MAKING THE SOIL SURVEY

This section discusses several of the activities that go into the making of the soil survey. Of special interest is the initial soil survey work by the Soil Erosion Service. This section also includes the Nebraska State Soil Survey Legend used for conservation planning. This old state legend is a collector's item. Copies were almost non-existent. The reproduction of old original file copies will make these documents a very unique historical part of not only the Nebraska Soil Survey Program but will record a part of the National and Great Plains soil survey records of the past. The part on the development of STATSGO provides the historical setting of how STATSGO emerged as a National Cooperative Soil Survey product.

How We Made A Soil Survey

The soil scientist went into each county to learn what types of soil were present on the landscape. As they worked across each farm and ranch, they observed the steepness, length and shape of slopes, the general pattern of drainage, and kind of bedrock. They dug many small holes to study the soil profile, which is the sequence of natural layers, or horizons, in the soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity. The study of the soil profile also revealed the depth to water table in the lower landscape positions and the depths to bedrock and gravelly material, which can restrict plant root growth.

The soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enabled them to identify soils. Also, during the survey some samples of the different soil profiles were collected for laboratory analyses to verify and support their field decisions. After describing the soils in the county or survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile.

Individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kind of soil in an area and to determine the boundaries.

Soil descriptions and transects of soil mapping units were made to describe and document the soils mapped by soil scientists. This soil description information was recorded on a standard form SCS-232 A, B, or C, for many years. The following page is a Soil Description Guide prepared by Loren Greiner, a Nebraska Soil Scientist, in 1956. This guide was an early attempt to semi-automate the recording of soil properties and information by using a numbering system similar to that used in libraries at that time. In the late 1990's a pedon program to electronically record soil descriptions was available for use by field soil scientists. "A Field Guide for Describing Soils" was published in 1999, by the National Soil Survey Center. This Field Guide summarizes and illustrates much of the information that accumulated during the prior 50 years.

After soil scientists locate and identify the significant different units of soil in the county or survey area, they draw the boundaries of these soil units on aerial photographs and identify each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately. After all the map unit delineations have been made, the aerial photographs are then called soil maps. On completion of the soil maps, the field soil survey for that county or survey area is completed.

SOIL DESCRIPTION GUIDE*

A multiple choice selection arranged for Form SCS-232 A, B or C

FILE NO. .... **DATE** .... **STOP NO.** ....
PART NO. 1 **SURVEYOR** ....

1. **SOIL TYPE** (Standard Code) ....
2. **SOIL NAME** (For ref. only) ....
3. **AREA** (Co. and State) ....
4. **LOCATION** (Legal Desc.) ....

5. **CLASSIFIC. (Great Soil Group)**
   - **5.1 Zonal (Well developed common internal factors)**
   - ......5.11 Prairie (A, B, C, hor.)
   - ......5.12 Chern. (A, B, C, Cca-Ccs, C)
   - ......5.13 Chestnut (Arid side Chern.)
   - ......5.14 Other ....
   - ......**5.2 Intrazonal (2 plus zones, local fact.) (A1, A2, B, or B-G, C hor.)**
   - ......5.21 Planosol or claypan
   - ......5.22 Solonetz or var. sur. alk.
   - ......5.23 Other ....
   - ......**5.3 Azonal (Prof. not well developed A. C, D)**
   - ......5.31 Alluvial (Recent stratified)
   - ......5.32 Lithosol (Thin, thin stony)
   - ......5.33 Sands, dry (Loose sands) ......
   - ......5.34 Other ....
6. **NAT. VEG. or COMMON CROP**
   - ......6.1 Tall & mid grass
   - ......6.2 Mid & short grass
   - ......6.3 Cultivated crops ....
   - ......6.4 Pasture
   - ......6.5 Rushes, sedges
   - ......6.6 Cottonwood, willow
   - ......6.7 Sage brush
   - ......6.8 Hardwoods
   - ......6.9 Other ....
7. **CLIMATE (Prevailing weather)**
   - ......7.1 Humid temp. (60" plus rain)
   - ......7.2 Subhumid (20-60")
   - ......7.3 Semiarid (20" or less)
   - ......7.4 Other ....
8. **PARENT or UNDERLYING MAT.**
   - ......8.1 Loess (Peorian, Bignell)—D
   - ......8.2 Loveland loess—D1
   - ......8.3 Sandstone—F
   - ......8.4 Glacial till—G
   - ......8.5 Shale—K
   - ......8.6 Limestone—L
   - ......8.7 Sand—Q
   - ......8.8 Caliche—R
   - ......8.9 Unconsolidated (silt)—S
   - ......8.10 Terrace—T
   - ......8.11 Colluvial—U
   - ......8.12 Recent Alluvium—X
   - ......8.13 Gravel—Z
   - ......8.14 Other ....
   - ......8.15 Geol. form. ....
9. **PHYSIOGRAPHY (Desc. of surf.)**
   - ......9.1 Loess upland
   - ......9.2 Residual upland
   - ......9.3 Till plain
   - ......9.4 Loess - Till plain
   - ......9.5 Terrace
   - ......9.6 Colluvial slope
   - ......9.7 Bottom land
   - ......9.8 Bottom land (channelled)—c
   - ......9.9 Depression—k
   - ......9.10 Low hummocks—x
   - ......9.11 Dunes (over 16% slope)—xx
   - ......9.12 Morainic hills, eskers, drumlins
   - ......9.13 Other ....
10. **RELIEF (Difference in elevation)**
    - ......10.1 Normal (Sloping)
    - ......10.2 Subnormal (Nearly level)
    - ......10.3 Excessive (Hilly to steep)
    - ......10.4 Flat, or concave (Depressed)
    - ......**10.5 Micro-relief (1-3' or less elev.)**
    - ......10.51 Mounds
    - ......10.52 Swales
    - ......10.53 Pits
    - ......10.54 Mounds around shrubs
    - ......10.55 Truncated, or cut squarely
    - ......10.56 Other ....
11. **DRAINAGE (Water movement)**
    - **11.1 Natural Conditions (Aeration)**
    - ......11.11 Excessive
    - ......11.12 Somewhat excessive
    - ......11.13 Well dr. (A, B, mot. fr.)—d1
    - ......11.14 Mod. well dr. (S. mot. B)—d2
    - ......11.15 Imp. dr. (Many mot. B)—d3
    - ......11.16 Poorly drained (Mottles or gray layer A)—d4
    - ......11.17 Very poorly drained (Depressional, gr. or br. mot.)—d5
    - **11.2 External or surface run off**
    - ......11.21 Ponded—0
    - ......11.22 Very slow—1
    - ......11.23 Slow—2
    - ......11.24 Medium—3
    - ......11.25 Rapid—4
    - ......11.26 Very rapid—5
    - **11.3 Internal (As controlled by water table or restrictive layer)**
    - ......11.31 None—0
    - ......11.32 Very slow—1
    - ......11.33 Slow—2
    - ......11.34 Medium—3
    - ......11.35 Rapid—4
    - ......11.36 Very rapid—5
    - **11.4 Flooding (From ext. sources)**
    - ......11.41 Floods rare
    - ......11.42 Occasional—f1
    - ......11.43 Frequent—f2
    - ......11.44 Very frequent—f3
12. **SALT or ALKALI (Conductivity—Millimhos per cm.)**
    - ......12.1 Free (0-4)—0
    - ......12.2 Slight (4-8)—1
    - ......12.3 Moderate (8-16)—2
    - ......12.4 Strong (above 16)—3
13. **ELEVATION** .... **FEET**
14. **GROUND WATER (water table or wetness)**
    - ......14.1 Deep (Not affected)
    - ......14.2 Mod. shallow (6-9'), or slightly wet—w1
    - ......14.3 Shallow (3-6'), or moderately wet—w2
    - ......14.4 Very shallow (0-3'), or very wet—w3
    - ......14.5 Extremely wet (Marsh)—w4
15. **STONINESS (Percent of area)**
    - ......15.1 None
    - ......15.2 Few
    - ......15.3 No intertilled crops
    - ......15.4 Machinery V. limited (3-15%)
    - ......15.5 No machinery (15-90%)
    - ......15.6 Rubble (90% area plus)
16. **SLOPE**
    - ......**16.1 Single, %** ....
    - ......16.11 Level, or nearly level—A
    - ......16.12 Gently sloping—B
    - ......16.13 Sloping—C
    - ......16.14 Moderately steep—D
    - ......16.15 Steep—E
    - ......16.16 Very steep—F
    - ......**16.2 Complex, %** ....
    - ......16.21 Level, or nearly level—A
    - ......16.22 Undulating—B
    - ......16.23 Rolling—C
    - ......16.24 Hilly—D
    - ......16.25 Steep—E
    - ......16.26 Very steep—F
    - ......**16.3 Other** ....
17. **MOISTURE (present)**
    - ......17.1 Wet—m1
    - ......17.2 Moist—m2
    - ......17.3 Moderately dry—m3
    - ......17.4 Dry—m4
18. **ASPECT (Direction of slope)**
    - ......18.1 North
    - ......18.2 East
    - ......18.3 South
    - ......18.4 West
    - ......18.5 Other ....
19. **ROOT DISTRIBUTION**
    - **19.1 Max. penetration or feeding zone. Inches** ....
    - ......19.11 More than 60"—1
    - ......19.12 To 60 inches—2
    - ......19.13 To 36 inches—3
    - ......19.14 To 20 inches—4
    - ......19.15 To 10 inches or less—5
    - **19.2 Number (Note boundaries)**
    - ......19.21 Abundant (From.... to.... in)
    - ......19.22 Plentiful (From.... to .... in.)
    - ......19.23 Few (From .... to .... in.)
20. **EROSION (Soil movement)**
    - **20.1 Water**
    - ......20.11 Slight to none (0-25% A)—1
    - ......20.12 Moderate (26-75% A)—2
    - ......20.13 Severe (76% A to all B)—3
    - ......20.14 Very severely gullied—5
    - **20.2 Wind**
    - ......20.21 Wind blown—1
    - ......20.22 Severely blown—2
    - ......20.23 Blown-out land—3
    - ......20.24 Other ....
21. **PERMEABILITY (Percolation)**
    - **21.1 Subsoil (B horizn)**
    - ......21.11 V. slow (Under .05 in.-hr.)—1
    - ......21.12 Slow (.05-.2 in.-hr.)—2
    - ......21.13 Mod slow (.2-.8 in.-hr.)—3
    - ......21.14 Moderate (.8-2.5 in-hr.)—4
    - ......21.15 Mod. rapid (2.5-5.0 in.-hr.)—5
    - ......21.16 Rapid (5-10 in.-hr.)—6
    - ......21.17 V. rapid (Over 10 in.-hr.)—7
    - **21.2 Substratum (C or D hor.)**
    - ......21.21 V. slow (Under .05 in-hr.)—1
    - ......21.22 Slow (.05-.2 in.-hr.)—2
    - ......21.23 Mod. slow (.2-.8 in.-hr.)—3
    - ......21.24 Moderate (.8-2.5 in.-hr.)—4

*L. M. Greiner, Nebr. 6-56

......21.25 Mod. rapid (2.5-5.0 in.-hr.)—5
......21.26 Rapid (5-10 in.-hr.)—6 ......
......21.27 V. rapid (Over 10 in.-hr.)—7

22. **ADDITIONAL NOTES**

22.1 Organic matter
......22.11 High—h1
......22.12 Medium—h2
......22.13 Low—h3
......22.14 Very low—h4

22.2 Worms, Insects, etc.
......22.21 None
......22.22 Some
......22.23 Many

22.3 Observed location
......22.31 Ortho or Typical
......22.32 Variation or Inclusion

22.4 Dominant Limitation
......22.41 Water erosion—e
......22.42 Excess water—w
......22.43 Soil—s
......22.44 Climate—c

22.5 Other ......

PART NO. 2 (Use ruled form)
PROFILE (Note each horizon)

1. **HORIZON (Identification)**
......**1.1 A—Surface, or plow layer plus subsurface**
......**1.2 B—Subsoil, or accuml. layer**
......**1.3 A plus B—Solum, or soil forming area**
......**1.4 C—Substratum, parent or uncons. mat., undet. lower limit**
......**1.5 D—Limiting layer below B, C**
......1.51 Solid rock
......1.52 Shattered rock—85% plus
......1.53 Gravel—85% plus
......1.54 Sand—95% plus
......1.55 Hardpan (Iron pan, etc.)
......1.56 Claypan. Sodium sat. layer
......**1.6 G—Gray in solum (water saturated A—B)**

2. **DEPTH (Hor. bound., top A1 zero) From ...... to ...... in. deep**

2.1 Thickness (Top A1 to lower A boundary)
......2.11 Thin (0-6")—a1
......2.12 Mod. thick (6-12")—a2
......2.13 Thick (12-24")—a3
......2.14 Very thick (24-36")—a4

2.2 Total effective depth (Indefinite, or to limiting layer)
......2.21 Very deep (60" plus)—1
......2.22 Deep (36-60")—2
......2.23 Mod. deep (20-36")—3
......2.24 Shallow (10-20")—4
......2.25 V. shallow (Less than 10")—5

3 **COLOR (See Muncell Chart)**

3.1 Definitions
3.11 Hue—Yellow, Y-R, or Red
3.12 Value—Blk. to Wht., Neut. (Compare eyes partly closed)
3.13 Chroma—Amt. hue to gray

3.2 Conditions of moisture
......3.21 Dry—air
Hue ...... Val. ...... Chr. ......
......3.22 Moist (Moist. decr. value)
Hue ...... Val. ...... Chr. ......

4. **TEXTURE (Note ea. hor. sep.)**
......**4.1 Heavy—H**
......4.11 Clay, (or V. Heavy—V)—c
......4.12 Silty clay—sic
......4.13 Sandy clay—sc
......**4.2 Moderately heavy—F**
......4.21 Silty clay loam—sicl
......4.22 Clay loam—cl
......4.23 Sandy clay loam—scl
......**4.3 Medium—M**
......4.31 Silt—si
......4.32 Silt loam—sil
......4.33 Loam—l
......4.34 V. fine sandy loam—vfsl
......**4.4 Mod. light (50-70% sand)—S**
......4.41 Fine sandy loam—fsl
......4.42 Sandy loam—sl
......4.43 Coarse sandy loam—cosl
......**4.5 Light (70-85% sand)—L**
......4.51 Loamy very fine sand—lvfs
......4.52 Loamy fine sand—lfs
......4.53 Loamy sand—ls
......4.54 Loamy coarse sand—lcos
......**4.6 V. Light (85-100% sand)—C**
......4.61 Very fine sand—vfs
......4.62 Fine sand—fs
......4.63 Medium sand—ms
......4.64 Coarse sand—cos
......4.65 V. coarse sand—vcos
......**4.7 Undifferentiated—X**
......**4.8 Very gravelly—r**

5. **STRUCTURE (of peds)**

5.1 Grade or Durability
......5.11 Structureless—Massive (Coherent)—Om
......5.12 Structureless—Single grain (Noncoherent)—Osg
......5.13 Weak (Indistinct peds)—1
......5.14 Moderate (Well form. peds)—2
......5.15 Strong (Durable peds)—3

5.2 Size (check form for range)
......5.21 Very fine—vf
......5.22 Fine—f
......5.23 Medium—m
......5.24 Coarse—c
......5.25 Very coarse—vc

5.3 Form or Type (Meas. mm.)
......5.31 Platy (Horizontal, 1-10)—pl
......5.32 Prismatic (Top angular, 10-100)—pr
......5.33 Prismatic, Col. (Top round, 10-100)—cpr
......5.34 Blocky, Angular (5-50)—abk
......5.35 Blocky, Subang. (Round-plane mix, 5-50)—sbk
......5.36 Spheroid, Gran. (Non-por., 1-10)—gr
......5.37 Spher., Crumb (Por., 1-5)—cr
......5.38 Compound (Combinations)

6. **CONSISTENCE (Deg. adh., coh.)**

6.1 Dry
......6.11 Loose—dl
......6.12 Soft—ds
......6.13 Slightly hard—dsh
......6.14 Hard—dh
......6.15 Very hard—dvh
......6.16 Extremely hard—deh

6.2 Moist
......6.21 Loose—ml
......6.22 Very friable—mvfr
......6.23 Friable—mfr
......6.24 Firm—mfi
......6.25 Very firm—mvfi
......6.26 Extremely firm—mefi

6.3 Wet—Stickiness
......6.31 Nonsticky—wso
......6.32 Slightly sticky—wss
......6.33 Sticky—ws
......6.34 Very sticky—wvs

6.4 Wet—Plasticity
......6.41 Nonplastic—wpo
......6.42 Slightly plastic—wps
......6.43 Plastic—wp
......6.44 Very plastic—wvp

6.5 Cementation
......6.51 Weakly cemented—cw
......6.52 Strongly cementated—cs
......6.53 Indurated (Hard)—ci

7. **REACTION**

7.1 Intensity
......7.11 St. acid (pH 5 or less)—pJ
......7.12 Mod. acid (pH 5.1-6.5)—p2
......7.13 Neutral (pH 6.6-7.3)—p3
......7.14 Mod. alk. (pH 7.4-8.4)—p4
......7.15 Str. alk. (pH 8.5-9.0)—p5
......7.16 pH 9.1 plus—p6

7.2 Effervescence (with HCl)
......7.21 Slight—e
......7.22 Strong—es
......7.23 Violent—ev

8. **BOUNDARY (Note lower)**

8.1 Distinctness
......8.11 Abrupt (Less than 1")—a
......8.12 Clear (1-2½")—c
......8.13 Gradual (2½-5")—g
......8.14 Diffuse (5" plus)—d

8.2 Topography of profile
......8.21 Smooth (Nearly plane)—s
......8.22 Wavy (Wider than depth)—w
......8.23 Irregular (Deep. than wide)—i
......8.24 Broken (Parts unconn.)—b

9. **MOTTLING (Spots or blotches)**

9.1 Abundance (Pct. horiz. surf.)
......9.11 Few (Less than 2% surf.)—f
......9.12 Common (2-20%)—c
......9.13 Many (20% plus)—m

9.2 Size
......9.21 Fine (Less than 5mm.)—1
......9.22 Medium (5-15mm.)—2
......9.23 Coarse (15 mm. plus)—3

9.3 Contrast (Muncell Color)
......9.31 Faint (From ...... to ......)—f
......9.32 Distinct (From ...... to ......)—d
......9.33 Prominent (From...... to ......)—p

10 **SPECIAL FEATURES (Accum., conc., or var.) Details in notes**
......10.1 Buried soil—b
......10.2 Calcium accumulation—ca
......10.3 Lime concretions—conca
......10.4 Iron, Iron-man. accum.—cn
......10.5 Iron concretions—conir
......10.6 Silicious—consi
......10.7 Calcium sulfate accum.—cs
......10.8 Gley, gray layer C hor.—g
......10.9 Iron, fine accum.—ir
......10.10 Krotovinas (Animal bor.)—k
......10.11 Disturbed by plowing, etc.—p
......10.12 Soluble salt accum.—sa
......10.13 Stratification
......10.14 Stone lines
......10.15 Peds, color cl. films ......
......10.16 Other ......

11 **ENGINEERING DATA**
......11.1 Max. wet dens. Proct. ......
......11.2 Max. dry dens., Proct. ......
......11.4 Opt. moist. % Proct. ......
......11.5 Other ......

(See supplemental material)

Initial Soil Survey Work by The Soil Erosion Service

H. H. Bennett was successful in his effort to establish the Soil Erosion Service (later known as the Soil Conservation Service - SCS) in the late 1930's. Bennett's early work experiences had been as a Soil Scientist with the Soil Survey Division of the Bureau of Soils. Bennett as the chief for the new organization, insisted that soil surveys be made to provide a technical basis of the decisions made in the preparation of conservation plans for farms and ranches.

The Civilian Conservation Corp (CCC) camps were established within the USDA in the mid-1930's. The Soil Erosion Service provided technical services to the farmers for applying conservation land treatment with help of the men who were enrolled in the CCC camps. Soil mapping was used in determination of land use and treatment in working with land operators.

Pilot projects were established to do conservation planning for farms and ranches throughout the United States as the new organization began its operations to assist Local Conservation Districts to reduce soil erosion. The first pilot project in Nebraska was in Boone County. One of the first Soil Scientists to do soil mapping on individual farms and ranches on these projects was John Elder, a graduate of Iowa State University. Within a few years the work of the Soil Conservation Districts had expanded throughout the state. Soil survey maps were needed to prepare conservation plans in all counties. An individual Soil Scientist was often assigned several counties in which to do what was known among the soil scientists as "request mapping. " The conservation planners would send or provide the responsible soil scientist the name, location, and acres of soil surveys needed to do requested conservation planning. The soil scientist, where practical, would group the request by geographical areas and spend the entire day or several days in the same area doing the requested soil survey. This reduced the amount of time on the road going from one location to another in mapping the individual tracts of land.

This soil mapping was done on aerial photographs, normally at a scale of 4 inches per mile. The area mapped was outlined on the back side of the aerial photograph and the acres, name of cooperator, name of soil scientist who did mapping, and the date mapped were recorded within the land area mapped. These soil maps were normally sent to a cartographic unit where reproduced copies of the soil map were made to provide one to the cooperator and one for the official district file.

These kinds of farm-to-farm individual soil surveys were a great departure from what had been done and was being done by the Soil Scientists employed by the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil surveys made by the Bureau were for an entire area, and were inspected, correlated, and published as a USDA soil survey.

The soil survey maps, made by the new Soil Erosion Service, were referred to as farm planning surveys. The policy was such that these surveys were not required to contribute to the national effort to map the county. Such surveys did not require inspection and correlation. Individual soils were shown on the maps using a descriptive soil map symbol code. High priority was given to those properties affecting soil erosion and soil productivity. Many soil recommendations centered on the Land Capability Class, Subclass, and Land Capability Unit assigned to each soil map symbol.

In the 1940's and early 1950's, nearly all Soil Conservation Service soil scientists were doing request mapping of individual farms and ranches. Each SCS field office had annual planning goals and it was often difficult for the soil scientist to complete the often large work load of requested soil maps in the time desired by the field office staff. In some areas the district staff were allowed to prepare Land Capability maps for conservation planning instead of using soil maps prepared by soil scientists.

Records show that a soil scientist making farm planning surveys used three different kinds of soil legends. Early ones were the Farm Planning Legend and the Soil Type Legend. Later a National Code Legend was used. A high percent of the farm planning surveys made in the state used the National Code Legend. The soil map symbol using the National Code Legend showed the most important soil characteristics, percent slope, and the erosion class, plus associated land features of wetness, overflow and salinity if present. Additional soil characteristics were shown if they were significant. Symbols were written in fractional form with the soil characteristics above the line and the slope and erosion classes below the line. For example, the texture of the topsoil used the following codes: H - Heavy (fine textured); F - Moderately heavy (moderately fine textured); M - Medium textured; S - Moderately light (moderately sandy); L - light (Course Textured very sandy); C - very light (Very coarse sands); X - Undifferentiated and r - very gravelly. See figures 8 and 9 as an illustration of the National Code Legend. It was not uncommon to have one photograph where all three kinds of legends had been used through the years in preparing individual requested soil maps. Special irrigation soil mapping projects such as the Sargent Project used modified National Code Legend with emphasis on additional soil data needed to make irrigation suitability determinations.

A major shift of doing soil survey business occurred throughout the United States in 1952. The soil survey program of the Bureau of Plant Industry, Soils and Agriculture Engineering was combined with the soil survey of the Soil Conservation Service (later the Natural Resources Conservation Service). The use of a wide-open soil legends ended. A large percent of many counties had soil survey maps prepared during the 1940's and early 50's using the National Code Legend. The National Code Legend had the advantage that a field soil scientist could easily map most anything they observed in the landscape. The result was that often several hundred to over a thousand different kinds of map symbols and individual map units in a county were not joined, or correlated. This made the publication of map data on a county basis most difficult.

Range conservationists mapped a large acreage of the Nebraska Sandhills with major input by Soil Scientists using the Range Site Name to identify each mapping delineation. Soil scientists and Range Conservationists worked closely and in cooperation in developing and designing soil map units in the state. The acreage of surveys made by Range Conservationists were for the most part good for range planning but did not meet the requirements for soil surveys as defined by the National Cooperative Soil Survey. From a management perspective there was often a discussion of how much of the older soil surveys prepared under different legends were of the quality to be acceptable by the standards of the day. In 1971 Herb Kollmorgen, Assistant State Soil Scientist and Jim Culver, State Soil Scientist recommended that the large acreage previously mapped by range sites in the Sandhills be deleted from the official acreage of soil surveys mapped in the state. Management accepted this recommendation.

Soil surveys in 1952 were restructured to include inspections or field reviews, correlations, use of a national soil classification system and publication of the county soil survey by the Department of Agriculture and the cooperating State Agency, the Conservation and Survey Division - University of Nebraska. Standard soil survey legends using a connotative part of the National Code Legend were developed for all soil survey areas. Approved Soil Series names and phases of soil series were used in each soil legend. Memorandum of Understanding were prepared and approved for all progressive soil surveys. Initial, Progress and Final Field Reviews were conducted. Soils were classified and correlated by state soils staff and approved by Regional soil correlation staff.

Nance County was the first soil survey to be published using the new soil survey procedures of the Soil Conservation Service. Nance County was essentially completed with soil surveys done on a request basis using the National Code Legend. Herb Kollmorgen, Soil Scientist, was assigned to review the entire previous mapping and to bring the entire soil survey up to the new standards. This required collection of representative soil descriptions, collection of soil interpretative data, soil correlation samples, ensuring all mapping conformed to standards, and preparation of the manuscript for publication.

After 1952 all request mapping was done with the intention of using a county soil legend and that the areas mapped would contribute to the acreage of soil mapping required for completion and publication. The use of the connotative National Code Legend continued to be used in several soil survey field maps until the early 1970’s. Alphabetic letters for map symbols gradually replaced the use of the National Code Legend. By the early 1980’s, all soil survey maps being made used alphabetic letters to identify the soils of each soil mapping unit.

Roger Hammer studying Hasting soils. Clay County, 1974.

Dean DaMoude mapping soils in Saline County, 1981.

Tyler Labenz describing soils in the update of Saunders County, 1995.

Richard Zink using motorbike in field mapping. Rock County, 1980.

Aerial Photography Used in Soil Survey Field Mapping

The first aerial photographs used by Soil Conservation Service soil scientists in field mapping were 1938 photos at a scale of 4 inches to one mile or 1:15,840. This photography was used by SCS soil scientists to do individual farm request mapping and project mapping, such as special irrigation projects. Copies of the same aerial photography at a scale of 8 inches equal to a mile or 1:880 was used by SCS soil conservationists as a base map in working with cooperators in preparing resources or what was commonly called conservation plans of individual land operators.

These photos were high quality in terms of detail and contrast. The photography was widely adapted to a wide range of temperatures and moisture conditions. This resulted in a good map base. It was easy to ink over the penciled soil boundary lines placed on the aerial photography in the field by the soil scientists. This photography was on a non-controlled base thus problems occurred in joining and later desire to digitize due to displacement of land features.

Much of this request soil mapping was done on a farm-to-farm basis. Usually on the back of the aerial photo soil map the area was outlined and the date, name of soil scientist doing the work, the acres mapped, name of land owner, and other soil map information was recorded. This soil map information showing the land area of the district cooperators was reproduced for the cooperator's plan and for the district's copy of the plan. File copies and original soil maps were retained in SCS field offices for district use. These "individual farm by farm soil maps" were not correlated or published.

In 1954, following the consolidation to the SCS of all soil survey mapping of private lands, some of this older soil mapping in a few counties such as Nance County, where the area was 100 percent mapped, or almost 100 percent mapped, was reviewed for consistency, correlated, and published. The original soil maps completed were inked, often using a quill pen. There were definite instructions on what features to ink and what color of ink to use for the variety of kinds of information on the map. For instance all "join map numbers" were inked in green, all drainage in blue ink, and special symbols were recorded in red ink, etc.

Procedure for publication involved cartographic transcribing of all soil map information on the 4 inches to the mile to the mosaic control base map. The soil map information was physically transferred to a semi-controlled base map and a series of overlays were prepared for use in publication through the Government Printing Office.

Publication procedures included the cartographic transcribing of 4 inches to the mile soil map information to a moasic control base map. This process was very costly and time consuming. Starting in the early 1970's high flight aerial photography was used as the base map for publication. This high flight photography worked well for base maps where local relief was less than 300 feet. Where relief exceeded 300 feet, the base map was prepared by the expensive, time consuming, mosaic process.

The cost of the high flight aerial photography in Nebraska was paid for by several sources including the Old West Regional Commission, local County funds, NRD funds, State funds and SCS funds. The aerial flying was contracted through the SCS National Cartographic Unit. There were problems in getting the flying done at the right time, by the contractor, to get quality aerial photographs. Some of the problems were 1) cloudiness – flying time was restricted to cloud-free days, however, often flying was done when there was partial cloud cover; 2) leaf-off flying was desired in early spring or late fall when tree vegetation was at a minimum; and 3) heavy rains. If there were heavy rains a day or so before flying time then the moist surface colors were commonly dark and subsequent photos taken were too dark and did not show the obvious soil patterns desired by the field soil scientists.

There was the problem on the quality of the reproduction from the original photo negative taken by the contractor as the negative went through the carto reproduction process. Often the final photo used by the field soil scientist was a third generation reproduction and the contrast of photo tones was poor. In some counties due to size, changes in weather conditions during the flying time, contractor not staying on flight lines and missing physical land areas, photos were flown at different times, often even in different years.

The Holt County high flight photography contained a large number of poor quality photos. However, occasionally we lucked out as in the case of Merrick County. Merrick County is essentially level, mostly irrigated cropland, and has a high percent of bottomland soils with varying degrees of drainage. Good quality photos showing soil patterns are critical under these conditions. The high flight aerial photography received to map Merrick County was of excellent quality for high flight type photography. This greatly assisted in the timely preparation of a quality soil survey for this area.

Agriculture Stabilization Conservation Service (ASCS) periodically flew aerial photography in all Nebraska counties having a significant amount of cropland for use in program application. Copies of this aerial photography were often ordered for those specific years that showed good soil mapping tones. This photography was usually taken to the field and used as a reference source in preparing the soil map. In many areas the ASCS photographs were taken when the crops were at their maximum growth and their use for soil mapping was limited.

ASCS also took aerial slides of each section of land (mostly cropland) for several years. Soil scientists sometimes used these colored slides as a reference source. In some instances where slides were available for the same area for several years, they were most helpful in evaluation of wetness trends and other soil features.

In more recent years color infrared photography has been used in several soil surveys to assist in photo interpretation and soil investigations. Butler County soil survey had a trial project on the use of thermal aerial photography flown by the Air National Guard. The photography was highly distorted and identified signatures did not show the expected added value to making soil interpretations.

Advance Soil Maps and Reports

Soil survey mapping was accelerated through cooperative agreements with County Commissioners, County Supervisors, and State agencies. These groups often required soils information before publication by the Government Printing Office (GPO). At the completion of field mapping and soil correlation, advance copies of soil maps and soil interpretations were compiled and presented to cooperators. The soil maps provided were a set of 100 copies of the completed soil map on a high altitude aerial photograph base reproduced by the Cartographic Unit at Ft. Worth, Texas. A separate document included soil interpretations prepared from adjusted data on the Soils 5 - Soil Interpretation, a General Soil Map for the county, and other selected data.

Special General Soil Maps were requested for several state and agency program needs. Some examples included a very detailed general soil map with emphasis on irrigation potential in the Nebraska Sandhills for the Platte Level B study and general soil maps for the Little Blue Watershed and the North Central RC&D.

Advance soil maps and reports were prepared for soil interpretations for land equalization. The major thrust for State and local funds to accelerate field soil mapping was to provide unbiased soil data for use in land equalization. The need for quality soil maps and production interpretations was the result of several factors:

1. -- Some counties had spent several thousand dollars for basic resource data through contracting with private industry with very poor results. Officials in Holt County and several counties in eastern Nebraska spent local money, with private contractors, and were not pleased with the results.

2. -- The Nebraska Association of County Officials and the Nebraska Department of Revenue were jointly looking for unbiased consistent guides on which to make tax assessment of agriculture lands.

Herb Kollmorgen, retired Assistant State Soil Scientist for Nebraska, went to work for the Nebraska Department of Revenue in 1972. His principal assignment was to prepare a manual using soil map and production information for use in land equalization throughout the state. Herb worked with Larry Worth of the Department of Revenue. Larry was a former SCS soil survey project leader in Sioux County and had worked in several other locations in the state as a soil scientist. They prepared a soil manual for land evaluation. The first Land Evaluation Manual for Nebraska was published in 1974. This manual placed each soil map unit of every county into a land evaluation group. These land evaluations were grouped by cropland, rangeland, and irrigated cropland.

SCS soil scientists and staff from the Department of Revenue cooperatively worked together very well in resolving technical soil issues with local county assessors throughout the state during the first years of implementation. They made numerous joint field visits to individual counties to answer questions and resolve local issues from a statewide application viewpoint.

This land evaluation manual has been updated periodically to address changes in state guides and development of new technology.

Steve Schaefer provided leadership in all phases of map compilation for publication of Nebraska soil surveys from 1972 to present.

Margaret Warner, Cartographer, checks soil map data prior to publication.

Nebraska General Soil Map drafting and checking by Steve Schaefer. Map illustrated by Jim Culver at NCSS conference in North Platte.

Steve Brooks, Cartographer, worked in all phases of soil map preparation for publication for many productive years.

General Soil Maps of the State

One of the first general soil maps of the state of Nebraska was "The Soil Resources of Nebraska" by G. E. Condra, Director of the Nebraska Conservation and Soil Survey; Bulletin 15; Lincoln, Nebraska 1920. This is an excellent 76-page report with a map showing the Soil Regions of Nebraska, a description of the major soils in each region, illustrated examples of localized soil maps and landscape patterns, and some excellent landscape and land use photographs. At this point in time, the Nebraska Conservation and Soil Survey, in cooperation with the U.S. Bureau of Soils, had studied, mapped, described and published reports for 27 counties in Nebraska.

The early concepts of soil classification in Nebraska gave high priority to geological origin. Soil classification is given in this report of 1920 as follows: "First, the lands are classified into kinds according to their origin, then the soils on these lands are grouped into series on the basis of similarity in color, structure, origin, mode of formation, topography, and drainage. The series are divided into soil types on the basis of agricultural value and texture which is determined by the relative amounts of various materials such as clay, silt, sand, and gravel."

A map in the report shows 14 different divisions of Soil Regions of Nebraska. The major soil series, general land use, and land values of each region are reported. The 14 different divisions of the High Plains Region are 1)--Perkins Plain; 2)--Cheyenne Table; 3--Pumpkin Creek Valley; 4)--Wildcat Ridge; 5)--North Platte Valley; 6)--Box Butte Table; 7)--Niobrara Valley; 8)--Dawes Table; 9)--Pine Ridge; 10)--Hat Creek Basin; 11)--White River Basin; 12)--Springview Table; 13)--Ainsworth Table; 14)--Holt Plain.

A bulletin entitled "Nebraska Soils," Conservation and Survey Division, University of Nebraska, Lincoln, Nebraska, 1959, by J. A. Elder, was a very popular document showing the kinds and uses of soils in the state. This bound report consists of a one-page map of Nebraska showing the "Occurrence of Great Soil Groups - Nebraska" and a two-page description of the Great Soil Groups. The nine Great Soil Groups identified are 1)--Regosols - Alluvial; 2)--Regosols - Sand Uplands; 3)--Regosols - Silt Uplands; 4)--Lithosols; 5)--Humic Gley Soils; 6)--Planosols; 7)--Prairie Soils; 8)--Chernozem Soils; and 9)--Chestnut Soils. This bulletin contains an excellent series of soil-geology block diagrams showing the relationship of soils to landscapes.

A series of 12 general soil maps at a scale of 1:250,00 (STATSGO) was prepared in 1988 for the state. These colored soils maps were very popular with local Natural Resource Conservation Districts in broad planning. A series of six different soil interpretations were prepared for each of the individual general soil maps.

A General Soil Map at a scale of 1:1,000,000 was published in 1990 by Mark Kuzila, Research Soil Scientist, and Ann Mack, Cartographer, Conservation and Survey Division-UNL and Jim Culver, Soil Scientist, and Steve Schaefer, Cartographer, Soil Conservation Service-USDA. This general soils map was prepared from the more detailed 1: 250,000 scale STATSGO.

Loren Greiner doing request soil mapping in Pawnee County, 1957.

Jim Mundorff ready for a day of mapping on irrigated land. Hall County, 1954.

Phil Harlan, soils student trainee, describing Geary soils. Harlan County, 1966.

Jim Culver assisting with soil engineering field study - Sharpsburg soil, Lancaster County, 1980's.

Nebraska State Soil Survey Legend Used for Conservation Planning

Soil scientists, in the making of soil surveys, have used three distinctly different kinds of map symbols. During the late 1930's and early 1940's, a state soil type legend was used. During the 1940's the state went to a national code symbol system. These systems had the advantage, whereby; a field soil scientist could easily map almost anything observed on the landscape. The result was often several hundred to more than a thousand different kinds of individual map units that were not joined or correlated and made publication of the map data on a county basis most difficult. A large acreage of soils in the state were mapped using this legend, much of the acreage was on a farm-to-farm or ranch request basis, and the soil information was used by soil conservationists, Range Conservationists, and other agency personnel in resource planning.

Nebraska developed a state soil legend, called the "Nebraska Detail Legend," in 1941. This soil legend was used to map soils when new Soil Conservation Districts formed. Soil surveys were an important part of determining land conservation treatment needs on farms and ranches. Aerial photo coverage was available over nearly all of Nebraska. The Soil Conservation field offices were supplied with two sets of stereo coverage photographs. The eight-inch to-the-mile photos were used by the Work Unit Conservationist (WUC) for developing a conservation plan with the landowner or operator. The four-inch to-the-mile photos were used by the soil scientist for recording field mapping. When the WUC received a request for a conservation plan he would outline the boundaries of the farm on the back of the 4" aerial photos. The Soil Scientist would obtained the photos and proceed to make the soil map. When completed it became part of the landowner's conservation plan.

Examples of map symbols and soil names in the 1941 "Nebraska Detail Legend:"

IM	Anselmo fsl or ls
9H	Colby sil
9L	Colby fsl
21H	Holdrege sil
63H	Hall sil
63L	Hall vfsl
95R	Valentine lfs or ls

The degree of slope, erosion, and land use were shown on the soil map. Land Capability Classes were assigned to map units.

H. C. Mortlock, State Soil Scientist in 1946 revised the State Soil Survey legend. The new legend was titled the "Farm Planning Legend."

Examples of soil symbols and names in the 1946 "Farm Planning Legend"

2a	Pawnee l	18c	Anselmo fsl
2c	Crete sil	22c	Thurman ls
9e	Hall sil	26c	Valentine ls or s
9C	Holdrege sil		

A fractional symbol was used to show soil type, slope, degree of erosion, and landscape position.

$\frac{9c}{6\text{-}2}$ or 9c-6-2

A dash was used to outline the different land uses on the soil map. Land Capability Class, Subclass, and Unit were assigned to each map unit.

The Nebraska interpretation for the "National Coding Legend" was issued to the field in early 1951. This legend was based on interpretation of the functional characteristics of the soil profile. The field map unit had a series of numbers and capital letters to identify the soil properties, for example, 3M47Z. The 3 indicated moderately deep, the M indicated silt loam surface, the 4 indicated moderate permeability, the 7 designated the substratum permeability, and the Z designated gravel. The fractional and straight-line symbol was used. The outlining of the different land uses was discontinued. Other associated soil properties such as thickness of surface soil, depth to water table, degree of flooding, and salinity were shown as "floating" symbols.

Examples of soil symbols and names used in the "National Coding Legend."

M4U	Judson sil	3S5Q	O'Neill fsl
S5T	Anselmo fsl	L6Q	Thurman ls
M4DaI	Colby sil	C6Q	Valentine s
M4D	Holdrege sil	4SXw3	Plate fsl

Figure 8 - “Explanation of the Symbols on your Soils Map” and figure 9 - “Explanation of Mapping Symbols” illustrates the kinds of map symbols and their definitions for the National Coding Legend.

Soil surveys in SCS field offices were made on an individual Soil and Water Conservation District basis by soil scientists. Often a SCS office would have soil surveys made over a span of many years where several different soil legends were used. A conversion legend was developed to assist SCS field offices in use of soil maps and to be able to compare the soils of the older soil legends to the more recent ones. Figure 10 shows conversion legends between the Soil Type Legend, the National Code, and the Farm Planning Legend.

The use of the National Code Map symbols was phased out beginning in 1971. The Antelope County soil survey was one of the first production soil surveys to use alphabetic letters for map symbols. An example of map symbols used was “NoC2 – Nora silt loam, 2 to 6 percent slopes, eroded.”

Use of National Code Mapping was not supported by Dr. Kellogg and staff in Washington, D.C. Bill McKinzie started using the National Code when he began to provide direction and leadership, as State Soil Scientist, for starting the soil survey in Puerto Rico in 1960. The first inspection review by the Washington, D.C. Soil Correlation staff was not in support of the National Code. Thus, its use in Puerto Rico soil survey was very short lived.

Figure 8. Explanation Of The Symbols On Your Soils Map - National Coding Legend

A soil symbol shows the most important soil characteristics, percent slope, and the erosion class, plus associated land features of wetness, overflow and salinity if present. Additional soil characteristics are shown, if they are significant. Symbols are written in fractional form with soil characteristics above the line and with slope and erosion classes below the line.

EXAMPLE: 3M47X
1-1

EXPLANATION OF THE MAPPING SYMBOLS:

Effective Depth of Soil
3-Moderately deep – 20 to 36"
4-Shallow – 10 to 20"
5-Very shallow – less than 10"
If the soil is more than 36" deep, the depth number is omitted.

Permeability of Subsoil
2—Slow (clays)
3—Mod. Slow (clay loams
4—Mod. (silt loam & loam)
5—Mod. Rapid (mod. sandy)
6—Rapid (very sandy)
7—Very Rapid (gravel)

Permeability of Substrata
Same rates as subsoil
(If the number is the same as for subsoil, it is not repeated).
This digit is omitted on most standard soil surveys.

SYMBOL WILL APPEAR ON YOUR SOIL MAP LIKE THIS ....

3M47X
1 -1

Type of underlying material
D-Loess
F1-Brule
Q-Sand
R-Caliche
T1-Terrace alluvium
U-Colluvium
X-Bottomland alluvium
Z-Gravel

Texture of topsoil
H-Clays
F-Clay loams
S-Sandy loams
M-Silt loams-loams
L-Loamy sands
C-Sand

Percent slopes
Difference in elevation per 100 feet distance.

Erosion
1-0 to 25% of topsoil lost
2-25 to 75% of topsoil lost
3-more than 75% of topsoil lost

Additional soil characteristics and associated land features are shown where they exist. These are wetness, reaction, salinity, and overflow. EXAMPLE: 3M47Xa1 w2p5
1-1

Wetness – refers to water table
w2-crops mod. affected
w3-crops seriously affected
w4-marshy land

Salinity (Soluble salt)
S2 – 0.2 to 0.5%; crops mod. affected
S3 – 0.5% or more; crops severely affected

Thickness of topsoil
a1—thin – 0 to 6"
a3—thick – 12 to 24"

Reaction
p5 - pH 8.5-9.-0 strongly alkaline
p6 - pH 9.1 or over – very strongly alkaline

Overflow
f1 -- occasional overflow
f3 -- frequent overflow

Figure 9. Explanation of Mapping Symbols - National Coding Legend

Standard Mapping Symbol

Example: 3L67Tls2 (See explanation of symbols right below)

- 3 - Effective depth of soil to inhibiting layer (3 depth is 20-36 in.)
- L - Texture of topsoil (L is light textured, usually loamy fine sand)
- 6 - Permeability of subsoil (6 is rapid)
- 7 - Permeability of underlying material (7 is very rapid-coarse sand and gravel)
- T1 - Type of underlying material or position (T1 is terrace position)
- S2 - Moderately saline or alkali – crops moderately affected

EFFECTIVE DEPTH

1. Very deep (60 in. plus)
2. Deep (36-60 inches)
3. Moderately deep (20-36 inches)
4. Shallow (10-20 inches)
5. Very shallow (0-10 in.)

Depth is not shown on soils more than 36 inches deep. The 1 and 2 depths are omitted from the mapping symbols.

TEXTURE OF TOPSOIL

H—Heavy (fine textured)
F—Moderately heavy (moderately fine textured)
M—Medium textured
S—Moderately light (moderately sandy)
L—Light (Coarse textured very sandy)
C—Very light (Very coarse sands)
X—Undifferentiated
r—Very gravelly

PERMEABILITY OF SUBSOIL & SUBSTRATUM

2—Slow
3—Moderately slow
4—Moderate
5—Moderately rapid
6—Rapid
7—Very rapid

The above numbers are shown only once in composite symbol where subsoil and substratum are the same.

TYPE OF UNDERLYING MATERIAL

D---------- Peorian Loess
D1 -------- Loveland Loess
F ---------- Sandstone
G---------- Glacial Drift
K---------- Shale
L ---------- Limestone
Q---------- Sand
T1 or T --- Terrace
U---------- Colluvium
X---------- Bottomland
Z ---------- Gravel
R---------- Caliche and
------------ Tertiary outwash

SLOPE GROUPS

0-2%	Nearly level	17-20%	Steep
3-6%	Gently sloping	21-30%	Very steep
7-11%	Moderately sloping	31 plus	Canyons and Bluffs (mapped as "G" slope—No %
12-16%	Strongly sloping		

SLOPE IRREGULARITIES

(shown with percent of slope)
k—Depression or restricted drainage
c—Channelleed surface on bottomland
X—Low hummocky or slight hummocky
XX—Dune-lime hummocks or dunes with slopes over 16%. (XX is not mapped with percent)

SPECIAL LAND FEATURES

a1	Thin or severely eroded topsoil
f1	Occasional overflow land
f3	Frequent overflow or rough broken bottomlands
w2	Moderately wet, crops sometimes affected
w3	Very wet, too wet for cultivation
s2	Moderately saline or alkali; crops moderately affected
s3	Very saline or alkali, crops severely affected

Figure 10. Conversion Legends - Soil Type Legend; National Code, & Farm Planning Legend

SOIL TYPE LEGEND	NATIONAL CODE	SOIL TYPE LEGEND	NATIONAL CODE	SOIL TYPE LEGEND	NATIONAL CODE	SOIL TYPE LEGEND	NATIONAL CODE	FARM PLANNING LEGEND	NATIONAL CODE
IH, L	M5Q	35D	$M24Da_1f_1$	73H, L	M4X	85R	L5X, (L6X)	9eo, fo	C4
IM, N	S5Q, (S5QD)	35H	$M24Da_1f_3$	73M, N	S4X	100, 89, 89-100	CQ	10C	M4
IM, N(3 erosion)	$S5Qa_1$	47H	$M4Da_3$	75N	4S7X	89X	$C6Q_{a1}$	11b	3M42
IP	L5Q	48K	4M7Z, (3M47u)	77H	M5X	90H, L	INT. LAKE	12b, c	$M4a_1$
IP (3 erosion)	$L5Q_1$	48N, R, R, W	5rSZ	77M	S5X	90M	$S5Q_{w3}$	13b	4M2
IR	L6Q, (L6QD)	48-16	5rSZ	77R	L5X	90R	$(I6Q_{I1})$, $(I4D_{I1})$	14b, c, e, f	S4
IR (3 erosion)	$L6Qa_1$,$(L6QDa_1)$	49K	4S7Z	78D	F34X	91, 91W	XQf_3	14fo	C54
Z	K_1, F_1	50D	$3F32F_1$	78H	M34X, $(M24Xa_1)$, (M24X)	92H, N	$(S56X_{a1})$	16c, f	M5
6H	$M24dF_1$	50H, L	$3M42F_1$, $(M4F_1)$	78H12	$M34X_{w2}$	92W	C6X	16fo	C45
7K	4M2R, (5MR)	50M	$S4F_1$, $(S4F_1a_1)$	78M	S34X	94W	$(C6T_1)$	17f	F46
7N, N, R	4S2R	51K	3M47u, (4M7Z)	78M12	$S34X_{w2}$	95R	$L6Qa_1$, (L6Q)	18b, c, e, f	S5, S5a
9O	$F4Da_1$	51, M, N	3S57u	78R	L4X	95W	$C6Qa_1$, $(C6T_1)$, (C6Q), $(C6T_1a_1)$	18c	S5QD
9h, L	$M4Da_1$	54L	M5Q	78R12	$L4X_{w2}$	95-48	$C6Qa_1$	19b	3S52
10H	M24D	54M	S5Q	79D	$F34XP_2$	97L	$M5T_1$	21f, 20f-21f	$S56A_1$
12H, K	M24DR	55M	S5Q	79D12	$F34XP_{2w3}$	97M, N	$S5T_1$	22c	L6QD
12R	(3 erosion) L4D, $L4D_1$	55P, R	L6Q	79H, K, L	$M4XP_5$, (M4X), $(M34XPa_5)$, (3M47X)	97R, T	$(L5T_1)$, $(L6T_1)$	22b, c, d, e, f	L6, $L6a_1$
14 H, K	M34DR, (M34D)	59H, K, L	M4X, (M5X)	79H12	$M4XP_{5w2}$	98M	S5u	23b, c, d, e, f	L4
14 M, N	(3 erosion) S4R,$S4Ra_1$	59M, N	S4X, (S5X)	79M, N	$S4XP_5$, (S4X), (3S57X)	98P, R	L5u	24b	3L62
15R	$L6Qa_1$, (L6Q) $(L6T_1a_1)$, $(L6T_1)$	61H, L	-M4u, $(M4T_1)$	79M12	$S4XP_{5w2}$	98P12	$L5u_{w2}$	25f	$L6Xa_1$
15W	$C6Qa_1$, $(C6T_1a_1)$ (C6Q), $(C6T_1)$	61H12	$-M4u_{w2}$, $(M4T_{1w2})$	79R	$F24XP_6$	99H, L	$M5T_1$	26c, e, f	C6, $C6a_1$
16H	$4M2F_1$	61M	-S4u, $(S4T_1)$	80D	$F24XP_{6w3}$	99M, N	$S5T_1$	26f	$C6XSa_1$
16M	$4S2F_1$	61M12	$-S4u_{w2}$, $(S4T_{1w2})$	80D12	$F24XP_{5w2}$	99P, R, T	$(L5T_1)$, $(L6T_1)$	27b, e, f, m	4M7
18H	$M24Df_1$	61P, R	$-L4u_{w2}$, $(L4T_{1w2})$	80F	$F3XP_6$	99R12	$L5T_{1w2}$	28e, f, m	3M47
19H	M4uX	62H, K	$3M47T_1$	80H	$M24XP_6$	102M, N	S4D, $(S4Da_1)$	29e, f, d, m	3S57
19M, N	S4Ux	62K3	$M4T_1Z$	80M	$S3XP_6$, (S3X), $(S35XP_6)$	102R	L4D, $(L4Da_1)$	30f	4S7
21H, L	MaD	62M, N	$3S57T_1$	80M12	$S35XP_{6w2}$	104B	4H2K, (5HK)	31e, f	3L67
24H	M4D	62M3	$S4T_1Z$	83H, K, M	$S56Xa_1$	111H	$3M32K_1P_4$	32 b	5MR
24 M, N	(3 erosion) S4D, $S4Da_1$	62R	$3L67T_1$	83H12	$S56Xa_{1w2}$	112M	S3D	32 c	MD
30B	$3H2K_1$, $(4H2K_1)$	65H, L	$-M4T_1$	83M, N	INT. LAKE			32m	5Rs
30D	$3F32K_1$	65H12	$-M4T_{1w2}$	83R	L6X, (3L67X), (4S7X)	F.P.S.	NAT'L CODE	33b	K_1, F_1
32D	3H2K	65M	$-S4T_1$	83H, L	(4M7X)	1b, e	H2, $H2a_1$	34e, f	$M24a_1$
33H	3M42R, (3M42DR), (M4R)	65M12	$-S4T_{1w2}$	83R12	$L6X_{w2}$	2b, c, e, f	M24	35b, c	M34
33K, K_3, K_6, L	3M42R, (M4R), (3M47Z)	67B	$H2T_1$	83W	$C6X_{w2}$	2Kg	$M24Da_1f_1$	36f	3F37
33M, N	3S52R, $(S5Ra_1)$ (S5R), (S4R), $(S4Ra_1)$	68H, H11, L	$M4T_1$	83W-16W	C6X	3df	S3, S35	37f	3M27
33P, R	3L62R, (L4R), (L6R)	68H12	$M4T_{1w2}$	83W-95W	C6X	4b	4H2	39c	M4
34, 34-7	5MR	68M, N	$S4T_1$	84-91	XQf_3	5c, f, d	F34	47c	S5
34-7-16, 34-48-16	5MR	68M12	$S4T_{1w2}$	84W	C6X	6b, c, e, f	M3, M34	48e	C4
34-16	$5MF_1$	68P, R	$L4T_1$	85B	$3H27X_{w3}$	7b	3M32	49b	M4R
34-95-48	5Rsz	71H	$M34T_1$, $(M24T_1)$, $(M24T_1a_1)$	85D	3F37X	8c	$F4a_1$	54e, f	S35
34-9	Md	71M	$S35T_1$	85H, K	3M47X, (M5X)	9b, c, d, e, f	M4		
35B	INT. LAKE	73D	F34X	85M	3S57X, (S5X), $3S57Xf_3$	9_1e	S4		

Productive soil is a valued resource by Nebraska farmers and ranchers.

Val Bohaty (L), long time District Conservationist in Lancaster County using soils information in resource planning.

This slide set was used extensively in the state and nationally to educate and train people on the use and value of soils.

Soils information is required in consolidated USDA Service Centers in administrating USDA Farm Programs.

Soil Surveys for SCS Programs

Several other soil mapping programs were accelerated in the mid-to-late 50's. The Conservation Needs Program for each state was started. Soils information was needed to determine the acreage base for projecting the conservation land treatment through 1975. This program called for the soil scientist to map quarter sections of land, which was statistically selected, in each county. The counties that were primarily hard land, used the quarter sections selection, whereas in the counties that were primarily sandhills, the section sample was mapped. The soil information was expanded to represent the total acreage of each soil and capability unit. The land capability unit acres were used to project the land conservation treatment needed by 1975. The soil mapping took about two years to complete. After the data had been statistically expanded, three-to-four-day meetings were held in each county projecting the total land treatment needed on each Land Capability Unit in the county. The conservation needs have been periodically updated about each 5 to 10 years.

The watershed program, land treatment program, was accelerated in the late 50's and 60's. This required a number of special details for the soil scientist to keep ahead of the watershed land treatment program.

Typical Nebraska Soil Scientist Experiences 1950-1960's
By: Bob Pollock

The mapping and publishing of soil survey information was lagging behind in the late 50's. Generally, throughout the soil survey program the Soil Survey Supervisor position was discontinued and the people were assigned Party Leaders on Progressive Soil Surveys. I was assigned as Party Leader in Buffalo County in the fall of 1958. During the mid-50's I mapped soils with Don Yost on the bottom lands in Hall County. In 1961, I was assigned to be Party Leader in Thayer County at Hebron. The field mapping was completed for Thayer County.

Special Soil Survey Details that I participated in 1950-60's

2/51 Sherman County — Mapped the land area to be covered by water from the Sherman County dam. Greenawalt, Pollock, and Wiese.

9/52 Lancaster County — Mapping in the Upper Salt Creek watershed south of Lincoln. Kollmorgen Party Leader, Plantz, Clapper, DaMoude, Pollock, H. Sautter, Good, and Davis.

4/54 Franklin County — Mapping the terraces and bottom land along the Republican River for the Bostwick irrigation project. Greenawalt Party Leader, K.Young. J. Young, Pollock, Davis.

5/55 Custer County — Mapping the land covered by the Sargent Irrigation District. Pollock Party Leader, Dean DaMoude, Indra, Hammond, and J. Young.

4/56 Webster County — Mapping the terraces and bottom land along the Republican River for the Bostwick irrigation project. Pollock Party Leader, Hammond, Greiner, Yost.

5/64 Alaska — Seven soil scientists from the lower forty—eight were detailed to Alaska for five months to soil map areas in the Susnita Valley area north west of Palmer. While there, they volunteered for a month's detail to map selected areas along the Kuskokwim and Yukon rivers. Two soil scientists were flown into the remote area by float plane and left for two weeks of mapping near Indian villages. The locals provided the boat and motor so we could get up and down the river to map along the river with an armed guide.

There were other special soil survey details going on in other parts of Nebraska that I didn't participate in, such as the watershed special surveys in the McCook area, Washington County bottom lands, Northeast Nebraska research station, etc.

In the summer of 1950, the first training session for SCS personnel relating to furrow intake rate of irrigation water was held at the Kearney Air Base. I participated in the development of the initial irrigation guide for western Nebraska at Scottsbluff in December 1954. In the mid- to late 50's the Area Engineers worked together on recording the initial intake rate for different soil types. Three steel rings about 18 inches in diameter were driven with a sledge hammer and 4x4 into the surface soil. Water was added to each ring with an initial reading showing the number of inches the water was from the top of the ring. Additional readings were taken every ten to fifteen minutes for an hour. This procedure was done on a number of different soil types and different crop cover.

The Federal Farm Bill of the late 1980's required a soil survey for all private land. The determination of highly erodiable land was based on the "K" -- erodible soil value, "T" -- allowable soil loss in tons per acre and percent of slope mostly for water erosion and surface texture largely for wind erosion. These values were coordinated between states for the most part. For the Federal Farm Program this data became known as the "frozen soil data set". Extensive studies were made on wet soils soon to be known as Hydric Soils. National lists were developed. Training was coordinated with the Army Corp of Engineers on the identification and mapping of hydric soils. National field indicators assisted in the identification of hydric soil. The criteria for wetlands had three components 1) hydric soil, 2) wetland hydrology, and 3) wetland vegetation.

The SCS and later NRCS Field Office Technical Guide (FOTG) contained a section II that provided all of the soil interpretation needed for the NRCS field office operations. Resource Soil Scientists and other interdiscipline staff were continually working from time to time the keep this guide current. Use of soils information was required for Land Evaluation and Site Evaluation (LESA) where new construction and/or building was planned to address if there was going to be conversion of prime farmland. Prime farmland soil interpretative maps were made of several counties in Nebraska to show the location and importance of prime farmland.

Detailed soils information was used in all conservation plans prepared for individual land owners or operators by the local SCS/NRCS soil conservation staff. Programs such as the Great Plains, Resource and Development projects, Watershed Projects, Conservation Reserve Program (CRP), Wetland Reserve, and EQUIP (Environmental Quality Incentives Program) used soils data in section II of the FOTG. Several new initiatives such as conservation tillage, buffer strips, site specific management, waste management assessment, phosphorus loading, and the ability of the soil to store carbon required detailed soils data. The models used to determine soil water and wind erosion, carbon and organic mater, and drainage needs required soils information. As more soil information became available for all lands, more and more researchers, land owners local units of government and private industry increased the request for a variety of different kinds of soil information. The digitizing of soils significantly increased the demand for electronic soil information. An increasing larger percent of the soil scientist's time was required to assist in training SCS/NRCS field office staff and in providing direct assistance in carrying out the intent of the federal programs. Often large amounts of time were required in working with field, state, and national staff on appeals of wetland, and/or erodible soil determinations.

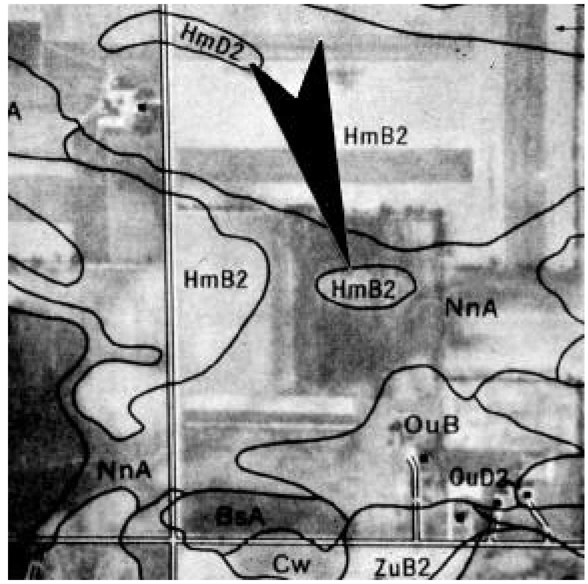
L-R: Don Kerl and Dave Lewis collecting soil correlation samples in Dixon County, 1974.

Example of soil correlation tray used to collect soil samples for soil correlation as part of the soil survey process.

John Elder studying soils in Clay County, 1974.

L-R: Marvin Dixon, Dave Hoover, and two other soils scientists provide soil survey assistance in Sheridan County, 1985. A cold windy day.

Land capability classes, subclasses, and units were soil interpretations used extensively in early conservation planning.



The most famous soil map in the world. This illustration was used locally, nationally, and internationally to explain the concept of soil delineations and map symbols.

Paralithic field study in Nebraska and South Dakota. Dale Gengenbach (lower left), Mike Stout standing near road cut. Box Butte County, 1976.

Paul Bartlett providing official scoring for State Land-Judging Contest, 1971.

Larry Brown and Frank Wahl are showing field tools used to examine soils. Dawson County, 1976.

Loyal Quandt using power probe to examine soils in Lancaster County, 1971.

Example of a power probe truck and field hand tools used in the 1950's by Nebraska soil scientists. This unit used by Dean DaMoude, Cuming County, 1957.

Glenn Borchers using power probe to examine soils. Omaha, Nebraska, 1990's.

Soil Survey Field Equipment

The field equipment used to observe the soil profile characteristic remained about the same as the early 50's. A sharpshooter spade and bucket type auger, with some using the 1" screw auger. The soil hand probe, as we know it today, was introduced into Nebraska in the summer of 1952 by Ross Greenawalt. He purchased his own. Mitchell was hard to convince it would work in Nebraska until he was on a field trip in Merrick County with Greenawalt and Pollock. Pollock purchased his own soil probe during the fall and within a year the state office was purchasing them for the soil scientists in the western 2/3's of Nebraska. Mitchell didn't think they would work in the clays of eastern Nebraska.

The power soil probe mounted on a vehicle was introduced into Nebraska in the spring of 1955. The State Office obtained 3 broken down jeeps from the border patrol. The probes were mounted on the back of the open jeeps. One jeep went to Scottsbluff, another to North Platte, and one to West Point. Dean DaMoude brought the one from West Point to the special soils detail at Sargent in the spring of 1955. The first thing he did after arriving at Sargent was take Orville Indra for a demonstration run. While moving down the road at a rapid pace, Dean decided to cross the ditch and go into the field since there was no fence, but he forgot to tell Orville what he was going to do. Orville was so shaken when he got back that he couldn't remember a thing about how the power probe operated. Within two years the jeeps were gone and the Dodge power wagon supported the probes. The next improvement was to mount them on regular pickups, using the truck engine to operate the hydraulic probe. The one-inch soft tube was standard equipment on the early power probe. The 2-inch probe was developed later on, provided a better view of the soil profile.

The following is a quote from "Soil Survey Field Notes" of July 1958 on power soil probes.

> Nebraska: "We have been well pleased with the operation of the power probes. The efficiency with which the operators soon learn to use the probes is almost unbelievable. The entire operation from the time the truck stops until the sample is ready for examination is usually less than a minute. Efficiency studies have shown that they increased the acreage mapped per man-hour by as much as 25 percent. In addition to this increase, we feel that the resulting surveys are more accurate. When the soil scientist is able to take complete soil profiles with the ease with which he can take them with the power probe, he will make many more examinations than he would with a spade."

The Montana Sharpshooter — Mark Willoughby started the Sioux County soil survey in October of 1980 on the Ogalala National Grasslands in the northern end of the county. The soils in North Sioux contain high amounts of clay, often ranging from 55 to 70 percent. Also, some soils were affected by salts and sodium that dispersed their natural structure, making them even tougher to dig and investigate.

One day as Mark was attempting to excavate a small hole with a normal wooden handle tile spade, to show a ranger from the Forest Service what a natric horizon was, he was having great difficulty trying to pound through all that massive clay with a normal spade. The blade was bending and Mark was about to snap the wooden handle when the Ranger said, "here try this" and produced a Montana Sharpshooter from his truck.

The Montana Sharpshooter has a blade made from 3/16-inch steel plate with a heavy-duty handle made from steel pipe. It is just about indestructible. You can pry, pound, wedge, and dig to your hearts content and never hurt the thing. Mark soon got permission from the Area Conservationist to order one for use in Sioux County. Mark's records show it was probably the first one used in a Nebraska Soil Survey.

Soil scientists used two-wheel motor bikes rather extensively during the 1980's in central and western parts of the state as transportation. Small inclined ramps were used to load the motor bikes into the back of the probe trucks or pickups in some cases. Using the motor bikes, the soil scientists could get to remote, inaccessible areas that the probe truck could not travel. The bikes were adapted to carry a hand probe and the aerial photograph on which the soil mapping was done. The first bikes were lower powered, but later bikes had additional power and enabled even the larger, heavier soil scientists to have that added power to transect the more steep landscapes. There were several stories of the bikes front end going into a hidden ditch or gully and the soil scientist quickly departing from the bike. The state office staff and management were concerned than there would be a serious bike injury to a soil scientist in a remote area. To their knowledge, there were no serious injury accidents, but that's not to say there wasn't loss of some skin, bruises and minor non-reported injury, and some loss of soil scientists' biking ego along the way. Later, the two-wheel bikes were replaced with the four-wheel vehicles. The four-wheelers were safer, however, the limited extra space in the back of the probe trucks was not conducive for easy loading.

Several of the soil survey offices had good laboratory equipment and space to run special analysis. Gib Bowman at North Platte had one of the better soil laboratories. The reason for this was that when a new office building was being constructed, he had the laboratory built to his specifications. Some of the common analyses were particle size, pH, calcium carbonate content, and sodium content.

The day-to-day normal field equipment included augers, various kinds of hand probes, spades known as "sharpshooters," color book, large knife, hand lens, pocket stereoscope to check joins between maps and the see stereoscopic vision of the landscape, abney level or clinometers to measure percent slope, picks, shovels, weak acid to determine if soil was calcareous, aerial photograph on which to map, field notebooks on which to record notes about the soils observed, and various soil series, soil taxonomy and other technical documents needed as reference during the field work. Due to the nature of the soils, such as stones, the use of a hand probe was limited in some areas.

Occasionally deep borings were needed to study the underlying soil material and to understand soil landscape relationships. The Giddings power probe, with a rotary head, enabled scientists to take a soil core to a depth of 10 to 30 feet, depending on the nature of the soil material. If the bedrock was shallow or there were stones in the soil material, this restricted the use of the Giddings probe. Drilling units used by SCS geologists were used to look at soil material at depths of 5 to 40 feet. Also, the Conservation and Survey Division drill rig was used on some special studies to study soils at greater depths. One special project was looking at deep alluvial sediment on some of the streams in southeast Nebraska. This data was valuable in determining the thickness of alluvial material and the amount of stored organic material in these older alluvial sediments.

A backhoe mounted on a pickup was purchased in 1988 to easily dig pits or excavations to study soils and to collect soil samples for laboratory analysis. This equipment was regularly scheduled by the field soil scientists and kept busy during the field season.

Providing formal soils training to SCS personnel and local farmers or ranchers was part of the soil scientist's job. The soil monoliths were extensively used as a teaching and training aid in regards to the different kinds of soil profiles. A soil monolith is a soil profile attached to a mounting board. The early soil monoliths were about 48 inches long and 6 inches wide and 1/2 to 3/4 inch thick. A later version was made with the 2-inch tube, using the power probe. The mounting boards were 48 inches long and 4 inches in width. The soil profiles were glued to the mounting boards with vinylite resin. The exposed facing of the soil monolith showed the natural appearance of the different soil properties and characteristics.

L-R: Lou Buller and Lester Sherfey observing soils in Arthur County, 1972.

Steve Hartung records soil boundary lines on aerial photo base for Cass County Soil Survey, 1980.

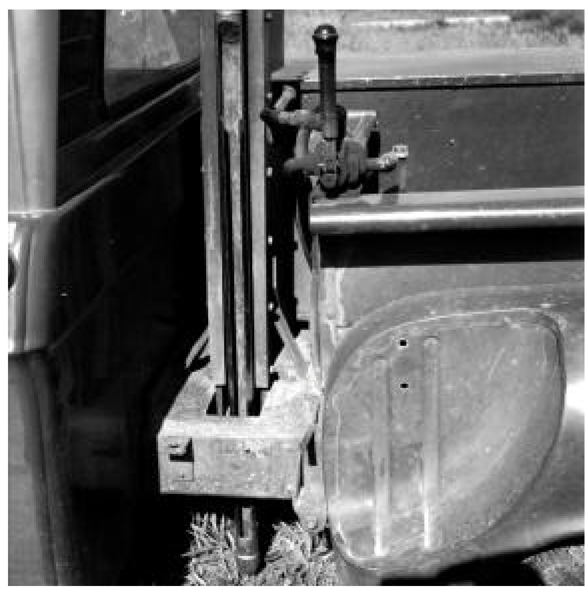
Loren Greiner using bucket type auger to examine soils. Pawnee County, 1957.

Kenneth Good extracting soil profile while providing training to scientists from Liberia and Ghana, West Africa. 1962.

Dean DaMoude displaying power probe tube, hand probe, spade, shovel, and hand auger. Cuming County, 1957.

Ed Sautter using power probe to examine soils. Soil description notes being recorded. Western Nebraska, 1957.

Glenn Borchers using power probe to examine soils in Omaha area, 1990’s.



Close up of power probe used extensively by soil scientists in accelerating soil survey mapping.

L-R: Frank Matanzo, J.B. McHenry, and Blonnie Williams collecting soil samples for laboratory analysis. Western Nebraska, approximately 1955.

Soil characterization sampling project. Central Nebraska. Fern Adams in sampling pit and Maurice Mausbach (R) from the National Soil Survey Laboratory, Lincoln.

Soil Investigation Sampling Project in Cheyenne County, 1987. L-R: Norm Helzer, Dick Base, Larry Ragon (in pit), Wayne Vanek, Steve Hartung, and Warren Lynn (sitting at the end of pit).

Soil Survey Laboratory Analysis and Investigations

Organized soil survey investigations and subsequent sampling for laboratory analysis began in the early 1950's to characterize the major soil properties. Investigation project plans were required. Extensive fieldwork was required by the field soil scientists to ensure that typical or modal soil sampling sites were selected. The State soils staff assisted in the final site selection in the early days, and a research soil scientist from the Soil Survey Laboratory in Lincoln generally assisted in the field sample collection work for each site. Normally, one-half to one day was required to dig the sampling pit and to remove the required number of soil samples. In some cases the field soil scientists needed only a few analyses of selected soil horizons for use in making field-mapping decisions. These kinds of samples were generally called partial samples or grab samples.

Backhoe equipment was used to excavate a sampling pit and enabled the soil scientists to describe a more detailed soil description. In 1988, a special backhoe mounted on a truck was purchased for use by the soil scientists in sample collection and to expand the ability to observe and study soils. Soil sampling projects were normally scheduled several months in advance. On many sampling trips the weather was great; however, in some instances rain, snow, or cold wind made the sampling project a real challenge. One particular sampling project during the fall in Boyd County was just after a major fall snowstorm that left 4 to 8 inches of snow on the ground. Marvin Dixon from the Nebraska State Office and Orville Indra, Project Leader, remember well the conditions endured in collecting samples from the shale soils of this area.

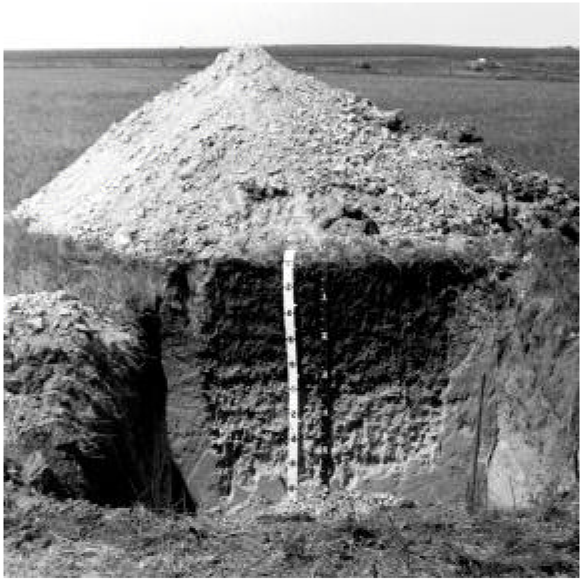
Normally, one sampling project was scheduled with the laboratory each year as part of a long-range investigation plan to have laboratory samples for all major soils in the state. During the peak period of the accelerated soil mapping, the University Conservation and Survey Division staffed one soil scientist with the SCS soils laboratory in order to get more data run through the laboratory to assist with the state program. In the late 1980's all of the other SCS soil laboratories were relocated to Lincoln to form one National Soil Survey Laboratory.

Presently, a substantial volume of quality soil characterization laboratory data is available for many of the soils in the state. The University soil-testing laboratory ran the soil fertility analysis for soil correlation samples from many correlated survey areas in the 1980's.

Soil samples were collected from about 6 to 10 soils in each soil survey area for analysis by the soil testing laboratory of the Nebraska Department of Roads. A large amount of data related to the engineering uses of soils have been collected through this project.

In most cases the soil samples were collected during the field season and sent to the laboratory to be analyzed during the winter months.

Often, special field studies were made to investigate how the soils were mapped and to study the natural occurrence of soils over a broad geographic distribution of several counties or between states. Field trips between Nebraska and Kansas, such as one to study the Hord series, were examples of the National effort to produce a consistent quality National Cooperative Soil Survey Product.



Sampling of Holdrege Soil, Phelps County.

L-R: Maurice Mausbach, NRCS, and Mark Kuzila, Conservation and Survey Division, collecting Holdrege soil samples for laboratory analysis. Phelps County, 1980's.

Soil investigations sampling project in Cheyenne County, 1987.

Soil scientists collecting soil samples for engineering soil tests. Western Nebraska, 1962.

Development of STATSGO — A New Soil Survey Product

Believe it or not, the Old West Regional Commission resources (money) to accelerate soil surveys in the States of Montana, North Dakota, Wyoming, and South Dakota had significant impact on the development of the technology and preparation of the first STATSGO-like map series for a state and in the development of the National STATSGO map series. Nebraska, along with Montana, were the leading states influencing the Old West Regional Commission to provide money for acceleration of National Cooperative Soil Survey work.

During a Nebraska cooperative soil survey conference between the Conservation and Survey Division, University of Nebraska and the Soil Conservation Service in Nebraska Hall in 1980, plans were initiated to prepare a general soil map of Nebraska at a scale of 1:250,000. Leaders in this discussion were John Elder, Principal Soil Scientist, C&SD; Vince Dreszen. Director, C&SD; Marvin Carlson, Administrator and Geologist, C&SD; and Jim Culver, State Soil Scientist, SCS.

Since the money from the Old West Regional Commission was what is often termed as "soft money," a decision was made not to invest all of this money into a full-time field soil scientist. Instead, a decision was made to use of some of these monies on a contract to prepare an initial draft of a state soil general map at a scale of 1:250,000. The selection of this map scale centered around the fact that the USGS 1:250,000 Quad maps were an excellent controlled base map that also included elevation contour lines. Also the C&SD had used this map series to prepare other kinds of resource data. They had already consolidated parts of several quad maps in the eastern part of the state along the Missouri River into two quad maps.

Bill McKinzie, retired Soil Correlator in the Soil Conservation Service Soil Correlation Office Regional Office, was contracted to develop a State legend using the General Soil Map Legend of individual published and unpublished soil data. His work also included using the general soil map in published soil surveys and unpublished data in transferring and correlating this data to the 1:2500,000 USGS Quad Maps. A considerable amount of fieldwork was required to revise and adjust maps to ensure joins and coordination of soils between counties.

Bill worked in the field with soil scientists throughout the state to develop map data for all 12 USGS quad maps in the state. During one part of the review phase Bill and Jim Culver spent one week on the road checking the compiled data in the Sandhills Area. One begins to get a real sense on the immense size and complexity of the Sandhills when you drive all of the major roads entirely in the Sandhills. After a few days one gets the feeling that you have seen the same area perhaps two or three times; however, your map route data shows this not to be the case.

Our contract with Bill enabled him to complete the review draft of these soil maps on each of the 12 1:250,000 quad maps for Nebraska in 1981.

Jim Culver, SCS, and John Elder began the next phase on preparation of the final draft. An extensive search of other resource data, such as geological maps, land use maps, topographical maps, and similar resource data, was made to improve the placement of soil boundaries and to define the composition of individual map units. Extensive work was undertaken to make each map unit significant and to define significant soil series, percentage of composition, and important soil properties such as depth, drainage, parent material, and landscape.

A final legend was developed for each quad map but was part of the legend for the entire state. The first map to carry through cartographic color separations and publication was the McCook Quad. The Soil Conservation Service Cartographic Unit at Lincoln, Nebraska under the direction of Bob Wilson, Director, did the drafting work and published in color the General Soil Map for the McCook Quad in 1983. Steve Schaefer, Cartographic Technician on the Nebraska State Soils staff, performed excellent drafting, joining of data between quads, and review of attribute data from the beginning to the end and beyond this project.

Several quads were in various stages of preparation when Bill Reybold, National Leader for Soil Geography, SCS was in Lincoln in 1983 working with the Regional Soil Correlation Staff. While Bill was in Lincoln, Jim Culver reviewed this Nebraska General Soil Map State cooperative soil survey project with him. Bill was excited and thought this kind of map could be expanded to a coordinated national map series. Bill took copies of the McCook Quad with him back to Washington. Based on the Nebraska guidelines for map preparation and his ideas on using several components and relating them back to the Soils 5 Soil Interpretation Records at Ames, Iowa the final guides and specifications for the states to use in preparation of this national map series were developed. The name STATSGO was coined by Bill from his expression to get states started on this project "States Go!!!!"

A series of colored General Soil Maps for each Quad in Nebraska using one correlated legend was completed. Subsequently the River Basin Planning staff in Nebraska requested a series of soil interpretative maps for their use. A series of six different colored interpretations were prepared for each of the 12 Nebraska Quad maps. These soil interpretations were for water erosion potential, wind erosion potential, prime farmland potential, land use, distribution of slope, and irrigation potential.

The first use of this data in a publication by a Federal Agency was in "Hydrologic Characteristics of Nebraska Soils" United States Geological Survey Water-Supply Paper 2222 by Jack T. Dugan, published by the United States Government Printing Office, Washington: 1984. This report used the soil delineations of each quad map and the Soils 5 Soil Interpretative data in a computer program that assigned a value rating to each soil map unit. Jim Culver worked collectively with Jack Dugan in development of the criteria and in review of the data before publication.

Larry Ragon, Assistant State Soil Scientist, led the revision of this initial map series using the STATSGO criteria developed by Reybold and others in 1985. Field soil scientists made random transacts of delineations to prepare the list of dominant soil map units for each map unit. Surprisingly, there was strong agreement between the major soils in each soil map unit using this approach, as compared to the data given for each map unit of the original map series initiated by McKinze in 1980.

The first STATSGO interpretative maps in the United States were prepared using advance Nebraska data by Norm Bliss of EROS at North Sioux City, South Dakota. Bill Reybold requested Jim Culver and Larry Ragon to provide advance Nebraska data and to assist Norm Bliss in understanding the data and how soil interpretations were currently being made.

Using the STATSGO data, Jim Culver, Mark Kuzila, Principal Soil Scientist, Ann Mach, Cartographer, C&SD, and Steve Schaefer prepared a General Soil Map for the State of Nebraska at a scale of 1:1,000,000. The University of Nebraska, Conservation and Survey Division published this map in color. This states general soil map was an instant success and was distributed widely throughout the state.

L-R: Jim Drew, Robert Jordan, Don Borgmann (farmer), and Loyal Quandt at soil moisture data site in Seward County, 1968.

Don Yost editing a soil survey manuscript, Lincoln, 1975.

Jim Culver taking soil profile photographs during field tour of North Platte Regional Cooperative Soil Survey Conference, 1988.

Chimney Rock is a well-known landform on the historical Oregon Trail in Morrill County, 1981.

Manuscripts for Soil Survey Publications

In the early days of soil survey, the properties of the soils were studied during the field mapping. Notes were gathered and detailed profile descriptions written. Laboratory samples were collected by the field soil scientists and by National Soil Survey Laboratory scientists. The data collected was used to make the final decisions about the map units in the soil survey at the final correlation.

After the final correlation was completed it would be the field soil scientist's job to prepare a manuscript describing the soils and their properties for the survey. Guidelines were usually set forth and could be followed for order and content of the manuscript. Specialists wrote specific sections of the manuscript from the State Office Staff or guest authors from cooperating agencies including the Conservation and Survey Division of the University of Nebraska-Lincoln. Some of the manuscript would be very similar from county to county and these parts were assembled in a package commonly referred to as the "Prewritten Material." Even though this information was standardized, it still required editing to give local examples and fit local conditions.

Until computers started coming into common use at the State Office level all of the writing and rewriting usually involved red-mark corrections and then having a secretary retype the manuscript. In addition to the manuscript, tables of soil properties also needed to be typed, edited and retyped multiple times. With the retyping there was always a chance that errors could be reintroduced so careful proofreading was necessary. Many a secretary probably developed nightmares from the thought that the soil scientist was involved in a manuscript writing project. Most times the soil scientist who was writing the manuscript, usually the project leader, would be moved to a new location before the manuscript was finished so the secretary at the new location got the experience.

As computers started making their way into use at the State Office, the later stages of the manuscript writing was typed into storage on these machines. The first innovation was the keypunch card reader. This machine stored the information by punching holes in pieces of card stock, with about 80 characters per card. This was replaced with the mag-card reader which used magnetic cards to store the data. Its advantage was that data could be edited on the card, unlike the keypunch that had to have new cards punched for each change. These were slowly replaced by mini-computers and terminals with central storage. The manuscripts could be stored and printed at the State Office and files were updated from red marked copies by the author and various other editors including the Assistant State Soil Scientist assigned to the project.

With the changes to computers for data storage came the computer produced property and interpretation tables. The information about each soil series and phase were stored in Ames, Iowa at Iowa State University on a mainframe computer. A set of instructions called the SOI-6 was used with SQL (Standard Query Language) to produce a set of property and interpretation records that were specific to the county. Usually these were further edited to produce the final tables for the soil survey. Another tool used by the manuscript writer was the SOI-16 which was a checklist of soil properties that needed to be cross-checked between different parts of the manuscript and tables. A new format was introduced for writing soil survey manuscripts which allowed easier cross-checking and set up the stage for computer generated manuscripts. The "semitabular" format listed the information about each soil instead of using complete sentences.

The advent of smaller, more powerful computers allowed more of the manuscript preparation to be done locally and also saved retyping of checklists, tables and the manuscript. New programs for handling soil information helped in organizing manuscripts. The State Soil Survey Database was used to download a statewide subset of soil properties and interpretations from the main storage in Ames. The records in 3SD were tailored to the counties and allowed limited local access to the data. Development also continued on a separate program which would store and manage detailed pedon descriptions.

With the end of the century also saw the end of 3SD and a new program "NASIS." This program combined the data used in 3SD and added more flexibility in managing the ever-growing amount of soil property and interpretation data. When complete it would allow querying of the data, printing reports, printing manuscripts and export data to other users.

Introducing Soil Survey Reports to the General Public

When the Soil Conservation Service and other cooperating agencies received word from the printing office that the Soil Survey Report for a county was ready for distribution, immediate action was taken to get it into the hands of the public.

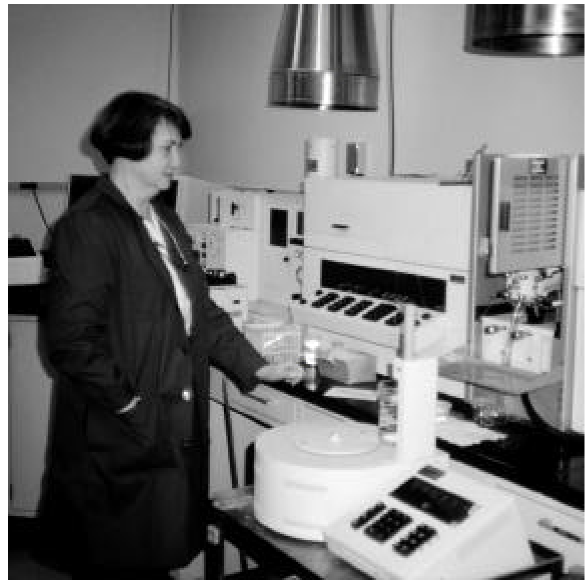
The local Soil Conservation Service, Natural Resources Conservation Districts, and county extension staffs collectively, often took leadership for getting the reports out to the public.

Advertising through the local print and electronic media sources, for at least 2 weeks, preceded the distribution of the soil survey reports.

The first distribution was made to the "very important persons" or VIPs, namely realtors, bankers and others related to agriculture who most likely would make maximum use of the soil survey report. This distribution was made at a luncheon or dinner meeting sponsored by the local Natural Resources District(s). The Soil Survey Report was explained and the VIPs were shown how to use the report.

The second distribution was made to the general public. This was sometimes done through luncheon or dinner meetings but most commonly at small townhall type meeting throughout the county. All these distribution meetings included an explanation of the soil survey and how to use the report. The luncheon/dinner meetings were always the most successful, usually well attended because everyone likes a free meal.

Ken Grant, Administrator and Chief of Soil Conservation Service looking at soils in Nebraska Sandhills, 1971.



Many Nebraska soil samples were sent to the Soil Survey Laboratory in Lincoln, Nebraska. Jan Eno is shown preparing soil analysis during the 1970/80's.

Ron Schulte reading soil colors during Antelope County Field Review, 1973.

Educational meeting to introduce the new published soil survey to the general public.

Dean DaMoude using hand probe to take a core of surface soil as part of field work for Saline County, 1981.

Dean is showing a close up of the soil core taken with the hand probe.

Dean using the "sharpshooter" spade to examine soil.

Dean DaMoude using Abney hand level to determine slope of land.

Dean is drafting soil boundary lines on aerial photograph.

Dean using Giddings probe mounted on pickup to examine soils.

Dean examining soil core in 4-foot 2-inch power probe.

Dean with a 4-foot soil core that was removed from the probe.

Dean is examining and studying the soil core for preparation of the soil description and soil classification.

Dean is recording his findings from studying the soil profile core on aerial photograph.

Loyal Quandt using a “stereoscope” to evaluate landscapes and match joins between soil maps. Lancaster County, 1973.

Loyal Quandt is using a pH meter to determine the soil pH. Lancaster County, 1973.

Holt County Progress Field Review, 1975. Dain Roof, Area Conservationist (L) with spade and Marvin Dixon on the far right.

Toadstool Park, Sioux County, 1972. Bill McKinzie on soil survey assistance.

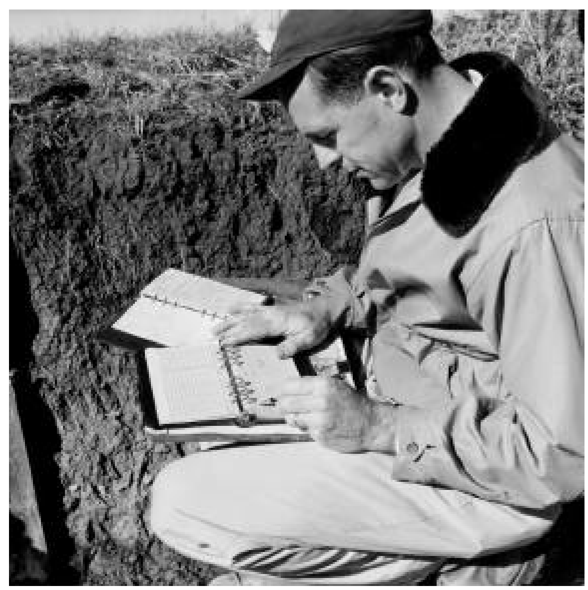
Francis Belohavy using “Big Red” probe truck in Holt County.

Dave Lewis and John Elder examining soils in Saline County along part of the Pathfinder Pipeline from Beatrice, Nebraska to Wyoming.

L-R: Max Sherwood, Soil Scientist, and Francisco Salazar, International Trainee describing a soil profile. Kimball County, 1958.

A soil scientist measures thickness of soil horizons to record in the soil description. 1959.

Kenneth Good providing soils training to International Soil Scientists.
Otoe County, 1962.



A soil scientist records information in describing the soil profile. 1959.

Steve Scheinost operating backhoe to excavate a pit to study soils. Saunders County, 1995.

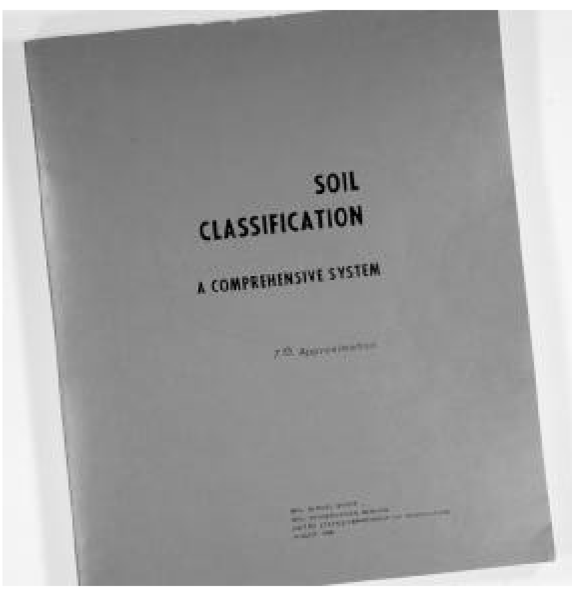
Tyler Labenz updating the mapping of soils in Saunders County, 1998.

Harry Paden (L) and Lou Buller studying Nuckolls soils in Harlan County, 1972.

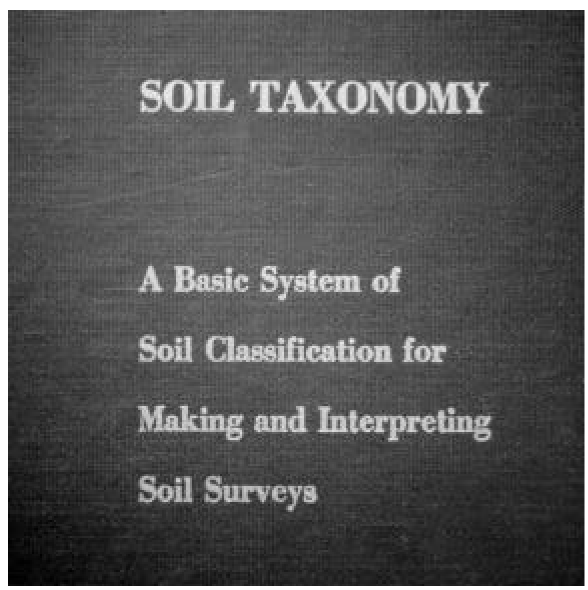
L-R: Charles Morris, Dave Lewis, and John Elder examining soils in Pathfinder pipe-line trench. Fillmore County, 1982.

State Capitol of Nebraska in Lincoln. Excavation for building in foreground.

Steve Holzhey (L) and Jim Culver (R) at the North Platte Soils Conference, 1988.



A new system of soil classification - *The 7th Approximation*, August 1960. These standards were used in the soil classification, soil correlation, and publication during the 1960's.



Soil Taxonomy, A Basic System of Soil Classification for Making and Interpreting Soil Surveys, December 1975. These new standards replaced *The 7th Approximation*.