as part of Swampbuster legislation. Also in 1985, the committee published the first edition of Hydric Soils of the United States. The FSA greatly increased the visibility of hydric soils and the need for soil survey maps to make wetland determinations. It also increased the number of comments on the hydric soil criteria and the need for more data on soil processes in these wet soils.

National Technical Committee for Hydric Boils: The NTCHS is an interagency, interdisciplinary committee. Its functions are to:

- Develop and improve hydric soil definition and criteria
- Publish a national list of hydric soils
- Respond to comments on hydric soil criteria
- Provide technical consultation on hydric soils to other technical groups
- Investigate new technology for defining hydric soils

The committee representation includes 7 from the Soil Conservation Service (SCS), 5 from universities, and one each from EPA, FWS, CE, Bureau of Land Management (BLM), Forest Service (FS), and a private consultant. Of the 18 total members we have 13 soil scientists, 4 biologists, and 1 engineer. The SCS members include:

- Maurice Mausbach (Chairperson)
- Ray Miles (West representative)
- C. L. Girdner (Midwest representative)
- De Wayne Williams (South representative)
- H. Chris Smith (Northeast representative)
- Arville Touchet (State soil scientist representative)
- Billy Teels (National Biologist)

The other members are:

- D. Fanning, University of Maryland
- Richard Guthrie, Auburn University
- W. Patrick, Jr.; Louisiana State University
- R. W. Skaggs, North Carolina State University
- J. Richardson, North Dakota State University
- P. Reed, FWS
- R. Theriot, CE
- W. Sipple, EPA
- C. Voigt, BLM
- P. Avers, Forest Service
- W. Blake Parker, private consultant

The committee is chaired by SCS. Committee membership has gradually grown to the present 18. Avers, Voigt, and Richardson have been added in the past year.

The committee usually meets once a year to review comments on the hydric soil definition and criteria. They often meet in an area tc study hydric soil issues in the field. The next meeting is scheduled for Massachusetts in September. The 1990 meeting was held in Florida to study the sandy soil issue.

Hydric soils: The most recent changes in the hydric soil criteria added frequency to the saturation criterion (2) to require frequent saturation (more than 5 out of 10 years). This change matches frequency criteria for flooded and ponded soils. Duration for saturation was increased to more than two weeks during the growing season. This change reflects current research which shows anaerobic conditions occurring after 10 to 20 days of continuous saturation.

The NTCHS revised the criterion for depth of water table in sandy soils to occur above 0.5 feet instead of 1.0 feet. Sandy soils have sand, coarse sand, or fine sand textures in the upper 20 inches. This requires the water table at the surface for these sandy soils. This change is supported by the thickness of the capillary fringe in these soils.

The current hydric soil definition and criteria are given in the appendix. The SCS publishes a national list of hydric soils for the United States. The list is computer generated by matching the criteria to soil properties on the Soil Interpretations Record (SIR). Soils are added and deleted from the national list only buy changing the estimated properties on the SIR. The national list contains taxa at the series level of Soil Taxonomy. The third edition is at the printers. This publication is in high demand by wetland delineators and other users of the information. This national list is maintained on computer file and can be subdivided by state.

The national list of hydric soils is of limited value for wetland determinations as it is generated from the general information for a series in the SIR. The SCS has local or field office lists of hydric soils that are generated using the specific information in the state soil survey database for the soil survey area. We have recently released software to generate these lists using data in the Map Unit Interpretations Record (MUIR) for a survey area. These lists contain all map units named by taxa that meet the hydric soil criteria and map units that potentially contain hydric soil inclusions. The lists contain information on the landscape position of the hydric component of the map unit.

The NTCHS has a number of issues mostly related to our understanding of soil processes in wet soils. The period of saturation, flooding and ponding necessary for a soil to become anaerobic is crucial to the criteria and to the wetland hydrology criterion. We continue to use drainage classes in the definition mostly to provide a gross indication of duration of wetness. We have a number of soils that have hydrologic features that border the soil hydric criteria. The wet phase of the soil is hydric but the dry phase is nonhydric. We are considering asking states to give morphological clues for separating the wet and dry phases of these soils in the field.

Biological zero is a fine concept, but is difficult to quantify. The 50 cm depth in Soil Taxonomy is questioned by biologists and others as its relationship to plant growth. All of these issues point to the need for quality data on water table depths, periods of saturation, and soil temperatures. Another concern is quality assurance of the local lists of hydric soils and the data used to generate these lists.

In an effort to resolve some of the issues, the SCS in conjunction with the CE is extending the wet soils research projects. In addition to the sites in Louisiana and Texas, we are contracting with Dr. Richardson, North Dakota State University; Dr. Huddleston, Oregon State University; Dr. Ping, University of Alaska; Dr. Franzmeier, Purdue University; and Dr. Venenan, University of Massachusetts to study water tables, oxidation reduction potentials, and other soil processes. The information will help in understanding soil processes in these wet soils, help to support or refine hydric soil criteria, and assist in defining aquic conditions in soils. The study in Alaska will also help refine biological zero in cold soils.

Federal Wetlands Manual: The first edition of the Federal Manual for Identifying and Delineating Jurisdictional Wetlands was published in 1989. During 1990 the CE and EPA held a series of public hearings on the manual. The interagency committee responsible for the manual has redrafted the manual addressing the concerns of the public and wetland delineators. The revised manual is currently at the Office of Management and Budget for administration approval.

Changes in the 1989 manual include:

- The hydrology criterion is separate from hydric soils and requires 14 days of continuous saturation and/or inundation to the surface.

- The growing season for hydrology is the interval between 3 weeks before average date of last killing frost in spring to 3 weeks after average date of first killing frost in fall.

- Specifies the use of hydric soils criteria and minimizes the use of hydric soil (morphological) indicators.

- Emphasizes that all three criteria must be met for an area to qualify as wetland.

The revised manual will be out for public comments via the Federal Register procedures.

Summary: Hydric soil and wetland issues are at the forefront, politically and scientifically. We in the Nationally Cooperative Soil Survey are being asked to better quantify are information on soil saturation, flooding and ponding and to further develop our knowledge on genetic soil processes in wet soils.

APPENDIX
DEFINITION OF HYDRIC SOIL

A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. The following criteria reflect those soils that meet this definition.

CRITERIA FOR HYDRIC SOILS

1. All Histosols except Folists, or

2. Soils in Aquic suborder, Aquic subgroups, Albolls suborder, Salorthids great group, Pell great groups of Vertisols, Pachic subgroups, or Cumulic subgroups that are:

   a. Somewhat poorly drained and have a frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season, or

   b. poorly drained or very poorly drained and have either:

      (1) a frequently occurring water table at less than 0.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 in , or for other soils

      (2) a frequently occurring water table at less than 1.0 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is equal to or greater than 6.0 in/h in all layers within 20 in, or

      (3) a frequently occurring water table at less than 1.5 ft from the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

3. Soils that are frequently ponded for long duration or very long duration during the growing season, or

4. Soils that are frequently flooded for long duration or very long duration during the growing season.

Revised NTCHS 9/27/90

BLM Status Report - Scott Davis

Presented at the National Cooperative Soil survey Conference
Bellevue, Washington, July 22-26, 1991

The BLM manages almost 40% of all federal lands, nearly 270 million acres, one-third of which is in Alaska. Over 2.6 million acres comprise the Oregon and California revested forest lands. Located primarily in Oregon, these lands were grants made to private concerns to contract the O&C Railroad. The remainder of the BLM lands occur mostly as rangelands in the western states.

Currently, the BLM employs 46 soil scientists. Most are involved with mapping and site specific interpretative projects. Efforts will continue to soil map the remaining 25% of BLM lands in the lower 48 states. Surveys done prior to 1974 will be reviewed for possible enhancement. A strong emphasis will be placed on soil/plant relations. The Denver Service Center provides soil information services, and develops interpretative automative forest tables. Soil surveys will be digitized for automation.

A shift from traditional program management, such as grazing, mining, oil and gas, and timber harvesting is occurring with emphasis being placed on fish, wildlife, outdoor recreation, biological diversity/ecological sites, and riparian management. Also, land disposition and exchanges are continuing to help accomplish future management goals. Areas of critical and environment concerns, status of threatened and endangered plant and animal species are very important.

An increase in population trends towards the western states is creating more interest in the use of BLM lands. More people now live in the West than in the Northeast: this trend will continue. People in the West tend to be younger, better educated, and more affluent than the rest of the nation. Over 3,000 interest groups in the United States are expressing issues involving management of our lands. People want to see positive results on the ground. Demands on BLM lands will continue to grow. Soil scientists will need to be involved in:

1. Land appraisals for exchange and disposition.

2. Salinity and sediment control projects/nonpoint source pollution.

3. Reclamation efforts/hazardous materials cleanup.

4. Tourism/recreation planning (trails, campgrounds).

5. Mapping/correlation for more detailed soil surveys for riparian areas, wetland, threatened and endangered species sites.

6. Soil correlation with ecological sites; linkage of soil capability to desired plant conditions.

7. Making soil data and interpretations automated for easier use by others.

8. Management of range lands and forest lands for biodiversity.

9. The Water Erosion Prediction Project (WEPP).

10. Developing native plants for rehabilitation, reclamation and riparian projects (i.e., cooperation with SCS plant centers).

The soil scientist will be an important collaborative player on integrated interdisciplinary resources management teams.

On August 5-8, 1991, the BLM will hold a BLM Soils National and State Strategy meeting at Keystone, Colorado. Each state will be developing a specific action plan to get soil science information incorporated into our integrated resource management. Automation of data, soil data analysis, soil survey enhancement, vegetation, soil-plant-management relationships, ecological sites, nonpoint source, riparian, salinity, recreation, wildlife, and fisheries, and reclamation, will be key discussion items with relation to future work of soil scientists in the BLM.

In recent moves within the BLM, Cliff Fanning has filled the BLM Oregon State Soil Scientist position.

Recently, the Bureau of Land Management in Eugene and Salem has purchased two winged subsoilers to more effective11 restore old roadbeds to productive conditions.

The BLM will continue to shift efforts to the Resource Area level to better get jobs done on the ground. We will continue to gear soil map unit descriptions to be appropriate for our users. We will identify needs for soil survey enhancement, including soil quality standards to meet interpretations for riparian areas, ecological sites, soil condition changes, nonpoint source, salinity control, recreation, and fish and wildlife.

National Soil Survey Conference, Bellevue, WA, July 22-28, 1991

WATER EROSION PREDICTION PROJECT (WEPP)
- DEMANDS ON SOIL SURVEY

C. Steven Holzhey

General

There Is a Catch 22 In the development of models. Realistic modellers use those data that are widely available. and producers of information make widely available those data that are used

The WEPP is one of the few, perhaps the first study of this magnkude, in which NCSS data were tested as part of the experiment. The testing identified some new data elements that improved predication of Inherent soil erodibility. How do we respond? Do we model the new data elements, thereby reinstalling Catch 22? Do we embark on a nationwide survey and measurement of properties? What part of the modelling process belongs to WEPP and what part to NCSS? The possibilities are interesting end the answers will help define the NCSS of the Mure.

Because the new system Is process-oriented, it will not only require new information about soil properties, but also about soil distribution. The system can accommodate information at the map unk level. Recognizing that data will be downloaded and completely separated from the main soils information base, how do we help non-sol scientists deaf with more than one component, or with possible contrasting Inclusions? How do they decide where each occurs along a slope? Do we create a special WEPP database with a number of the decisions already made? If so. do we do the same for other Important applications? What part is NCSS and what part Is WEPP?

There will be a hillslope profile version for use with one linear slope at a time and a version for fntegration of processes over an area. Routines and algorithms will be the same, but the aerial modelling will include more complex routing and much more Input. The hillslope version is planned for general use in conservation planning.

The WEPP System

Soil attributes are important to the hydrdoglc component of the system. The processes of infiltration and percolation of water are modelled, using aspects of particle size distribution, organic matter content, and cation exchange capacity to compute hydraulic conductivity and

I believe the precision of the prediction In the experiment decreases from first to last, respectively.

In the database the algorithms for computation of erodibilities from soil properties will probably be of two types. First might be considered experimental. Experimental algorithms are In use now, during testing of the system, and were derived statistically during exhaustive work by Bill Elliot, formerly wkh ARS, Ames, Iowa. and now with Ohb State University.

Work by Otto Baumer, Research Soil Scientist, and others at the National Soil Survey Center (NSSC), In conjunction wlth Bill Elliot and others, will test modifications of the experimental algorithms witn the idea of maintaining robust mathematics that will hold with combinations of properties not included In the experiment.

A sizeable team of scientists Is testing the WEPP system and the soils database, and a set of SCS field people are testing the system at a number of locations.

The attributes currently in the experimental ● bcrtthms are as follows:

Interrill ● rodlblltty:

a) Smectitic and mixed clay mineralogy. Vary fine sand, catlon exchange capacity, clay, specific surface (by EGME), and Mg, Ca, Wischmelr texture (silt t vfs)/(100 - clay).

b) Non-smectitic clay mineralogy. Clay, water dispersible clay, specific

How Data Were Delivered Thus Far

SCS established a series of test counties across the USA Earl Blakley, soil scientist at the SCS SNTC worked with an interdisciplinary team to identify soil attributes needed for the test. As part of Dralnmod development, Otto Baumer had created a program for the estimation of several key soil attributes. Generalizations were created for new attributes, through a committee of Baumer, Raymond Sinclair and Dewayne Mays, all of the NSSC.

Baumer's program was used to generate values from the Soil Interpretation Record (SIR). The values were sent to State SCS Offices for review, to the SCS team end to the ARS team testing WEPP.

No special analyses were conducted durlng this phase. No efforts were made to deal with multicomponent map units, which were apparently not important in the lest counties.

Decisions

Three questions include:

(1) How much to emphasize specific WEPP computations within the soil survey Information base end the tradeoff between storing models for generating parameters as opposed to storing the parameter values themselves,

(2) How much to tailor map unk component Information to the needs of WEPP users, and

(3) Where to provide algorithms for users who don't have a soil survey database?

Two major changes in our information delivery will be desirable:

(1) Addition of new data elements to the database and

(2) Improving the ease of access to attributes of map unit components (and possibly some inclusions?)

New data ● lemenfs -- How we respond will relate to Catch 22. When the worklng versions are In pace this year, we will respond at 2 levels to add data elements to the database:

(a) Using data elements from SIR and SSSD to compute values for new data elements and

(b) Nationwide sampling and measurement and locally calibrated predictive algorithms.

Baumer's system currently computes values horn information available, but the level of specificity is contrdled by the kind of input data available. For example, Woo water retention data is available, a water retention curve is computed from texture organic matter and kind of day. This procedure of calibrating algorithms to ● valabfe local measurements, but having the capacity

Map unit components -- Our National Soil Information System will focus on components of map units. The issue with the WEPP system is to define how far to go. For example, we have been asked what to do In multicomponent map units. Should the non-soil scientists just average the value? If not, where Is the information about location of each on the dope? What protocol should we advise? Should NCSS make the decisions, map unit by map unit, and supply the numbers In acceptable input format or simply supply the basic soil attribute data?

Some map unit inclusions are hydrological Important, occurring where water Is concentrated on a hillslope. How do we transmit our knowledge of location, likelihood of occurrence, and how to determine presence or absence, remembering that some users will visit the hillslope and some will not?

How do we respond? The question of whether we reinforce Catch 22 is very Important. Initially we have to make estimates of new attrfbutes. based on old attributes in the system. Continuation of that practice without new measurements would reinstall Catch 22 after the strong, coordinated WEPP effort to overcome the dosed circle. Over a longer period we should plan to measure new attributes in enough locations to calibrate estimation procedures locally.

The plan for the National Soil Information System in general Is to emphasize components of map units In local Information bases. Hence, the needs of WEPP In this regard are partly met by existing plans.

For the Future

The present system does not signal the end of erosion research. Please note the use of the term "inherent" soil erodibility when referring to the system presently being developed. Temporal variations In susceptibility to erosion are modelled oniy to ths extent that changes In biomass, bulk density and, perhaps, a few other soil attrfbutes are modelled. The soil database to drive the model cannot be used to Incorporate temporal variations until further joint NCSS-ARS-USFS work creates that capacity.

Bob Grossmsn of the NSSC has done a great deal to dramatize the need for work on temporal variation. The Interest in ARS seems to be increasing as the extreme demands of the present WEPP goals are steadily put behind us.

Whereas we In NCSS cannot unilaterally add temporal Information to ths WEPP system, we can improve our knowledge base through simple expedience of field observation, description and, perhaps, simple measurements, against the day when Catch 22 might otherwise make the modelling of such seasonal patterns unrealistic.

The WEPP brings to a head issues that will strongly influence the future role of NCSS. It is serendipitous that this development occurs just as NCSS is making a change from a paradigm that focused on mapping to one that focuses on the transfer of knowledge.

US Forest Service Report
National Cooperative Soil Survey National Work Planning Conference
Seattle, Washington, July 22-26, 1991

Peter E. Avers
Soils Program Manager

This report includes information on current Forest Service emphasis areas, budgets and trends, soil quality monitoring, and long term soil productivity research.

This year marks the Centennial of the Forest Service (FS) and we are celebrating throughout the year. I've provided you with brochures describing background information on the centennial and FS programs. The first national forests were set aside in 1891 under the Forest Reserve Act. Many of the issues and concerns at that time are similar to todays issues. For instance, the concern of protecting public forests from exploitation by loggers and miners in the early years is somewhat similar to current conflicts about protecting environmental values on the National Forests.

Most of you are aware of the highly volatile and publicized conflicts of recent years over clearcutting, spotted owls, red cockaded woodpeckers, soil and water quality, etc. We get caught in the middle and take heat from all directions. Yesterdays field trip on the Mt. Baker-Snoqualmie National Forest gave you a glimpse of the forest values and management practices that ignite the controversy.

The mission of the FS was first articulated by Congress in the 1897 Organic Act which stated "no National Forest shall be established except to improve and protect the forest". Congress laid out primary resource goals to maintain favorable conditions of water flows and provide a continuous supply of timber for the use and necessities of the citizens of the U.S. Many of our publics feel we have deputed too far from the "improve and protect" part of our mission. They tell us we are not concerned enough with protecting all resource values and lean too much towards commodity production. Some of this criticism is appropriate and some is misguided, but the overall result is that our credibility suffers.

So, what are we doing about this? First of all we are listening to our customers and are renewing our efforts to improve our work. We've received the basic message that societies values have changed, resulting in an expectation of environmentally oriented forest management. In short, we are trying to adopt a "customer focus". More specifically, there are five broad areas where we plan to focus our efforts in the next few years. These are briefly described below:

1. Recreation, Wildlife

We will provide more opportunities for hunting, fishing, and other outdoor experiences such as watching birds.

We will intensify efforts with threatened and endangered species. and will pay particular attention to sensitive species to ensure they do not become threatened and endangered.

2. Achieve Work Force Diversity

The principal points of work force diversity in the Forest Service are:

It's more than numbers of different races, it is utilizing the talents of every person; it means recognizing the values each individual can bring into the organization.

It's reflecting the diversity and interests of the people we serve. As the Nation's population is multicultural, so should our work force be multicultural in action.

c. increase tree planting on private lands in the United States to help improve the environment and reduce the production of carbon dioxide, which could contribute to global climate change.

d. increase research to understand the possible impacts of global climate change on the environment.

Budget and Trends

The watershed program has experienced significant increases in funding in recent years. This shift is the result of Forest Service management moving more towards environmental protection. Soil and water quality monitoring and soil inventory are receiving moderate, but continued growth. Much of this sustained program growth is due to improving the quality of inventories through the collection of additional landscape data to design ecological land units for mapping and to improve the interpretations and delivery of soils information to resource managers. Soil inventory is funded at about 7.8 million for FY 1992. The number of soil scientists in the Forest Service is currently at about 225 and slowly growing. With this increase, our involvement in the NCSS continues to expand.

Soil Quality Monitoring and Long Term Soil Productivity

To set goals for resource planning and to evaluate the effects of management activities on soil productivity. the Forest Service is establishing soil quality standards. Pasically, standards are threshold values for soil properties that serve as early warning signals of impaired soil conditions. They are designed to help planning teams maintain or improve the health. suitability, or productivity potential of soil. The standards become benchmarks that are used in monitoring trends in soil condition, and in monitoring the implementation and

To help in this endeavor the Forest Service has initiated a nationwide research effort on soil productivity to (1) quantify the effects of soil disturbance from management activities; (2) validate soil quality standards and; (3) better understand the fundamental relationships between soil properties, long-term productivity, and forest management practices. The study is an internal cooperative effort between National Forest System managers and the Forest Service Research division. The national study provides a framework for the development of detailed cooperative study plans by Research Stations and Regional Offices. The goal is to establish studies in major forest ecosystems through out the United States. Currently studies are being installed on the Kisatchie National Forest in Louisiana, on the Challenge Experimental Forest on the Plumas National Forest in California, on the Chippewa National Forest in Minnesota and on the Priest River Experimenatl Forest in Idaho

Each study area will have a range of soil porosity and site organic matter treatments on benchmark soils. The treatment plots will cover the changes expected to occur under present or future forest management. Plant growth and soil and site processes will be measured periodically and adjustments will be made as needed in soil standards and management planning. The experimental design provides deliberately imposed stress conditions on vegetation creating the likelihood of pest and disease interactions. Multidisciplinary collaboration and cooperation with industry, Soil Conservation Service, and university colleagues is encouraged. Basic models of soil and growth processes can be integrated with site and climate data to extrapolate finding to a broad array of sites and to project the possible impacts of changing climate on future productivity.

Field Office Technical Guide
NCSS Conference - Seattle, Washington
D. Williams - 1991

The effort to update the Field Office Technical Guide (FOTG) began in 1989. The effort evolved from many sources, including state resource conservationists, the conservation measures course design team, NTC technical guide committees and others. A major shift came out of these efforts from resource concerns to identify and treat equally the five natural resources we work with: soil, water, air, plants, and animals.

The FOTG contains five major sections:

Section I is basically a reference section

Section II contains soil and site information

Section III contains conservation management systems

Section IV contains practice standards and specifications

Section V is a store house of knowledge called conservation effects.

Today, we will concentrate on Section II because it is the section that soil scientists traditionally have taken ~~to take~~ leadership in, and will need to continue to do so. We will also take a look at part of section III to get an idea of how our soil information is being utilized in developing resource management systems to address the five natural resources.

Section II, Soil and Site Information. This section has traditionally belonged to the soil scientist for leadership, but it is now totally interdisciplinary. For example, we must work with the agronomist or resource conservationist on section IIA, the range conservationist (rangers) On section IIB, the forester (wood ticks) on section IIC, the biologist on section IIF and the engineers on section IIJ.

Where does the data for interpretations come from? It is gathered by soil sampling, range site clippings, site index measurements, crop yield collections, and other activities including research and investigations.

Data gathering is time consuming, but is critical to the functions of a technical agency. At no time in history than the present is data more important than it is today. The Food Security Act with highly erodible soils and wetland determinations, water quality issues, the revised USLE, WEPP, and other such programs are causing increased pressure on our soil surveys. We must be up to the challenge. Old numbers must be verified and new ones collected.

The basis for interpretations is information in the State Soil Survey Database (3SD) and/or CAMPS. (FOCS) 3SD resides in the state office and CAMPS is a subset of 3SD at the field office level. 3SD/CAMPS is a tailored subset of the Soil Interpretation Record data. The data is commonly edited to reflect local conditions. For example, yields may be modified at the local level. This applies to certain other properties also. An important point is that we must remain consistent.

The General Manual has been changed to allow for hard copy of interpretations or reference source documents such as published soil surveys or CAMPS. Hard copy insertion in the field office technical guide is highly recommended.

Two new subsections have been added. These are water quantity and quality interpretations and hydric soil interpretations.

The subsections are:

- Soil Legend
- Soil Descriptions
  - nontechnical
  - technical
- Detailed Soil Interpretations
  - Cropland
  - Rangeland, Grazed Forest Land and Native Pasture
  - Forestland
  - Nonagricultural
  - Recreation
  - Wildlife
  - Pastureland and Hayland
  - Minedland
  - Windbreak
  - Engineering
  - Waste Disposal
  - Water Quantity and Quality
  - Hydric Soil

CAMPS is the major source. Most interpretations can be generated by a menu item or a simple query. We now have a FOTG module in 3SD that will generate most FOTG material. The introductory parts and explanation of tables will likely need to be tailored within each state.

The modern soil survey is "in fact" section II of the field office technical guide. A caution, however, interpretations of older surveys must be updated. Older surveys are those not satisfying todays user needs.

The first major subsection is soil legends. Items housed here are map symbol, map unit name, and interpretative groups. An interpretative group is such interpretations as capability classification or woodland suitability group. It is similar to the guide to map units in older soil surveys.

The Nontechnical Soil Descriptions subsection is brief, written in lay terms and consists of a brief soil description as a minimum. Added to this are statements specific to land use such as agronomic, woodland, range, pasture, or urban as appropriate. These are used in planning resource management systems.

The Technical Soil Descriptions are generally not filed in the FOTG. A reference page is included to the source document such as published soil survey, local soil handbook, or official series description. We might also reference geomorphic studies here.

Under the cropland interpretations subsection the following interpretations are filed if applicable.

Prime Farmland

Highly Erodible

Land Capability Classification

Erodibility Index

Fertility Capability Classification

Orchard Groups

Yield Estimates

Soil Potentials

Ornamental or Selected Plants

Tillage Groups

Temporal Properties

Other Related

There are 13 use related subsections. Forest land will be used as an example. In this subsection we store an explanation of the woodland ordination system, an explanation of the tables, the woodland management and productivity table, woodland suitability groups and annual productivity estimates. The productivity estimates could be presented as cubic feet per acre, board feet per acre, or cords per acre or other appropriate measurements. Soil potentials, if developed, would be filed here also.

As stated earlier two new subsections have been added. The first of these is water quantity and quality. Here such things as pesticide leaching potential, pesticide loss potential, nitrate leaching index and leaching index maps are filed. In addition, this subsection should include the explanation of the pesticide and nitrate ratings. The soil ratings for phosphorous will be included here when developed.

It was first thought that we could provide little or no assistance on water quantity interpretations. However, after a little soul searching and a few prayer meetings, we realized that even though no specific interpretation for water quantity has been developed, several soil properties and interpretations are related. Runoff, flooding, ponding, and water table are on the water features table in the engineering subsection. Available water capacity is also in the engineering subsection. Infiltration can be interpreted from the intake families of the irrigation guide. Moisture deficient and evapotranspiration can be taken from maps in Section 1. Drainage class is related and is located on the series descriptions.

The last subsection to be discussed is hydric soils. This list is extremely important. It must be current and up-to-date, as it is used by not only SCS but other agencies and consultants. The list should contain all the components required in the FSA manual. In some survey areas, soils have been renamed to match current data and interpretations. Where updated names do not match published names, justification statements for the name changes that moves a soil to or from the hydric list must be included in this section of the FOTG. Justification will include reason and data to support the change. Although we have national lists and state lists, the county list of hydric soils is the preferred list.

The green page handout of labeled CONTENTS. This is considered a shopping list. Not all of the contents listed will be in all field offices. The contents required in all offices are marked with an asterisk.

That ends the slides. Next, please refer to the two paged (11 x 17) handout labeled CONSERVATION PRACTICE PHYSICAL EFFECTS. Using the overhead projector, I will walk through this handout.

First, lets look at the categories of consideration - S. W. A. P. A. - SOIL, EATER, AIR, PLANTS, ANIMALS

Under soil, three categories are considered - Erosion, Condition, and Deposition.

For water, two are considered - Quantity and Quality
Air has two - Quality and Condition

For plants, three are considered - Suitability, Condition, and Management

And animals have two - Habitat and Management

We will use conservation tillage and contour farming to see how all this fits together. Please note that these were developed nationally and need soil scientist input for many local conditions.

Contents

(Not all of these will be in each field office)

Section II Forest Land Interpretations
Guide to Woodland Ordination
Guide to Interpretative Groups for Forest land
**Woodland Management and Productivity Table
Woodland Suitability Groups
Annual Productivity Estimates
Soil Potential Ratings
Rating guide or reference to National Forestry Manual

Section II Nonagricultural Interpretations
Explanation of limitations and table column headings
Rating guide or reference to National Soil Handbook
*Building Site Development Table
*Construction Materials Table
Soil Potential Ratings

Section II Recreation Interpretations
Explanation and guide to interpretative groups for recreation
*Recreational Development Table
Soil Potential Ratings
Rating guide or reference to National Soil Handbook

Section II Wildlife Interpretations
Explanation and guide to interpretative groups for wildlife
*Wildlife Habitat Suitability Table
Description of Habitat Elements
Soil Potential Ratings
Rating guide or reference to attachment to soil memo 74

**Section II Pasture and Hayland Interpretations
Pastureland and Hayland Suitability Groups
Land Capability and Yield Estimates
Yield estimates for individual grasses
Soil Potential Ratings

**Section II Mined Land Interpretations
Limitation to Minedland Reclamation
Limitation to Minedland Revegetation
Limitation to Minedland Maintenance
Soil Potential Ratings
Rating guide or reference to National Handbook or other loca document

**Section II Windbreak Interpretations
Explanation of Windbreak Interpretations
Windbreak Suitability Groups
Windbreaks and Environmental Plantings Table

Section II Engineering Interpretations
Explanation and guide to interpretative groups for engineering
*Engineering Index Properties Table
*Physical and Chemical Properties Table
*Water Features Table
*Soil Features Table
*Water Management Table
Soil Potential Ratings
Reference to laboratory data
Rating guide or reference to National Soil Handbook

Section II Waste Disposal Interpretations
Explanation and guide to interpretative groups for sanitary facilities
*Sanitary Facilities Table
Suitability of Soils for Disposal of Organic Wastes
Suitability of Soils for Disposal of Inorganic Wastes
Soil Potential Ratings
Rating guide or reference to National Soil Handbook

Section II Water Quantity and Quality Interpretations
Explanation and guide to interpretative groups for water quality
*Soil Pesticide Interaction Ratings
*Soil Rating for Nitrate and Soluble Nutrients
Leaching index maps
Soil properties and interpretations related to water quantity

Section II Hydric Soil Interpretations
Definition and criteria for hydric soils
*Hydric soils list

*Required in all field office technical guides.

**Required where applicable to the field office.

The conservation Practice physical effects shown will generally apply lo resource problen

RESOURCE: A. SOIL

CONSIDERATIONS:			[1] EROS		
ASPECTS/ PROBLEMS — PRACTICE			(a) SHEET AND RILL	(b) WIND	CONCENTRATE (c) EPHEMERAL GULLY; CONCENTRATED FLOW
Note Numbers refer to Soil Conservation Service practice codes	TYPE OF PRACTICE	RESOURCE PROBLEM CONSIDERATION DEFINITION — OTHER EXPLANATIONS	The movement of soil from water forces, requiring treatment when the soil loss tolerance level is exceeded.	The movement of soil from wind forces, requiring treatment when soil loss tolerance is exceeded	Concentrated flow channels along depressional water courses that begin where overland flow, including rills, converge. Usually obscured by tillage operations.
329 Conservation Tillage	Mulch Till	Total surface manipulated with tillage before planting	Moderate to significant decrease because of increase in surface residue cover	Moderate to significant decrease because of increase in surface residue cover	Slight decrease
330 Contour Farming		Applicable on cropland, recreation land, and wildlife areas where crops are grown. Effectiveness depends o row grade and ridge height. Where patterns are arranged and field operations are aligned in a direction nearly perpendicular to the slope o land	Slight to significant reduction depending on row grade, ridge height, and length of slope	Negligible to moderate reduction depending on orientation of ridges to the prevailing wind direction and the height of the ridge	Slight reduction in the number of ephemeral gullies because of interception of concentrated flow. Slight increase in ephemerals where "breakovers" occur or inadequate grassed waterways exist
556 Planned Grazing Systems		Two or more grazing units are alternately rested and grazed in a planned sequence for a period of years. Rest periods may be through the year or during the growing seas of the key plants. Applicable to all grazing lands except grazed cropla Assumes problem is caused by poo grazing	Slight to significant decrease because of increased vegetative cover and increased water infiltration	Slight to significant decrease because of improved vegetative ground cover	Slight to significant reduction in concentrated flow erosion because of increased protective cover
Terrace	Storage	Underground outlets or infiltration i the soil. Slow release of water, requires stable outlet	Slight to moderate reduction because of reduced slope length	Slight reduction depending on alignment to prevailing wind during critical wind erosion period. Slight to moderate reduction for vegetated terraces	Significant reduction because of interception of concentrated flow
600 Terrace	Gradient	Vegetated outlet. Rapid release of water. Requires stable outlet	Slight to moderate reduction because of reduced slope length	Slight reduction depending on alignment to prevailing wind during critical wind erosion period. Slight to moderate reduction for vegetated terraces	Significant reduction because of interception of concentrated flow

OSION

ATED FLOW (d) CLASSIC GULLY	(e) STREAMBANK	(f) IRRIGATION INDUCED	(g) SOIL MASS MOVEMENT	(h) ROADBANKS AND CONSTRUCTION SITES
Gullies are channels that may grow or enlarge from year to year by head cutting and lateral widening. They are too deep to be erased by normal operations.	Sloughing of banks caused by overland flow, unstable soils, obstructions, unstable channel bottom, or all of these.	Erosion that is caused by excessive amounts and/or velocity of water in row, furrow, and sprinkler activities or by water concentrates and tracks from center pivots and traveling guns.	Soil slippage, landslides, or slope failure, normally on [illegible], or deep cuts or through unstable soil on sloping land, that creates a large volume of soil movement.	This erosion is identified as causing problems and damage, both onsite and offsite.
Negligible to slight decrease because of reduced runoff	Negligible	Moderate to significant decrease in sheet and rill erosion for sprinkler irrigation. Slight to moderate decrease on concentrated flow because of increase in surface residue.	Slight increase because of increased water retention and infiltration	Negligible
Negligible to slight decrease because of reduced runoff.	Negligible	Slight to significant reduction depending on row grade, ridge height, and length of slope.	Slight increase because of increased infiltration.	
Slight to moderate long-term decrease because of reduced water flow and vegetation establishment in bottom of gully and on side slopes	Slight to significant reduction because of reestablishment of protective riparian vegetation.	Moderate reduction because of improved cover.	Slight to moderate decrease because of improved binding of soil profile by root systems of more vigorous plant community	Negligible
Moderate to significant reduction where used to divert runoff from gully [illegible]	Slight to moderate reduction where water is diverted from streambank.	As applicable to sprinkler irrigation, slight increase for terraces constructed from uphill side. Moderate reduction for terraces constructed from downhill side. Slight reduction because of reduced slope length.	Slight to moderate increase because of increased	Slight to moderate reduction where water is diverted from sites.
		As applicable to sprinkler irrigation, slight increase for terraces constructed from uphill side. Moderate reduction for terraces constructed from downhill side. Slight reduction because of reduced slope length.		

The conservation practice physical effects shown will generally apply to resow

RESOURCE: A. SOIL — Continued

CONSIDERATION:—Continued [2] CONDITION

	(a) SOIL TILTH, CRUSTING, WATER INFILTRATION, ORGANIC MATERIAL	(b) SOIL COMPACTION	SOIL CONTAMINANTS: (c) EXCESS CHEMICAL CONTENT, SALINITY, SELENIUM, BORON, HEAVY METALS	SOIL CONTAMINANTS: (d) EXCESS ANIMAL WASTES & OTHER ORGANICS	SOIL CONTAMINANTS: (e) EXCESS FERTILIZER	SOIL CONTAMINANTS: (f) EXCESS PESTICIDES
	Unfavorable soil tilth. Soil tilth is the condition of the soil based on suitable combinations of mineral, air, water, and organic matter, resulting in a proper habitat in which microbial activity and chemical reactions can occur.	Compaction is excess compressing of soil particles and aggregates by machine, livestock, and natural consolidation, thereby affecting plant-soil-moisture-air relationship	Excess chemical content, salinity, selenium, boron, heavy metals—includes the amounts of desirable and undesirable chemical elements and compounds consisting of either organic or inorganic forms and restricts the desired use of the soil	Excess animal waste and other organics restrict the desired use of the soil. [redacted]	Excess fertilizer occurs if the application of fertilizer or quantity of nutrients restricts the desired use of the soil [redacted]	Excess pesticides occur if the application method type or the quantity of the residuals restrict [redacted]
	Slight to significant improvement in maintaining soil organic matter levels Slight to moderate reduction in crusting Moderate increase in infiltration Slight to moderate increase in biological activities	Moderate to significant reduction because of less tillage resistant layers and operations.	Negligible to slight increase with chemical problems on sloping land where water resurfaces. Moderate decrease in chemical problems on sloping land where water does not resurface	Negligible	Negligible	Potential for increase or decrease depending on type of pesticide applied
330	Negligible affect on crusting Slight to moderate increase in infiltration Negligible effect on organic material	Negligible	Slight decrease because of increased infiltration.	Negligible	Negligible	Negligible
556	Moderate to significant improvement because of increased vegetative cover, deeper root systems, increased soil organic material and biological activity, and improved nutrient cycling	Slight increase in bulk density on intensive planned grazing system on short term. Slight to significant decrease in bulk density on long term basis	Slight to significant improvement in salinity because of increased infiltration and less evaporation from soil surface.	Slight to moderate improvement because of greater use of nutrients by more vigorous plants	Slight to moderate improvement because of reduced application rates to produce desired amounts of forage. Vigorous plants maximize fertilizer efficiently	Slight to moderate improvement because of improved vegetative cover of desired plants that hinder establishment of weed species that require additional pesticide application.
	Slight to significant decrease in residue and organic material in area of construction. Increased infiltration. Negligible to slight decrease with push-up terraces	Short term increase in area of construction and thereafter negligible.	Slight to moderate decrease in chemical problems because of increased infiltration	Negligible	Negligible	Negligible
600G	Slight to significant decrease in residue and organic material in area of construction.	Short term increase in area of construction and thereafter negligible.	Slight decrease in chemical problems because of increased infiltration.	Negligible	Negligible	Negligible

ce problems nationwide. Effects may need to be modified to reflect local conditions.

(g) OTHER	[3] DEPOSITION: DAMAGE (a) ONSITE	DAMAGE (b) OFFSITE	...TY (c) ONSITE	...TY (d) OFFSITE	(e) OTHER
May include pH and dissolved free gasses.	Need to rework ground because of sediment thickness and distribution, crops destroyed; and infertile deposition, especially for coarse textured sediment	Same as onsite damage. Offsite practice effects are generally less than onsite because of increased distance from source problem.	Deposition on roads and railroads that cause accidents, loss of life, and loss of access for emergency vehicles	Same as onsite safety. Offsite practice effects are generally less than onsite because of increased distance from source problem.	
	Significant reduction in land damage, crop damage, and loss of productivity	Moderate to significant reduction in land damage, crop damage, and loss of productivity	Significant reduction in hazard and loss of access	loderate to significant eduction in hazard and loss of ccess	
	Slight to significant reduction because of reduced runoff and erosion	Slight reduction because of reduced runoff and erosion	Slight to moderate reduction in hazard to roadways and other structures.	light reduction in hazard to oadways and other structures aries by size of area	
	Moderate reduction because of increased cover and reduced sediment yield	Slight reduction because of increased cover and reduced sediment yield	Slight reduction because of increased cover and reduced sediment yield	light reduction because of creased cover and reduced ediment yield	
	Significantly reduced land damage, crop damage, and loss of productivity below terrace. Slight crop damage in terrace channel.	Moderately to significantly reduced land damage and loss of productivity	Slight reduced hazard to onsite roadways and other structures	loderate to significant duction of hazard to adway and other structures	
	Significantly reduced land damage, crop damage, and loss of productivity below terrace. Slight crop damage in terrace channel	Moderately to significantly reduced land damage and loss of productivity	Slight reduced hazard to onsite roadways and other structures	loderate to significant duction of hazard to adway and other structures	

SOIL SURVEY ACTIVITIES IN MEXICO

Rivera Díaz, Jorge [1]
Aguilar Santelises, Andrés [1]
Orozco Chávez, Francisco [2]
Torres Estrada, Angel [3]

1 Universidad Autónoma Chapingo, México.
2 Instituto Nacional de Estadística. Geografía e Informática, México.
3 Colegio de Postgraduados, México.

INTRODUCTION

Mexico is a nation of aproximately two million square kilometers and 83 million inhabitants The population Is concentrated In the central part of the country; for instance, In Mexico City and surroundings live more than 20 million people.

Mexican agriculture comprises 21 million hectares of rainfed land and 5.8 million hectares of irrigated land. Other non-agricultural areas occupy the remaining 169 million hectares. However, large amounts of agricultural products have to be imported due to low national productivity. Some causes of this insufficient production are unfavorable climatic and topographic conditions, soil degradation, highly populated rural areas, inadequate land distribution among farmers and the persistent use of traditional techniques.

During the last four decades dramatic changes have taken place in the national situation. A continued population growth and the development of overcrowded urban areas have serlously affected national economy. Agricultural productivity has not kept pace with these developments. Table 1 shows the growth rate of the Mexican agricultural sector from 1945.

As a consequence of the above-described problems It has been necessary to increase imports. Table 2 summarizes Mexican grain imports In the period 1966-1990.

Great efforts are being made by farmers and by the Government to improve food production In Mexico. More modern technology is being introduced and, simultaneously, studies are conducted to understand traditional agricultural practices and improve communication with farmers descending from ancient cultures.

Table 1. Growth tendencies of the Mexicanagricultural sector.

Period	Growth rate %
1945-1965	3.6
1966-1976	1.3
1977-1981	3.13
1982-1990	0

Source: Auplng Birch (1990).

Table 2. Grain imports (1966-1990).

Perlod	Tons
1966-1970	230 000
1971-1976	1 991 000
1977-1982	5 435 000
1983-1987	6 883 000
1988-1990	10 000 000

The objective of this report is to summarize the work carried out In Mexico on soil survey as a tool to Improve soil management for agricultural purposes.

FIRST SOIL SURVEYS IN MEXICO

Soil survey activities were started. in Mexico by the National Commission of Irrigation In 1927. ThIs institution was in charge of the development of agricultural areas located in regions where the establishment of irrigation systems was feasible. In Meoqui, Chihuahua, the Meoqui College was founded where soil specialists from the United States Department of Agriculture offered a course on general aspects of soil research methods, soil classification schemes and cartography. The Mexican participants to that course were graduated from schools of basic agriculture and some were specialists in irrigation. Afterwards, some of them decided to go on towards their specialtration in soil science, therefore, they traveled abroad to study at international agricultural institutions.

The National Commission of Irrigation created the Department of Agrology where Mexican and foreign agronomists carried out soil studies In the irrigation districts of the country. During the period 1930-1950, soil surveys consisted of identification and mapping of soil series, soil series associations and soil groups. These studies were utilized as a general soils inventory and as a basis for the establishment of cultivation and Irrigation programs. Those studies could be regarded to as soil surveys of 3rd and 4th order, The Department of Agrology installed regional centers In several states of Mexico to carry out soil surveys required to support irrigation projects.

It was during the development of the Mexican irrigation systems that suddenly many soil experts were required For that reason the Natlonal School of Agriculture, In 1958, formed a Soil Science Department to offer agronomic studies towards a specialization on soil science. Furthermore, the Graduate College started a master of science program on soil science and this institution initiated research on soil genesis, classification, and cartography In addition to soil physics, chemistry, fertility, and so on.

Later on, new institutions, all of them Integrated into the present Secretariat of Agriculture and Water Resources, took care of further developments on soil science in general and, in particular, on soil survey in Mexico.

The National Institute of Agricultural Research increased its activities on soil fertility and productivity, particularly related to maize and wheat and, as a consequence of these investigations, many agrologic studies were conducted. Special studies (1st and 2nd order) were made in specific areas where drainage or salinity problems were detected.

The Mexican Society of Soil Science was founded in 1962 and has organized 23 national congresses where research results and technical reports on soil science, including soil surveys, are presented. (Cuanalo de la C., 1989).

PHYSIOGRAPHIC STUDIES

Due to the fact that soil genesis Is strongly related to landscape, climate, and vegetation, physiographic maps serve as bases to conduct soil studies. In Mexico, the Graduate College started in 1970 a project to make physiographic studies at scales of 1:100,000 and 1:500,000. Figure 1 shows the resulting physiographic areas of Mexico which are also described In the Tables 3 and 4.

SOIL MAPS

In 1968 the Federal Government created a Commission for Studies of the National Territory which nowadays after several changes in functions and structure is the National Institute for Statistics, Geography, and Information (INEGI).

INEGI has produced series of soil maps at different scales. Soil maps on the scale of 1:1,000,000 were prepared In 1979-1981 with LANDSAT-MSS images, aerial photographs and field and laboratory work. At this scale eight charts cover the entire country.

Soil maps (1:250,000) are being elaborated using the 1:1,000,000 maps, LAN&AT-TM images, aerial photographs and field and laboratory work. At this scale 75 % of the country has been described (89 charts out of 122).

Figure 1. Physiographtc areas of Mexico (scale approx. 1:17,800,000).
(Graduate College, Mexico).

Table 3. PHYSIOGRAPHIC AREAS OF MEXICO
(Surface, geomorphology, and age).

Area	Surface km2	Geomorphology	Ane
A	127069.18	Flat plain, rolling coastal plain, dunes	Tertiary Quaternary (Pleistocene)
B	42672.75	Coastal plalns, marshes, sloping	Tertiary Quaternary (Pleistocene)
C	31642.44	Flat plain, sloping, alluvial fans, valleys	Middle Mesozoic — Recient
D	59790.42	Folded and faulted mountains, valleys	Mesozoic — Recient
E	139670.4	Scarped mountains, cuesta scarps, small valleys, faulted scarps	Paleozoic — Quaternary (Pleistocene)
F	2356.66	Uplands, young volcanoes, flat lands	Tertiary — Quaternary
G	99127.72	Folded and faulted mountains, scarped areas	Mesozoic — Quaternary (Pleistocene)
H	113822.33	Volcanic pediments, cinder cones, uplands, dissected pediments	Paleozoic — Quaternary (Pleistocene)

Cont inues..

PHYSIOGRAPHIC AREAS OF MEXICO
(continuation)

Area	Surface km^2	Geomorphology	Age
I	25297.09	Alluvial plains, bajadas, coastal plains, low lands	Mesozoic — Quaternary (Pleistocene)
J	118104.06	Uplands, dissected valleys, folded areas, plains	Tertiary — Quaternary (Pleistocene)
K	367396.53	Folded mountains, dissected pediments, plains, valleys, plateaus	Mesozoic — Pleistocene
L	539965.33	Mountains, gorges, canyons, plateaus, cones, upland, plains	Paleozoic — Quaternary
M	36268.09	Coastal plain, low lands, beaches, swamps, marine terraces	Cenozoic — Quaternary
N	176389.67	Mountain, alluvial plain, desert, bajadas, dunes, delta, beaches	Paleozoic — Quaternary
0	37818.48	Cuesta scarps, dissected pediments, valleys, coastal plains	Paleozoic — Quaternary
P	48193.76	Cuesta scarps. pediments, gorges, lava, volcanoes, valleys, uplands	Cenozoic — Quaternary

Source: Graduate College, Mexico.

Table 4. PHYSIOGRAPHIC AREAS OF MEXICO
(Parent material, MAT, MAP, and soil units).

Area	Parent material	MAT °C	MAP Inch	Soil units
A	Limestone, detritus	25.5 - 27	2.6 - 56.8	LVx, LPk, NTh, LVg, VRe, GLe, PLd
B	Shales, sandstone, limestone, detritus	25.6 - 26.8	43.3 - 139	GLm, FLe, PLd, VRe, LVf
C	Shales, breccia, sandstone, detritus	24 - 26.4	47.2 - 156	LVh, ACh, FLe, CMe.
D	Limestone, shales, and igneous	17 - 25.5	42	CMd, CMe, CMx, VRd, LVh, LPk
E	All kinds of rocks	21.5 - 27.5	17.4 - 75.6	ANh, VRe, RGe, LVx, LVh
F	Andesites, basalts, ash, detritus	21.6 - 27.9	53.4 - 135	CMd, ANh, LVx, VRe
G	Limestone, gneiss, lava, granite, breccia	16 - 25.5	19 - 170	CMe, CMd, LVx, LPk, ANz, LVv VRe, CMc
H	Volcanic ash, basalt, andesite, rhyolite, breccia	13 - 26.5	18.8 - 90.5	ANz, ANh, RGe, [illegible], VR[illegible]

PHYSIOGRAPHIC AREAS OF MEXICO
(continuation)

Area	Parent material	MAT	MAP	Soil units
		°C	Inch	
I	Limestone, shales, sandstone, detritus	23 -26	16.7 - 38.6	VRe,KSh,GLk, RGe
J	Limestone, shales, siltstone, marl	21.6- 24	15.7 - 74.8	KSh,VRe,LPk, CMe,LPq
K	Limestone, shales, dolomite, granite, andesite	16.2- 26.3	6.29- 59	LPq,RGe,RGd, RGc,LPk,LVh
L	Rhyolite, andesite, lava, marble slate, detritus	13.2- 26.6	11.81-51.18	LVx,KS1,LPq, ANz,KSk,RGc, RGe
M	Clastic, detritus, lava, breccia, marine sediments	23 - 25.6	11.81- 50	LVf,NTu,GLm, KS1,RGe
N	Granite, basalt, quartzite, shales, limestone	15 - 25.5	1.3 - 35	RGd,KSh,LPq, RGc,FLc
0	Granodiorite, quartzite, gneiss, lava, detritus	15.4- 20	6 - 0.48	RGd,RGc,LVx, LPq
P	Granites, basalt, lava, limestone, sandstone	21.6- 24.2	3.86- 6.6	RGd,LPq

Source: Graduate College, Mexico.

Furthermore, 760 charts (1:50,000) have been published which ccnprize 32% of the territory. Figures 2-4 show the advances of thls project. All' these charts are prepared based upon the 1968 FAO/UNESCO scheme. Table 5 shows the most representative soil groups found In Mexico.

SOIL SURVEYS

The maps published by INEGI have served as starting point for other soil studies conducted by various institutions. For instance, the Department of Agrology produces soil surveys with subgroups, phases of series and land capability classes as mapping units. This Department has covered approximately 40% of the national territory with soil surveys from 4th to 1st order, as shown in Table 6 and Figures 5-8.

Educational and research institutions. such as the Autonomous University of Chapingo (formerly National School of Agriculture) and the Graduate College have produced maps on scale 1:100,000, 1:50,000, 1:20,000, and 1:5,000 based on USDA Soil Taxonomy, FAO scheme, and USDA land capability, covering areas of both irrigated and ralnfed agriculture. The most widespread Soil Taxonomy orders are Andisols, Alfisols, Aridisols, Entisols, Inceptlsols, hiollisols, Ultisols, and some scattered Histosols. Table 7 presents information on these soil orders and their equivalents in the FAO scheme.

Table 5. The most representative soil groups in Mexico (in order of Importance).

1. Regosols	10. Acrisols
2. Lithosols	11. Andosols
3. Xerosols	12. Solonchaks
4. Yermosols	13. Gleysols
5. Camblsols	14. Kastanozems
6. Vertisols	15. Nltosols
7. Phaeozems	16. Planosols
8. Rendzlne	17. Fluvisols
9. Luvisols	

INSTITUTO NACIONAL DE ESTADISTICA
GEOGRAFIA E INFORMATICA

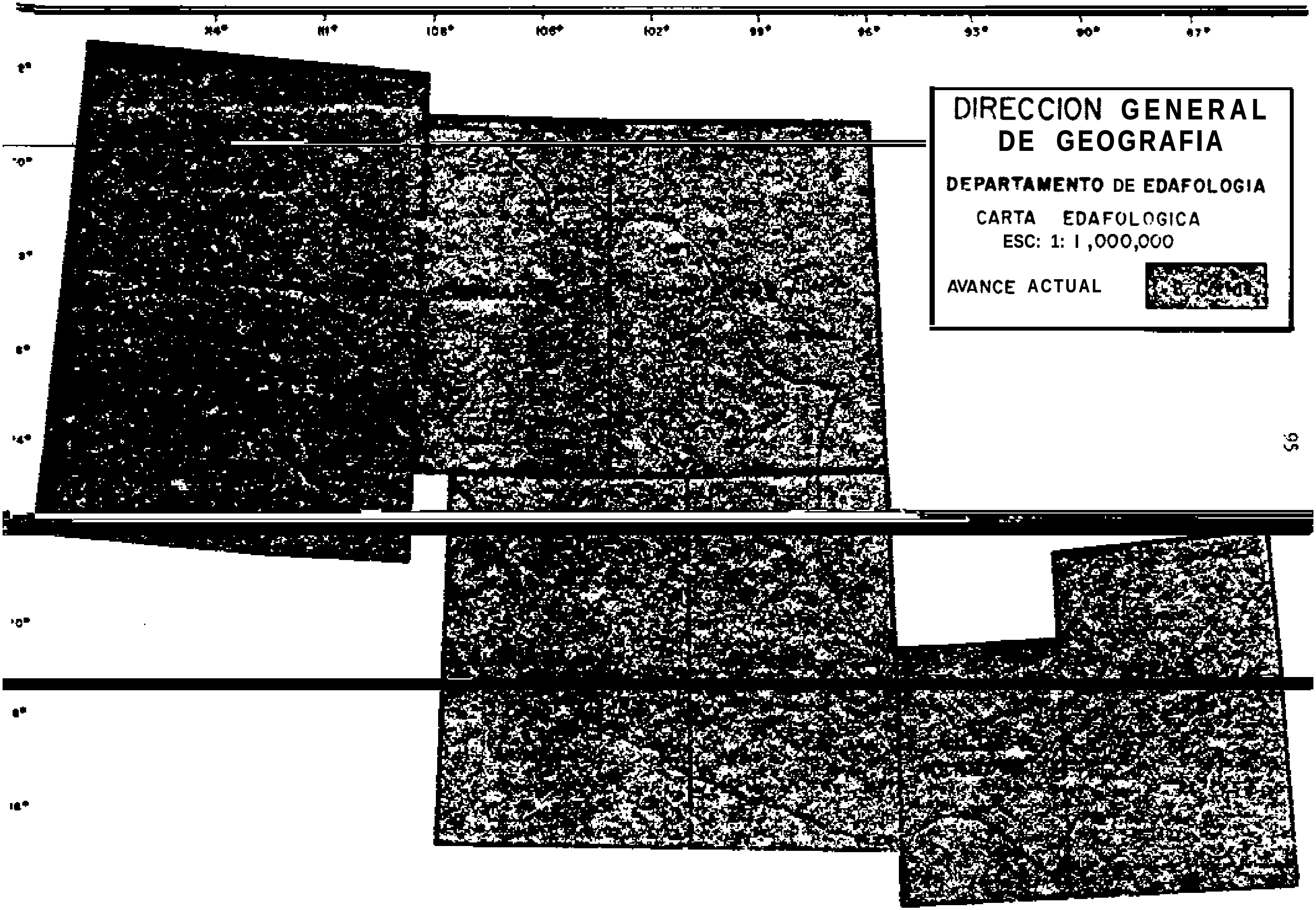


FIGURA 2

INSTITUTO NACIONAL DE ESTADISTICA
GEOGRAFIA E INFORMATICA

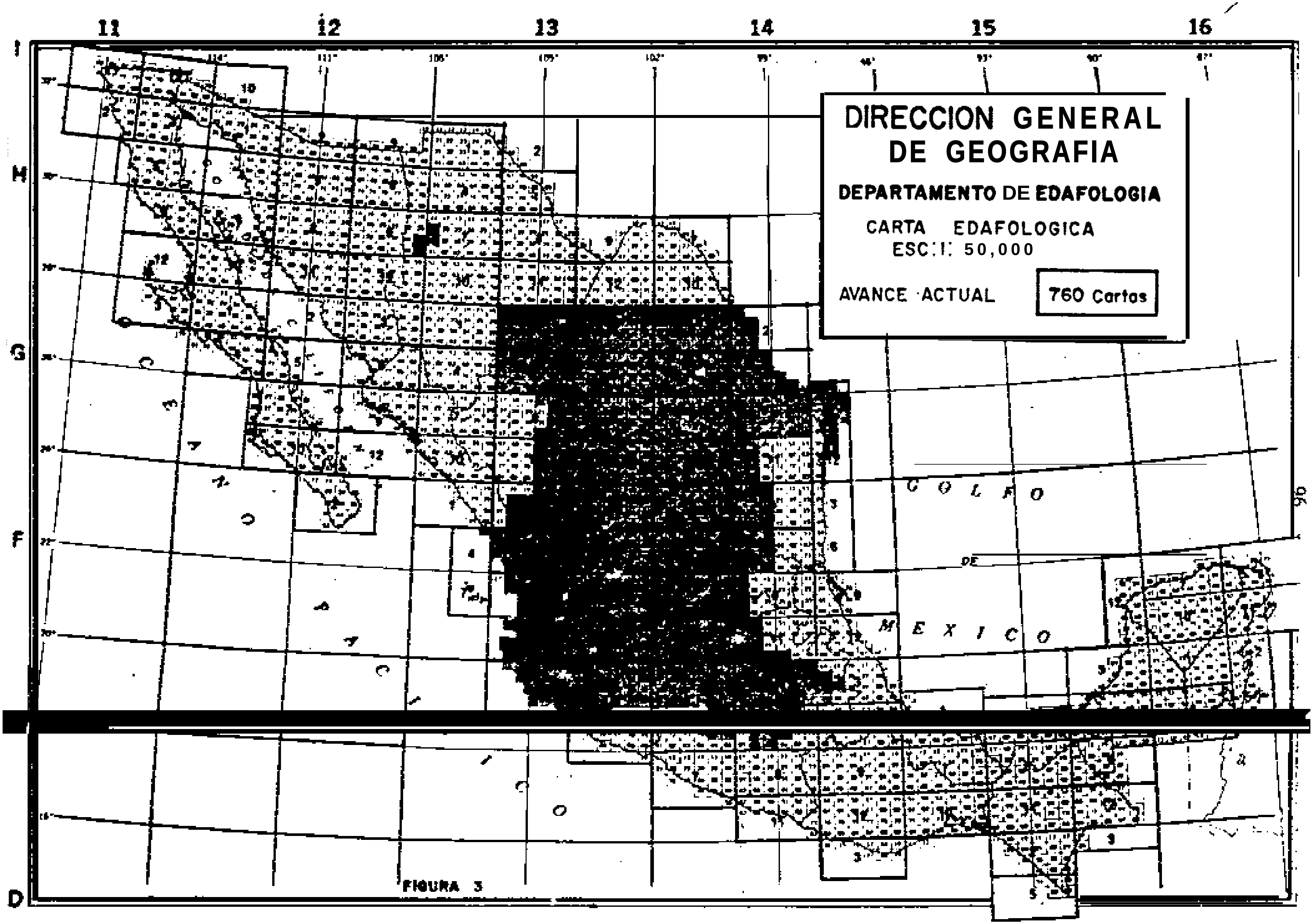


FIGURA 3

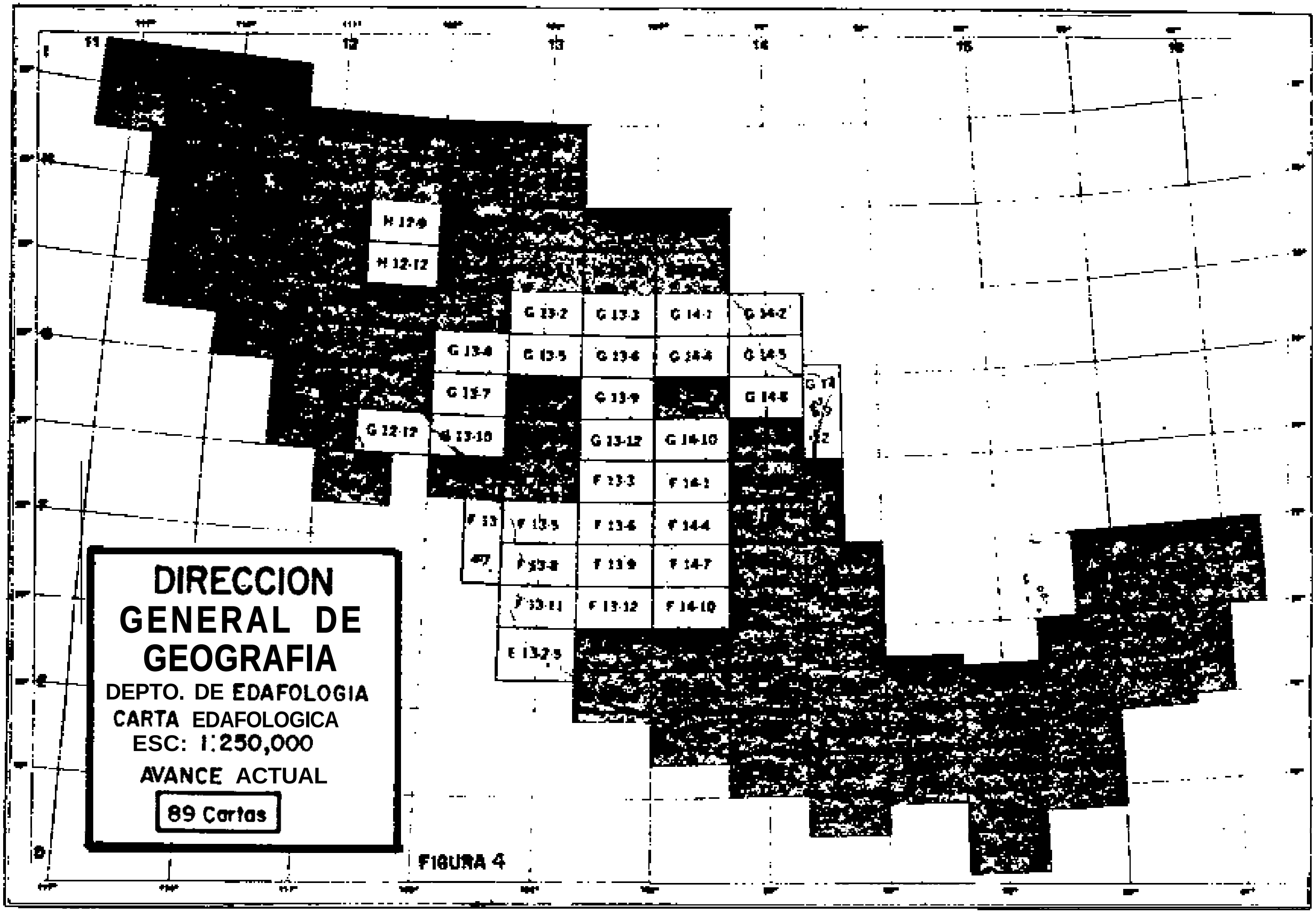

DIRECCION GENERAL DE GEOGRAFIA
DEPTO. DE EDAFOLOGIA
CARTA EDAFOLOGICA
ESC: 1:250,000
AVANCE ACTUAL
89 Cartas
H 12-9
H 12-12
G 13-2
G 13-3
G 14-1
G 14-2
G 13-4
G 13-5
G 13-6
G 14-4
G 14-5
G 13-7
G 13-9
G 14-8
G 12-12
G 13-10
G 13-12
G 14-10
F 13-3
F 14-1
F 13-5
F 13-6
F 14-4
F 13-8
F 13-9
F 14-7
F 13-11
F 13-12
F 14-10
E 13-2-5
FIGURA 4

Table 6. Soil surveys in Mexico. Department of Agrology.

Kinds of soil survey	Surface	Percentage of the country	Kinds of map units	Kinds of components
	km^2			
1st Order	47,091	2.3	Consociations and some complexes	Phases of soil series
2nd Order	92,515	4.6	Consociation and complexes	Phases of soil series
3rd Order	16,182	0.6	Consociations and associations	Phases of soil series
4th Order	807,186	40.3	Association and some consociations	Subgroups

Land evaluation projects combining physiographic surveys, soil surveys, agro-climatic conditions, traditional agricultural technology and crop yields have been carried out. Consideration of traditional techniques has brought about what is called folk classification which is a method of detailed soil survey at parcel level (scales 1:10,000 and 1:5,000). This new' approach allows an easier communication with the farmer by using autochthonous and modified names of the studied land (Table 8). In this manner soil scientists try to link technical soil properties with the empirical terms used by farmers descending from ancient cultures.

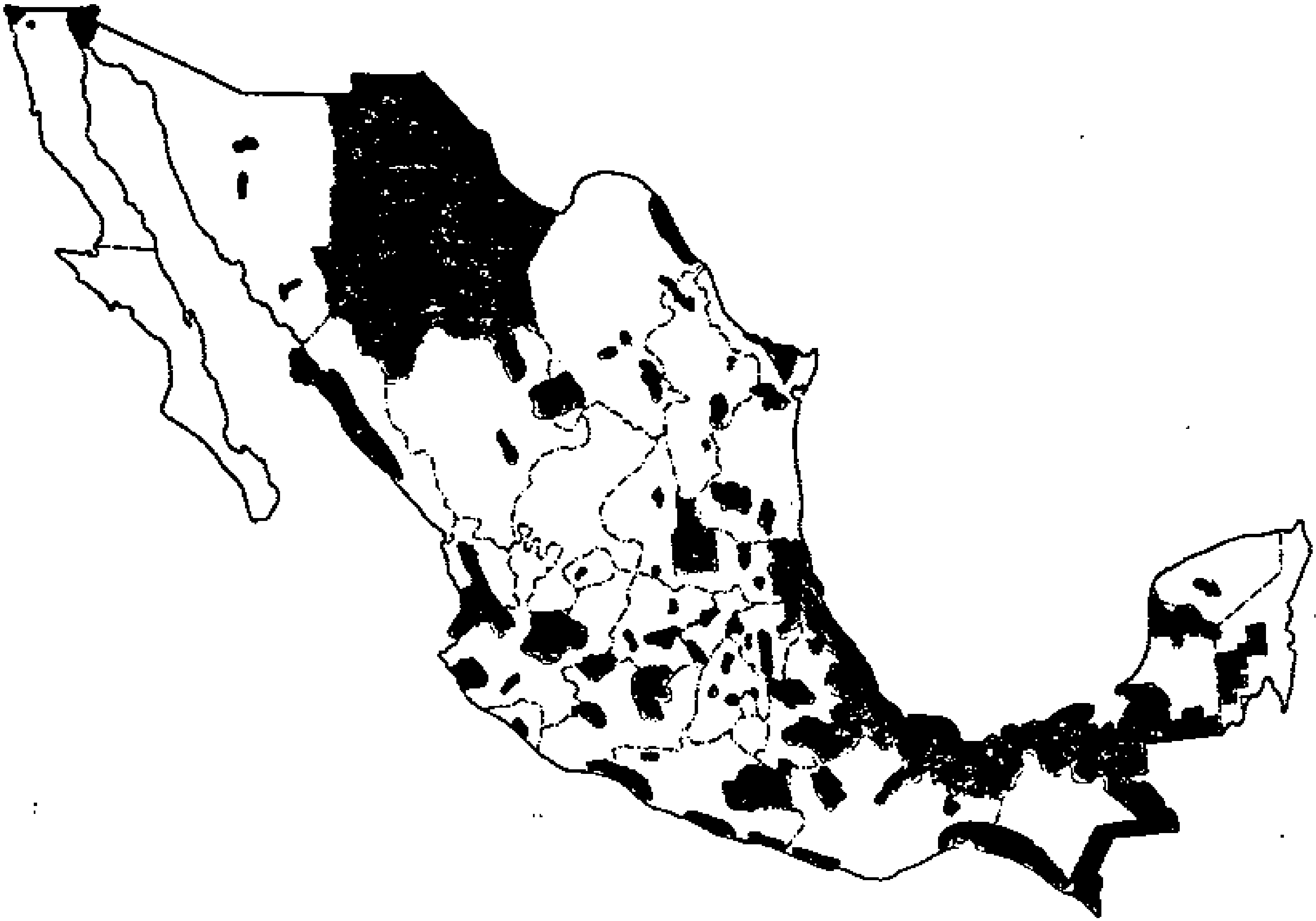


Figure 5. Soil surveyed areas in Mexico (4th Order).
Scale approx. 1:15 000 000. Department of Agrology, Mexico.

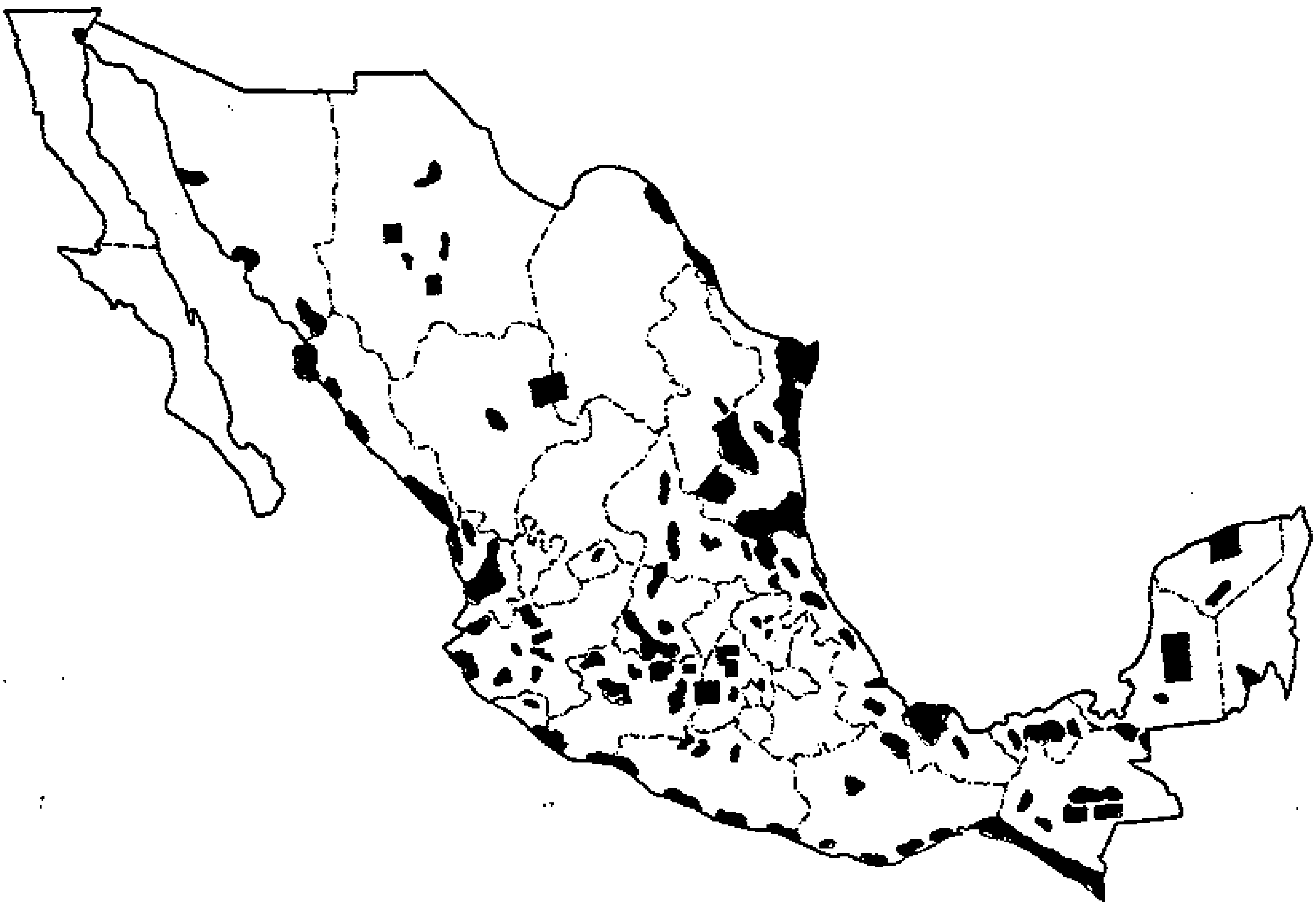


Figure 6. Soil surveyed areas in Mexico (3rd Order).
Scale approx. 1:15 000 000. Department of Agrology, Mexico.

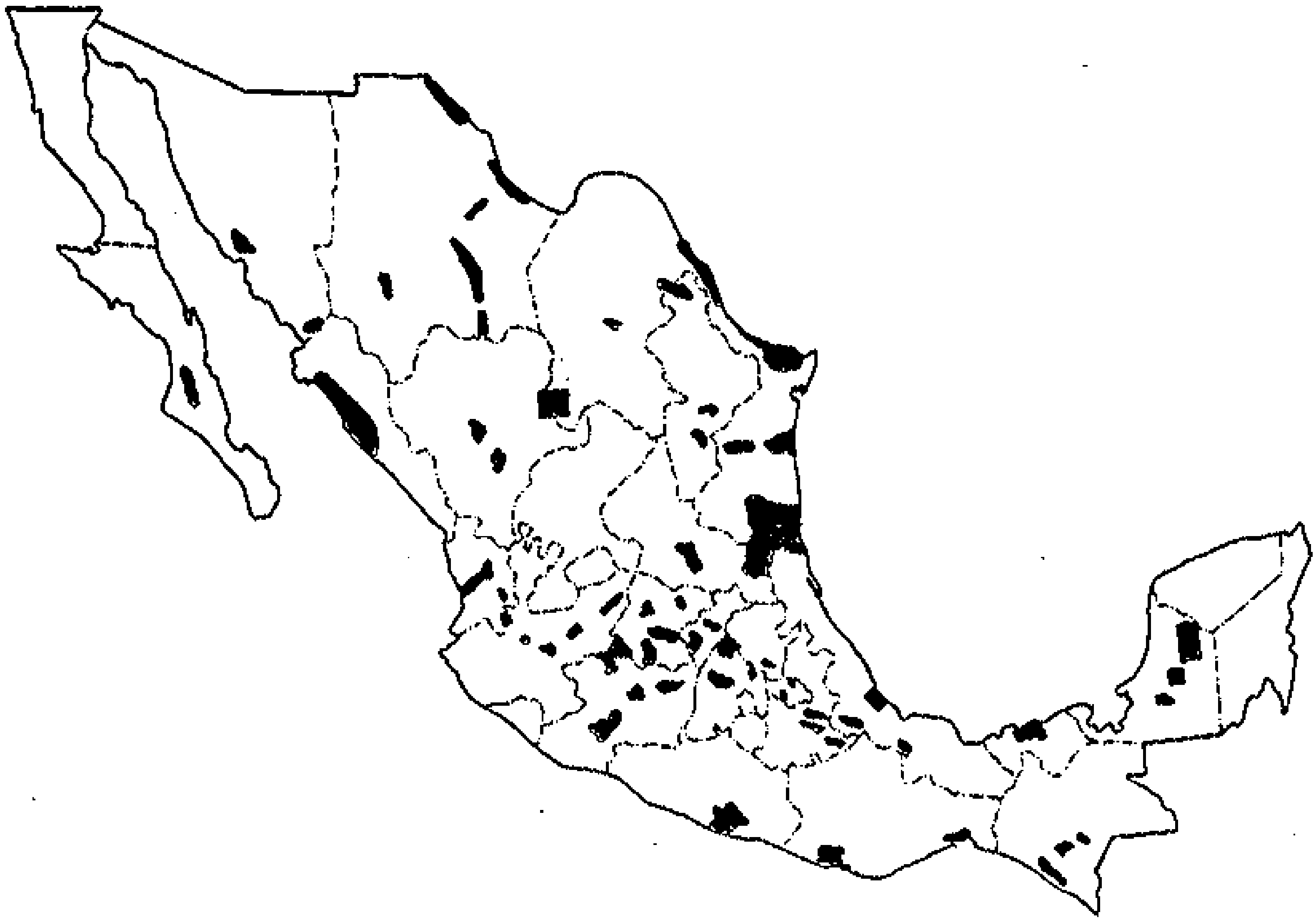


Figure 7. Soil surveyed areas in Mexico (2nd Order).
Scale approx. 1:15 000 000. Department of Agrology, Mexico.

Figure 8. *Soil surveyed areas in Mexico* (1st Order).
Scale approx. 1:15 000 000. Department of Agrology, Mexico.

Table 8. Examples of folk classification.

Derived from	Local name	English
Nahuatl:	Barro	Heavy clay
	Limo	Silt
	Arenoso	Sandy soil
	Tepetate	Claypan or Hardpan
	Lama	Mud
Otomi:	Xido	Rainfed hardpan
	Xidohai	Irrigated hardpan
	Pehai	Mud
	Bomuhai	Fine sand
Maya:	Kancab	Red or Yellow land
	Yaax-horn	Fertile land
	Akalche	Swampy land

Source: Ortiz _et al_

Final Report, 14 August 1991

NATIONAL SOILS HANDBOOK - NATIONAL COOPERATIVE SOIL SURVEY MANUAL Committee, National Soil Survey Conference, 1991.

The following persons were members of this committee:

(1) Mr. William P. Volk
Montana State Office
Bureau of Land Management
Granite Tower
222 N. 32nd St.
P. O. Box 36800
Billings, Montana 59107
Comm: 406-255-2934

(2) Dr. Larry Wilding
Dept. of Soil and Crop Science
Texas A and M University
College Station, Texas 77843-2474
Comm: 409-845-3603

(3) Dr. Mary Collins
Soil Science Department
University of Florida
G-159 McCarty Hall
Gainesville, Florida 32611
Comm: 904-392-1951

(4) Mr. Jim Gulliford
Director, Division of Soil Conservation
Iowa Department of Agriculture and Land Stewardship
Wallace State Office Building
Des Moines, Iowa 50319
Comm: 515-281-6146

(5) Mr. Dennis Heffran
National Society of Consulting Soil Scientists
P. O. Box 206
Idleyld Park, Oregon 97447
Comm: 503-496-3724

(6) Mr. Jerry Freeboff
USDA-U. S. Forest Service
11177 West 8th Ave.
P. O. Box 25127
Lakewood, Colorado 80225
Comm: 302-236-9473

(7) Mr. Ray Sinclair
National Soil Survey Center
USDA-Soil Conservation Service
Midwest National Technical Center

Final Report, 14 August 1991

<u>NATIONAL SOILS HANDBOOK - NATIONAL COOPERATIVE SOIL SURVEY MANUAL Committee, National Soil Survey Conference, 1991.</u>

The following persons were members of this committee:

(1) Mr. William P. Volk
Montana State Office
Bureau of Land Management
Granite Tower
222 N. 32nd St.
P. O. Box 36800
Billings, Montana 59107
Comm: 406-255-2934

(2) Dr. Larry Wilding
Dept. of Soil and Crop Science
Texas A and M University
College Station, Texas 77843-2474
Comm: 409-845-3603

(3) Dr. Mary Collins
Soil Science Department
University of Florida
G-159 McCarty Hall
Gainesville, Florida 32611
Comm: 904-392-1951

(4) Mr. Jim Gulliford
Director, Division of Soil Conservation
Iowa Department of Agriculture and Land Stewardship
Wallace State Office Building
Des Moines, Iowa 50319
Comm: 515-281-6146

(5) Mr. Dennis Hollran
National Society of Consulting Soil Scientists
P. O. Box 206
Idleyld Park, Oregon 97447
Comm: 503-496-3724

(6) Mr. Jerry Freehoff
USDA-U. S. Forest Service
11177 West 8th Ave.
P. O. Box 25127
Lakewood, Colorado 80225
Comm: 302-236-9473

(7) Mr. Ray Sinclair
National Soil Survey Center
USDA-Soil Conservation Service
Midwest National Technical Center

Federal Building, Room 345
100 Centennial Mall North
Lincoln, Nebraska 68508-3866
Comm: 402-437-5423

(8) Dr. Tom Fenton
Department of Agronomy
Iowa State University
Ames, Iowa 50011-1010
Comm: 515-294-2414

(9) Mr. Sylvester C. Ekart
USDA-Soil Conservation Service
Box 1458, Federal Building
Bismarck, North Dakota 58502-1458
Comm: 701-250-4435

As of the date of the meeting in Washington State, replies to the charges have been received from 5 of the committee members. A summary of the comments by individual charge are as follows:

CHARGE 1A - WHAT MANUALS AND HANDBOOKS ARE USED IN CONDUCTING THE NATIONAL COOPERATIVE SOIL SURVEY (NCSS)? The number following each item is the number of committee members mentioning the document.

(a) National Soils Handbook (4)
(b) Soil Survey Manual (4)
(c) Soil Survey Investigations Field Procedure (2)
(d) Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples (2)
(e) Procedures for Collecting Soil Samples and Methods of Analysis for Soil Survey (1)
(f) Reports of Investigations - Laboratory Data by State - Soil Survey Investigation Reports (2)
(g) List of Published Soil Surveys (1)
(h) Soil Taxonomy (4)
(i) Keys to Soil Taxonomy (3)
(j) Classification of Soil Series of the United States (2)
(k) The Guy Smith Interviews (1)
(l) Resource Conservation Glossary (1)
(m) Glossary of Soil Science Terms (1)
(n) Glossary of Selected Geomorphic Terms (1)
(o) Glossary of Geology
(p) Principles and Procedures for Using National Soil Survey Laboratory Data (1)
(q) Agriculture Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils" (1)
(r) Agriculture Handbook 294 "Aerial Photo (1) Interpretation in Classifying and Mapping Soils"
(s) Technical Writing Manual (1)
(t) NCSS Soil Map Standards and Specifications (1)
(u) American Association of State Highway and

Transportation Officials (1)
(v) American Society of Testing and Materials (1)
(w) Various College, University, and State, and Federal Geologic Publications (1)
(x) Agriculture Handbook 296 "Land Resource Regions and Major Land Resource Areas of the United States." (1)
(y) State Soil Survey Database Handbook (1)
(z) Soil Survey Techniques (ASA-SSSA Publication 20) (1)
(aa) Agriculture Handbook 210 "Land Capability Classification (1)
(bb) Munsell Color Book (1)
(cc) National Forestry Manual (2)
(dd) National Range Handbook (2)
(ee) National Agronomy Handbook (1)
(ff) National Engineering Handbook (1)
(gg) Field Office Technical Guide (1)
(hh) Chapter of the New Soil Survey Manual, 1991 in press (1)
(ii) Policy Memorandum (1)
(jj) SCS Erosion Handbooks (1)
(kk) SCS Drainage and Irrigation Guides (1)
(ll) Forest Service Manual 2551, Soil Resource Inventories (1)
(mm) Forest Service Handbook 2509.18, Chapter 1, Soil Resource Inv. (1)

CHARGE 1B - WHICH OF THE MANUALS AND HANDBOOKS LISTED IN ITEM 1A ARE ACCEPTED BY COOPERATORS IN NCSS, WHICH ARE NOT?

A general summary of the responses indicates most manuals and handbooks are accepted provided they have input from the cooperators in the NCSS, a summarized statement of individual committee members is as follows:

1. They are all accepted, but cooperators do not agree with all that is in the manuals and references, one committee person mentioned the National Soils Handbook in particular in this respect.

2. The following are most used (a) National Soils Handbook, (b) Soil Taxonomy and the Keys, (c) Munsell Color Book, (d) Soil Survey Investigations Report 1, (e) The US Forest Service Handbooks and Manuals.

3. All are accepted.

4. The following are accepted because they had input from cooperators (a) Soil Survey Manual 1951, (b) Keys to Soil Taxonomy, (c) Soil Taxonomy 1975, (d) chapters of the Soil

Survey Manual 1993, and (e) Soil Series of the United States.

CHARGE 1C - WHICH OF THE

The responses to this charge seem to indicate that most handbook and manuals generally are available, but there is a problem knowing what is current and maintaining current copies. In summary, perhaps a list of publications distributed on a periodic basis would be helpful to most cooperators.

CHARGE 2A - SHOULD AGENCY POLICY, FOR EXAMPLE, SCS OR COOPERATOR AGENCY POLICY, BE INCLUDED IN NCSS HANDBOOKS AND MANUALS?

The responses varied from prefer policy in a separate publication to yes on this subject. Most responses seem to indicate that policy can be included in either manuals or handbooks. In summary, perhaps policy is best included in manuals and handbooks provided a clear distinction is made between policy and procedures.

CHARGE 2B - WHICH AGENCY(S) OR WHO SHOULD BE RESPONSIBLE FOR LEADERSHIP IN DEVELOPING AND MAINTAINING NCSS MANUALS AND HANDBOOKS?

Most responses seem to indicate that SCS should have this responsibility because they have (1) the people resources, and (2) the federal leadership. Some responses suggest that this should be a cooperative effort, perhaps with contractual arrangements between SCS and cooperators. In summary, perhaps SCS should provide the leadership and seek more cooperator input, and perhaps contractual arrangements with cooperators for some handbooks and manual or parts thereof.

CHARGE 3 - WHAT SHOULD BE THE FORMAT FOR THE MANUALS AND HANDBOOKS OF THE NCSS? (For example, Soil Taxonomy was [illegible]

be issued on a 5 to 10 year interval, with soft bound revisions as is being done for the Keys to Soil Taxonomy. Advances in computer disc storage, transmission, intertie with cooperators, optical scanners, etc., should be followed and adopted as resources permit.

CHARGE 4 - SOME OF THE CRITERIA FOR INTERPRETING SOILS IS CURRENTLY IN DISCIPLINE MANUALS AND HANDBOOKS, THAT IS, SCS FORESTRY MANUAL, SCS RANGE HANDBOOK, ETC. HOW CAN THESE CRITERIA BE MADE AVAILABLE TO NCSS COOPERATORS THAT USE AND ACCEPT THE CRITERIA? SHOULD THEY BE INCLUDED IN NCSS HANDBOOKS AND MANUALS?

In summary, most responses indicate that these materials should be together in one place, and computer technology should be explored as a way of making them readily available. If the materials are not in one place the NCSS cooperators should be provided a copy of the handbook or manual containing these kinds of interpretations. Again the responses indicate that publishing a periodic list of these kinds of publications would be helpful. One response indicated that it would be helpful for each state to maintain a list of the participants in the NCSS.

CHARGE 5A - WHAT ADDITIONAL OR SEPARATE NCSS HANDBOOKS OR MANUALS ARE NEEDED? (Some that have been mentioned are Field Data Collection Procedures, Soil Characterization Procedures, Guide for estimating Soil Properties in Models, Handbook of Criteria for Interpreting Soils, Manual on Soil Landscape Description Procedures.)

The number following each item indicates the number of times the item was mentioned in the responses.

(a) Manual of Soil Landscape Descriptions (2)
(b) Data Dictionary for Laboratory Procedures and Methods (2)
(c) Laboratory Data Volume (on CD ROM, etc.) (1)
(d) Geology and its effects on soil/map units (1)
(e) Soil-Vegetation relationships (1)
(f) Field Data Collection Procedures (1)
(g) Guide for Estimating Soil Properties in Models (1)
(h) Handbook of Criteria for Interpreting Soils (1)

CHARGE 5B - HOW MANY ADDITIONAL MANUALS OR HANDBOOKS, IN ADDITION TO SOIL TAXONOMY AND THE SOIL SURVEY MANUAL, WOULD BE ACCEPTED AND USED?

The responses to this charge seem to indicate that any manual or handbook that helps define, describe, and standardize soil survey activities would be accepted and the emphasis should be not on the number of handbooks and manuals, but on the quality of each.

CHARGE 5C - WHO SHOULD DEVELOP AND MAINTAIN THESE ADDITIONAL MANUALS AND HANDBOOKS.=?

The responses to this charge indicate that SCS should take the lead, expand cooperator input, seeks contractual arrangements to do part of the work.

The preliminary report was discussed at the Washington State meeting at breakout sessions under the leadership of Dr. Larry Wilding. The following are the recommendations of the committee:

1. The committee has completed its charges and should be disbanded. Perhaps a new committee is needed to follow through on recommendation 2.

2. A list of NCSS manuals, handbooks, and other special publications available through the NCSS should be distributed by the SCS to cooperators on a periodic basis, perhaps every 2 years, so they can maintain current files and determine what is the current status.

3. In developing NCSS manuals and handbooks, the SCS should provide the primary leadership but seek more cooperator input. Contractual arrangements with Cooperators for drafting all or parts of some handbooks and manuals should be considered. This would enhance acceptability and use among Cooperators and ensure infusion of state-of-the science technology. New manuals to be developed would be a joint NCSS decision. Perhaps via the National Soil Survey Center Technical Advisory Committee and the NCSS Steering Committee.

4. The Soil Survey Manual and Soil Taxonomy should be revised and published in hard copy on a 5 to 10 years interval. Initiation of revisions should start in 5 years so final drafts may be published in not longer than 7 to 10 years. Advancements in computer disc storage (CDROM) and distribution should be followed closely and adapted as resources permit. A soft-bound format similar to Keys to Soil Taxonomy is suitable for updates of Soil Taxonomy and the Soil Survey Manual on a more frequent basis as necessary.

5. A soft-bound manual or suitable computer technology format, i, e., CDROM, should be developed to publish criteria and procedures used for soil interpretation in a single volume. This would include current discipline manuals and handbooks. Strong effort should be made to get NCSS Cooperator's input into this activity for current technology and credibility.

Respectively submitted,

Sylvester C. Ekart
Chairperson

Final Report, 14 August 1991

NATIONAL SOILS HANDBOOK - NATIONAL COOPERATIVE SOIL SURVEY MANUAL Committee, National Soil Survey Conference, 1991.

The following persons were members of this committee:

(1) Mr. William P. Volk
Montana State Office
Bureau of Land Management
Granite Tower
222 N. 32nd St.
P. O. Box 36800
Billings, Montana 59107
Comm: 406-255-2934

(2) Dr. Larry Wilding
Dept. of Soil and Crop Science
Texas A and M University
College Station, Texas 77843-2474
Comm: 409-845-3603

(3) Dr. Mary Collins
Soil Science Department
University of Florida
G-159 McCarty Hall
Gainesville, Florida 32611
Comm: 904-392-1951

(4) Mr. Jim Gulliford
Director, Division of Soil Conservation
Iowa Department of Agriculture and Land Stewardship
Wallace State Office Building
Des Moines, Iowa 50319
Comm: 515-281-6146

(5) Mr. Dennis Heffran
National Society of Consulting Soil Scientists
P. O. Box 206
Idleyld Park, Oregon 97447
Comm: 503-496-3724

(6) Mr. Jerry Freehoff
USDA-U. S. Forest Service
11177 West 8th Ave.
P. O. Box 25127
Lakewood, Colorado 80225
Comm: 302-236-9473

(7) Mr. Ray Sinclair
National Soil Survey Center
USDA-Soil Conservation Service
Midwest National Technical Center

Federal Building, Room 345
100 Centennial Mall North
Lincoln, Nebraska 68508-3866
Comm: 402-437-5423

(8) Dr. Tom Fenton
Department of Agronomy
Iowa State University
Ames, Iowa 50011-1030
Comm: 515-294-2414

(9) Mr. Sylvester C. Ekart
USDA-Soil Conservation Service
Box 1458, Federal Building
Bismarck, North Dakota 58502-1458
Comm: 701-250-4435

As of the date of the meeting in Washington State, replies to the charges have been received from 5 of the committee members. A summary of the comments by individual charge are as follows:

CHARGE 1A - WHAT MANUALS AND HANDBOOKS ARE USED IN CONDUCTING THE NATIONAL COOPERATIVE SOIL SURVEY (NCSS)? The number following each item is the number of committee members mentioning the document.

(a) National Soils Handbook (4)
(b) Soil Survey Manual (4)
(c) Soil Survey Investigations Field Procedure (2)
(d) Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples (2)
(e) Procedures for Collecting Soil Samples and Methods of Analysis for Soil Survey (1)
(f) Reports of Investigations - Laboratory Data by State - Soil Survey Investigation Reports (2)
(g) List of Published Soil Surveys (1)
(h) Soil Taxonomy (4)
(i) Keys to Soil Taxonomy (3)
(j) Classification of Soil Series of the United States (2)
(k) The Guy Smith Interviews (1)
(l) Resource Conservation Glossary (1)
(m) Glossary of Soil Science Terms (1)
(n) Glossary of Selected Geomorphic Terms (1)
(o) Glossary of Geology
(p) Principles and Procedures for Using National Soil Survey Laboratory Data (1)
(q) Agriculture Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils" (1)
(r) Agriculture Handbook 294 "Aerial Photo (1) Interpretation in Classifying and Mapping Soils"
(s) Technical Writing Manual (1)
(t) NCSS Soil Map Standards and Specifications (1)
(u) American Association of State Highway and

Transportation Officials (1)
(v) American Society of Testing and Materials (1)
(w) Various College, University, and State, and Federal Geologic Publications (1)
(x) Agriculture Handbook 296 "Land Resource Regions and Major Land Resource Areas of the United States" (1)
(y) State Soil Survey Database Handbook (1)
(z) Soil Survey Techniques (ASA-SSSA Publication 20) (1)
(aa) Agriculture Handbook 210 "Land Capability Classification (1)
(bb) Munsell Color Book (1)
(cc) National Forestry Manual (2)
(dd) National Range Handbook (2)
(ee) National Agronomy Handbook (1)
(ff) National Engineering Handbook (1)
(gg) Field Office Technical Guide (1)
(hh) Chapter of the New Soil Survey Manual, 1991 in press (1)
(ii) Policy Memorandum (1)
(jj) SCS Erosion Handbooks (1)
(kk) SCS Drainage and Irrigation Guides (1)
(ll) Forest Service Manual 2551, Soil Resource Inventories (1)
(mm) Forest Service Handbook 2509.18, Chapter 1, Soil Resource Inv. (1)

CHARGE 1B - WHICH OF THE MANUALS AND HANDBOOKS LISTED IN ITEM 1A ARE ACCEPTED BY COOPERATORS IN NCSS, WHICH ARE NOT?

A general summary of the responses indicates most manuals and handbooks are accepted provided they have input from the cooperators in the NCSS, a summarized statement of individual committee members is as follows:

1. They are all accepted, but cooperators do not agree with all that is in the manuals and references, one committee person mentioned the National Soils Handbook in particular in this respect.

2. The following are most used (a) National Soils Handbook, (b) Soil Taxonomy and the Keys, (c) Munsell Color Book, (d) Soil Survey Investigations Report 1, (e) The US Forest Service Handbooks and Manuals.

3. All are accepted.

4. The following are accepted because they had input from cooperators (a) Soil Survey Manual 1951, (b) Keys to Soil Taxonomy, (c) Soil Taxonomy 1975, (d) chapters of the Soil

Survey Manual 1991, and (e) Soil Series of the United States.

CHARGE 1C - WHICH OF THE MANUALS AND HANDBOOKS LISTED IN ITEM 1A ARE READILY AVAILABLE TO NCSS COOPERATORS IN SUFFICIENT COPIES.

The responses to this charge seem to indicate that most handbook and manuals generally are available, but there is a problem knowing what is current and maintaining current copies. In summary, perhaps a list of publications distributed on a periodic basis would be helpful to most cooperators.

CHARGE 2A - SHOULD AGENCY POLICY, FOR EXAMPLE, SCS OR COOPERATOR AGENCY POLICY, BE INCLUDED IN NCSS HANDBOOKS AND MANUALS?

The responses varied from prefer policy in a separate publication to yes on this subject. Most responses seem to indicate that policy can be included in either manuals or handbooks. In summary, perhaps policy is best included in manuals and handbooks provided a clear distinction is made between policy and procedures.

CHARGE 2B - WHICH AGENCY(S) OR WHO SHOULD BE RESPONSIBLE FOR LEADERSHIP IN DEVELOPING AND MAINTAINING NCSS MANUALS AND HANDBOOKS?

Most responses seem to indicate that SCS should have this responsibility because they have (1) the people resources, and (2) the federal leadership. Some responses suggest that this should be a cooperative effort, perhaps with contractual arrangements between SCS and cooperators. In summary, perhaps SCS should provide the leadership and seek more cooperator input, and perhaps contractual arrangements with cooperators for some handbooks and manual or parts thereof.

CHARGE 3 - WHAT SHOULD BE THE FORMAT FOR THE MANUALS AND HANDBOOKS OF THE NCSS? (For example, Soil Taxonomy was published as a hard bound volume in 1975, but it is updated in periodically issued soft bound volumes and on computer discs.)

The most mentioned formats are loose-leaf binder, hard copy, and computer discs. In summary, hard bound volumes should be issued on a 5 to 10 year interval, with soft bound revisions as is being done for the Keys to Soil Taxonomy. Advances in computer disc storage, transmission, intertie with cooperators, optical scanners, etc., should be followed and adopted as resources permit.

CHARGE 4 - SOME OF THE CRITERIA FOR INTERPRETING SOILS IS CURRENTLY IN DISCIPLINE MANUALS AND HANDBOOKS, THAT IS, SCS FORESTRY MANUAL, SCS RANGE HANDBOOK, ETC. HOW CAN THESE CRITERIA BE MADE AVAILABLE TO NCSS COOPERATORS THAT USE AND ACCEPT THE CRITERIA? SHOULD THEY BE INCLUDED IN NCSS . HANDBOOKS AND MANUALS?

In summary, most responses indicate that these materials should be together in one place, and computer technology should be explored as a way of making them readily available. If the materials are not in one place the NCSS cooperators should be provided a copy of the handbook or manual containing these kinds of interpretations. Again the responses indicate that publishing a periodic list of these kinds of publications would be helpful. One response indicated that it would be helpful for each state to maintain a list of the participants in the NCSS.

CHARGE 5A - WHAT ADDITIONAL OR SEPARATE NCSS HANDBOOKS OR MANUALS ARE NEEDED? (Some that have been mentioned are Field Data Collection Procedures, Soil Characterization Procedures, Guide for estimating Soil Properties in Models, Handbook of Criteria for Interpreting Soils, Manual on Soil Landscape Description Procedures.)

The number following each item indicates the number of times the item was mentioned in the responses.

- (a) Manual of Soil Landscape Descriptions (2)
- (b) Data Dictionary for Laboratory Procedures and Methods (2)
- (c) Laboratory Data Volume (on CD ROM, etc.) (1)
- (d) Geology and its effects on soil/map units (1)
- (e) Soil-Vegetation relationships (1)
- (f) Field Data Collection Procedures (1)
- (g) Guide for Estimating Soil Properties in Models (1)
- (h) Handbook of Criteria for Interpreting Soils (1)

CHARGE 5B - HOW MANY ADDITIONAL MANUALS OR HANDBOOKS, IN ADDITION TO SOIL TAXONOMY AND THE SOIL SURVEY MANUAL, WOULD BE ACCEPTED AND USED?

The responses to this charge seem to indicate that any manual or handbook that helps define, describe, and standardize soil survey activities would be accepted and the emphasis should be not on the number of handbooks and manuals, but on the quality of each.

CHARGE 5C - WHO SHOULD DEVELOP AND MAINTAIN THESE ADDITIONAL MANUALS AND HANDBOOKS.=?

The responses to this charge indicate that SCS should take the lead, expand cooperator input, seeks contractual arrangements to do part of the work.

The preliminary report was discussed at the Washington State meeting at breakout sessions under the leadership of Dr. Larry Wilding. The following are the recommendations of the committee:

1. The committee has completed its charges and should be disbanded. Perhaps a new committee is needed to follow through on recommendation 2.

2. A list of NCSS manuals, handbooks, and other special publications available through the NCSS should be distributed by the SCS to cooperators on a periodic basis, perhaps every 2 years, so they can maintain current files and determine what is the current status.

3. In developing NCSS manuals and handbooks, the SCS should provide the primary leadership but seek more cooperator input. Contractual arrangements with Cooperators for drafting all or parts of some handbooks and manuals should be considered. This would enhance acceptability and use among Cooperators and ensure infusion of state-of-the science technology. New manuals to be developed would be a joint NCSS decision. Perhaps via the National Soil Survey Center Technical Advisory Committee and the NCSS Steering Committee.

4. The Soil Survey Manual and Soil Taxonomy should be revised and published in hard copy on a 5 to 10 years interval. Initiation of revisions should start in 5 years so final drafts may be published in not longer than 7 to 10 years. Advancements in computer disc storage (CDROM) and distribution should be followed closely and adapted as resources permit. A soft-bound format similar to Keys to Soil Taxonomy is suitable for updates of Soil Taxonomy and the Soil Survey Manual on a more frequent basis as necessary.

5. A soft-bound manual or suitable computer technology format, i, e., CDROM, should be developed to publish criteria and procedures used for soil interpretation in a single volume. This would include current discipline manuals and handbooks. Strong effort should be made to get NCSS Cooperator's input into this activity for current technology and credibility.

Respectively submitted,

Sylvester C. Ekart
Chairperson

MMENDATIONS:

1. A list of NCSS manuals, handbooks and other special publications available through the NCSS should be distributed by SCS to Cooperators on a periodic basis (every 2 years), so they can maintain current files and determine what is the current status.

2. In developing NCSS manuals and handbooks, the SCS should provide the primary leadership but seek more Cooperator input. Contractual arrangements with Cooperators for drafting all or parts of some handbooks and manuals should be considered. This would enhance acceptability and use among Cooperators and ensure infusion of state-of-the-science technology. New manuals to be developed would be a joint NCSS decision. (Perhaps via the National Soil Survey Center Technical Advisory Committee and the NCSS Steering Committee).

3. The Soil Survey hlanual and Soil Taxonomy should be revised and published in hard copy on a 5 to 10- year interval. Initiation of revision should start in 5 years so final drafts may be published in not longer than 7 to 10 years. Advancements in computer disc storage (CDROM) and distribution should be followed closely and adapted as resources permit. A soft-bound format similar to Keys to Soil Taxonomy is suitable for update of Soil Taxonomy and The Soil Survey Manual on a more frequent basis as necessary.

4. A soft-bound manual or suitable computer technology format (i.e. CDROM) should be developed to publish criteria and procedures used for soil interpretations in a single volume. This would include current discipline manuals and handbooks. Strong effort should be made to get NCSS Cooperator's input into this activity for current technology and credibility.

NATIONAL COOPERATIVE SOIL SURVEY
DATA DICTIONARY
COMMITTEE REPORT
07/25/91

BACKGROUND

Over the last decade, the complexity of information systems has grown tremendously. Several factors have contributed to this: First, technical advances have lead to computer and communication systems that can handle vast amounts of information at a reasonable cost. Secondly, the human need for more diverse yet integrated information has more than kept pace with these rapid technological advances.

This is especially true of soils information. Soils information can now originate from many sources, often physically scattered across the country or the world. Since these diverse sources of information must serve a number of users, it is vital that users understand precisely what the data is and what it means.

The tool that has evolved for organizing information about the meaning and content of computerized databases is referred to as the Data Dictionary. In the past, this may have been nothing more than a notebook containing information about the data. Now, with today's complex systems, the data dictionary is typically managed by a computer resident data base so that changes or additions can be recorded accurately and easily, and its information can be accessed by users as well as the machine's resident software.

The data dictionary manages information about data elements. The "data element" is the most atomic representation of information. It is the smallest "piece" of information that can be uniquely defined. No two data elements should share the same definition.

As more emphasis is placed on the management of soils data in computerized databases it is important that the definition of the data in these systems be standardized and consistent among NCSS data systems. There are many soils databases developed and used by members of the NCSS. Although these databases contain the same kinds of data, in many instances they use terminology that is assigned different meanings in different databases. This creates confusion and increases the difficulty in integration and sharing data between NCSS cooperators and the general public.

The Steering Committee for the NCSS Conference, in keeping with this year's theme for the conference - Providing Quality Soil Survey Information To Our Customers, - established a committee to investigate the role of the NCSS in establishing and maintaining common standards for the definition of soils data.

COMMITTEE CHARGE

The charges for the committee were as follows:

1) Develop a clear definition of the committee's purpose, goals, and objectives, and the role the committee should play in the management and use of NCSS soil data element information,

2) Develop an inventory and description of the databases managed and maintained by the NCSS. The inventory will include:
   a. name of the database
   b. responsible agency
   c. database manager
   d. description of database (who has access, location, update frequency, size, computer environment)
   e. list of data elements

COMMITTEE MEMBERS

The following people are members of the committee:

Mr. David L. Anderson chairman
Leader, Soil Data Systems
National Soil Survey Center
SCS, Lincoln, NE

Mr. Gordon Decker
State Soil Scientist
SCS, Bozeman, MT

Dr. Gary Peterson
Department of Agronomy
The Pennsylvania State University
University Park, PA

Mr. Al Amen
USDI - Bureau of Land Management
Denver, CO

Dr. Gerald Nielsen
Department of Plant and Soil Science
Montana State University

Bozeman, MT

Dr. Elissa Levine
Biospheric Sciences .
National Aeronautical Space Agency
Goddard Space Flight Center
Greenbelt, MD

Mr. Bob Meurisse
USDA - U.S. Forest Service
Portland, OR

Dr. Jimmy Williams
USDA - ARS
Grasslands Research Center
Temple, TX

Mr. Colin Voigt
USDI - Bureau of Land Management
Washington, DC

Mr. Duane Lammers
EPA - Earth Research Laboratory
Corvallis, OR

A teleconference was held in February to discuss the committee charges. Each member was asked to respond to the chairman in writing. The chairman consolidated the responses and comments made during the teleconference and circulated a draft for review. An additional teleconference was held in July to review the draft committee report.

COMMITTEE RECOMMENDATIONS

* There was unanimous agreement that:

  1) a mechanism is needed for standardizing the definition of data elements used in soil databases, and
  2) a permanent NCSS committee should be established as the mechanism to achieve this goal.

* The name of the committee should be the NCSS Data Management Standards Committee.

* The purpose of the committee would be:

  a. Provide leadership and guidance to cooperators and other collectors and users of soils information in the development of soils data bases.

b. Provide leadership for the establishment, maintenance, and administration of an NCSS data dictionary (NCSS-DD) to serve as the repository for standards for naming and describing soils data elements.

c. Coordinate the review and approval of data element standards and periodically publish a list of approved NCSS data elements.

d. Develop, maintain, and periodically publish an inventory of sources of automated NCSS soils data bases.

It was recommended that the data elements used to describe soil profiles be used as a starting point for developing the NCSS-DD. The data elements that are used in the SCS Pedon Description Program (PDP) would be used as the basis for starting. The revised PDP contains over 200 data elements that describe the setting and horizon data for soil profile descriptions. These data elements would be circulated for review and approval by the committee.

COMMITTEE MEMBERSHIP AND OPERATIONS

A permanent committee would be established with the following membership:

chairman

a representative from each cooperating agency who collect soils information and maintain soils databases. (SCS, Forest Service, BLM, BIA,)

a member from each NCSS region, which could be a representative from one of the above groups

a representative from the Association of Consulting Soil Scientists

Regional representatives would be responsible for coordination of the review of data definitions within each region.

DATA DICTIONARY ATTRIBUTES

The following attributes will be used to defined each data element:

DATA ELEMENT LONG NAME
LENGTH/PRECISION
UNIT OF MEASURE
DESCRIPTION
VALIDATION CRITERIA
DATA QUALITY
DATA ELEMENT SHORT NAME
DATA ELEMENT TYPE
DATA BASE USING
DEFINITION OF CODES
DERIVATION LOGIC

INVENTORY OF NCSS SOILS DATABASES

The NCSS-DD Committee would conduct and maintain an inventory of NCSS automated soils databases. This information would be made available to NCSS members and the general public on a periodic basis. The following attributes are recommended as the primary information to be collected:

DATABASE NAME
AGENCY RESPONSIBLE (name, address, phone)
DATA BASE MANAGER (contact person, address, phone)
DESCRIPTION OF THE CONTENTS
- text description
- access privilege
- spatial, attribute or both
- size
- number of records
- update frequency
- computer environment
- costs for data
- data formats provided
- list of data elements (optional)

OUTSTANDING ISSUES

The committee feels strongly that some mechanism is needed to identify "data quality." The committee recommends that a NCSS committee be established to resolve the issues and define how to document the concept of data quality,

The format and mechanism of publishing the approved list of data elements and the list of soils databases will need to be resolved.

The distension of exactly what constitutes a "soils data element" will need to be resolved.

LONG NAME	SHORT NAME	DATA TYPE	LENGTH/ PRECISION	UNIT OF MEASURE	MANAGING STAFF	STATUS	ORIGIN	CODING SCHEME	MINIMUM VALUE	MAXIMUM VALUE
LATITUDE_DEGREES	LATDEG	INTEGER	2	DEGREES	QA	URT			0	TBD

DEFINITION

Latitude in degrees. (Snyder, J.P., 1982, Map projections Used by the USGS)

COMMENTS

LONG NAME	SHORT NAME	DATA TYPE	LENGTH/ PRECISION	UNIT OF MEASURE	MANAGING STAFF	STATUS	ORIGIN	CODING SCHEME
BOUNDARY_DISTINCTNESS	BNDDIST	CHARACTE	1		QA	UR1		BOUNDARY_DISTINCTNESS

DEFINITION

Thickness of the interface between adjacent soil horizons. (SSM, chap3)

COMMENTS

CODING SCHEME DOMAIN: bnddist

CODE	MEANING
A	abrupt
C	clear
D	diffuse
G	gradual

LONG NAME	SHORT NAME	DATA TYPE	LENGTH/ PRECISION	UNIT OF MEASURE	MANAGING STAFF	STATUS	ORIGIN	CODING SCHEME
LOCATION_MERIDIAN_PLSS	LOCMERID	CHARACTE	50		QA	NR1		

DEFINITION

A line along an astronomical meridian that establishes the reference for township boundaries. This is part of the Public Land Survey System (PLSS) which includes meridian, township, range and section. (Man. of Instr. for Survey of Public Lands of U.S., 1947)

COMMENTS

LONG NAME	SHORT NAME	DATA TYPE	LENGTH/ PRECISION	UNIT OF MEASURE	MANAGING STAFF	STATUS	ORIGIN	CODING SCHEME
MAJOR_LAND_RESOURCE_AREA	MLRA	CHARACTE	4		IT	UR1	DERIVED	STATE MLRA

DEFINITION

A symbol used to identify the information available about a part of the U.S. as a resource for farming, ranching, forestry, engineering, recreation and other uses. (Agriculture Handbook 296. Land Resource Regions and Major Land Resource Areas of The United States)

COMMENTS

CODING SCHEME DOMAIN: DEmlra

CODE	MEANING
148	NORTHERN PIEDMONT
149A	NORTHERN COASTAL PLAIN
150C	MID-ATLANTIC COASTAL PLAIN

APPENDIX A - Pedon Description Program Data Element Long Names

Data Element Long Name

Associated_Sail
Bedrock_Dip
Bedrock_Fracture
Bedrock_Hardness
Bedrock_Kind
Bedrock_Strike
Bedrock_Weathering
Boundary_Distinctness
Boundary_Topography
Cementation
Cementation_Agent
Component_Kind
Component_Name
Concentration_Color_Chroma
Concentration_Color_Value
Concentration_Color_Hue
Concentration_Hardness
Concentration_Kind
Concentration_Location
Concentration_Origin
Concentration_Percent
Concentration_Shape
Concentration_Size
County_Name
Degree_of_erosion
Describers_Name
Diagnostic_Feature_Type
Diagnostic_Feature_Kind
Diagnostic_Feature_Depth_Upper
Diagnostic_Feature_Lower_Depth
Drainage_Class
Effervescence_Agent
Effervescence_Class
Effervescence_Continuity
Effervescence_Location
Elevation
Erosion_Type
Field_Measured_Hor_Prop_Value
Field_Measured_Prop_Code
Field_Measured_Site_Prop_Value
Flooding_Beginning_Month
Flooding_Duration
Flooding_Frequency
Geomorphic_Surface
Hillslope_Component
Horizon_Color_Chroma
Horizon_Color_Hue
Horizon_Color_Moisture_State
Horizon_Color_Percent
Horizon_Color_Physical_State
Horizon_Color_Value
Horizon_Depth_To_Bottom
Horizon_Depth_to_Top
Horizon_Designation
Horizon_Feature_Kind
Horizon_Hydraulic_Conductivity
Horizon_Lab_Sample_Number
Horizon_Lateral_Area
Horizon_Moisture_Content
Horizon_Note
Horizon_Note_Formatted
Horizon_Thickness_Average
Horizon_Thickness_Maximum
Horizon_Thickness_Minimum
Horizon_Volume_Total
Horizon_Wetness_State
Laboratory_Sample_Number
Laboratory_Source_ID
Land_Use
Landform_Local
Landform_Major
Latitude_Degrees
Latitude_Direction
Latitude_Minutes
Latitude_Seconds
Location_Description
Location_Meridian_PLSS
Location_Range_PLSS
Location_Section_Details_PLSS
Location_Section_PLSS
Location_Township_PLSS
Longitude_Degrees
Longitude_Direction
Longitude_Minutes
Longitude_Seconds
Major_Land_Resource_Area
Manner_of_failure
Mapunit_Name
Mapunit_Symbol
Mean_Annual_Air_Temperature
Mean_Annual_Precipitation
Mean_Annual_Soil_Temperature
Mean_Summer_Air_Temperature
Mean_Summer_Soil_Temperature
Mean_Winter_Air_Temperature
Mean_Winter_Soil_Temperature
Microrelief_Elevation
Microrelief_Kind
Microrelief_Pattern
Mottle_Color_Chroma
Mottle_Color_Hue
Mottle_Color_Moisture_State
Mottle_Color_Value
[illegible]

APPENDIX A - Pedon Description Program Data Element Long Names

Slope_Length_Usle
Slope_Position
Slope_Shape_Laterally
Slope_Shape_Longitudinal
Soil_Description_Note
Soil_Name_As_Sampled
Soil_Survey_Area_Id
Soil_Survey_Area_Name
Stickiness
Structure_Grade
Structure_Parts_To
Structure_Shape
Structure_Size
Surface_Rock_Cover
Taxonomic_Family_Other
Taxonomic_Great_Group
Taxonomic_Mineralogy
Taxonomic_Moisture_Regime
Taxonomic_Order
Taxonomic_Particle_Size
Taxonomic_Reaction
Taxonomic_Subgroup
Taxonomic_Suborder_Modifier
Taxonomic_Temperature
Texture_Class
Texture_Modifier
Toughness
Transect_Identification
Transect_Interval
Transect_Stop_Number
Used_In_Lieu_Of_Texture
UTM_Easting
UTM_Northing
UTM_Zone
Water_Table_Depth
Water_Table_Duration
Water_Table_Kind
Weather_Station_Id
Weather_Station_Name
Weather_Station_Type
Yield_Identification

National Cooperative Soil Survey 1991 Conference
Map Unit and Data Variability Committee

Background: Soil survey information is being used more. intensively than ever before. Our clients are becoming more sophisticated in use and interpretation of soils data. These users are asking for measures of the variability within mapped areas and for indicators of the reliability of soil maps.

Charge: Identify, define, and review the reliability of existing methods and, if possible, develop improved methods for estimation or determination of:

1. Map unit composition (proportion of components),
2. Landscape patterns of components within map units, and
3. Variation of soil properties within map unit components.

Activities: In January, I sent prospective committee members Methods Descriptions for Determination of Map Unit Composition, First Approximation (attached). These draft descriptions are a first attempt to outline the range in levels of hard information that back up the statements about map unit composition in data bases and in soil survey reports. In June, I finally sent the prospective committee members information (also attached) about methods actually used in the field.

In May, Bill Edmonds, VPISU, sent Binomial Probabilities for Estimating Soil Map Unit Composition in Virginia by Edmonds and Crouch.

The NCSS committee on Map Unit Composition and Map Quality reviewed information on the subject including the geostatistical literature and concluded that geostatistics could help determine the geographic scale (fineness or coarseness) of patterns of soil variability as a guide to the intervals between observation or sampling points and Tom Reinsch collected test data on lo-meter spacings.

Berman Hudson, NSSC, proposed a new approach (presented in a poster by Hudson and Knox at this conference) to evaluate and understand soil variability. It is based on the concepts that (1) much of the variability within map units is at a very small scale, (2) the smallest areas (blocks) large enough to be considered for differential land use or differential application of management practices encompass much variation among pedons, and (3) because so much soil variability is very local, each of these blocks is likely to exhibit a significant proportion of the total variation within the total map unit. This approach would substitute block-to-block variability for point-to-point variability as the basic measure of map unit composition.

Status: Based on the response of 16 states to the NSSC, the straight line point intercept method based on Steers and Hajek, 1979, is the method most commonly used today. It has the advantage of being relatively standard and familiar. Several states have rejected this approach because it is not fully objective. The Virginia procedure is the most thoroughgoing, statistically-sound method. A few states specify a short interval between transect points. Otherwise, the procedures in use do not yield any information on short-range variability. All of the known methods in use measure point-to-point variability.

Issues:
1. Would the separation of short-range from longer-range variability be an important advance?
2. If so, are blocks of closely spaced points better than transects with fixed short intervals?
3. Apart from the issue of short-range variability, do the advantages of the partially subjective transect method outweigh the additional statistical validity of the fully random method used in Virginia?
4. Can the transect method be substantially improved by use of fixed small intervals and predetermined or randomly selected bearings?
5. Are there alternative not considered here?

Possible Recommendations:
1. Let the whole issue die.
2. Ask the NSSC to continue work.
3. Constitute a continuing working committee of the NCSS.
4. Ask the NSSC to find volunteer states to try out the block approach.

Ellis Knox, 10 July 1991

Method Descriptions
for Determination of Map Unit Composition
First Approximation

Subjective Judgement Method - Fewer than three recorded pedon observations. The party leader reviews the recorded pedon observations, other field notes, recorded pedon observations from closely similar map units (such as other consociations named for the same series), the delineations of the map unit on aerial photographs, and impressions from conversations with party members and from his or her own field observations while mapping and formulates a best guess of the composition. This is reviewed and adjusted or confirmed in consultations with the correlator.

Subjective Judgement Method - More than three recorded pedon observations. There are from three to 29 sites selected arbitrarily and fewer than ten sites selected randomly or systematically. The party leader reviews the recorded pedon observations, other field notes, recorded pedon observations from closely similar map units (such as other consociations named for the same series), the delineations of the map unit on aerial photographs, and impressions from conversations with party members and from his or her own field observations while mapping and formulates a best guess of the composition. This is reviewed and adjusted or confirmed in consultations with the correlator.

Informed Judgement Method. There are 30 or more recorded pedon observations at sites selected arbitrarily or from ten to 30 pedon observations at sites selected randomly or systematically. The composition calculated from the distribution of recorded pedon observations is reviewed by the party leader together with other field notes, recorded pedon observations from closely similar map units (such as other consociations named for the same series), the delineation!: of the map unit on aerial photographs, and impressions from conversations with party members and from his or her own field observations while mapping and formulates a best guess of the composition. This is reviewed and adjusted or confirmed in consultations with the correlator.

Statistical Method - Arbitrary transect(s). There are at least 30 recorded pedon observations on one or more fixed-interval transects selected arbitrarily. Either the delineation(s) in which the transect(s) are placed, the direction(s), the starting point(s), or some combination of these are selected arbitrarily. The composition is calculated from the distribution of recorded pedon observations and used without modification.

Modified Statistical Method - Arbitrary transect(s). There are at least 30 recorded pedon observations on one or more fixed-interval transects selected arbitrarily. Either the delineation(s) in which the transect(s) are placed, the direction(s), the starting point(s), or some combination of these are selected arbitrarily. The composition calculated from the distribution of recorded pedon observations is reviewed by the party leader in light of other field notes, recorded pedon observations from closely similar map units (such as other consociations named for the same series), the delineations of the map unit on aerial photographs, and impressions from conversations with party members and from his or her own field observations while mapping and adjusted as appropriate in consultations with the correlator.

Statistical Method - Random points. There are at least 30 recorded pedon observations each at a site selected randomly, without bias of a soil scientist. The composition is calculated from the distribution of recorded pedon observations and used without modification.

Modified Statistical Method - Random points. There are at least 30 recorded pedon observations each at a site selected randomly, without bias of a soil scientist. The composition calculated from the distribution of recorded pedon observations is reviewed by the party leader in light of other field notes, recorded pedon observations from closely similar map units (such as other consociations named for the same series), the delineations of the map unit on aerial photographs, and impressions from conversations with party members and from his or her own field observations while mapping and adjusted as appropriate in consultations with the correlator.

Statistical Method - Systematic points. There are at least 30 recorded pedon observations on one or more fixed-interval, randomly-placed transects or grids such that the sites are determined without respect to bias of a soil scientist. The composition is calculated from the distribution of recorded pedon observations and used without modification.

Modified Statistical Method - Systematic points. There are at least 30 recorded pedon observations on one or more fixed-interval, randomly-placed transects or grids such that the sites are determined without respect to bias of a soil scientist. The composition calculated from the distribution of recorded pedon observations is reviewed by the party leader in light of other field notes, recorded pedon observations from closely similar rap units (such as other consociations named for the same series), the delineations of the map unit on aerial photographs, and impressions from conversations with party members and from his or her own field observations while mapping and adjusted as appropriate in consultations with the correlator.

January 11, 1991 EGK

Procedures for Documenting Map Unit Composition

Soil Conservation Service (SCS) state soil scientists were requested to provide information on how the composition of soil map units is documented in their states. Responses received at the National Soil Survey Center (NSSC) are summarized in the table attached and in the discussion below. Fifteen of the 16 states use a straight line point intercept procedure. Alaska and Michigan use line segment transects in addition. Kentucky uses a stratified, subjective, statistical procedure in addition. North Dakota makes a random subsample of transect points for statistical analysis. Virginia uses a random stratified point procedure.

I. Straight Line Point Intercept Methods

The procedures in a number of states, based on Steers and Hajek (1979), call for subjective location of a potential transect in each delineation, random selection of transects, and examination of enough transects to satisfy predetermined statistical standards. Transects extend completely across the delineation, perpendicular to any linear soil or landscape pattern, and have at least 10 egually-spaced points.

Variations from this basic procedure include (1) subjective selection of transects, (2) stratification by components within map units, (3) a fixed minimum number of transects, (4) fewer points per transect, (5) fixed intervals between points, and (6) deviation from the direction that crosses the geographic pattern.

II. Line Segment Transect Methods

Maine and Nebraska report use of the line segment method in which map unit components are identified continuously along the transect line. The lengths of the segments that cross the various components are measured. The cumulative lengths for the individual components divided by the length of the transect are taken as a measure of the area1 composition of the map unit. Use of this method is restricted to map units in which components are readily identified on the basis of surface features.

III. Other Methods

A. Virginia

Virginia uses the extent of map units to determine the required level of documentation. The most extensive map units receive evaluation to a standard level of statistical validity. Map units in the mid range of extent are evaluated but not necessarily to the same statistical level. The least extensive map units may or may not be evaluated.

Six map sheets known to have delineations of the target map unit are selected by drawing one number at a time from the full set of map sheet numbers. (Drawn numbers are returned to the set after each draw.) The map sheets are divided into map sheet cells by superposing a standard grid. Map sheet cells are selected by use of a random number table until one with a delineation of the target map unit is identified. If the selected cell has more than one delineation or part of a delineation, one is selected randomly. A random-point grid is superposed in a standard procedure to select 10 to 15 points in the selected part or whole delineation for examination of the soil. After two or more delineations have been evaluated, a statistical program is used to determine how many additional delineations, if any, are needed to meet statistical standards.

B. North Dakota

North Dakota developed a two-stage sampling procedure that combines north-south or east-west line transects (with a total of at least 150 points) with a random subsample of 40 points for statistical analysis. This was based on the judgement that line transects that cross the linear pattern are biased by their nature (because of inherent autocorrelation and other deficiencies) and do not provide reliable statistical information.

C. Floyd and Johnson Counties, Kentucky

In a mountainous landscape, various landfonns were recognized within soil map units. The area1 proportions of landforms within a map unit determined the number of points for examination of the soil on each of the landforms within that map unit. Sets of 10 points were treated as a transect for statistical analysis (Steers and Hajek, 1979). Points within one set were restricted to one 1/3 quadrangle sheet and to the predetermined number of points for each landfonn. Otherwise, they were picked at the convenience and by the judgement of the soil scientist. The number of sets was determined by statistical analysis.

EGK June 1991

Straight Line Point Intercept Transect Methods for Documenting Map Unit Composition

State	Selection of Delineation	Transects/ Map Unit	Points/ Transect	Interval	Orientation
AL	random	3+ plus stat. standard	10-20	fit delin.	cross pattern
AK	selected	1 <100 A 2 100-200 A 3 >300 A	10 +	not specified	cross pattern
	(Alaska also uses line segment transects.)				
CO	"standard line transects"				
FL	random	3+ plus stat. standard	10-20	fit delin.	crosss pattern
IA	random	3+ plus stat. standard	10-20	fit delin.	cross pattern
KS	random	3+	10+	fit delin.	cross pattern
KY	- Bell and Harlan Counties, mountainous areas:				
	random	4 x 4 per stratum	4	200 feet	45° to slope
	- Bell and Harlan Counties, along flood plains and in mine areas:				
	random	4 x 4 per stratum	2	100-200 feet	not specified
	(Kentucky also uses a stratified point method.)				
ME	selected?	- - not specified - -		50-500 feet	not specified
	(Maine also uses line segment transects.)				
MI	selected?	- - - - - - - - - - not specified - - - - - - - - - -			
ND	selected	15+	< 16	25+ paces	NS or EN
	At least 150 points/map unit: statistics on 40 picked randomly.				
NE	random or selected	not specified	10	50 feet or fit delin.	cross pattern
	(Nebraska also uses line segment transects.)				
NY	random	3+ plus stat. standard	10-20	fit delin.	cross pattern
NC	- Consociations:				
	selected?	3+ plus stat. standard	10	- - - not specified - - -	
	- Multi-taxa units:				
	selected?	5+ plus stat. standard	10	- - - not specified - - -	
TN	stratified random	6	10	100 feet (50 in small delineations)	not specified
VA	(Virginia uses a random stratified point method.)				
WI	selected?	- - - - - - - - - not specified - - - - - - - - -			

From information provided by SCS state soil scientists September 1990 through January 1991.
EGK June 1991

REPORT

Task Force - Past Conference Reports

Introduction

The theme for this year's meeting is "Providing Quality **Soil** Survey Information to Our Customers." As a part of that goal, the steering committee believed that there was a need to review copies of proceedings of past National and Regional Soil Survey Work

(Task Force) Conference lanning) Tj ET q 4..800492 0 017.159982 3 25.159982 01.15999692 cm BI /W 347

A document could be printed for each region and the national base showing disposition of each report.

1. The first need was to design or find a computer program to store the needed material.

2. The second step would be to search the recommendations to determine the disposition, if any.

3. A desirable action would be to scan the past reports into or onto a CD ROM system. The chairman discussed this with several people, including a USDA library representative at the American Society of Agronomy Annual meeting in San Antonio. She said the scanning and CD ROM field is undergoing rapid change. A better time for this activity will be in a few years.

ACTION

1. Javier Ruiz, of the South NTC Soils Staff, used a shell program on the Prelude Data Base to design an input, storage, and output program. This program was sent by soil net to a task force member at each NTC. The program has been tested on sample entries made. The data can be switched to other data bases. A format of the input and a format of the output is in Appendixes A and B.

2. A survey was made of reports available and a list compiled. See Appendix C for the information.

EXECUTIVE SUMMARY

The goal of this committee was to react to the need to review past National and Regional Soil Survey Work Planning reports for recommendations and dispositions. In addition, future workers on subject matter would benefit from knowledge of past committee work.

Charge 1 - The committee should assemble as many copies as possible of proceedings of past national and regional conferences.

Recommendation: The work planning conference reports have been assembled at respective NTC's. The national reports have been assembled at the South NTC. See Appendix C for this information.

Charge 2 - The recommendations from each committee report should be evaluated for status using best available information and personal knowledge. Results of the evaluation should be tabulated, electronically if possible, for wide distribution.

The task force recommends computer storage of charges and recommendations to facilitate determination of disposition. This program, written by Javier Ruiz, is workable and several years data is stored. This will be circulated to task force members and others willing to help. A side benefit is that the program can be used for future searches to find out how many work planning conferences worked on a subject. See Appendix A for the program input and Appendix B for a sample output. We will continue to develop the database. The material will then be circulated to those who have knowledge of the disposition.

Charge 3 - A simple classification scheme should be devised so that recommendations are categorized as to their adoption or not. It may be desirable to note what directive the adopted recommendation resides in and whether it is national, regional, or state level.

Recommendation categories of disposition classification:

1. NSH - National Soil Handbook, section where possible
2. SSM - Soil Survey Manual, section where possible
3. ST - Soil Taxonomy
4. RN - Referred from regional to national
5. E - For educational purposes
6. P - In policy - where, if possible
7. O - Other

Charge 4

The committee should make recommendations on follow-up procedures for committee reports from future conferences.

1. The task force recommends a format such as the executive summary to facilitate future entry of material into the data base. The charge should be listed and followed by a brief recommendation.
2. We also recommend a study in a few years to put the past work planning conference reports into CD ROM.

Committee Members
Work Planning Conference Task Force

Steve Base
NSSQA Staff, MNTC
Federal Bldg., Room 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Stan Buol
Soil Science Department
College of Agriculture
North Carolina State University
Raleigh, NC 27650

Ed Ciolkosz
Agronomy Department
119 Tyson Building
Pennsylvania State University
University Park, PA 16802

Richard Dierking
USDA - SCS
Federal Building, Room 248
511 N.W. Broadway
Portland, OR 97209-3489

Frederick Gilbert
State Soil Scientist
USDA - SCS, Federal Building
100 S. Clinton Street, Room 771
Syracuse, NY 13260

Chuck Goudy
USDA - U.S. Forest Service
630 Sansome Street
San Francisco, CA 94111

Bob Grossman
NSSL, MNTC
Federal Bldg., Room 345
100 Centennial Mall North
Lincoln, NE 68508-3866

Richard Ball
State Soil Scientist
USDA - SCS
9 East Loockerman Street
Dover, DE 19901-7377

K. Keith Huffman
State Soil Scientist
USDA - SCS
200 North High Street
Columbus, OH 43215

Karl Langlois
Bead, Soils Staff, NENTC
USDA - SCS
160 East 7th Street
Chester, PA 19013

Joe D. Nichols
Head, Soils Staff, SNTC
USDA - SCS
P.O. Box 6567
Fort Worth, TX 76115

Davie Richmond
State Soil Scientist
USDA - SCS
201 East Indianola Avenue
Phoenix, AS 85012

Lawson Spivey
USDA - SCS
P.O. Box 2890
Washington, D.C. 20013

DATABASE DEVELOPMENT

The following column headings are those that are found in the table where data is entered.

The following gives a definition of each column:

conf = conference (south, west, midwest or northeast)
year = the conference year
committee = what committee is this entry dealing with
charge = committee charge
dispos = charge disposition
key-word = one or two words that will key in to the type of entry made:
(gis database, taxonomy, soil moisture etc.) These words will be used in the query portion of the shelf.

IMPORTANT: Where more than one word is used for the key word, the asterisk (*) can be used to key in on only one of the words (gis* is equivalent to gis database or *database is equivalent to gis database)

conf	year	committee	charge	recomm	dispos	key_word

U.S. Department of Agriculture
Soil Conservation Service

7/12/91

			0		
			0		
			x		
			x		
			x		
			x		
			x		
			x		
			x		
			x		