Introducing the 4th Edition of the
Soil Survey Manual
Agricultural Handbook #18

H. Curtis Monger, National Leader, Soil Survey Standards
Kenneth F. Scheffe, National Soil Classification Specialist (Soil Taxonomy)

June 20, 2017
What is the Manual?

- One of 4 pillars of the National Cooperative Soil Survey
     Operational Procedure and Policies
     Communication and Classification
  4. Laboratory Methods Manual (SSIR #42)
     Specific lab procedures supporting definitions and criteria
History of the Manual
History of the Manual

  - Charles Kellogg
Charles Kellogg
Curtis Marbut
1920 to 1930
INTRODUCTION

This manual is intended for the use of soil surveyors in the particular projects of, or cooperative work of, the Bureau of Chemistry and Soils of the United States Department of Agriculture. Its present form and content reflects the development of science and the needs of those engaged in soil surveys.
History of the Manual

  - Charles Kellogg
  - Soil Survey Staff
SOIL AND LANDSCAPE

First let us briefly review the working concepts of soil and of the principles of scientific method upon which this Manual is based. These have been formulated only after many years of trial and error.

When the Soil Survey began in the United States, more than 50 years ago, there was no organized body of knowledge that we have come to know as soil science. This is not to say that nothing was known about soils. Indeed farmers had learned a great deal through experience over the centuries, and much of their knowledge had been brought together in several compilations, some as early as Roman times. With the rise of agricultural chemistry during the nineteenth century, more was learned about soils that was useful. Yet it was not until some time near the end of the century that the knowledge about soils gained from farming, from agricultural chemistry, from botany, and from geology was coordinated. Nor could it be coordinated without some unifying concept of the soil itself.

The early concepts.—With few exceptions, like Hilgard’s ideas, the notions of soils held by soil workers at the time the Soil Survey began were based upon assumptions stemming mainly from the ideas of the great German chemist, Liebig, as modified and perfected by agricultural chemists and plant physiologists working on samples of soils in laboratories and greenhouses and on small plots of soils in the field. The soils were rarely examined below the layer turned in regular tillage. The assumption of soil character, or working theory, which was more or less unconsciously conceived, may be briefly summarized as the balance-sheet theory of plant nutrition or the soil-in-a-bank idea. Soils were considered to be more or less static storage bins for plant nutrients that could be used by plants but had to be replenished as used. Of course, the amounts of nutrients removed from soil by harvested crops and those returned in manure, lime, and fertilizers are important to an understanding of soil productivity;

3 The soil scientists of today cannot help being amazed at the general neglect of E. W. Hilgard’s important and pioneer work, first in Mississippi (GEOLOGY AND AGRICULTURE OF THE STATE OF MISSISSIPPI. 326 pp., Jackson, Miss., 1880); then in the Cotton Belt as a whole (A REPORT ON COTTON PRODUCTION IN THE UNITED STATES; ALSO EMBRACING AGRICULTURAL AND PHYSIOGRAPHICAL DESCRIPTIONS OF THE SEVERAL COTTON STATES AND CALIFORNIA IN VOLUMES 8 AND 6 OF THE 10TH Census OF THE United States. Washington, 1880); and finally in California (SOILS; THEIR FORMATION, PROPERTIES, COMPOSITION, AND RELATIONS TO CLIMATE AND PLANT GROWTH IN THE HUMID AND DRY REGIONS. 523 pp., Illus. New York and London. 1906.).
History of the Manual

  - Charles Kellogg
  - Soil Survey Staff
- 1993 Soil Survey Manual, Ag, Handbook #18
  - Soil Survey Division Staff
### Soil Survey Manual

by

Soil Survey Division Staff

United States Department of Agriculture
Handbook No. 18

Issued October 1993

This is a Revision and Enlargement of U.S. Department of Agriculture Handbook No. 18, the Soil Survey Manual, Issued October 1962, and Supersedes it.

---

**Table**

<table>
<thead>
<tr>
<th>SAMPLE NO.</th>
<th>DEPTH (CM)</th>
<th>HORIZON</th>
<th>TOTAL</th>
<th>CLAY</th>
<th>SILT</th>
<th>SAND</th>
<th>FAINE</th>
<th>FINE</th>
<th>COARSE</th>
<th>VE</th>
<th>FRACTIONS (MM)</th>
<th>COARSE</th>
<th>FRACTIONS (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>89P 7706</td>
<td>0 - 8</td>
<td>A1</td>
<td>30.6</td>
<td>65.9</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89P 7707</td>
<td>0 - 10</td>
<td>A2</td>
<td>37.8</td>
<td>62.2</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89P 7708</td>
<td>0 - 12</td>
<td>A3</td>
<td>28.6</td>
<td>61.4</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89P 7709</td>
<td>0 - 15</td>
<td>B1</td>
<td>29.0</td>
<td>60.2</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89P 7710</td>
<td>0 - 18</td>
<td>B2</td>
<td>29.2</td>
<td>60.0</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89P 7711</td>
<td>0 - 20</td>
<td>B3</td>
<td>30.7</td>
<td>69.3</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Open Air**

- **Depth (CM)**: 0 - 8
  - **Total**: 30.6, 65.9, 3.5
  - **Clay**: 37.8, 62.2, 3.6
  - **Silt**: 28.6, 61.4, 3.6
  - **Sand**: 29.0, 60.2, 3.7
  - **Surface**: 29.2, 60.0, 3.5
  - **Below**: 30.7, 69.3, 3.6

**Table**

<table>
<thead>
<tr>
<th>DEPTH (CM)</th>
<th>EXTRACTABLE</th>
<th>DITH DICT</th>
<th>PCT</th>
<th>PERCENT OF &lt;2MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 8</td>
<td>0.39</td>
<td>11.9</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>8 - 16</td>
<td>0.44</td>
<td>14.4</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>16 - 26</td>
<td>0.44</td>
<td>16.0</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>26 - 36</td>
<td>0.44</td>
<td>16.7</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>36 - 46</td>
<td>0.44</td>
<td>17.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>46 - 56</td>
<td>0.44</td>
<td>17.3</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>56 - 66</td>
<td>0.44</td>
<td>17.3</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>66 - 76</td>
<td>0.44</td>
<td>17.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>76 - 122</td>
<td>0.44</td>
<td>17.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>122 - 170</td>
<td>0.44</td>
<td>17.3</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

**Analysis: All on Sieved <2MM Basis**

- Particle Size Distribution: 293
- Fabric-Related Analysis: 294
- Engineering Classification: 295
- Chemical Analysis: 296
- Physical Features or Processes: 297
- Erosion: 297
- Corecision: 298
- Interpretative Applications: 299
- National Inventory Groupings: 300
- Land-Use Planning: 302
- Farmland: 303
- Rangeland: 305
- Forest Land: 308
- Windbreaks: 310
- Recreation: 310
- Wildlife Habitat: 310
- Construction Materials: 311
- Building Sites: 312
- Waste Disposal: 313
- Water Management: 317
- Areal Application of Interpretations: 319
- Map Units: 319
- Areal Extension of Interpretations: 321
- Areal Generalization: 322
- Illustrative Map Units: 325

**Chapter 5. Information Recording and Management**

- Field Notes: 261
- Form and Storage of Notes: 264
- Soil Profile Descriptions: 266
- Standard Forms for Soil Profile Descriptions: 266
- Block Descriptions of Pedons: 273
- Maps and References: 273
- Photographs: 275
- Automatic Data Processing: 277

**Chapter 6. Interpretations**

- Approaches to Generalizing Relative Soil Behavior: 281
- Interpretative Systematics: 283

**Chapter 7. Disseminating Soil Survey Information**

- Uses of Soil Surveys: 327
- Making Information Available: 330
- Soil Survey Publications: 331
- Soil Survey Reports: 332
- Interim and Supplemental Reports: 333
- Special Reports: 334
- General Soil Maps: 336
History of the Manual

  - Charles Kellogg

- **1951 Soil Survey Manual, Ag. Handbook #18**
  - Soil Survey Staff

- **1993 Soil Survey Manual, Ag, Handbook #18**
  - Soil Survey Division Staff

  - Soil Science Division Staff
INTRODUCTION  1937

This manual is intended for the use of soil surveyors in the field, particularly those engaged on projects of, or cooperative with, the Bureau of Chemistry and Soils of the United States Department of Agriculture. Its present form and content reflects the development.
Purpose and Users of the SSM

INTRODUCTION 1937

This manual is intended for the use of soil surveyors in the field, particularly those engaged on projects of, or cooperative with, the Bureau of Chemistry and Soils of the United States Department of Agriculture. Its present form and content reflects the development

INTRODUCTION 1951

The Soil Survey Manual is intended for use by soil scientists engaged in soil classification and mapping. Attention is directed primarily to problems and methods of making and interpreting detailed basic soil surveys in the United States and territories. The earlier edition,¹ published in the autumn of 1937, reflected the developments growing out of the ideas, work, and publications
INTRODUCTION  1937

This manual is intended for the use of soil surveyors in the field, particularly those engaged on projects of, or cooperative with, the Bureau of Chemistry and Soils of the United States Department of Agriculture. Its present form and content reflect the development

INTRODUCTION  1951

1993

The Soil Survey Manual provides in a single volume the major principles and practices needed for making and using soil surveys and for assembling and using data related to them. The Manual is intended primarily for use by soil scientists engaged in the classification and mapping of soils and in the interpretation of soil surveys. Although the Manual is oriented to the needs of those actively engaged in preparing soil surveys for publication, workers and students who have limited soils experience or are less familiar with the soil survey process also will be able to use the information.
Purpose and Users of the SSM

Purpose

The Manual is intended primarily for use by soil scientists engaged in the work of making soil surveys. It is an especially important reference for soil scientists early in their careers as they learn the many complex aspects of making a soil survey. It is also an important reference for experienced soil surveyors who want to review the details regarding many of the standards used in soil survey. For example, chapter 3, “Examination and Description of Soil Profiles,” contains the accepted

The Soil Survey Manual provides in a single volume the major prin-

Although the Manual is oriented to the needs of those actively engaged in preparing soil surveys, workers and students who have limited soil science experience or are less familiar with the soil survey process can also use the information. Teachers, researchers, and students of soil science and related disciplines, especially those interested in pedology, soil morphology, soil geography, ecology, geomorphology, and the science underlying soil survey, will find this manual useful. Resource specialists, such as wetland scientists, foresters, and agronomists, and others who use soil surveys in their work, can refer to the Manual to better understand how soil surveys are made and how to interpret the technical information they provide. Parts of the Manual, especially those
Why now?

- A lot has happened since 1993? Digital Revolution
  - NASIS
  - SSURGO
  - Web Soil Survey
  - Technology Tools
  - Demands of the Data – i.e. modeling
Why make a printed hardcopy?

- Stability
- Credibility (it is physical with peer review)
- Helped set a hard date for completion
- Provided a tangible goal for authors
- Ease of review
Chapter 1. Soil and Soil Survey

- Revised and updated from the 1993 ed.
  - Definitions – **Soil as a natural 3-D body**
  - History of developments in soil survey
  - Scientific foundations
  - Evolution of the US program, now the NCSS
Chapter 2. Landscapes, Geomorphology, and Site Description

- The Site (split from old chapter 3)
  - Importance of scale
  - Descriptive terms
    - Geomorphology
    - Landscapes and landforms
    - Land cover
    - Vegetative communities
Chapter 3. Examination and Description of Soil Profiles

- The Pedon
  - Terms and classes used in describing soils including:
    - Horizon designations
    - Properties and features
      - Depth - Structure
      - Moisture - Color
      - Roots - Temp
      - Texture - Pores
      - Frags. - etc.
Chapter 4. Soil Mapping Concepts

How do you begin?
- Soil mapping process
- Equipment/tools
- Soil map units
  - kinds and design
- Soil components
- Orders of soil surveys
- Soil correlation
- QC and QA processes
Chapter 5. Digital Soil Mapping

- New chapter
  - Principles and concepts of DSM
  - Processes used
  - Applications of DSM

- DSM ushers in a paradigm shift in soil survey
Chapter 6. Tools for Proximal Soil Sensing

- New chapter
- Geophysical tools and methods
  - save time, money, sweat
- Includes such tools as:
  - Ground penetrating radar
  - X-ray florescence
  - Electromagnetic Induction
  - Optical spectroscopy
  - Electrical resistivity
Chapter 7. Soil Survey Data Collection, Management, and Dissemination

- Major advances since 1993
  - Rationale behind data mgt.
  - Records management
  - Standard Forms

- Information Systems
  - Data collection, analysis, and dissemination

- History of soil data management in US
  - OSD/SIR
  - SSSD/MUIR
  - NASIS/SSURGO
Chapter 8. Interpretations: The Impact of Soil Properties on Land Use

- Principle purpose for conducting soil survey
  - rate soils for their uses

- Updates models for soil survey
  - Models based upon measured and observed properties
  - Designed for specific land uses/applications
Chapter 9. Assessing Dynamic Soil Properties and Soil Change

- New chapter
  - Properties that change on the human time scale
  - Includes: soil moisture & temp, nutrients (N-P-K), Db, SOC, pH, organisms, etc.
  - Outlines design of DSP data collection and analysis

- Modern agriculture and NRCS conservation programs are dependent upon the manipulation of DSP
Chapter 10. Subaqueous Soil Survey

- New chapter
  - Describes the subaquatic soil environment
  - Outlines survey techniques
    - description, sampling, characterization and classification
  - Describes tools and technologies employed in surveying subaqueous soils
Chapter 11. Human-Altered and Human-Transported Soils

- New chapter
- Man’s use alters the nature of soil
- Adds new terminology and classes for HATM soils

Overview

- Methods and procedures used HATM environments
- Resource management issues and safety concerns
Appendices

- Appendix 1. Official Soil Series Description
- Appendix 2. Detailed Map Unit Description
- Appendix 3. NCSS Soil Characterization Database
- Appendix 4. Web Soil Survey
Where to from here?

The cycle starts anew. There will continue to be need for:

- Greater precision, accuracy, and completeness
- Technical advances in inventory, analysis, and delivery
- New information for new uses
- Maintenance of technical standards
Soil Survey Manual Availability

- Printed and Bound – NRCS Distribution Center in Ames, Iowa

- Digital Download – Soils Web page
  - Soils Web Page:
  - NRCS Distribution Center:
Our sincerest thanks to the authors, contributors, reviewers, technical and English editors, and the NSSC leaders for lending your experience, expertise, patience, and support in the development of this 4\textsuperscript{th} edition of the Soil Survey Manual. The success of this effort makes you a part of the long lineage of innovators and leaders of the soil survey program in the US.