Issued January 1969

SOIL SURVEY

McPherson County, Nebraska

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with
UNIVERSITY OF NEBRASKA
Conservation and Survey Division

Major fieldwork for this soil survey was done in the period 1962 to 1964. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1964. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska Conservation and Survey Division as a part of the technical assistance furnished to the Logan-McPherson Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of McPherson County, Nebraska, contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in judging the suitability of tracts of land for agriculture, industry, or recreation.

Locating Soils

All of the soils of McPherson County are shown on the detailed map at the back of this survey. This map consists of many sheets that are made from aerial photographs. Each sheet is numbered to correspond with numbers shown on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the description of the range site. It also gives the capability unit and the windbreak group into which the soil has been placed.

Interpretations not included in the text can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Ranchers and others interested in range can find, in the section "Range Management," the plants that grow on each range site and suggestions for managing the soils in the range site. A range site is a grouping of the soils according to their suitability for range.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the section "Management and Predicted Yields of Cultivated Crops."

Foresters and others can refer to the section "Woodland and Windbreaks," where soils grouped according to their suitability for trees are briefly described and where trees suitable for planting are listed.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Management of the Soils for Wildlife Habitat and as Recreation Areas."

Engineers and builders will find, under "Engineering Uses of Soils," tables that give engineering properties of the soils in the county and that name soil features that affect engineering practices and structures.

Scientists and others can read about how the soils were formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in McPherson County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County."

Cover picture

Livestock windbreak on Valentine fine sand, rolling.

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Contents

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SOIL SURVEY OF McPHERSON COUNTY, NEBRASKA

BY LESTER E. SHERFEY, SOIL SCIENTIST, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

McPHERSON COUNTY is in the south-central part of the Sandhills region of Nebraska (fig. 1). The county is 24 miles from north to south and 36 miles from east to west. Total area is 855 square miles, or 547,200 acres. In 1960, population was 735, all rural. The climate is subhumid and characterized by extremes of temperature.

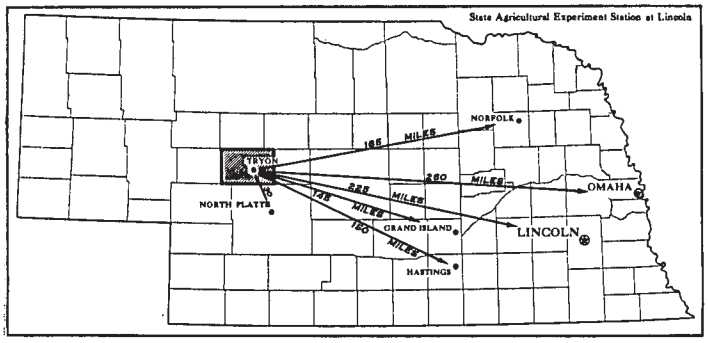

Figure 1.—**Location of McPherson County in Nebraska.**

The soils in about 97 percent of the county are in native grasses that are grazed mostly by beef cattle, though cultivated crops are grown in a few areas. Most of these crops are fed to cattle, for the main enterprise in the county is producing feeder cattle. Breeding purebred cattle is also important.

In most of the county are stabilized loose sands that developed from material derived from the Ogallala formation, eolian sand, or a mixture of these. Sandy loams occur in a few small areas. The landscape consists of dunes in ranges separated by small to fairly large, nearly level valleys (fig. 2).

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in McPherson County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Valentine and Elsmere, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Elsmere fine sand and Elsmere loamy fine sand are two soil types in the Elsmere series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Valentine fine sand, rolling, is one of several phases of Valentine fine sand, a soil type that ranges from level to hilly.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, trees, and other

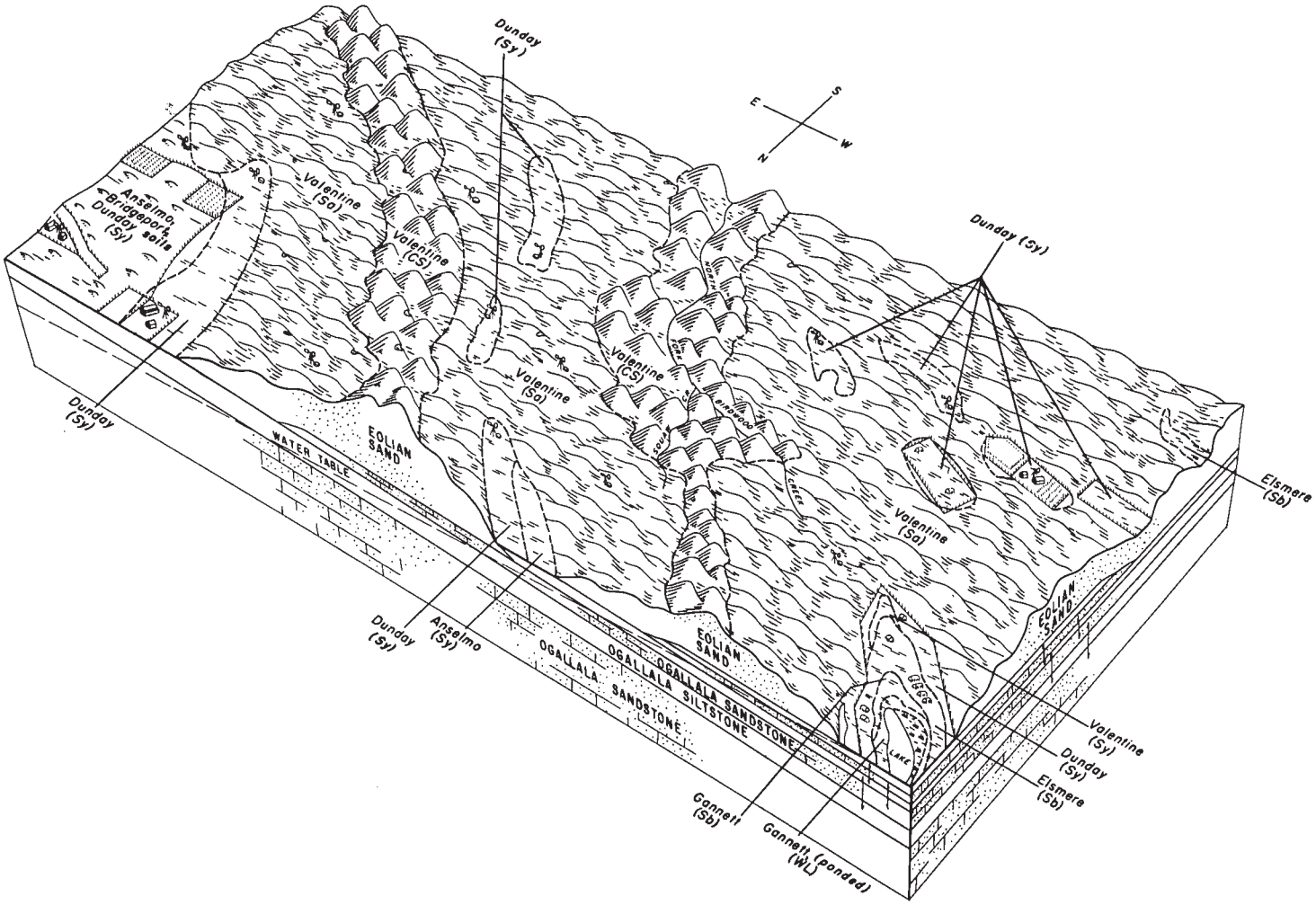

Figure 2.—**Landscape in southern part of McPherson County showing soils, underlying material, and range sites. Range sites are described in the section, "Range Management." They are identified in this diagram as follows: *Sa,* Sands; *CS,* Choppy Sands; *Sy,* Sandy; *Sb,* Subirrigated; *WL,* Wet Land.**

details that greatly help in drawing boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Anselmo-Dunday loamy fine sands.

Another kind of mapping unit is the undifferentiated soil group, which consists of two or more soils not separated on the map because differences among them are small or the soils are too difficult to delineate. An example is Anselmo and Bridgeport soils.

Most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but are given descriptive names, such as Blown-out land or Marsh, and are called land types.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and

homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey. On the basis of yield and practice tables and other data, the soil scientists set up trial groups, and then test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

Figure 3 is a general soil map that shows the soil associations of McPherson County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in the county, who want to compare different parts of the county, or who want to know the location of large tracts that are suitable for certain kinds of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, or other characteristics that affect management.

Following are descriptions of the five soil associations in McPherson County.

1. Valentine-Dunday Association

Rolling and hilly soils on choppy sandhills and in swales

This soil association extends mostly along the northern boundary of the county, but a broad tongue dips into the

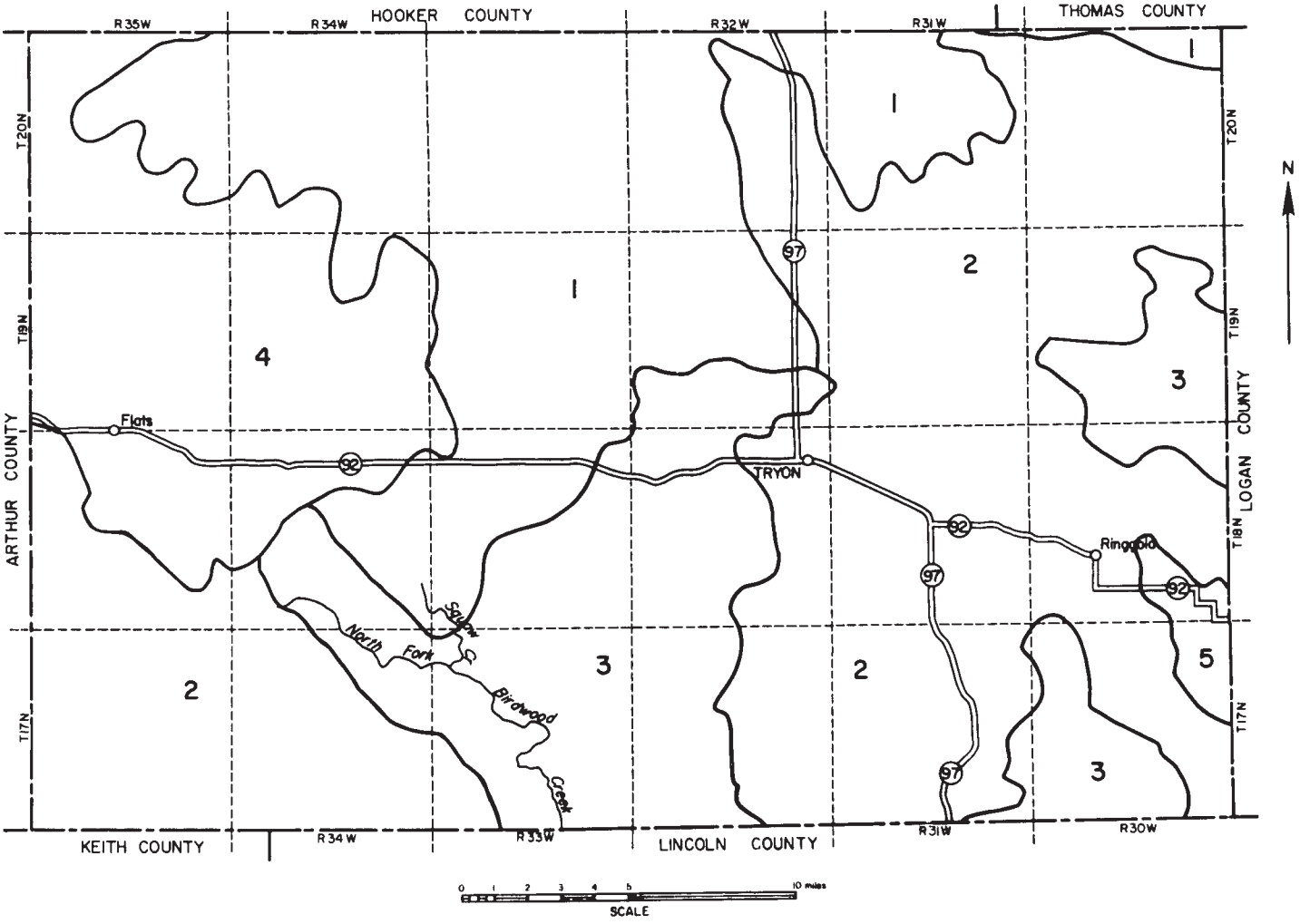

Figure 3.—General Soil Map, McPherson County, Nebraska

1. Valentine-Dunday association: Rolling and hilly soils on choppy sandhills and in swales.
2. Valentine-Anselmo association: Soils on rolling sandhills and in swales.
3. Valentine association: Soils on choppy sandhills.
4. Valentine-Elsmere-Gannett association: Soils on hills and in wet valleys.
5. Anselmo-Valentine-Dunday association: Soils in loess-sandhill border.

central part. It is characterized by ranges of large, high dunes that are separated by fairly large, level to rolling valleys. The association covers about 20 percent of the county.

Rolling Valentine soils make up about 75 percent of this association; hilly Valentine soils, 20 percent, and Dunday soils, 5 percent.

The rolling Valentine soils occupy most of the valley floors and the north and west faces of the dunes. The hilly Valentine soils occupy the steepest and highest dunes, some of which rise more than 200 feet above the valley floors. Valentine soils are well drained to excessively drained. The Dunday soils are nearly level and well drained. They lie on the valley floors.

The Valentine soils have a grayish-brown fine sand surface layer about 7 inches thick. This layer is underlain by light brownish-gray and very pale brown fine sand.

The Dunday soils have a dark-gray loamy fine sand surface layer about 7 inches thick. This layer is underlain by grayish-brown and pale-brown loamy fine sand.

Also in the association are a few small areas of Anselmo soils. These areas are in depressions of the valley floors. A few small areas of Elsmere soils are in the southern part of the association near the head of Squaw Creek.

Large ranches occupy most of this association. Little of the acreage is now cultivated, and most formerly cultivated areas have been allowed to return to native range.

2. Valentine-Anselmo Association

Soils on rolling sandhills and in swales

This soil association occupies the southwestern corner of the county and most of the eastern half. It has broader and flatter valleys and lower and smoother hills than association 1. Only a few hills rise more than 150 feet above the valley floor. The association covers about 40 percent of the county.

Rolling Valentine soils make up about 80 percent of this association; hilly Valentine soils, 10 percent; and Anselmo and Dunday soils, the remaining 10 percent.

The rolling Valentine soils occupy most of the lower hills and rolling areas. The hilly Valentine soils occupy steep faces of dunes and a few high hills. The Valentine soils are well drained to excessively drained. Anselmo and Dunday soils are level to gently rolling and occur on the valley floors. These soils are well drained. The largest acreage of the Anselmo soils is in the southeastern part of this association.

The Valentine soils have a grayish-brown fine sand surface layer about 7 inches thick. This layer is underlain by light brownish-gray and very pale brown fine sand.

The Anselmo soils have a grayish-brown fine sandy loam plow layer about 4 inches thick. Beneath this layer is about 5 inches of dark grayish-brown very fine sandy loam that is underlain by pale-brown fine sandy loam.

Most of this association is in native range. Ranches are small and medium sized. Of the acreage in Dunday and Anselmo soils, about 35 percent is cultivated and about 45 percent has been cultivated but is returning to native range.

3. Valentine Association

Soils on choppy sandhills

This association is in a large area that extends from the southern boundary of the county to the central part. Also, a small area is in the southeastern part of the county and another is in the eastern. The large area is cut by the narrow valleys of North Fork Birdwood Creek and Squaw Creek. This association covers about 19 percent of the county.

Rolling Valentine soils make up almost 60 percent of the association, and hilly Valentine soils make up 40 percent. The rolling Valentine soils are in the valleys and on the lower and smoother hills. The hilly Valentine soils are on the higher and steeper dunes and on steep dune faces.

The Valentine soils have a dark grayish-brown fine sand surface layer about 7 inches thick. This layer is underlain by light brownish-gray and very pale brown fine sand.

Also in the association are a few small areas of Dunday and Anselmo soils in the wider valleys, a few small areas of Elsmere soils, and a narrow band of Marsh along creeks.

Large ranches occupy most of this association, and nearly all of the acreage is used for range.

4. Valentine-Elsmere-Gannett Association

Soils on hills and in wet valleys

This association occurs in the northwestern part of the county. It is characterized by ridges consisting of small and large dunes that separate broad, wet valleys. In most of the valleys are lakes formed by ground water. Many of the ridges rise more than 200 feet above the valley floors. This association covers about 20 percent of the county.

Rolling Valentine soils make up about 50 percent of this association; hilly Valentine soils, 15 percent; Elsmere soils, 10 percent; and Gannett soils, 10 percent. The remaining 15 percent consists of lakes, Marsh, and small areas of Dunday soils.

The rolling Valentine soils occupy the smoother hills, and the hilly Valentine soils are on the steep faces of dunes and the higher, steeper hills. Valentine soils are well drained to excessively drained. The Elsmere, Gannett, and Dunday soils are in the valleys. The Elsmere soils are somewhat poorly drained, the Gannett soils are poorly drained, and the Dunday soils are well drained.

Valentine soils have a dark grayish-brown fine sand surface layer about 7 inches thick. This layer is underlain by light brownish-gray and very pale brown fine sand.

The Elsmere soils have a gray to grayish-brown fine sand or loamy fine sand surface layer about 11 inches thick. Beneath this layer is about 14 inches of grayish-brown sand underlain by a layer of light brownish-gray fine sand.

Gannett soils have a gray very fine sandy loam surface layer about 5 inches thick. Beneath this layer is about 7 inches of gray silt loam underlain by gray loamy fine sand.

Most of the acreage of this association is used for range. The ranches are large or medium sized. Most of the wet hay land in the county is in this association on the Gannett and Elsmere soils. Some of the lakes have been stocked and can be used for fishing.

5. Anselmo-Valentine-Dunday Association

Soils in loess-sandhill border

This soil association occupies a small area southeast of Ringgold. It is a transitional area between loessal soils and the sandhills. The association consists of nearly level to gently rolling soils in valleys and rolling soils on a few hills. The valleys have well-defined drainageways, and the hills are between the larger drainageways. This association covers about 1 percent of the county.

Anselmo soils make up about 50 percent of the association; Valentine soils, 35 percent; and Dunday soils, 15 percent.

The Anselmo soils are well drained and have a grayish-brown fine sandy loam surface layer about 4 inches thick. Beneath this layer is about 5 inches of dark grayish-brown fine sandy loam that is underlain by pale-brown fine sandy loam.

The Valentine soils are well drained to excessively drained and have a grayish-brown fine sand surface layer about 7 inches thick. This layer is underlain by light brownish-gray and very pale brown fine sand.

The Dunday soils are well drained and have a dark-gray loamy fine sand plow layer about 7 inches thick. It is underlain by grayish-brown and pale-brown loamy fine sand.

Farms and ranches occupy most of this association, of which about 36 percent is cultivated. The rest is pasture or range. About 60 percent of the acreage of Anselmo soils is cultivated, as is about 10 percent of the acreage of Valentine soils.

Descriptions of the Soils

This section describes the soil series and the mapping units in McPherson County. The acreage and proportionate extent of each mapping unit are shown in table 1.

The procedure is first to describe the soil series, and then the mapping units in the series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the series to which it belongs. An essential part of each soil series is the description of the soil profile. A soil profile is the sequence of layers beginning at the surface and continuing downward to depths beyond which the roots of most plants do not penetrate. Each soil series contains both a brief nontechnical and a detailed technical description of the soil profile. The nontechnical description will be useful to most readers. The detailed technical description is included for soil scientists, engineers, and others who need to make thorough and precise studies of the soils.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Anselmo and Bridgeport soils	554	0. 1
Anselmo-Dunday loamy fine sands	3, 823	. 7
Blown-out land	1, 344	. 3
Dunday loamy fine sand	14, 864	2. 7
Dunday loamy fine sand, loamy substratum	5, 158	. 9
Elsmere fine sand	2, 583	. 5
Elsmere loamy fine sand	2, 971	. 5
Gannett sandy loam	2, 699	. 5
Gannett sandy loam, ponded	1, 004	. 2
Marsh	1, 685	. 3
Valentine fine sand, level	1, 010	. 2
Valentine fine sand, rolling	486, 891	89. 0
Valentine fine sand, hilly	21, 891	4. 0
Lakes	723	. 1
Total	547, 200	100. 0

Each mapping unit contains suggestions on how it can be managed under dryfarming. Management of soils under native grass, however, is discussed in the section "Range Management" according to groups of soils, called range sites, that produce about the same type of range vegetation and that require about the same management when used for grazing. Suitability of the soils for trees and shrubs used in windbreaks is given in the section "Woodland and Windbreaks." Behavior of the soil when used as sites for structures or as material for construction is discussed in the section "Engineering Uses of Soils."

Terms used in describing the soils are briefly defined in the Glossary at the back of this survey and are more fully defined in the "Soil Survey Manual" (*5*)[1].

Anselmo Series

The Anselmo series consists of deep, loamy and sandy, very friable soils that are nearly level to undulating and occur in the upland valleys. These soils are mostly in the southeastern part of the county, but they are also in scattered areas throughout. They developed in Ogallala windblown material under a cover of tall and mid grasses.

In a typical profile, the surface layer is grayish-brown, mildly alkaline fine sandy loam 4 inches thick. Beneath this layer is very fine sandy loam that is 5 inches thick and has weak, medium, prismatic structure. It is underlain by about 15 inches of very friable, mildly alkaline, pale-brown fine sandy loam. It is soft when dry and has prismatic structure (fig. 4). The substratum is pale-brown fine sandy loam.

Anselmo soils are well drained, but some ponding occurs in swales following heavy rains or when snow melts rapidly. Surface runoff ranges from ponded to rapid. Permeability ranges from moderate to moderately rapid. These soils have moderate capacity to hold water. They are easy to work and respond favorably to good management. Unless management is good, the hazard of erosion is moderate to high.

About half of the acreage of Anselmo soils is cultivated, and the rest is in native grass. The main crops are corn (fig. 5), rye, vetch, alfalfa, and tame grasses.

Profile of Anselmo fine sandy loam (300 feet south and 300 feet west of the east quarter corner of section 13, T. 17 N., R. 30 W.) in a low, hummocky field of rye where the slope is 2 percent:

Ap—0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, dark gray (10YR 3.5/1) when moist; weak platy structure breaking to single grain; soft when dry, very friable when moist; noncalcareous; pH 7.6; abrupt, wavy boundary.

[1] Italicized numbers in parentheses refer to Literature Cited, p. 33.

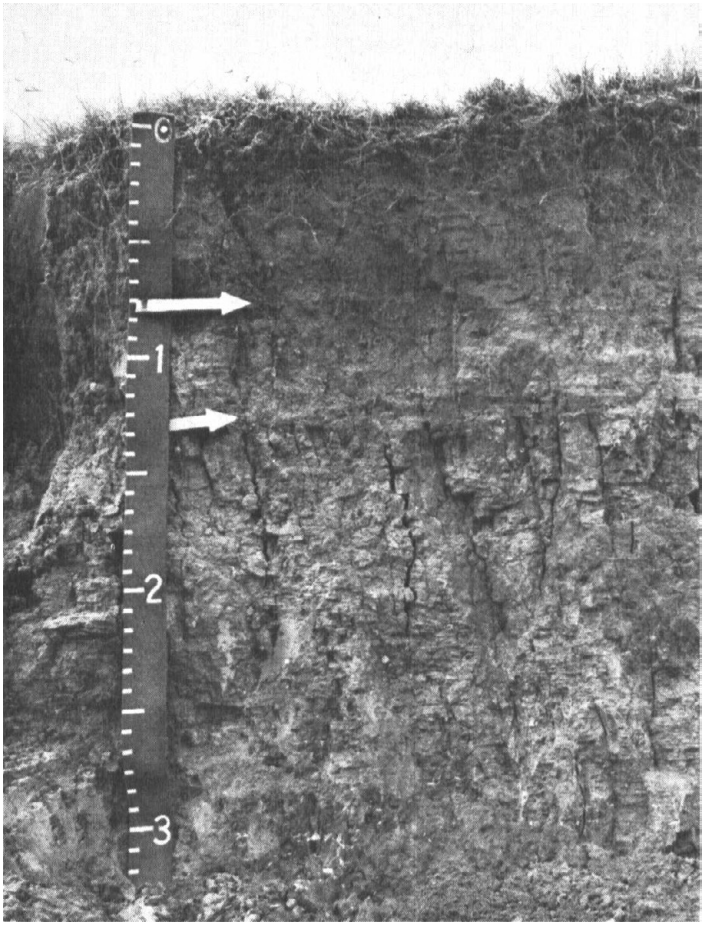

Figure 4.—**Profile of Anselmo soil in an area of Anselmo-Dunday loamy fine sands.**

A1—4 to 9 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark gray (10YR 3/1) when moist; weak, medium, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.4; clear, smooth boundary.

AC—9 to 24 inches, pale-brown (10YR 6/3) fine sandy loam, grayish brown (10YR 5/2) when moist; weak, fine, prismatic structure; soft when dry, very friable when moist; noncalcareous; pH 7.4; gradual, smooth boundary.

C—24 to 42 inches, pale-brown (10YR 6/3) fine sandy loam, grayish brown (10YR 5/2) when moist; massive; soft when dry, very friable when moist; noncalcareous; pH 7.6.

The A horizon of Anselmo soils ranges from loamy fine sand to fine sandy loam in texture, neutral to mildly alkaline, and from 2 to 14 inches in thickness. It is gray to dark grayish brown in some cultivated areas. The C horizon is stratified with fine sand or loamy sand in some places. In most areas the soil profile is noncalcareous throughout.

Anselmo soils occur closely with Dunday and Valentine soils. Anselmo soils are finer textured below the surface layer than Dunday soils. They are finer textured throughout the profile than Valentine soils and are darker colored below the surface layer.

Anselmo and Bridgeport soils (AB).—These soils occur mainly in the southeastern part of the county. They are most extensive southeast of Ringgold. Slopes range from 0 to 3 percent. The Anselmo and the Bridgeport soils are so closely intermingled that it is not practical to map them separately.

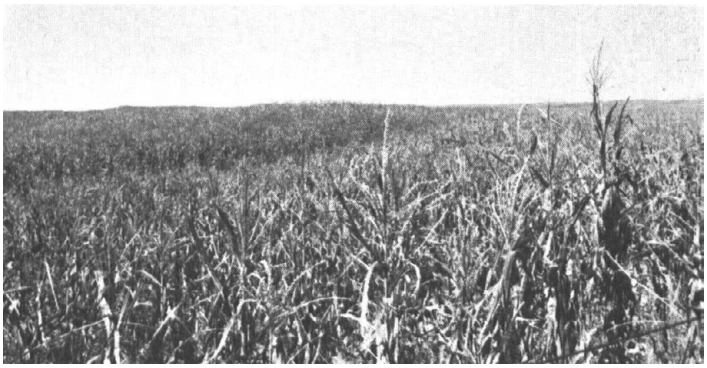

Figure 5.—**Cornfield on Anselmo-Dunday loamy fine sands. Uneven growth of corn is a result of variable winnowing, erosion, fertility, and moisture content.**

The Anselmo soils make up about 60 percent of the total acreage of this mapping unit, but the percentage of these soils in individual areas ranges from 30 to 90 percent. The Bridgeport soils make up most of the rest. Except that the surface layer varies in texture, each kind of soil has a profile similar to the one described as typical for its respective series.

The Anselmo soils occupy ridges and hummocks in areas that are irregular in shape and vary in size. The Bridgeport soils occur on small bottoms and terraces along drainageways and the base of slopes.

Included with these soils, in tracts of less than 5 acres, are areas of Dunday loamy fine sand and of Dunday loamy fine sand, loamy substratum. These inclusions are on ridges or are in areas transitional to Valentine soils. Dunday soils make up less than 10 percent of this mapping unit.

The soils in this unit take in water readily and have good capacity to hold it. Response to applications of fertilizer and to other good management is favorable. Susceptibility to wind and water erosion is moderate. Crops along drainageways are often damaged by floodwaters, and swales are often ponded.

Most of this mapping unit is cultivated to corn, rye, vetch, and alfalfa. A cropping system is needed that maintains fertility and improves the soil. Because soil blowing is the main hazard, crops that leave large amounts of residue are needed. This residue also protects the soil from water erosion. (Capability unit IIIe–3; Sandy range site)

Anselmo-Dunday loamy fine sands (AD).—These soils occur on hummocky floors of valleys or on the lower part of valley slopes. Slopes range from 3 to 8 percent. These soils are mainly in the southeastern half of the county and are most extensive in an area southeast of Ringgold. Areas vary in size and shape and occur in many different positions.

The Anselmo and the Dunday soils are so closely intermingled that it is not practical to map them separately at the scale used on the soil map. Anselmo soils make up about 70 percent of the total acreage in this mapping unit, but the percentage in individual areas ranges from 30 to 85 percent. The Dunday soils make up most of the rest. Areas of Dunday soils are similar to areas of Dunday loamy fine sand or Dunday loamy fine sand, loamy substratum, but are steeper.

The Anselmo soil has a loamy fine sand surface layer.

This layer ranges from 2 to 14 inches in thickness; average thickness is about 7 inches. In undisturbed areas this layer is very dark grayish brown to grayish brown, but in most cultivated layers it is lighter colored. In a few places a layer at varying depth contains small concretions of lime. This layer is 6 to 12 inches thick.

Included with these soils, on the tops of low hills, are oval areas of Valentine soil less than 5 acres in size. Also included are small areas of Anselmo and Bridgeport soils and small areas of steeper soils along some drainageways and swales. A few severely eroded areas, generally less than 2 acres in size, occur in cultivated or formerly cultivated areas and are shown on the map by the symbol for erosion. Inclusions amount to less than 10 percent of this mapping unit.

These soils are highly susceptible to soil blowing and moderately susceptible to water erosion. They take in water readily and have moderate to high capacity for holding it. These soils are easy to cultivate, and crop response to good management, including fertilization, is favorable. Drainage is generally good, but some swales are ponded after heavy rains or when snow melts rapidly.

About 80 percent of the acreage is, or recently has been, cultivated. The rest is in native range. Crops that improve the soil are needed for restoring and maintaining fertility. Use of these soils for silage crops, hay, and pasture should be limited. Soil blowing is reduced if wind stripcropping is used and rye follows corn in the cropping system. If methods of seeding are suitable, the conversion of cultivated areas to range is generally successful. (Capability unit IVe–5; Sandy range site)

Blown-Out Land

Blown-out land (B) develops in areas made susceptible to soil blowing because the protective plant cover has been destroyed by cattle trailing, livestock concentration, or cultivation. Areas of this land are locally called blowouts. Blown-out land is generally in larger areas of Valentine soil.

After soil blowing starts, it spreads by undercutting plants, destroying them by sandblasting, or burying them. Soil blowing continues until the area is restabilized by vegetation. Most Blown-out land consists of bowllike depressions and adjacent overblown areas (fig. 6). In the depressions, the soil material has been removed to a depth of a few to many feet. In many places vegetation has stabilized overblown areas, and they are now areas of a Valentine soil; only the bowllike areas remain as Blown-out land.

The soil material of Blown-out land is light-gray fine sand, but in some places layers of pale-brown loamy

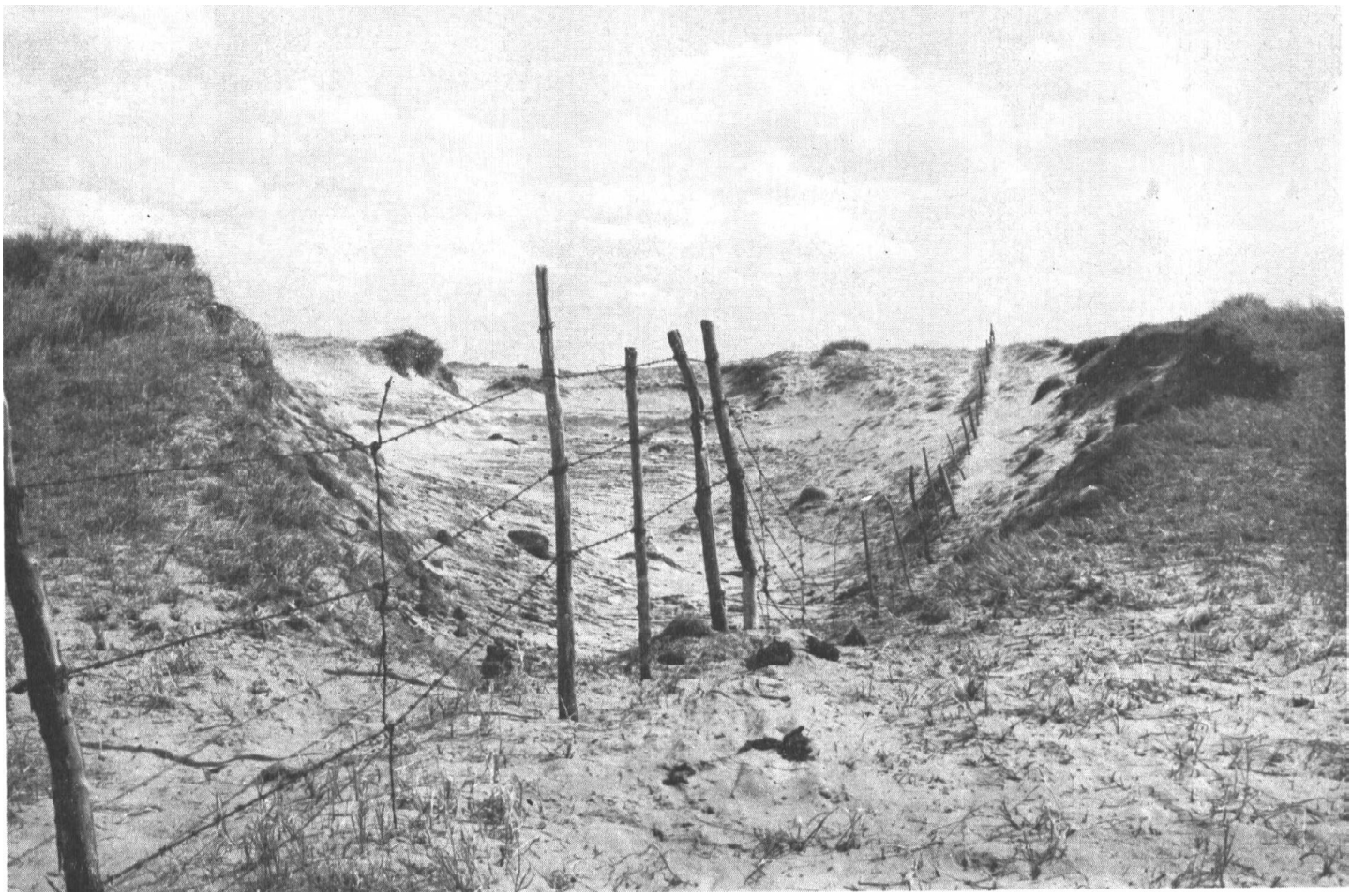

Figure 6.—Blown-out land started by cattle trailing along fence. Material blown from the depression is in the foreground.

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sand to fine sandy loam are exposed on the sides and bottoms of the blowouts. Blowouts 2 to 5 acres in size are shown on the soil map by the symbol for blowouts. (Capability unit VIe–5; Sands range site)

Bridgeport Series

This series consists of deep, friable, calcareous, sandy to silty soils that are nearly level. The soils occupy small terraces and colluvial slopes along the more nearly level drainageways. They developed from reworked Ogallala material under a cover of tall and mid grasses.

In a typical profile, these soils have a light brownish-gray loamy very fine sand surface layer about 9 inches thick. Structure is weak granular or prismatic. Beneath the surface layer is pale-brown, friable, neutral very fine sandy loam about 7 inches thick. The substratum is friable, massive very fine sandy loam that is neutral in the upper part and calcareous below a depth of 24 inches.

Bridgeport soils are well drained, but some flooding occurs after heavy rains or when snow melts rapidly. Surface runoff is slow to moderate. These soils are easy to work, and they respond favorably to good management. Unless management is good, the risk of erosion is slight to moderate.

Nearly all of the acreage of Bridgeport soils is cultivated to corn, rye, vetch, alfalfa, and tame grasses.

Profile of a Bridgeport soil, 0.2 mile south and 0.1 mile east of the center of section 24, T. 18 N., R. 30 W.; in an alfalfa field where the slope is 1 percent:

Ap—0 to 4 inches, light brownish-gray (10YR 6/2) loamy very fine sand, dark grayish brown (10YR 3.5/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.4; clear, smooth boundary.

A1—4 to 9 inches, grayish-brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 3.5/2) when moist; weak, fine, prismatic structure; slightly hard when dry, friable when moist; noncalcareous; pH 7.4; gradual, smooth boundary.

AC—9 to 16 inches, pale-brown (10YR 6.5/3) very fine sandy loam, grayish brown (10YR 5.5/2) when moist; weak, medium, subangular blocky structure breaking to weak, medium, granular; slightly hard when dry, friable when moist; noncalcareous; pH 7.6; clear, smooth boundary.

C1—16 to 24 inches, light-gray (10YR 7/2.5) very fine sandy loam, light brownish gray (10YR 6.5/2) when moist; single grain; soft when dry, loose when moist; noncalcareous; pH 7.8; clear, smooth boundary.

C2—24 to 36 inches, light-gray (10YR 7/2) very fine sandy loam, light brownish gray (10YR 6/2) when moist; massive; slightly hard when dry, friable when moist; calcareous; pH 8.4.

The A horizon of Bridgeport soils ranges from loamy very fine sand to silt loam in texture and from 6 to 18 inches in thickness. In most cultivated areas, the Ap horizon has weaker structure than the horizons below it, and it is lighter colored than the Ap horizon in the profile described. Calcareous material generally begins at a depth ranging from 18 to 30 inches, but in some places the entire profile is noncalcareous. In some places the C horizon contains yellowish-brown mottles.

Bridgeport soils are closely associated with Anselmo and Dunday soils and are distinguished from those soils by finer texture, lighter color, and a calcareous substratum.

Dunday Series

This series consists of deep, very friable, sandy soils that are nearly level to very gently undulating and occur in the valleys throughout the county (fig. 7). These soils developed from sandy windblown Ogallala deposits under a cover of tall and mid grasses.

In a typical profile, the surface layer is dark-gray loamy fine sand about 7 inches thick (fig 8). It has weak, fine, granular structure. Beneath the surface layer is about 17 inches of grayish-brown loamy fine sand. The substratum is pale-brown loamy fine sand.

Dunday soils are well drained, but some ponding occurs in swales following heavy rains or when snow melts rapidly. Surface drainage is slow to moderate, and internal drainage is moderately rapid. These soils take in water readily but have low to moderate capacity for holding it. They are easy to work and respond well to good management. The risk of soil blowing is high, however, if these soils are mismanaged.

About 80 percent of the acreage of Dunday soils is in range or is being returned to range, and the rest is in cultivated crops or tame grasses.

Profile of Dunday loamy fine sand, 0.3 mile east and 0.1 mile north of the center of section 2, T. 19 N., R. 32 W.; in a slightly hummocky native pasture where the slope is 2 percent:

A—0 to 7 inches, dark-gray (10YR 4/1.5) loamy fine sand, very dark gray (10YR 3/1.5) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.2; gradual, smooth boundary.

AC—7 to 24 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/1.5) when moist; weak, fine, crumb structure; soft when dry, very friable when moist; noncalcareous; pH 7.6; gradual, smooth boundary.

C—24 to 42 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.6.

The A horizon of Dunday soils ranges from 3 to 18 inches in thickness and from dark gray to very dark gray in color. In many cultivated areas, the plow layer is winnowed and has lost much of its silt, clay, organic matter, and structure. The AC horizon ranges from 6 to 28 inches in thickness and in places contains some fine sand. The C horizon ranges from light gray to very pale brown. It is stratified with fine sandy loam to sandy clay loam in places. Buried profiles are common in the AC and C horizons.

Dunday soils occur closely with the Anselmo, Elsmere, and Valentine soils. The AC horizon is coarser textured in the Dunday soils than that in the Anselmo soils. Dunday soils are well drained, whereas the Elsmere soils are somewhat poorly drained. Dunday soils have a darker colored surface layer than Valentine soils and are finer textured throughout the profile.

Dunday loamy fine sand (Du).—This nearly level to slightly undulating soil occurs in valleys. Areas vary widely in shape and extent. Slopes range from 0 to 3 percent.

The surface layer is loamy fine sand that generally ranges from dark gray to very dark gray in color and from 3 to 18 inches in thickness. Average thickness is 8 inches. In many cultivated or formerly cultivated areas, the plow layer is lighter colored than the surface layer described and is structureless.

Included in some areas of this soil are spots of Valentine fine sand, rolling, 1 to 5 acres in size. These areas generally have irregular shape and occur on ridges or slopes. They are shown on the soil map by the symbol for severe erosion. Also included are small areas of Dunday loamy fine sand, loamy substratum, and of Anselmo soils that generally

Figure 7.—View across a large valley consisting of Dunday soils. Hills at the side are Valentine soils.

occur in narrow strips along slopes or in swales. Spots of Elsmere and Gannett soils, 1 to 5 acres in size, occur in depressional areas in the western part of the county. They are shown on the map by the symbol for wet spots. These included areas make up less than 15 percent of any area mapped.

The main hazard is soil blowing. This soil takes in water readily but has low to moderate capacity for holding it. Response to good management, including additions of fertilizer, is favorable.

About 20 percent of this soil is cultivated to corn, rye, vetch, alfalfa, and tame grasses. About 40 percent was cultivated but is returning to native range. The remaining 40 percent is in native range.

Crops that restore and maintain fertility are needed. The use of silage or row crops should be limited. This soil is protected by a plant cover for most of the year if rye follows corn in the rotation. Wind stripcropping used with this rotation helps reduce soil blowing. Conversion of cultivated areas to range or tame pasture is generally successful where proper methods of seeding are used. (Capability unit IVe–5; Sandy range site)

Dunday loamy fine sand, loamy substratum (2Du).—This soil is in enclosed upland valleys where slopes range from 0 to 3 percent. The areas vary widely in shape and extent.

The loamy fine sand surface layer is about 8 inches thick in most places, but it ranges from 6 to 14 inches in thickness. It is very dark gray or very dark grayish brown, but in some cultivated areas the plow layer generally is dark gray or dark grayish brown. The substratum is stratified and contains fine sandy loam to sandy clay loam at a depth of 24 to 42 inches. In many places buried profiles occur in the substratum. In wet seasons a perched water table forms above the loamy layer in some places.

Included with this soil in mapping were some 1- to 5-acre areas of Valentine fine sand, rolling, on ridges; Dunday loamy fine sand on ridges; and Anselmo soils on brows of slopes or in swales. Also included were areas of Gannett or Elsmere soils in depressional areas in the western part of the county. These areas are 1 to 5 acres in size and are shown on the soil map by the symbol for wet spots. Severely eroded areas are shown by the symbol for severe erosion. The included areas make up less than 20 percent of any area mapped.

Soil blowing is the main hazard on the soil. The soil takes in water readily and has a moderate capacity for holding it. Crop response to good management, including fertilizer, is favorable.

About 40 percent of the soil is in native range. About 30 percent has been cultivated but is returning to range. The rest of the soil is in corn, rye, vetch, alfalfa, and tame grasses.

Soil-improving crops are needed to restore or maintain fertility. The use of silage or row crops should be limited. A crop rotation of corn followed by rye furnishes protection for most of the year. Wind stripcropping, used with this rotation, helps to control soil blowing. Conversion of

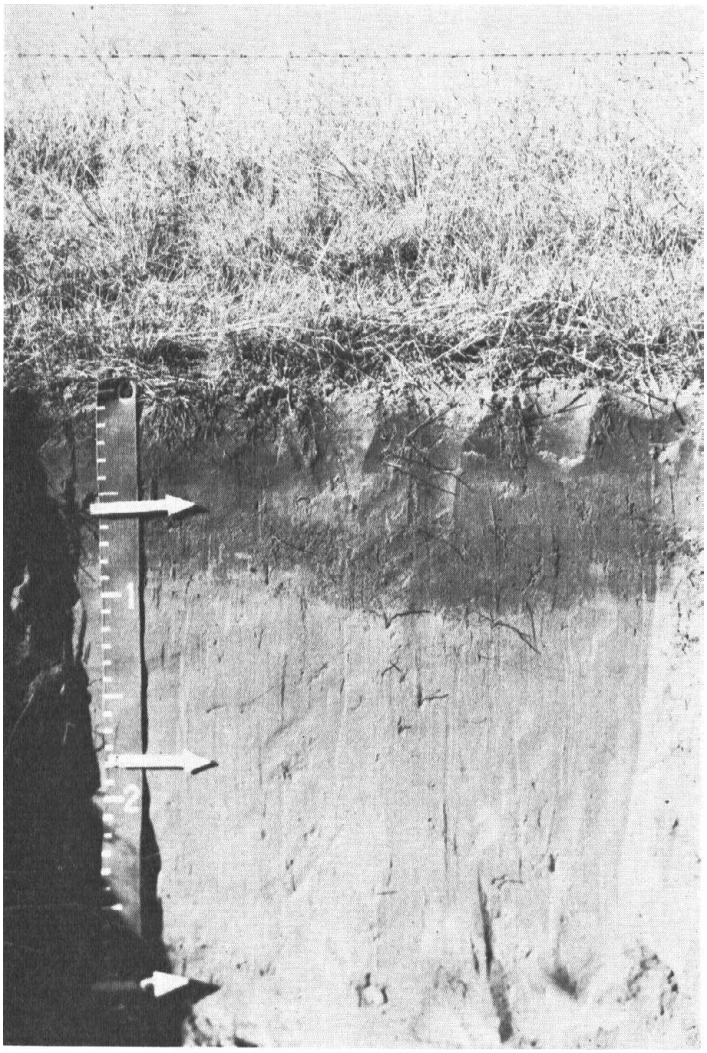

Figure 8.—Soil profile of Dunday loamy fine sand.

this soil to range or tame pasture is generally successful if methods of seeding are suitable. (Capability unit IVe–5; Sandy range site)

Elsmere Series

The Elsmere series consists of deep, loose to friable soils that are nearly level to gently undulating and somewhat poorly drained. Except for the surface layer, these soils are neutral to alkaline. They occur in valleys in the western part of the county, where they developed in windblown material under a cover of grass.

In a typical profile, the surface layer is gray, structureless, noncalcareous fine sand about 11 inches thick. In some places 1 or 2 inches of partly decayed organic matter is on the surface.

Underlying the surface layer is about 14 inches of grayish-brown material that has the same or slightly finer texture than the surface layer. This material is mildly alkaline to very strongly alkaline.

The substratum is light brownish-gray fine sand that is mottled with yellowish brown in most places.

Elsmere soils have a water table that, except in wet or droughty periods, fluctuates within depths of 30 and 60 inches. This water table is beneficial to plant growth, but it may interfere with farming or ranching operations in wet seasons. Although Elsmere soils have an adequate supply of water and are easy to work, they blow easily if mismanaged.

Most of the acreage of Elsmere soils is in native grass used for hay. A few fields are in alfalfa. Hay grows well, but alkalinity reduces yield in some places.

Profile of Elsmere fine sand (0.3 mile south of the center of section 29, T. 19 N., R. 35 W.) in a native pasture where the slope is 2 percent:

A1—0 to 11 inches, gray (10YR 5/1) fine sand, very dark grayish brown (10YR 3/2) when moist; single grain; loose when dry or moist; noncalcareous; pH 7.8; gradual, smooth boundary.

AC—11 to 25 inches, grayish-brown (2.5Y 5/2) fine sand, dark grayish brown (10YR 4/2) when moist; single grain; soft when dry, loose when moist; calcareous; pH 8.2; gradual, smooth boundary.

C—25 to 48 inches, light brownish-gray (2.5Y 6/2) fine sand, grayish brown (10YR 5/2) when moist with few, distinct, yellowish-brown mottles; single grain; soft when dry, loose when moist; slightly calcareous; pH 8.4; water table at 48 inches.

The A horizon of Elsmere soils ranges from 6 to 32 inches in thickness and from fine sand to loamy fine sand in texture. The AC horizon is similar to the A horizon but is lighter colored and, in some places, finer textured. It ranges from 6 to 24 inches in thickness. In a few places, the C horizon is fine sandy loam.

Elsmere soils occur closely with Dunday, Gannett, and Valentine soils. The water table of the Elsmere soils, but not of the Dunday and Valentine, is within reach of plant roots. Elsmere soils are darker colored than the Valentine soils. They are coarser textured and better drained than the Gannett soils.

Elsmere fine sand (Eb).—This soil occurs in valleys in the western part of the county. In many places it is in long narrow strips that parallel the edge of the valley. In other places it is in roughly oval areas in the lower parts of valleys. Slopes range from 0 to 3 percent. The size of areas varies greatly.

The fine sand surface layer ranges from 6 to 12 inches in thickness; average thickness is 8 inches. Underlying the surface layer is 8 to 16 inches of lighter colored fine sand. The substratum is light grayish-brown or light brownish-gray fine sand that is mottled with yellowish brown in most places. Buried profiles occur in some places.

Included with this soil in some places are areas of Valentine fine sand, rolling, on hummocks or ridges; Gannett soils; and Marsh. These areas are 1 to 5 acres in size. Inclusions make up less than 10 percent of the area.

This soil takes in water readily. Most of the time the water table is high and helps the growth of plants, though in wet periods it may hinder ranching operations or permit damage by trampling. Where plant cover is depleted, soil blowing is a hazard.

Nearly all of this soil is in native grass and is used for hay or grazing. A few small fields are in alfalfa. Grazing management is needed to prevent soil blowing in dry periods or damage by trampling animals in wet periods. (Capability unit VIw-5; Subirrigated range site)

Elsmere loamy fine sand (Ea).—This soil is in valleys in the western part of the county and has slopes ranging from 0 to 3 percent. The soil areas range widely in size. In some places the areas are about the shape of the valleys. In many

places, however, the lower part of the valley consists of Gannett soils, Marsh, or lakes, and the Elsmere loamy fine sand is in a strip or band that parallels the edge of the valley.

The loamy fine sand surface layer of this soil ranges from 6 to 32 inches in thickness; average thickness is about 8 inches. Underlying the surface layer is loamy fine sand or, in a few places, fine sandy loam. The substratum is fine sand except for the few places where it is fine sandy loam.

Included with this soil in some places are areas of Dunday loamy fine sand on small hummocks or ridges. Also included are areas of Gannett soils or Marsh in depressions. These areas are shown by the symbol for wet spots or marsh. Other inclusions are a few small areas of Elsmere soil that has a fine sandy loam surface layer (fig. 9). Inclusions make up less than 15 percent of any area mapped.

This soil takes in water readily. Most of the time the water table is high and helps the growth of plants, though it may hinder tillage in wet periods. Soil blowing is the primary hazard where the plant cover is depleted. Alkali is harmful in some places.

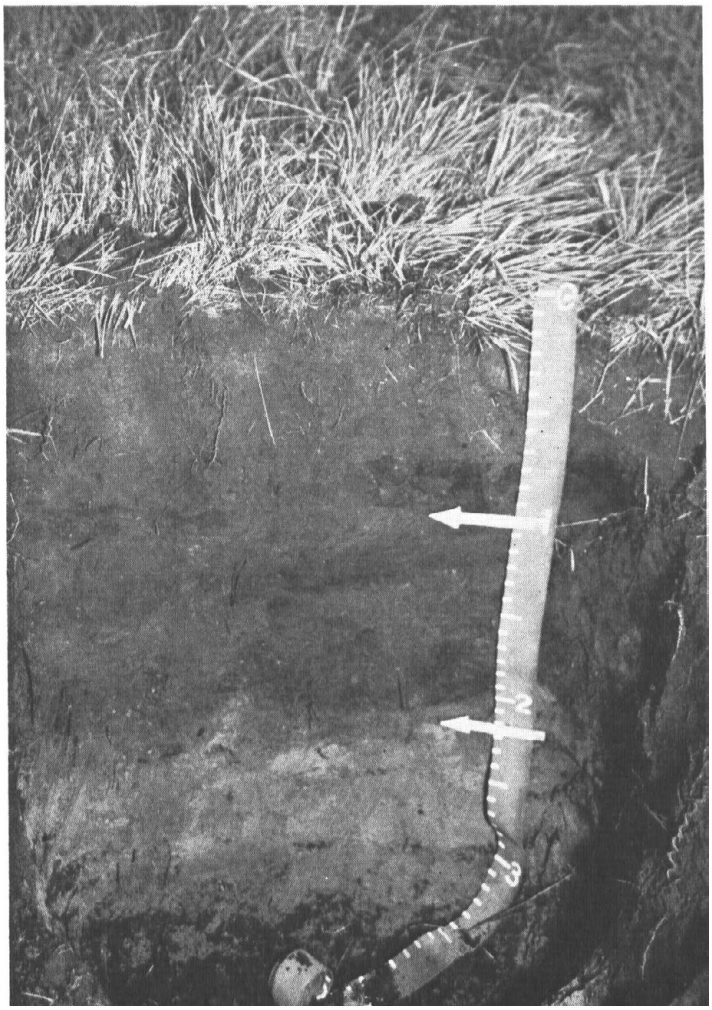

Figure 9.—**Profile of an Elsmere soil that has a fine sandy loam surface layer.**

Nearly all this soil is in native grass and used for hay or grazing. A few small fields are in alfalfa. Commercial fertilizers, especially phosphorus and sulfur, are needed before alfalfa is planted. Lime is also needed in some places. Mixtures of grass and alfalfa grow well. (Capability unit IVw–5; Subirrigated range site)

Gannett Series

The Gannett series consists of friable, nearly level to gently undulating soils that are poorly drained and alkaline. These soils occur in enclosed valleys in the western part of the county. Most slopes are less than 1 percent, but a few are 2 and 3 percent. These soils developed from windblown material under a cover of tall grasses and sedges.

In a typical profile, the surface layer is about 12 inches thick and is gray very fine sandy loam in the upper part and gray silt loam in the lower part. Beneath the surface layer is about 6 inches of gray loamy fine sand that is underlain by light brownish-gray fine sand distinctly mottled with yellowish brown.

Gannett soils are high in content of organic matter and fertility and are too wet for cultivation. Erosion is not a hazard.

Nearly all the acreage of Gannett soils is in native grass used for hay. Native grasses grow well, but a high water table interferes with haying and other operations in wet periods.

Profile of a Gannett soil, 0.2 mile north of the southeast corner of section 31, T. 19 N., R. 35 W.; in a native meadow where slope is less than 1 percent:

0—2 inches to 0, partly decomposed organic matter.
A11—0 to 5 inches, gray (10YR 5/1) very fine sandy loam, black (10YR 2/1) when moist; weak, medium, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 8.2; clear, smooth boundary.
A12—5 to 12 inches, gray (10YR 5/1) silt loam, black (10YR 2/1) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; pH 8.2; clear, smooth boundary.
IIAC—12 to 18 inches, gray (10YR 5.5/1) loamy fine sand, very dark gray (10YR 3/1) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; pH 8.4; abrupt, smooth boundary.
IIIC—18 to 54 inches, light brownish-gray (10YR 6.5/2) fine sand, grayish brown (10YR 5/2) with few, distinct, fine, yellowish-brown mottles when moist; single grain; slightly hard when dry, loose when moist; pH 8.4.

The A horizon ranges from 3 to 24 inches in thickness and, in many places, is made up of two or three layers that differ in texture. The IIAC horizon ranges from 0 to 18 inches in thickness. It is fine sandy loam in most places but loamy fine sand in a few places. The entire profile is calcareous, but the lime in the substratum may be only that in snail shells and the like. Alkalinity ranges from mild to very strong. The water table is in the upper 3 feet in most periods.

Gannett soils occur closely with Elsmere soils but have a darker colored, finer textured solum. Also, the water table is higher in the Gannett soils.

Gannett sandy loam (Gn).—This poorly drained soil is in enclosed valleys in the western part of the county. Soil areas vary in size and shape and occur in the lower parts of valleys or at the borders of lakes or marshes. The water table seldom saturates the entire profile during the growing season.

The surface layer is about 12 inches thick in most places but ranges from 6 to 24 inches in thickness. In many places it is made up of two or three layers of different texture. The texture ranges from loamy fine sand to silt loam. An overwash consisting of 3 or 4 inches of light-colored fine sand occurs in a few places. In many places the surface layer is covered with 1 or 2 inches of partly decayed organic matter. The layer between the surface layer and the fine sand substratum ranges from 4 to 20 inches in thickness; average thickness is about 10 inches.

In mapping, areas of Elsmere soils, 1 to 5 acres in size, were included. These areas occur on low hummocks or in narrow strips that are transitional to Dunday or Valentine soils. Also included were wet areas of Gannett sandy loam, ponded, and of Marsh or lakes that are shown on the soil map by the symbols for a wet spot and marsh. Included areas make up less than 10 percent of the areas mapped, except in a few narrow strips where they amount to as much as 50 percent.

Nearly all of this soil is in native grass used for hay, but some areas are in pasture. In wet periods, haying operations may be prevented by the high water table and grazing animals may damage pasture. (Capability unit Vw–3; Subirrigated range site)

Gannett sandy loam, ponded (2Gn).—This poorly drained soil is in enclosed valleys in the western part of the county. The water table frequently saturates the entire profile during the growing season. Soil areas are irregular in shape and variable in size. Slopes range from 0 to 3 percent.

Above the surface layer is 1 to 3 inches of partly decayed organic matter. The surface layer ranges from 3 to 18 inches in thickness; average thickness is about 12 inches. In most places, the surface layer is made up of two or three layers that range from loamy fine sand to loam in texture. In most places the surface layer rests directly on the fine sand substratum.

Included with this soil are areas of Gannett sandy loam or Elsmere loamy fine sand, on ridges or along higher borders, and of Marsh in depressional areas or along lower borders. These areas are 1 to 5 acres in size. They make up less than 10 percent of the mapped areas, except in a few narrow strips where they make up to 50 percent.

Nearly all of this soil is in native hay, but some of it is grazed. The vegetation is mainly reedgrasses and tall sedges, for the high water table has drowned out the bluestems, switchgrass, and indiangrass. Extreme wetness makes haying operations difficult or impossible in wet periods, and trampling animals may damage the turf if they are permitted to graze during wet periods. (Capability unit Vw–1; Wet Land range site)

Marsh

Marsh (M) consists of areas where water is shallow and cattails, rushes, arrowheads, willows, and other water-tolerant plants grow. It is in the western part of the county in depressions on valley floors in areas bordering lakes or streams (fig. 10).

Marsh is too wet to be used as hay or pasture. It is suitable only for wildlife habitat. (Capability unit VIIIw–1; range site not assigned)

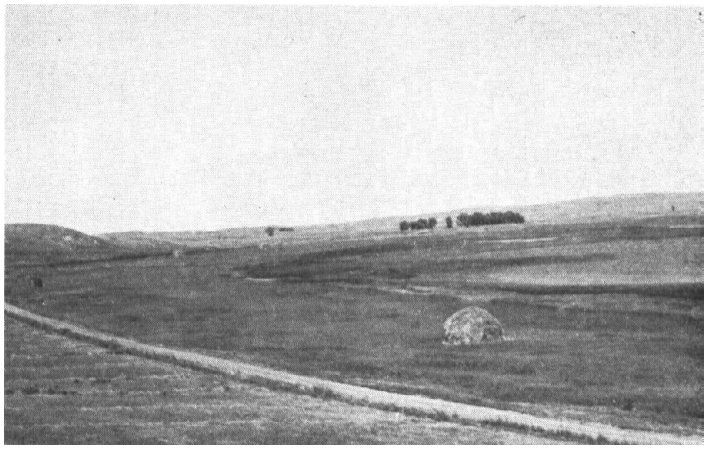

Figure 10.—**Marsh at right center along shore of Dry Lake. Marsh is bordered by bands of Gannett and Elsmere soils below Valentine soils on hills at the left and in the background.**

Valentine Series

The Valentine series consists of deep, loose, very sandy soils that are nearly level to steep and occur throughout the county. These soils are neutral to slightly alkaline. They developed in windblown fine sand under a cover of mid and tall grasses. Much of this sand is of Ogallala origin. Valentine soils cover more than 90 percent of the county.

In a typical profile, the surface layer is grayish-brown, structureless fine sand about 6 inches thick. Beneath this layer is about 11 inches of light-brownish gray fine sand. The substratum, to a depth of about 42 inches, is very pale brown fine sand.

Valentine soils are well drained to excessively drained. Permeability is rapid, and surface runoff is low. These soils have low water-holding capacity and natural fertility. The risk of soil blowing is high if management is not good.

Nearly all of the acreage of Valentine soils is in native range that is grazed by cattle. A few small areas are cultivated.

Profile of Valentine fine sand, rolling, 0.2 mile east of the southwest corner of section 28, T. 20 N., R. 31 W.; in native pasture where the slope is 4 percent.

A1—0 to 7 inches, grayish-brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/1.5) when moist; single grain; loose when dry or moist; noncalcareous; pH 7.6; clear, smooth boundary.

AC—7 to 18 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; single grain; loose when dry or moist; noncalcareous; pH 7.6; gradual, smooth boundary.

C—18 to 42 inches, very pale brown (10YR 7/3) fine sand, light brownish gray (10YR 6/2) when moist; single grain; loose when dry or moist; noncalcareous; pH 7.4.

Valentine soils are closely associated with Anselmo, Dunday, and Elsmere soils. They are lighter colored and coarser textured than Anselmo and Dunday soils. Valentine soils are lighter colored than the Elsmere soils and, unlike them, do not have a high water table.

The A horizon ranges from fine sand to loamy fine sand and is grayish brown or dark grayish brown. This horizon is 0 to 12 inches thick in areas of fine sand and 0 to 6 inches thick in areas of loamy fine sand. The C horizon is very pale brown, pale brown, light brownish gray, or light gray. Transitions between horizons are generally gradual.

Valentine fine sand, hilly (VaD).—This hilly soil has steep slopes, most of which are more than 17 percent. It occupies the steeper dune faces and the higher, steeper, pointed-topped hills. Most of the steeper slopes have cat-steps, or small irregular steps formed by cattle tracks. Areas of this soil vary extremely in shape and size.

The surface layer of this soil is dark grayish-brown fine sand 0 to 4 inches thick. It is underlain by 4 to 10 inches of brown fine sand. The substratum is pale-brown to light brownish-gray, loose fine sand.

Included with this soil are areas of Valentine fine sand, rolling, that make up 20 to 50 percent of the areas mapped. These included areas are 1 to 50 acres in size. They occur in irregularly shaped tracts on the less steep slopes. Also included are a few areas of Dunday soils in swales. These areas are 1 to 5 acres in size. In swales, in the western part of the county are areas of Elsmere and Gannett soils and of Marsh or lakes. These areas are less than 5 acres in extent and are shown on the soil map by the symbol for wet spots. Small areas of Blown-out land are common. Those areas 2 to 5 acres in size are shown on the soil map by the symbol for a blowout. Inclusions may make up as much as 50 percent of any area mapped.

Nearly all of this soil is in native grass and is used for range. (Capability unit VIIe–5; Choppy Sands range site)

Valentine fine sand, level (Va).—This nearly level soil is in enclosed upland valleys where slopes are 0 to 1 percent. Areas generally range from ovate to elongate and are up to 135 acres in extent.

The surface layer is dark grayish-brown fine sand about 6 inches thick. Beneath this layer is 6 to 12 inches of dark-gray fine sand that is underlain by a substratum of grayish-brown to pale-brown fine sand.

Included with this soil are areas of Valentine fine sand, rolling, on low ridges or in depressions. These included areas are 1 to 5 acres in size. Also included are a few areas of Blown-out land less than 2 acres in size. Included areas make up less than 5 percent of the areas mapped.

Nearly all of this soil is in native range. (Capability unit VIe–5; Sandy range site)

Valentine fine sand, rolling (VaC).—This soil occurs on hills, mainly where slopes range from 1 to 17 percent. It makes up about 89 percent of the county.

The surface layer of this soil is dark grayish brown. It ranges from fine sand 4 to 10 inches thick to loamy fine sand 1 to 6 inches thick. Average thickness is about 7 inches. Beneath the surface layer is 6 to 30 inches of grayish-brown fine sand. The substratum is pale-brown or light brownish-gray fine sand (fig. 11).

Included with this soil are areas of Valentine fine sand, hilly, on steep dune faces and pointed-topped ridges. These included areas are 1 to 50 acres in size, but they make up 0 to 50 percent of the areas mapped. Also included are areas of Valentine fine sand, level, in some enclosed valleys. These areas are 1 to 20 acres in size. Other soils included are Dunday loamy fine sand and Dunday loamy fine sand, loamy substratum. These included areas are in narrow swales and small depressions between hummocks and ridges. The areas of Dunday soils make up less than 20 percent of the areas mapped. Mapped in some places was a soil similar to Dunday loamy fine sand, but on slopes of 3 to 8 percent. It occupies a band, 100 to 500 feet wide, along the south side of broad valleys.

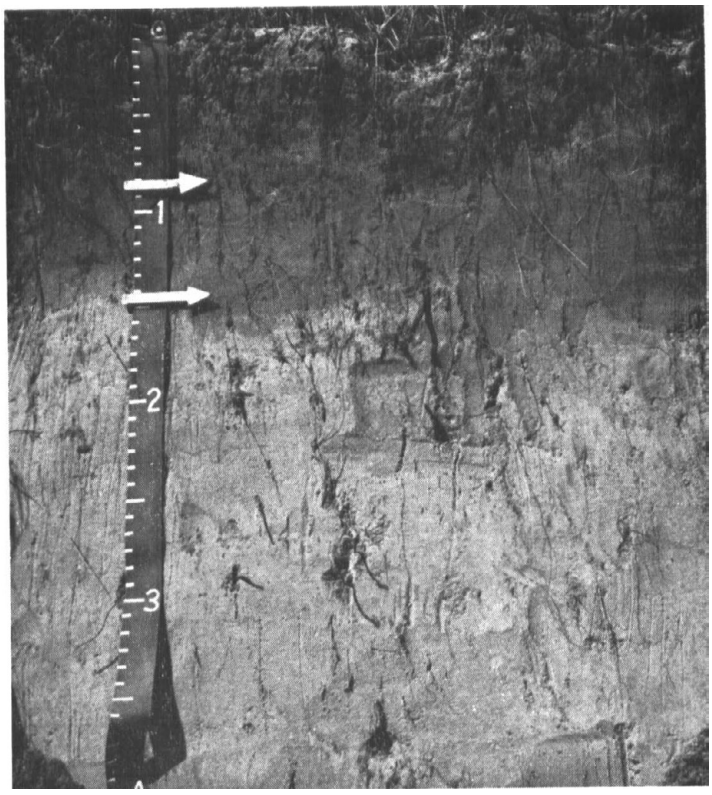

Figure 11.—**Profile of Valentine fine sand, rolling. Color becomes lighter as depth increases.**

Other included areas, in the southeastern part of the county, are spots of Anselmo soil 0 to 5 acres in size. These spots are mostly on north- or west-facing slopes of 3 to 8 percent. In some swales, in the western part of the county, are 1- to 5-acre spots of Elsmere or Gannett soils or of Marsh or lakes. These small areas are shown on the soil map by the symbol for wet spot or the one for marsh. Areas of Blown-out land, 2 to 5 acres in size, are shown on the soil map by the symbol for a blowout. Also included, in a few valleys, are areas of formerly cultivated soils 5 to 20 acres in size. These included areas have a grayish-brown fine sand or loamy sand surface layer 0 to 40 inches thick. This layer is underlain by a fine sandy loam.

Nearly all of Valentine fine sand, rolling, is in native grass or is being returned to native grass. Some of the grass is mowed for hay. Nearly 4,000 acres are in small parts of cultivated fields. (Capability unit VIe–5; Sands range site)

Use and Management of the Soils

The soils of McPherson County are used almost entirely for range. This section tells how the soils are used for that purpose, and also for cultivated crops, windbreaks, wildlife, and building highways and other engineering structures. Predicted yields of cultivated crops are listed, and the nationwide system of grouping soils according to their suitability for agricultural use is briefly described.

Range Management [2]

In McPherson County the management of range is particularly important because about 97 percent of the county is in native grasses that are used for grazing cattle.

Described in the following pages are range sites and condition classes, management of range sites, and general practices of managing range and hay land.

Range sites and condition classes

Different kinds of range produce different kinds and amounts of native grass. If the operator of a ranch is to manage his range properly, he needs to know the different kinds of soils, or range sites, in his holdings and the plants that each site is capable of producing. He can then manage the sites so as to favor the best forage plants.

Range sites are areas of rangeland that differ from each other in their ability to produce a significantly different kind and amount of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing practices or other management to maintain or improve the present vegetation.

Climax vegetation is the combination of plants that originally grew on a given site. It is generally the most productive combination of plants that can be grown there.

Range condition can be rated by comparing the present vegetation on a site with the climax vegetation. A rating of this kind is helpful because it can be used in comparing the present range plants with those that the site can produce under good management. Four classes of range condition are defined. Range is in *excellent* condition if 76 to 100 percent of the site consists of climax vegetation. It is in *good* condition if the percentage is between 51 and 75; in *fair* condition if the percentage is between 26 and 50; and in *poor* condition if it is 25 percent or less.

Plants growing on a range site are classed as *decreasers*, *increasers*, and *invaders*. Decreasers and increasers are climax plants. Because decreasers are generally the most palatable to livestock, and the most heavily grazed, they are the first to be injured by overgrazing and they decrease. Increasers withstand grazing better or are less palatable to livestock. At first they replace the decreasers, but most of them also decrease as heavy grazing continues. Invaders are weeds that become established after the climax vegetation has been reduced by grazing.

Descriptions of range sites

The range sites in McPherson County are the Wet Land, Subirrigated, Sandy, Sands, and Choppy Sands. These range sites are described in this subsection. In each description, the plants in the dominant vegetation are named and management of the range is suggested. Also given is the estimated total annual yield of forage on the site when it is in excellent condition. To find the mapping units in each range site, refer to the "Guide to Mapping Units" at the back of this survey. Marsh is too wet to support palatable grasses and has not been placed in a range site.

WET LAND RANGE SITE

Gannett sandy loam, ponded, is the only soil in this range site. This nearly level to very gently sloping soil is in marshy areas of valleys. Part of the growing season, there are ponded areas where the water table rises above the surface. The surface layer is made up of two or three layers that range from loamy fine sand to loam. The substratum is fine sand stratified with loamy fine sand in most places.

In the climax plant cover is a mixture of decreaser grasses, such as prairie cordgrass, northern reedgrass, bluejoint reedgrass, and reed canarygrass. Decreasers make up at least 75 percent of the total plant cover, and other perennial plants account for the rest. Tall sedges and rushes are the principal increasers. This site is too wet for big bluestem, indiangrass, and switchgrass.

This site is generally used as hay land, though some of it is grazed. When the site is abused by too much grazing or cutting of hay, some of the principal invaders are short sedges, bigroot ladysthumb, Pennsylvania smartweed, swamp mildweed, devils beggarticks, and sandbar willow.

In wet seasons, haying operations may be difficult or impossible and trampling animals damage the turf if they are permitted to graze. Stocking rates and haying should be limited so as to maintain the vigor of the grasses.

On this range site, the total annual yield of air-dry forage is 7,000 to 8,000 pounds per acre when rainfall is average and the site is in excellent condition.

SUBIRRIGATED RANGE SITE

This range site consists of nearly level to very gently sloping soils that have a loamy or sandy surface layer and a sandy loam to fine sand subsoil. The water table of these soils is seldom above the surface during the growing season, and it is within reach of plant roots, or 10 to 60 inches from the surface, during most of the growing season. The water table is highest early in spring and is lowest late in summer.

In the climax plant cover is a mixture of decreaser grasses, such as big bluestem, little bluestem, indiangrass, switchgrass, prairie cordgrass, and Canada wildrye. Decreasers make up at least 75 percent of the plant cover, and other perennial grasses and forbs account for the rest. Western wheatgrass and various sedges are the principal increasers.

This site is generally used as hay land, though small, irregular areas are often grazed. The aftermath on hay land is frequently grazed, and the hay cut from a field may be fed to livestock on the same field from which it was cut. When the site is abused by too much grazing or cutting of hay, some of the principal invaders are Kentucky bluegrass, foxtail barley, blue verbena, woolly verbena, annuals, and western snowberry.

Nearly all of the acreage of these soils is in native grass or sedges and is used for hay or grazing. The high water table is beneficial to the growth of grass, but it may interfere with grazing and with haying. Grazing should be limited to dry periods when trampling does not damage the grasses.

On this range site, the total annual yield of air-dry forage is 6,000 to 7,000 pounds per acre when rainfall is average and the site is in excellent condition.

SANDY RANGE SITE

This range site consists of nearly level to strongly sloping, deep soils on uplands. These soils have a fine sand or

[2] By PETER N. JENSEN, range conservationist, Soil Conservation Service.

loamy fine sand surface layer underlain by sandy loam to fine sand.

In the climax plant cover is a mixture of decreaser grasses, such as sand bluestem, little bluestem, indiangrass, switchgrass, porcupinegrass, and sideoats grama. Decreasers make up at least 65 percent of the total plant cover, and other perennial grasses and forbs make up the rest. The principal increasers are prairie sandreed, needle-and-thread, blue grama, and western wheatgrass. When this range site deteriorates, blue grama, Scribner panicum, and western wheatgrass are the last climax grasses to disappear. When the site is abused, some of the common invaders are annuals, western ragweed, windmillgrass, and tumblegrass.

About 70 percent of this range site is used for range or consists of soils that have been cultivated but are returning to range. Suitable methods of seeding are generally successful in areas returning to range. The primary hazard on the soils of this site is soil blowing where the grass cover is depleted.

On this range site, the total annual yield of air-dry forage is 2,000 to 3,000 pounds per acre when rainfall is average and the site is in excellent condition.

SANDS RANGE SITE

This range site covers almost 90 percent of the county. It consists of nearly level to rolling, deep, well-drained soils on uplands. These soils have a fine sand to loamy fine sand surface layer that is underlain by loamy sand to fine sand.

In the climax plant cover is a mixture of decreaser grasses, such as sand bluestem, switchgrass, bahiagrass, indiangrass, sand lovegrass, porcupinegrass, Canada wildrye, and prairie junegrass. Decreasers make up at least 65 percent of the total plant cover, and other perennial grasses and forbs account for the rest (fig. 12). The principal increasers are little bluestem, prairie sandreed, needle-and-thread, blue grama, Scribner panicum, Wilcox panicum, sand dropseed, sand paspalum, and sedges. Annuals and western ragweed are common invaders.

Nearly all this site is in native grasses that are used for grazing and hay. In addition, many small and medium-sized tracts that were formerly cultivated are returning to range. The condition of these tracts is not yet good, though proper methods of seeding are generally successful in returning them to climax grasses. The soils on this range

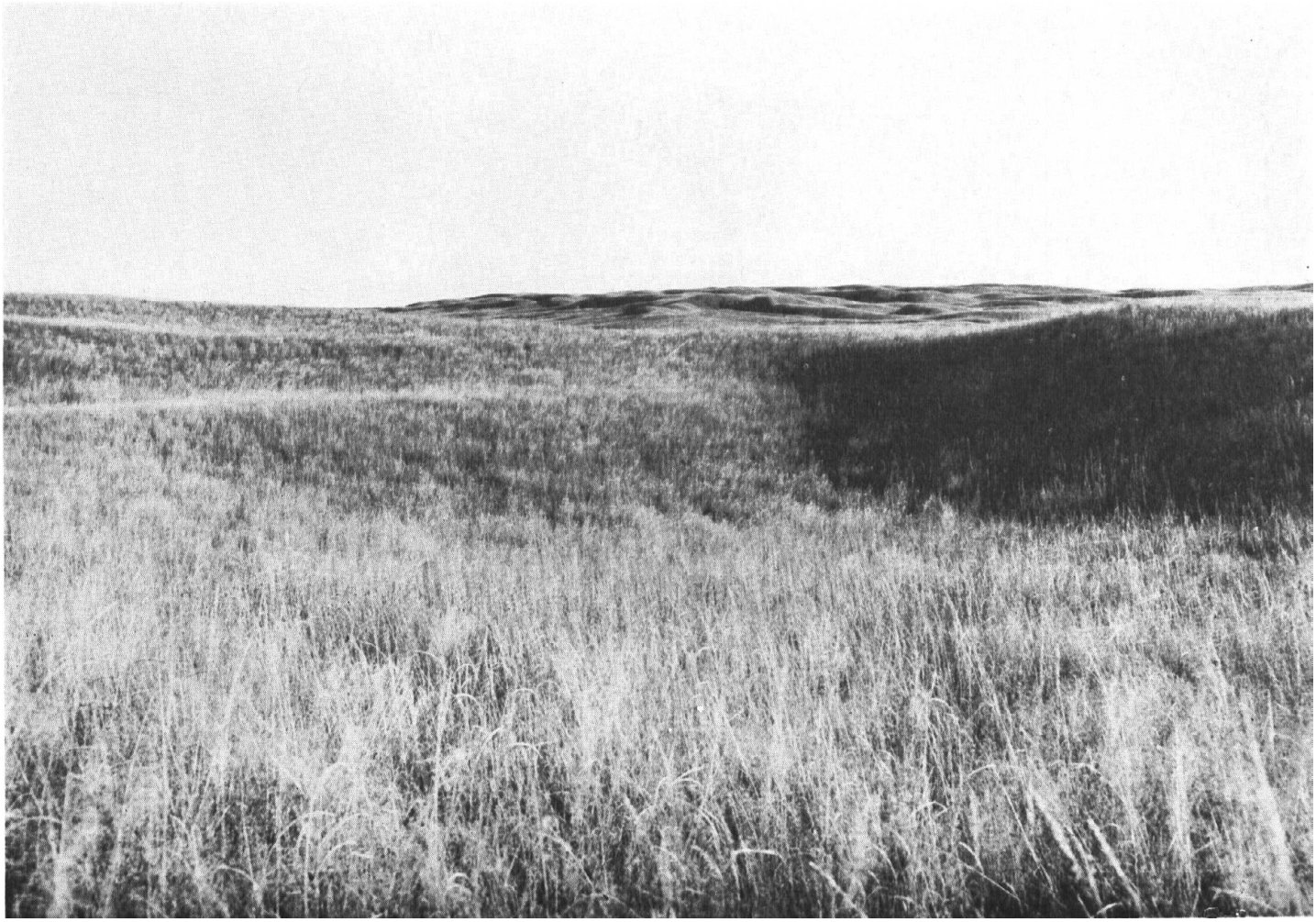

Figure 12.—**Valentine fine sand, rolling, in the Sands range site in excellent condition. The dominant grasses are sand bluestem, little bluestem, switchgrass, and prairie sandreed.**

site are subject to severe soil blowing where the plant cover is sparse or absent.

On this range site, the total annual yield of air-dry forage is 2,000 to 3,000 pounds per acre when rainfall is average and the site is in excellent condition.

CHOPPY SANDS RANGE SITE

Valentine fine sand, hilly, is the only soil on this range site. This deep, loose, excessively drained soil is on steep slopes. It has a fine sand surface layer and underlying material. Blowouts are common where this soil is bare.

In the climax plant cover is a mixture of decreaser grasses, such as sand bluestem, sand lovegrass, switchgrass, indiangrass, porcupinegrass, Canada wildrye, and prairie junegrass. Decreasers make up at least 75 percent of the total plant cover, and other perennial grasses and forbs account for the rest. The principal increasers are little bluestem, prairie sandreed, blowoutgrass, hairy grama, sand dropseed, sandhill muhly, sand paspalum, and sedges (fig. 13). The main forb and woody increasers are Arkansas rose, lemon scurfpea, and rush skeletonplant. Small soapweed increases on range grazed in summer.

Nearly all of this site is in native grasses and is used for grazing cattle. The soil is especially susceptible to soil blowing because it is sandy and, in most places, has slopes of more than 17 percent.

On this range site, the total annual yield of air-dry forage is 1,500 to 2,500 pounds per acre when rainfall is average and the site is in excellent condition.

Management of range and hay land

Management practices that are economical and are essential for maintaining the condition of range are proper range use, deferred grazing, and rotation-deferred grazing. Livestock can be distributed suitably on a range site by correctly locating fences, wells (fig. 14), and salt.

The condition of rangeland can be improved in many places by reseeding or interseeding with wild or improved native grasses. Formerly cultivated areas of Dunday, Anselmo, and other soils return to range faster if they are seeded to suitable native grasses. Also, Blown-out land and areas that are bare because of plowing or severe overgrazing should be seeded and mulched or, where not seeded, protected from livestock until the native grasses are firmly reestablished. The areas seeded should be suitable as range so that only management of grazing is needed for maintaining good forage.

In McPherson County the native meadows harvested

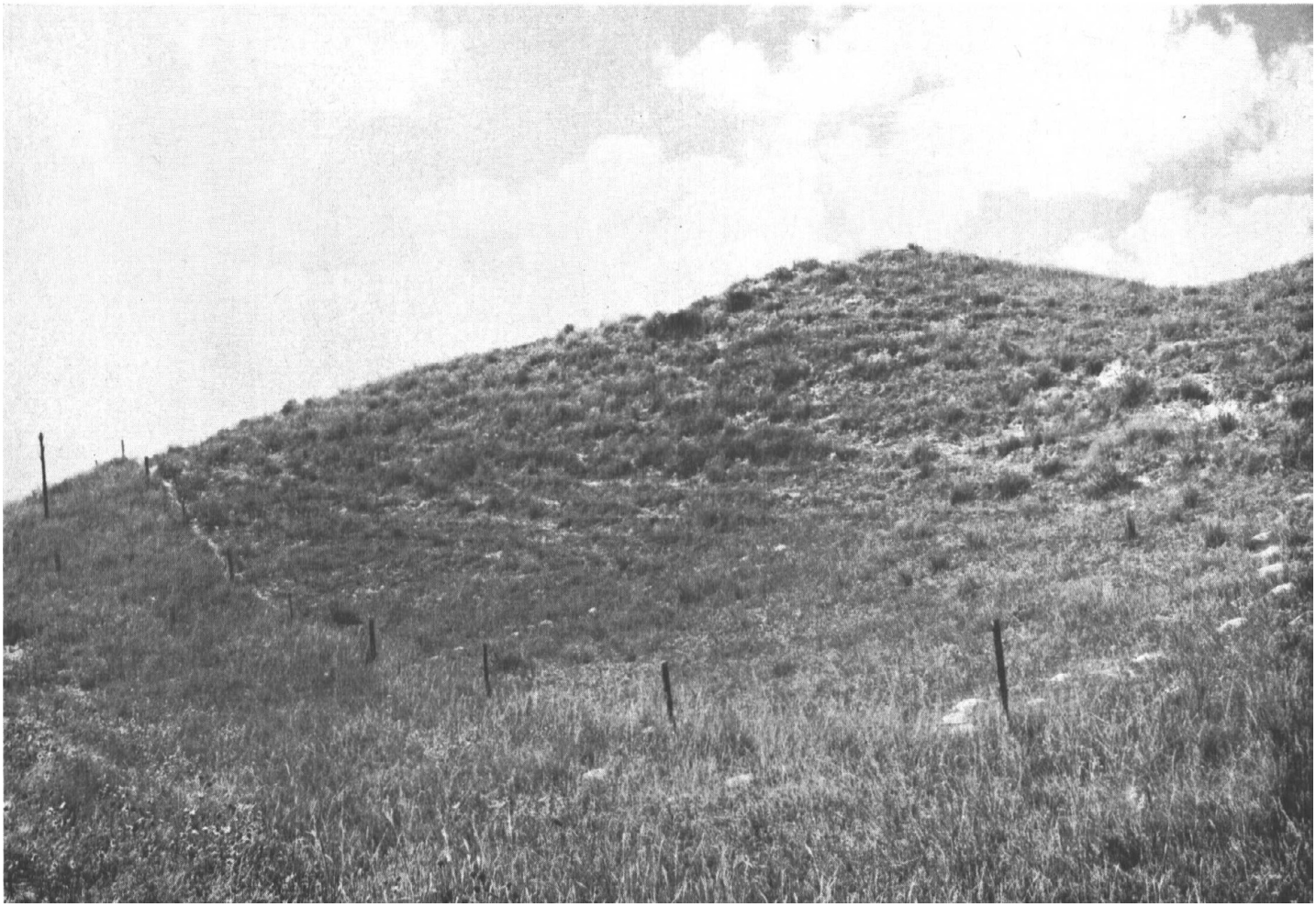

Figure 13.—Valentine fine sand, hilly, in Choppy Sands range site in good condition. The dominant grasses are sand bluestem, little bluestem, and prairie sandreed.

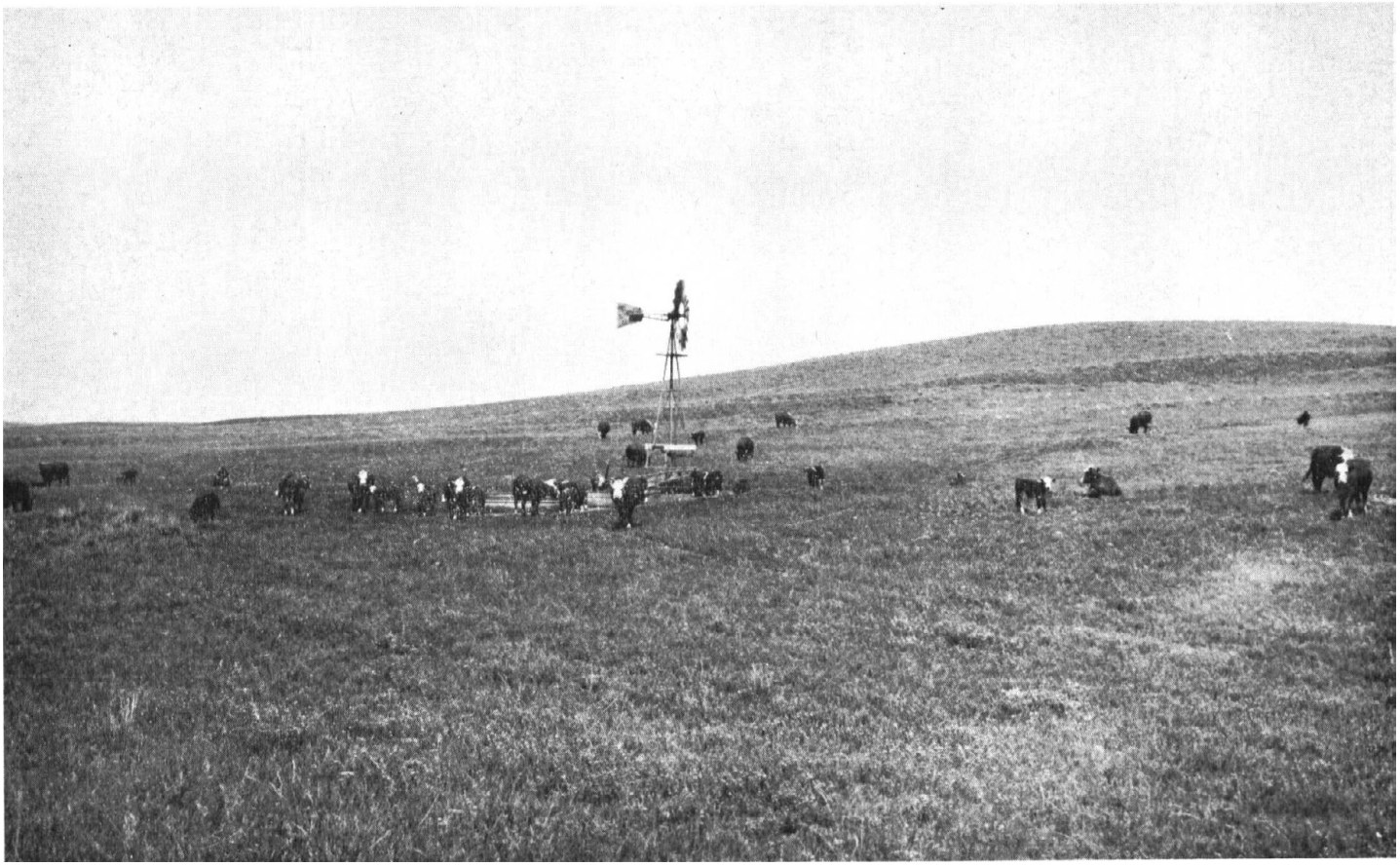

Figure 14.—Cattle watering at a well properly located in the Sandy range site. The soil is Dunday loamy fine sand.

each year for hay are generally in the Wet Land and Subirrigated range sites. These sites cover about 9,300 acres, or less than 2 percent of the county. On these range sites the hay cut is generally stacked, but on other sites it seldom is stacked. Instead, it is windrowed or baled and left to be eaten by livestock during fall or winter (fig. 15).

Management and Predicted Yields of Cultivated Crops

Less than 10,000 acres in McPherson County is used for crops. Most of this acreage produces feed for wintering livestock. The cultivated soils are fine sandy loams or loamy fine sands in the Anselmo, Bridgeport, Dunday, and Elsmere series.

Most of the cultivated acreage is dryfarmed. The principal crops are corn, rye, and alfalfa, though small amounts of oats, barley, wheat, and forage crops are also grown. Wheat is grown in a very small acreage of Anselmo and Dunday soils, but it does not grow well. Alfalfa is difficult to establish on the sandy soils. On these soils the surface layer dries quickly after rains, and young seedlings die because not enough moisture is available. The average yield of alfalfa hay is only about a ton per acre.

Minimum tillage is used on the Anselmo and Dunday soils. Corn is usually planted with a lister on fields where there has been little or no seedbed preparation. During spring, soil blowing is controlled by ridges made with a lister. By the time the ridges have been leveled by cultivation, the corn is high enough to protect against soil blowing. In fall, rye is seeded between the rows of corn so as to provide winter cover. Depending on its growth, the rye is grazed or harvested for grain.

Less than 500 acres in McPherson County is irrigated. Alfalfa is the main crop under irrigation, and it is harvested for hay. The sandy Anselmo and Dunday soils are suitable for irrigation by sprinklers.

Shown in table 2 are predicted yields of corn, rye, and alfalfa on the soils in the county that are generally cul-

TABLE 2.—*Predicted acre yields of the principal crops on the cultivated soils*

Soil	Corn	Rye	Alfalfa	
			Dry-land	Irrigated
	Bu.	*Bu.*	*Tons*	*Tons*
Anselmo and Bridgeport soils	25	15	1. 2	3. 5
Anselmo-Dunday loamy fine sands	20	15	1. 0	3. 0
Dunday loamy fine sand	18	10	1. 0	3. 0
Dunday loamy fine sand, loamy substratum	20	12	1. 0	3. 2
Elsmere loamy fine sand	30	14	1. 0	2. 5

Figure 15.—**Sands range site. Baled native hay left to feed cattle during winter. The soil is Valentine fine sand, rolling.**

tivated. The predictions are based on interviews with farmers and ranchers, but their records of yields are limited. Yields are difficult to estimate because the crops grown are often used for forage rather than for grain.

Interpreting Soils by Capability Classification

Some readers may find it practical to use and manage alike some of the different kinds of soils on their farm. These readers can make good use of the capability classification system, a grouping that shows, in a general way, how suitable soils are for most kinds of farming.

In the capability system, all the kinds of soil are grouped at three levels, the class, subclass, and unit. Following is a descriptive outline of the system as it applies in McPherson County. The placement of any mapping unit in the grouping can be learned by turning to the "Guide to Mapping Units" at the back of this survey, or by referring to the notation at the end of the description of each mapping unit in the section that describes the soils of the county.

The eight classes in the capability system, and the subclass and capability units in McPherson County, are described in the list that follows.

Class I.—Soils that have few limitations that restrict their use. (None in McPherson County)

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices. (None in McPherson County)

Class III.—Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe.—Soils subject to erosion if they are not protected.

Capability unit IIIe–3.—Nearly level to gently sloping, loamy and sandy soils.

Class IV.—Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Capability unit IVe–5.—Nearly level to gently rolling, sandy soils.

Subclass IVw.—Soils that have very severe limitations for cultivation, mainly because of excess water.

Capability unit IVw–5.—Nearly level, somewhat poorly drained, sandy soils.

Class V.—Soils that have little or no erosion hazard but have other limitations, impractical to remove, that limit

their use largely to pasture, woodland, or wildlife food and cover.

Subclass Vw.—Soils too wet for cultivation; drainage or protection not feasible.

Capability unit Vw–1.—Very wet, loamy soils on bottom lands that are frequently flooded during part of the growing season.

Capability unit Vw–3.—Very wet, loamy soils that are seldom flooded during the growing season.

Class VI.—Soils that have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe.—Soils subject to severe erosion if protective cover is not maintained.

Capability unit VIe–5.—Nearly level to rolling, sandy soils.

Subclass VIw.—Soils too wet for cultivation; drainage or protection not feasible.

Capability unit VIw–5.—Sandy soils with high water table.

Class VII.—Soils that have very severe limitations that make them unsuited for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe.—Soils very severely limited by risk of erosion if protective cover is not maintained.

Capability unit VIIe–5.—Steep, loose, sandy soils.

Class VIII.—Soils and landforms that have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Subclass VIIIw.—Areas too unstable to utilize.

Capability unit VIIIw–1.—Areas that consist of the land type, Marsh; submerged most of the time.

As shown in the foregoing list, the broadest grouping, the capability class, is designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. In the other classes the higher the Roman numeral, the greater the natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclass indicates major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, and not in McPherson County, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils are subject to little or no erosion hazard but have other limitations that confine their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Capability units are generally identified by numbers assigned locally, for example, IIIe–3 or IVw–5.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

Woodland and Windbreaks [3]

The native woody plants in McPherson County consist of small trees, shrubs, and vines. They are widely scattered throughout the county and are most plentiful in the western part, mainly along the upper reaches of streams and around shallow lakes. Species of trees are few.

Stands typical for areas around streams are in the valley of Squaw Creek. In these stands the main woody plants are hackberry, American elm, chokeberry, coralberry, wild grape, Virginia creeper, sandbar willow, wild rose, and cottonwood. Around Diamond Bar and Schick Lakes are typical lakeside stands in which cottonwood, black willow, and white willow are prominent. White willow is not native to McPherson County. Scattered throughout the grassland are leadplant, wild rose, inland ceanothus, and snowberry.

The native trees and shrubs are of little commercial value in the county, but they do give some protection to livestock from the sun and wind. Also, they improve wildlife habitat and add to the natural beauty.

The most useful trees and shrubs in the county are those planted in windbreaks. Windbreaks are needed because the plain is almost treeless, the wind is strong, and the temperature is extreme. The three kinds of windbreaks used in McPherson County are farmstead windbreaks, field windbreaks, and windbreaks that protect cattle on the range.

The farmstead windbreaks protect buildings, feedlots, driveways, and other areas around the farmstead or the ranch headquarters. They also contribute to human comfort, reduce heating bills, save livestock feed, and control drifting snow.

In field windbreaks trees and shrubs are planted to protect cultivated fields from soil blowing. These windbreaks are common in cultivated areas of Dunday, Anselmo, and Elsmere soils, which blow readily if they are not protected.

Windbreaks established to protect livestock on the range are located so as to protect the animals in their wintering areas, in calving areas, and in other places where they gather.

All kinds of windbreaks add to the appearance of an area and improve the areas as a habitat for wildlife.

The most desirable trees for windbreak plantings are conifers—eastern redcedar, Rocky Mountain juniper, and ponderosa pine. Where these trees are planted on the Valentine or Dunday soils, normal preparation of the site is

[3] By George W. Alley, woodland conservationist, Soil Conservation Service.

not practical. These soils are sandy, and the hazard of erosion is high. The trees are planted in shallow, wide furrows and are not cultivated. The redcedar and the juniper grow slightly less than 1 foot per year and are 15 to 25 feet tall at maturity. The pine grows faster and is taller at maturity.

Siberian elm, honeylocust, chokecherry, American plum, and lilac grow well on the Dunday, Anselmo, Elsmere, and similar soils. These broad-leaved trees and shrubs must be planted in prepared sites and cultivated until they are well established. In areas of grass and alfalfa, a period of summer fallow before planting is beneficial. On the Elsmere and other subirrigated soils, broad-leaved trees are planted in a plowed strip 4 to 6 feet wide. Strips of sod are left between rows to control soil blowing, and the trees are cultivated until they are well established. Broad-leaved trees generally grow faster than eastern redcedar or Rocky Mountain juniper and are taller at maturity.

The choice of trees for windbreaks is important. Cottonwood, Siberian elm, and Russian-olive grow fast but do not live long. In addition, Siberian elm and Russian-olive spread. Boxelder freezes back in severe winters, and green ash is often damaged by borers.

Specific information on design, establishment, and care of windbreaks is available from the local representative of the Soil Conservation Service and the Extension Service.

The soils of McPherson County have been placed in windbreak suitability groups according to their characteristics that affect the growth of trees. All the soils in a windbreak group have about the same capacity for supporting trees. The soils in a group can be determined by referring to the "Guide to Mapping Units" at the back of this survey. These groups are briefly described in the following paragraphs, and trees and shrubs suitable for planting on the soils of each group are listed. The mention of soil series in the descriptions of a group does not mean that all the soils in the series are in that group.

SLIGHTLY SANDY WINDBREAK GROUP

This windbreak group consists of slightly sandy and nearly level very sandy soils. These soils are in the Anselmo, Bridgeport, and Dunday series. Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar, Rocky Mountain juniper, ponderosa pine.
Tall broad-leaved trees: Siberian elm, honeylocust, cottonwood, white willow, golden willow, green ash.
Low broad-leaved trees: Diamond willow, boxelder.
Shrubs: American plum, honeysuckle, western chokecherry, western sandcherry, lilac, skunkbush sumac.

VERY SANDY WINDBREAK GROUP

This windbreak group consists of very sandy soils and loose sands that cannot be safely cultivated. In this group are Valentine soils and Blown-out land. Trees and shrubs suitable for planting are—

Conifers: Ponderosa pine, eastern redcedar.

MODERATELY WET WINDBREAK GROUP

This windbreak group consists of soils on bottom lands, on benches, and in upland depressions. These soils are occasionally wet because they are flooded for short periods or the water table is high. They are in the Elsmere and Gannett series. Trees and shrubs suitable for planting are—

Conifers: Eastern redcedar, Scotch pine.
Tall broad-leaved trees: Honeylocust, cottonwood, white willow, golden willow, boxelder, green ash.
Low broad-leaved trees: Russian-olive, diamond willow.
Shrubs: Western chokecherry, buffaloberry, red-osier, dogwood.

WET WINDBREAK GROUP

Gannett sandy loam, ponded, is the only soil in this windbreak group. This soil is on bottom lands, on benches, and in upland depressions that are wet most of the time because of a high water table, flooding, or poor drainage. Trees and shrubs suitable for planting are—

Tall broad-leaved trees: Cottonwood, white willow, golden willow.
Low broad-leaved tree: Diamond willow.
Shrubs: Red-osier, dogwood.

Management of the Soils for Wildlife Habitat and as Recreation Areas [4]

In this section important kinds of wildlife in McPherson County are discussed and ways of improving their habitat are suggested. The most important kinds of game in McPherson County are mule deer, antelope, sharptail grouse, prairie chicken, pheasant, and bobwhite quail. Ducks and furbearers use the lakes and marshes in the county, and so do a few beaver and white-tailed deer. Many kinds of fish live in the streams and lakes.

In any area the kinds of wildlife that can be supported depend largely on the kind, amount, and distribution of vegetation that the soils produce. Birds and animals are generally more plentiful where soils are fertile and food is abundant than where the soils are less productive. Also, streams or lakes fed by water drained from fertile soils produce more fish than streams and lakes fed by water drained from infertile soils.

Topography, through its influence on land use, affects the number of wildlife in an area. The vegetation in extremely rough areas may be beneficial to wildlife because it is not available to grazing animals and therefore is undisturbed. Topography also affects drainage, and drainage, in turn, has much to do with the availability of water and the ease or difficulty of improving aquatic habitat suitable for waterfowl and some furbearers, or of constructing ponds for fish.

Table 3 rates the potential of each soil association in the county for producing woody and herbaceous cover, aquatic habitat, and food suitable for important kinds of wildlife and fish in McPherson County. In the following paragraphs, the wildlife and fish in the county are discussed in their relation to each of these associations. The associations are described more fully in the section "General Soil Map."

Records kept on the number of deer killed by hunters in the county indicate that there is an average of one deer

[4] By ROBERT LEMAIRE, conservation biologist, Soil Conservation Service, Lincoln, Nebr.

per two sections of land. Deer are more plentiful, however, along the North Fork Birdwood Creek in the Valentine association.

Most of the range suitable for antelope is in two associations. Aerial inventories show that an average of one antelope per four sections of land is in the Valentine-Anselmo association in the southwestern part of the county. Antelope are somewhat fewer in the Valentine-Dunday association. They are very sparse in that part of the Valentine association in the eastern part of the county.

Sharptail grouse are numerous and are well distributed throughout all associations except the Anselmo-Valentine-Dunday. Available data indicate that the average number of grouse in the county is between 15 and 20 per section.

Prairie chickens are less numerous than sharptail grouse. Except in the choppy hills of the Valentine association, prairie chickens are fairly well distributed throughout the county.

Pheasants are few in McPherson County because the large areas of grassland are interspersed by cropland in only a few places. These birds are thinly scattered in most associations but are extremely scarce on the Valentine soils.

The lakes in the Valentine-Elsmere-Gannett association produce many kinds of fish, mainly catfish, bullhead, bass, perch, bluegill, carp, and crappie. Trout are in North Fork Birdwood Creek.

In addition to game birds and animals, many kinds of nongame wildlife are found in the county and are beneficial in controlling rodents and undesirable insects.

In McPherson County recreation is based mainly on hunting and fishing, but areas abundant with many kinds of wildlife would attract photographers and students of nature. On ranches wildlife areas could be established so as to combine recreation with ranching and thus attract people interested in wildlife and also in the day-to-day operation of a ranch. Such combination of ranching and recreation could be especially valuable on small ranches that need additional income.

Since almost all of the county is still grassland, much of the original potential for wildlife production has been retained. Some areas, particularly those bordering lakes and marshes, can be used primarily for wildlife. In other areas wildlife is secondary to the production of hay and grass for cattle.

On rangeland where producing wildlife is secondary, good range management is important both for producing forage for cattle and food and cover for wildlife. A habitat suitable for grouse can be provided by seeding clover in wet meadows. Windbreak plantings, especially those of conifers, protect livestock in winter and also provide cover for a number of birds and mammals.

Areas used primarily for wildlife can be improved by planting the streambanks to protect them against erosion and by fencing or other means for protection against livestock. Waters can be improved for trout by installing devices that increase the flow at the head of streams where the water is cool, and also by installing deflectors in other places to create pools of cool water. Deflectors also can be installed so that the streams scour sand and silt from gravel beds. Beds of gravel produce better food for fish than beds of sand and silt and are essential for trout spawning.

In overgrown marshes, areas of open water that waterfowl need can be created by chemical and mechanical treatment. By ditching and diking oxbows and creek

TABLE 3.—*Potential of soil associations for producing elements of wildlife habitat*

Soil association	Wildlife	Potential for producing—			
		Woody cover	Herbaceous cover	Aquatic habitat	Food
Valentine-Dunday.	Sharptail grouse	Good	Very good		Good.
	Prairie chicken	Good	Very good		Good.
	Pheasant	Fair	Good		Fair.
	Deer	Good	Very good		Fair.
	Antelope	Poor	Good		Good.
Valentine-Anselmo.	Sharptail grouse	Good	Very good		Good.
	Prairie chicken	Good	Very good		Very good.
	Deer	Good	Very good		Fair.
	Antelope	Poor	Good		Good.
Valentine.	Sharptail grouse	Good	Very good		Very good.
	Deer	Good	Very good		Good.
Valentine-Elsmere-Gannett.	Sharptail grouse	Good	Good		Good.
	Prairie chicken	Good	Good		Fair.
	Deer	Good	Very good		Fair.
	Furbearers	Good	Good	Good	Good.
	Waterfowl			Good	
	Fish			Good	
Anselmo-Valentine-Dunday.	Prairie chicken	Good	Good		Good.
	Pheasant	Fair	Good		Fair.
	Bobwhite quail	Fair	Fair		Fair.
	Deer	Good	Good		Fair.

bends in low areas, areas of water suitable for fish, waterfowl, and furbearers are formed.

Technical assistance in planning development of areas as wildlife habitat, and in planning and applying conservation practices for developing outdoor recreation facilities, can be obtained from the local Soil Conservation Office. Additional information and assistance can be obtained from the Nebraska Game, Forestation, and Parks Commission, from the Bureau of Sport Fisheries, and Wildlife, and from the Federal Extension Service.

Engineering Uses of Soils [5]

Some soil properties are of special interest in engineering because they affect the construction and maintenance of highways, airports, and pipelines, as well as the building of foundations of earth dams for storing water and controlling erosion, and of systems for irrigation, drainage, and sewage disposal.

Among the most important soil properties are texture, permeability, shear strength, plasticity, moisture-density relation, compressibility, workability, and water-holding capacity. Also important are topography, depth to water table and how much it fluctuates, and depth to bedrock or to sand and gravel.

The information in this survey can be used to—

1. Make studies of soil and land use that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of engineering properties of soils in the planning of agricultural drainage systems, farm ponds, and irrigation systems, and of diversion terraces and other structures for conserving soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting highway and airport locations and in planning a detailed investigation for the selected location.
4. Estimate the size of drainage areas and the speed and volume of runoff so that the estimates can be used in designing culverts and bridges.
5. Identify the soils along a proposed highway route so that preliminary estimates can be made of the thickness required for flexible pavements.
6. Estimate the need for clay used to stabilize the surface of unpaved roads.
7. Locate deposits of sand, gravel, rock, mineral filler, and soil binder for use in subbase courses, base courses, and surface courses of flexible pavements for highways and airfields.
8. Make preliminary evaluations of topography, surface drainage, subsurface drainage, height of water table, and other features that may affect the design of highway embankments, subgrades, and pavements.
9. Correlate performance of soil mapping units with engineering practices and structures and thus develop information that will be useful in designing and maintaining the practices and structures.
10. Determine the suitability of soil units for cross-country movement of vehicles and construction equipment.
11. Supplement information obtained from other published maps and reports, and from aerial photographs, for the purpose of making soil maps and reports that can be used readily by engineers.

It should be emphasized, however, that the interpretations in this subsection may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

By using the information in this survey, including the soil map, the engineer can select the soils suitable for the construction planned, and then concentrate on the ones more suitable. Thus, a minimum number of soil samples will be needed for laboratory testing.

Much of the information in this subsection is in tables 4, 5, and 6. Table 4 gives test data for selected soils. Estimates of the engineering properties of soils are in table 5, and engineering interpretations are in table 6. The engineer will find additional useful data in the sections "Descriptions of the Soils" and "Formation and Classification of Soils."

The terminology used in this survey is that used by agriculturists. Many of the terms have special meaning that is understood by soil scientists but should be defined for the engineer. Some of the more common terms are defined in the Glossary at the back of this survey.

Engineering classification systems

Two systems of classifying soils, the AASHO and the Unified, are generally preferred by engineers and are used in this survey. Most highway engineers classify soil materials in accordance with the AASHO system, which has been approved by the American Association of State Highway Officials (*1*).

In the AASHO system, soil materials are classified into seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, consisting of clayey soils that have low strength when wet. Within each group, the relative engineering value of the soil is indicated by a group index number. The group index for the soil groups A–1 and A–3 is 0. The poorest soils in group A–2 have a group index number of 4; in group A–4, 8; in group A–5, 12; in group A–6, 16; and in group A–7, 20. For the soils tested in this county, the group index number is shown in parentheses in the next to last column of table 4.

Many engineers prefer the Unified system (*7*). In this system, the soils are identified according to their texture and plasticity and are grouped according to their performance as construction materials. The system establishes 15 soil groups, which are identified as (1) coarse-grained soils (eight classes), (2) fine-grained soils (six classes), and (3)

[5] This subsection was prepared by H. B. Auch Moedy, area engineer, and Merritt A. Plantz and Lester Sherfey, soil scientists, Soil Conservation Service, with the assistance of William J. Ramsey, field geologist, Division of Materials and Tests, Nebraska Department of Roads, and Lee E. Smedley, assistant State conservation engineer, Soil Conservation Service. The work by the Department of Roads was performed under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads.

highly organic soils. These classes are designated by pairs of letters. Soils that have characteristics of two classes have a dual classification, for example, SP–SM. The classes range from GW, consisting of well-graded gravel or gravel-sand mixtures and little or no fines, to Pt, consisting of peat and other highly organic soils. The soils of this county have been classified only in the SP, SW, SP–SM, SM, ML, and CL classes. The Unified system provides a simple field method and a laboratory method for determining the amount and kind of basic constituents of the soils. Both methods are based on gradation and plasticity and vary only in degree of accuracy.

The laboratory method uses data on mechanical analyses, liquid limit, and plasticity index for classification. For a more accurate classification of the fine-grained soils, the liquid limit and the plasticity index are plotted on a plasticity chart. The classification of the soils tested according to the Unified system is given in the last column of table 4.

Engineering test data

If the engineer is to make the best use of the soil survey and its soil map, he should know the physical properties of the soil materials and the condition of the soil in place. After soil materials are tested and the behavior of soil in engineering structures and foundations is observed, the engineer can develop design recommendations for the soil units that are mapped.

Table 4 shows engineering test data for the samples of four soil series taken at six sites. These samples were tested for this survey according to standard AASHO procedures. The tests were made by the Division of Materials and Tests, Nebraska Department of Roads. Each soil was sampled by natural horizons.

The soils listed in table 4 were sampled at one or more locations. The test data for a soil sampled in only one location indicate the engineering characteristics of the soil at that location. At other locations, the soil may differ considerably. Even for those soils sampled in more than one location, the test data probably do not show the maximum range in characteristics of materials.

The engineering soil classifications in the last two columns of table 4 are based on data obtained by mechanical analysis and from tests to determine liquid limit and plastic limit. For each soil sample identified in table 4, mechanical analysis data were obtained by a combination of the sieve and hydrometer methods.

The tests for liquid limit and plastic limit measure the effect of water on the consistency of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from the plastic to a liquid state. The plastic limit is the moisture content expressed as a percentage of the ovendry weight of the soil, at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates a range of moisture content within which a soil material is in a plastic condition.

The mechanical analyses of the soils reported in table 4 show small percentages of materials less than 0.005 millimeter in size. Most of the soils in this county are sandy, granular, and noncohesive and are classified as nonplastic because they remain nonplastic regardless of the amount of moisture they contain. Exceptions are Dunday loamy fine sand, loamy substratum, and the Gannett sandy loam, ponded. The Dunday soil is somewhat plastic in its surface layer and the Gannett soil is somewhat plastic at a depth of 30 inches.

Estimated properties of the soils

In table 5, for each soil in the county, are estimates of properties significant to engineering. These estimates are based on the engineering test data in table 4, information in other parts of this survey, and knowledge of the individual soils in the county.

The texture, or grain-size, especially that of alluvial soils, varies considerably. Consequently, it should not be assumed that all soils listed in table 5 are the same wherever they occur, or that the engineering classification of all parts of the soils is the same as those given in table 5. The soils in this county are generally coarse grained. They have high infiltration rates, but surface runoff ranges from very slow to rapid and depends on the variations in slope as well as variations in profile characteristics.

Permeability refers to the rate that water moves through undisturbed soil material. Permeability depends largely on soil texture and structure. In table 5, it is given in inches per hour for each layer of soil. Ranges of permeability are defined in the Glossary.

Estimates for available water capacity, expressed in inches of water per inch of soil depth, indicate how much water is available to plants. This is the amount of water that the soil can hold between its field capacity and wilting point.

Reaction, or the acidity or alkalinity of the soils, is reported in terms of pH values. A soil with a pH of 7.0 is precisely neutral, one with a lower pH is acid, and one with a higher pH is alkaline. In this county reaction was determined by the Indicator method. The soils range from about neutral (pH of 6.8) to very strongly alkaline (pH of 9.6). The pH of surface layers generally ranges from 6.8 to 7.4, but the wet soils have mildly alkaline to moderately alkaline surface layers (pH 7.4 to 8.0).

Only the Elsmere and Gannett soils, in places where the water table is periodically high, contain enough salts to affect construction. The water table fluctuates between a depth of 2 and 6 feet in the Elsmere soils and between a depth of 0 and 3 feet in the Gannett soils. In the rest of the soils of the county the water table is at a great depth.

In general, the texture of a soil indicates shrink-swell potential. The soils in the county contain only small amounts of fines and have low shrink-swell potential. Dispersion is not a problem in the county, and is not rated in table 5, because there are only small amounts of silt and clay in the soils.

Engineering interpretations of the soils

In table 6 are engineering interpretations that will help engineers and others plan the use of soils in construction. The soils in the county are rated according to their suitability as a source of topsoil and sand, and according to their suitability for use as road subgrade and road fill. Also, soil features that affect highway location are named.

TABLE 4.—*Engineering test data on samples taken*

[Tests performed by the Nebraska Department of Roads in cooperation with U.S. Department of Commerce, Bureau of Public

Soil name and location	Parent material	Nebraska report No. S-63-	Depth	Horizon	Moisture-density [1]	
					Maximum dry density	Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
Dunday loamy fine sand:						
0.2 mile north and 0.2 mile east of center of section 2, T. 19 N., R. 32 W.	Eolian sands (some Ogallala influence).	8379	0–6	Alp	112	12
		8380	9–26	AC	115	12
		8381	26–42	C	111	10
Dunday loamy fine sand, loamy substratum:						
0.3 mile east and 0.2 mile north of center of section 17, T. 18 N., R. 30 W.	Eolian sands (some Ogallala influence).	8382	3–11	A12	117	12
		8383	11–30	AC	117	12
		8384	30–42	IIC	110	16
Elsmere loamy fine sand:						
0.4 mile south and 0.05 mile west of center of section 34, T. 20 N., R. 35 W.	Eolian sands.	8376	0–9	A1	113	12
		8377	9–26	AC	113	12
		8378	26–42	C	112	13
Gannett sandy loam, ponded:						
0.4 mile north of southwest corner of section 32, T. 19 N., R. 35 W.	Eolian sands (possibly some Ogallala influence).	8370	0–5	A11	94	25
		8371	9–30	AC	117	10
		8372	30–42	IIC	113	12
Valentine fine sand:						
0.2 mile north and 0.2 mile west of center of section 21, T. 20 N., R. 32 W.	Eolian sands.	8373	0–7	A1	110	12
		8374	7–15	AC	109	12
		8375	15–42	C	110	12
0.3 mile south and 0.1 mile west of center of section 12, T. 20 N., R. 33 W.	Eolian sands.	8369	6–54	C	112	14

[1] Based on AASHO Designation T 99–57, Method A (*1*).

[2] Mechanical analyses according to the American Association of State Highway Officials Designation: T 88–57 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

The ratings in table 6 for suitability of soil material as topsoil and sand apply only to McPherson County. The soils that are rated fair to poor as a source of topsoil are sandy and low in organic matter or natural fertility. The few soils that are rated good as a source of sand will require extensive exploration to find material that will meet gradation requirements. The soils are not rated for gravel in table 6, because none of them contain gravel of high quality.

In table 6 the ratings for road fill and for subgrade under paved roads (bituminous or concrete) are practically the same because they were based on about the same criteria. For both road fill and subgrade, most soil material classed A–3 is rated good; A–2, good to fair; A–4, fair to poor; and A–6, poor. Properly confined sand is the best subgrade for paved roads.

The ratings for gravel roads refer to the part of the subgrade that receives the gravel surfacing. Since sand is not cohesive, it does not provide a stable surface. Soils classified A–3 are rated poor, those classified A–2 are rated poor to fair, and those classified A–4 are rated good to fair.

The soil properties listed in the last column of table 6 are generally those that adversely affect the construction and maintenance of highways. Susceptibility to frost action is rated for some soils. These ratings were made on the basis of the texture of the surface soil and subsoil. Clays and silts are susceptible to frost action if the underlying soil layers are pervious enough for water to rise and form ice lenses.

Generally, only the Anselmo, Bridgeport, Gannett, and Dunday soils are susceptible to frost action. These soils are made up of material classified as SM or SM and ML to CL. Susceptibility to frost action depends mostly on the content of fines. Soils that have their surface layer, subsoil, and substratum classified as SM are rated moder-

from 6 soil profiles in McPherson County, Nebr.

Roads (BPR), in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Mechanical analysis [2]							Liquid limit	Plasticity index	Classification	
Percentage passing sieve			Percentage smaller than—						AASHO	Unified [3]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
100	98	13	9	8	6	6	[4] NP	[4] NP	A–2–4(0)	SM.
100	99	19	11	8	6	5	NP	NP	A–2–4(0)	SM.
100	99	17	8	5	4	4	NP	NP	A–2–4(0)	SM.
100	98	37	23	12	10	8	NP	NP	A–4(0)	SM.
100	99	32	20	15	10	9	NP	NP	A–2–4(0)	SM.
100	99	61	42	31	25	20	32	13	A–6(6)	CL.
100	97	11	11	7	4	3	NP	NP	A–2–4(0)	SP–SM.
100	97	10	7	5	5	4	NP	NP	A–3(0)	SP–SM.
100	95	5	5	4	4	4	NP	NP	A–3(0)	SP–SM.
100	99	50	46	37	22	16	42	14	A–7–6(5)	SM.
100	99	23	17	12	8	5	NP	NP	A–2–4(0)	SM.
100	99	21	13	10	6	4	NP	NP	A–2–4(0)	SM.
100	98	11	10	8	5	4	NP	NP	A–2–4(0)	SP–SM.
100	98	12	7	5	4	3	NP	NP	A–2–4(0)	SP–SM.
100	97	11	6	5	4	4	NP	NP	A–2–4(0)	SP–SM.
----------	100	4	4	4	2	1	NP	NP	A–3(0)	SP.

[3] Based on the Unified Soil Classification System, Tech. Memo. 3–357, v. 1, Waterways Experiment Station, Corps of Engineers (*7*). The Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. An example of a borderline classification is SP–SM.

[4] Nonplastic.

ate if fines make up more than 35 percent of the soil mass (Gannett), and they are rated low to moderate if the percentage of fines is less than 35 percent (Anselmo and Bridgeport). Soils that have their surface layer and subsoil classified as SM and their subsoil classified as ML to CL are rated low to moderate (Dunday).

The Elsmere and Gannett soils and Marsh have a water table that may be an engineering hazard. For highways constructed on these soils, earthfills, 4 to 7 feet high, and some drainage measures may be required. The water table also affects other kinds of structures. Elimination of water from foundations may be necessary.

Because of the topography in McPherson County and absence of flooding, dikes and levees generally are not needed or are not applicable. If low levees should be built, however, protection against piping and erosion of slopes will be required.

All the soils in the county except the Elsmere and Gannett are rapidly permeable and do not require agricultural drainage. The high water table in the Elsmere and Gannett soils benefits the growth of grasses, but drainage is needed where these soils are cultivated.

Surface irrigation is practical on some areas of Anselmo soils, and sprinkler irrigation is practical on Dunday soils. All other soils in the county are too sandy or too steep for irrigation. Information on suitability of soils for irrigation and methods of irrigation can be obtained from local representatives of the Soil Conservation Service.

Topography and the soils in this county are generally unsuitable for building terraces or diversions. Waterways normally are not needed. The coarse-grained soils that contain only small amounts of silt and clay generally are suitable for winter grading.

Because of permeability, steep slopes, or both, the soils of the county are not suitable for sewage disposal in lagoons. Only the Anselmo, Bridgeport, Dunday, and

TABLE 5.—*Estimates of*

[Properties of Marsh (M) are so variable

Soils and map symbols	Position	Underlying material	Surface runoff	Depth to sand	Depth from surface
				Feet	*Inches*
Anselmo and Bridgeport soils (AB):					
Anselmo	Upland valleys	Sands and silts	Slow to very slow	4–6	0–42
Bridgeport	Upland stream valleys.	Stratified silts and sands.	Slow	4–6	0–4 4–36
Anselmo-Dunday loamy fine sands (AD): (For properties of Anselmo soil, see Anselmo in mapping unit AB; see mapping unit Du for properties of Dunday.)					
Blown-out land (B)	Upland	Sands	Very slow	0	0–42
Dunday loamy fine sand (Du)	Upland valleys	Sands	Slow to very slow	4–6	0–42
Dunday loamy fine sand, loamy substratum (2Du).	Upland valleys	Sands and silts	Slow to very slow	4–6	0–26 26–42
Elsmere fine sand (Eb)	Upland basins and valleys.	Sands	Very slow to ponded	2–4	0–42
Elsmere loamy fine sand (Ea)	Upland basins and valleys.	Sands	Slow to very slow	3–5	0–26 26–42
Gannett sandy loam (Gn)	Upland basins and valleys.	Sands and silts	Very slow	3–5	0–9 9–42
Gannett sandy loam, ponded (2Gn)	Upland basins and valleys.	Sands and silts	Very slow to ponded	4–6	0–13 13–42
Valentine fine sand, level (Va)	Upland valleys	Sands (eolian)	Very slow	0–2	0–42
Valentine fine sand, hilly (VaD)	Upland	Sands (eolian)	Very slow to rapid	0–2	0–54
Valentine fine sand, rolling (VaC)	Upland	Sands (eolian)	Slow to very slow	0–2	0–42

Valentine soils can be used for disposing of sewage in septic tank filter beds, but even these soils may not be suitable where slopes are too steep or where there might be a danger of contaminating the water supply.

Formation and Classification of Soils

This section discusses the effect that the five factors of soil formation have had on the formation of the soils in McPherson County. Also, the current system of soil classification is explained and the soils in the county are placed in some of the categories in that system and in the great soil groups of an older system.

Factors of Soil Formation

Soil is produced by weathering and other factors of soil development acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since it accumulated; (3) the plant and animal life on and in the soil; (4) the relief and its effect on drainage; and (5) the length of time the forces of soil development have acted on the soil material.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of soil that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change the parent material into a soil profile. The time needed for horizon differentiation may be much or little. Usually, a long time is required for the development of distinct horizons.

engineering properties of soils

that they were not estimated]

Classification			Percentage passing sieve		Permeability	Available water capacity	Reaction
USDA	Unified	AASHO	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
					Inches per hour	*Inches per inch of soil*	*pH*
Fine sandy loam	SM	A–4 or A–2	100	30–40	2. 5–5. 0	0. 15	6. 8–8. 0
Loamy very fine sand	SM	A–2 or A–4	100	30–50	5. 0–10. 0	0. 10	7. 2–7. 6
Very fine sandy loam	ML	A–4	100	60–90	0. 8–2. 5	0. 16	7. 6–8. 4
Fine sand	SP or SP–SM	A–3	100	0–10	5. 0–10. 0	0. 06–0. 08	7. 0–7. 5
Loamy fine sand	SM	A–2	100	15–25	5. 0–10. 0	0. 10	7. 2–7. 8
Loamy fine sand	SM	A–2 or A–4	100	20–40	5. 0–10. 0	0. 10	7. 2–7. 8
Fine sandy loam	ML to CL	A–4 or A–6	100	50–65	2. 5–5. 0	0. 15	7. 4–8. 2
Fine sand	SP to SM	A–3 or A–2	100	3–20	5. 0–10. 0	0. 06–0. 08	7. 4–8. 4
Loamy fine sand	SM	A–2	100	13–20	5. 0–10. 0	0. 10	7. 5–9. 6
Fine sand	SP to SM	A–3 or A–2	100	3–15	5. 0–10. 0	0. 06–0. 08	7. 2–9. 2
Sandy loam	SM	A–2 or A–4	100	25–50	2. 5–5. 0	0. 15	7. 6–8. 4
Loamy fine sand	SM	A–2	100	15–30	5. 0–10. 0	0. 10	7. 6–8. 6
Sandy loam	SM	A–2 or A–4	100	30–50	2. 5–5. 0	0. 15	8. 0–9. 0
Loamy fine sand	SM	A–2	100	15–30	5. 0–10. 0	0. 10	7. 8–8. 8
Fine sand	SW or SP to SM	A–3	100	2–10	5. 0–10. 0	0. 06–0. 08	7. 0–8. 0
Fine sand	SW or SP to SM	A–3	100	2–10	5. 0–10. 0	0. 06–0. 08	7. 0–8. 0
Fine sand	SW or SP to SM	A–3	100	2–10	5. 0–10. 0	0. 06–0. 08	7. 0–8. 0

Although the individual factors of soil formation are discussed separately in this section, the interaction of all of these factors determines the characteristics of the soil.

Parent material

The soils in McPherson County developed from parent material that was derived from rock and other material laid down in early geologic periods. Before the Tertiary period, the area was covered several times by ocean waters. These waters deposited sediments that formed thick layers of sandstone, shale, and limestone. During the Tertiary period, gravel, sands, and silts were deposited in strata, generally many feet thick. These deposits were outwash from the Rocky Mountains, and they make up the Ogallala formation. This formation is covered by a few to several hundred feet of eolian sand of unknown origin. In McPherson County, many of the valleys are entrenched through the eolian sands and into the Ogallala formation. Material has been blown from these valleys, and part of it has been mixed with material in the adjacent windblown areas. The sands of the Ogallala formation are similar to the eolian sands and in many places cannot be distinguished from them. Local mixing of eolian sands with the finer Ogallala material is evident. The few streams that flow in McPherson County have cut through the eolian sands and are entrenched in the Ogallala formation.

The soils in McPherson County developed from eolian sands and from mixtures of eolian sands and Ogallala material. In a few places, the soils probably developed from almost pure Ogallala material.

Climate

McPherson County has a subhumid climate characterized by extremes of temperature and moisture distribution. Rainfall varies from about 15 to 35 inches per year and averages about 20 inches. Most of the rainfall comes during the growing season, but much of it is lost by deep percolation through the soil. Heavy or light rains, how-

TABLE 6.—*Engineering interpretations*

[Interpretations for Marsh (M) are so variable that they were not estimated]

Soils and map symbols	Suitability as source of—		Suitability for—		Soil properties that affect location of highways
	Topsoil	Sand [1]	Road fill and subgrade under paved roads	Road subgrade under gravel roads	
Anselmo and Bridgeport soils (AB): Anselmo	Fair	(2)	Good to poor	Fair to poor	Low to moderate susceptibility to frost action; erodible slopes; may need protection.
Bridgeport	Fair	Poor	Good to poor	Fair to poor	Low to moderate susceptibility to frost action; slopes erodible.
Anselmo-Dunday loamy fine sands (AD): (For properties of Anselmo soil see Anselmo in mapping unit AB; see mapping unit Du for properties of Dunday.)					
Blown-out land (B)	Poor	Fair	Good	Poor	Slopes erodible by wind and water; may need protection.
Dunday loamy fine sand (Du)	Fair	(2)	Good to fair	Poor to fair	Susceptibility to frost action low to none; erodible slopes; may need protection.
Dunday loamy fine sand, loamy substratum (2Du).	Fair	(2)	Fair to poor	Fair to poor	Susceptibility to frost action low to none; slopes erodible.
Elsmere fine sand (Eb)	Poor	Fair	Good to fair	Poor	Erodible slopes; may require 4 feet of fill.
Elsmere loamy fine sand (Ea)	Fair	Fair below 36 inches.	Good to fair	Poor	Erodible slopes; may require 4 feet of fill.
Gannett sandy loam (Gn)	Fair	Poor to 24 inches; good below.	Good to poor	Good to poor	Moderate susceptibility to frost action; may require 4 feet of fill; slopes erodible; may require protection.
Gannett sandy loam, ponded, (2Gn)	Fair	Good below 42 inches.	Good to poor	Good to poor	Slopes erodible; moderately susceptible to frost action; may require 4 to 7 feet of fill.
Valentine fine sand, level (Va)	Poor	Good	Good	Poor	Slopes erodible; may require protection.
Valentine fine sand, hilly (VaD)	Poor	Good	Good	Poor	Slopes erodible; may require protection.
Valentine fine sand, rolling (VaC)	Poor	Good	Good	Poor	Slopes erodible; may require protection.

[1] Rating based on availability of fine sand (0.4 to 0.074 millimeter).
[2] Sand of high quality generally not available.

ever, break the frequent, sometimes extended droughts in the county and wet the dry soil profile. This alternate wetting and drying of the soil profile results in wide fluctuations in biologic, especially microbiologic, activity. Rainfall is adequate for maintaining a good grass cover and for leaching lime from all but the finer textured well-drained soils.

Plant and animal life

In McPherson County vegetation has been very important in the formation of soils. Vegetation stabilized the shifting sands long enough for soil to develop. The vegetation is predominantly grasses mixed with some forbs and small shrubs. Sedges and rushes are dominant on poorly drained soils. Few native trees grow in the county. In McPherson County the soils are those typical for grassland. Decayed plant remains cause the dark color in the surface layer of the soil.

The numbers and kinds of living organisms are important in soil development. Micro-organisms use the undecomposed organic matter in the soil as food and change it into humus. Some kinds of bacteria take nitrogen from

the air and use it for their own growth. When these bacteria die, the nitrogen can be used by plants. Man through his activity also affects formation of soils. By the kind of management he uses, man determines the kinds and amounts of vegetation returned to the soil and whether the soil is conserved or lost through erosion.

Relief and drainage

The relief of McPherson County is a complex pattern in which areas of stabilized rolling to hilly sand dunes are separated by nearly level to gently rolling valleys. The soils are so sandy that they generally absorb water as fast as it falls, and there is little runoff from most of the county. Internal drainage is rapid, and excess water is drained by subsurface flow to stream channels.

One pattern of surface drainage is in a small area in the eastern part of the county, and another is in the valley of North Fork Birdwood Creek. These patterns are well-defined systems of intermittent drainageways that were formed in areas of steep slopes and finer textured Ogallala material. A few poorly defined drainageways occur on the longer steep slopes throughout the county.

Poorly drained and somewhat poorly drained soils occur where the water table is high in the broad valleys in the western part of the county and along the creek bottoms.

Time

The age of a soil is difficult to determine. It may be expressed in actual years of soil development, but it is more frequently expressed by its apparent age as shown by the stage of development. An example of a young soil is Valentine fine sand, hilly. In its profile only a thin surface layer has developed, and there is no structural development. Valentine fine sand, rolling, is somewhat older because there has been enough time for development of a much thicker surface layer. Anselmo and Dunday soils are still older, for they have thicker and darker surface layers and more definite structure and other characteristics.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us in understanding their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*4*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (*3*, *6*). In table 7 the soil series of McPherson County are placed in some categories of the current system and in the great soil groups of the older system.

The current system of classificaton has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The classes that make up the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized in the current system. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Table 7 shows two soil orders in McPherson County—Entisols and Mollisols.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of

TABLE 7.—*Soil series classified according to the current and older systems of classification*

Series	Current classification			Older classification
	Family	Subgroup	Order	Great soil group
Anselmo	Coarse-loamy, mixed, mesic	Typic Haplustolls	Mollisols	Chestnut soils.
Bridgeport	Fine-silty, mixed, mesic	Entic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Dunday	Sandy, mixed, mesic	Entic Haplustolls	Mollisols	Regosols intergrading to Chestnut soils.
Elsmere	Sandy, mixed, mesic	Aquic Haplustolls	Mollisols	Chestnut soils intergrading to Humic Gley soils.
Gannett	Coarse-loamy, mixed, noncalcareous, mesic.	Typic Haplaquolls	Mollisols	Humic Gley soils.
Valentine	Sandy, mixed, mesic	Typic Ustipsamments	Entisols	Regosols.

waterlogging or soil differences resulting from the climate or vegetation. The suborder is not shown in table 7.

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that have pans interfering with growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium). The great group is not shown separately in table 7, because the name of the great group is the last word in the name of the subgroup.

SUBGROUP: Great groups are divided into subgroups, one representing the central (typic) segment of the group and others, called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group.

FAMILY: Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils where used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Nature of the County

This section describes the geology, physiography, drainage, and climate of McPherson County. Also given is information about transportation and about settlement and development.

Geology, Physiography, and Drainage

The soils of McPherson County developed in eolian sands, which mantle the sandstone and siltstone bedrock. Extensive exposures of this bedrock, called the Ogallala formation, do not occur in McPherson County, but observation of several small exposures in the county and of larger exposures in adjoining Hooker County show that the formation is loosely cemented sandstone with thin layers of siltstone. The sandstone layers weather to fine sandy loam, fine sand, or loamy sand, and the siltstone layers weather to silt loam and clay loam.

In the northwestern part of the county the upper surface of the sandstone and siltstone is slightly above or at the level of the broad valleys, but it is rarely exposed. Southward and eastward the valleys have cut below the surface of the sandstone and siltstone, and the parent materials for the soils in the valleys and on footslopes are sediments weathered from the sandstone and siltstone. These sediments have been locally reworked by wind and water. They are dominantly loamy material of which 50 percent or more is sand, less than 20 percent is clay, and the rest is silt. Because of the reworking, the parent materials contain thin strata that range from sand to clayey loam in texture. Textural differences within the soil profiles are due to this stratification rather than to soil development.

The basic pattern of topography was probably formed in the early Wisconsin geologic stage when the area was a desert. In this stage, the large, high, elongated dunes were formed. These dunes are now most evident in the northern part of the county. They are parallel and collectively resemble waves of the sea. They are as much as 15 miles long, 90 to 300 feet high, and from ½ to 1 mile wide. Generally the highest dunes are the widest. The valleys between dunes have nearly level to gently rolling floors. They range from a few feet to nearly a mile in width and are as much as several miles long. In most of the nearly level areas are Anselmo, Dunday, Elsmere, or Gannett soils. The dunes most typical of the early Wisconsin stage have steep south faces and long, gradual north faces. The south faces are mostly Valentine fine sand, hilly, and the north faces are mostly Valentine fine sand, rolling. Dunes of this geologic stage existed in other parts of the county but were greatly modified by erosion and now are hardly distinguishable.

Another shorter or less severe period of dune formation followed the first one. The dunes formed during this stage are most evident in the eastern part of the county. In this second period, which was in the late Wisconsin stage, the dunes were smaller, more closely spaced, and steeper on both north and south faces. These dunes are not more than 3 miles long, and they are 300 to 600 feet wide and 40 to 80 feet high. During this stage dunes that formed earlier were obliterated in some places. In other places smaller dunes were superimposed on the topography that had formed earlier.

From the end of the Wisconsin stage to the present time, the topography of the county has been precariously stabilized. Locally, blowouts and other unstabilized areas have occurred. The blowouts have modified most dunes formed earlier and, in many places, have nearly obliterated them. Where the blowouts form most of the land surface, the topography is complex and consists of depressions and ridges with little or no lineation. This kind of topography is most evident in the south-central part of the county.

Blowouts show all gradations from almost constant movement to stabilization. They differ from each other mainly in the extent that their sand is bare and shifting. Recent and active blowouts have abrupt, sharp outlines, but those that are older have been rounded. The degree of rounding is a rough indicator of the length of time that the dunes have been stabilized. Most of the presently active blowouts are the results of management rather than geologic conditions.

Because the soils in the county are rapidly permeable, little runoff occurs. Drainage is through the soil rather than over it. A few intermittent drainageways are on the longer steep slopes, normally in the middle part of the slope. In only a few places do these drainageways exceed one-half mile in length, and they disappear at the gentle slopes near the base of the hill.

The only permanent streams in the county are North Fork Birdwood Creek and its branch, Squaw Creek. These creeks are in the south-central part of the county. The narrow valley of North Fork Birdwood Creek is entrenched to the water table. This creek is fed by springs or seeps that originate in the water table. Intermittent streams, most of them less than one-half mile in length, occur on the steep valley slopes in many places. Except for

these streams, slopes in the county show little or no evidence of water erosion.

Climate [6]

McPherson County, in the west-central part of Nebraska near the southern edge of the Sandhills, has a continental climate. The climate is characterized by light rainfall, cold winters, warm summers, and frequent changes in the weather from day to day and season to season.

Temperature and precipitation in the county are summarized in table 8. Table 9 lists probabilities of last freezing temperature in spring and the first in fall. Extremes of temperature and precipitation are given in table 10.

[6] By Richard E. Myers, State climatologist for Nebraska, United States Weather Bureau.

The elevation of the county ranges from approximately 3,100 feet along the eastern boundary to 3,400 near the southwest corner and 3,500 in the northwestern part. Beyond the western boundary, elevation continues to increase to the Continental Divide in Wyoming.

The Rocky Mountains directly west of the county do not form a solid ridge like the mountains to the southwest, and frequently strong westerly winds blow through the low areas during winter and early in spring. Because these mountains are high enough to cut off most of the moisture from the west, air masses from the Pacific Ocean are substantially modified before they reach McPherson County. In the other directions, there are no major climatic barriers, and cold masses of air from Canada move freely into the area with little change enroute. Most of the precipitation that falls in this area originates in the Gulf of Mexico.

Table 8.—*Temperature and precipitation, McPherson County, Nebr.*

Month	Temperature [1]				Precipitation [2]				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Days with 1 inch or more snow cover	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	36.5	10.3	57	−13	0.36	0.05	0.85	11	4.2
February	41.0	14.9	62	−2	.49	.08	1.25	11	4.2
March	46.7	20.1	70	3	1.03	.19	2.20	9	4.0
April	61.7	32.4	80	19	1.59	.50	4.10	2	3.0
May	71.8	43.8	88	31	3.51	1.20	5.60	[3]	2.3
June	81.6	53.4	98	43	3.39	1.12	5.40	0	----------
July	88.6	59.0	100	51	2.49	.75	4.95	0	----------
August	87.1	57.5	100	47	2.09	.80	4.55	0	----------
September	78.2	47.0	95	35	1.90	.23	3.30	0	----------
October	67.1	35.7	84	24	1.04	.10	2.50	[3]	3.2
November	49.8	22.2	70	1	.51	.02	1.50	3	2.8
December	39.9	14.8	59	7	.35	.05	1.10	9	3.6
Year	62.5	34.3	[4] 103	[5] −18	18.75	12.75	27.25	46	3.9

[1] Data from records at Tryon for period 1946 through 1964.
[2] Data interpolated from surrounding stations.
[3] Less than 0.5 day.
[4] Average annual highest temperature.
[5] Average annual lowest temperature.

Table 9.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data interpolated from records at Tryon and surrounding stations]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 17	April 24	May 6	May 17	May 26
2 years in 10 later than	April 11	April 18	April 30	May 12	May 21
5 years in 10 later than	April 1	April 8	April 20	May 1	May 10
Fall:					
1 year in 10 earlier than	October 20	October 14	October 5	September 24	September 13
2 years in 10 earlier than	October 26	October 19	October 10	September 30	September 18
5 years in 10 earlier than	November 6	October 29	October 20	October 10	September 27

TABLE 10.—*Extremes of temperature and precipitation by months at Tryon*

[For 19 years of record from 1946 through 1964]

Month	Temperature				Precipitation			
	Highest	Year	Lowest	Year	Driest [1]	Year	Wettest	Year
	°F.		°F.		Inches		Inches	
January	69	1950	−29	1950	(2)	1964 [3]	2.20	1949
February	78	1962 [3]	−24	1951	(2)	1954	1.34	1960
March	85	1946	−24	1960	0.05	1956	3.40	1949
April	92	1950	9	1961 [3]	.43	1946	3.11	1964
May	97	1950	18	1954 [3]	1.12	1948	8.00	1962
June	106	1952 [3]	33	1950	.64	1952	7.50	1947
July	112	1954	34	1950	.14	1955	6.36	1951
August	108	1954	37	1950	.68	1955	5.11	1950
September	103	1947	20	1951	.03	1956	3.99	1963
October	95	1947	10	1952	.08	1964	4.99	1946
November	76	1964	−13	1955	(2)	1963 [3]	1.91	1947
December	72	1962	−23	1963	(2)	1959	1.05	1962

[1] The driest year was 1952, when precipitation totaled 13.09 inches.

[2] Trace.

[3] Also earlier.

Local sources of moisture have only a small effect on the climate. No large bodies of water are nearby, but a number of small lakes are in the western third of the county. These lakes are fed by underground water, and they vary in size as the water table rises or falls. Many of the smaller lakes disappeared completely during the prolonged drought in the 1930's. The county is nearly devoid of a surface drainage system. A small area in the southwestern part of the county is drained by North Fork Birdwood Creek, but elsewhere most of the precipitation rapidly infiltrates the very sandy soils and becomes a part of the underground water.

Winds in the county may be beneficial or harmful to ranching. They are beneficial where used as a source of power to pump the shallow ground water to the surface. Fresh water for cattle is supplied by the many small windmills that dot the large ranches. By properly spacing these windmills, the overgrazing common around large watering places can be avoided. Also, cattle receive some protection from insect pests because steady winds hinder their activity. Where the sod has been broken, however, the frequent high winds cause severe soil blowing.

In winter, precipitation is light and periods of mild and cold weather alternate. Changes of temperature are frequent and sharp. A few prolonged cold spells have occurred, however, and frigid air remained nearly stationary over the county for a month or more. Most precipitation in winter is snow that falls when the weather is turning colder. The snow is dry because it generally starts falling when the temperature is between 10 and 20 degrees and stops falling when the temperature is near zero. The snow is frequently accompanied by strong winds that pile into huge drifts and leave in the fields large areas with little or no snow cover. The snow on the fields melts during the mild periods that ordinarily follow the storms in a few days. On about two-thirds of the winter days, the ground is bare or is covered by less than an inch of snow.

Severe blizzards are infrequent, but they hinder ranching operations when they do occur. The bitter cold keeps the snow dry, and the high winds blow the snow back onto the roads as fast as they are opened. Moving feed to the cattle is extremely difficult. In January 1949, all roads were blocked when repeated heavy snows were accompanied by strong winds and low temperatures. Livestock became weakened and a considerable number was lost because it was difficult to move feed to them and the animals were exposed to the bitter weather.

Disagreeable weather is common in March and April. Temperatures fluctuate widely as repeated surges of cold air move into the area from the north and replace the warm air from the west and southwest. Snowfall, which is normally light during winter, begins to increase the latter part of February and reaches a peak in March. The snows continue well into April but are infrequent in May. Snows in spring provide welcome moisture that gives the grass a good start, but these snows are unfavorable for the livestock. Because spring calving is in the open, the wet sticky snows cling to the cows and calves. These wet snows come when temperatures are near freezing. They are particularly troublesome because the snow is wet and does not fall from the cattle as well as the dry snow in winter. The change in snow comes in March; it is cold and dry early in the month and is wet and sticky later. Snows in April are wet, and many of them are associated with cold rains.

In May, snow of consequence is rare because the precipitation comes mostly in the form of showers and thunderstorms that reach a peak late in May and in June. Hail occurs at times, but it seldom does much damage to the range. Early in June, precipitation begins to lessen because then the moist air from the Gulf of Mexico is replaced by drier air from the west.

The weather is rather pleasant during summer, for temperature is mild, humidity is low, and breezes are almost constant. By keeping the soil temperature from rising extremely high, the grass cover helps to keep the air temperature in check during the afternoon. The dry air and moderate elevation permit rapid cooling after sundown. In the afternoon, temperature is generally between 85 and 95 degrees, but it falls to between 55 and 65 degrees during most nights.

During fall, precipitation is light and sunshine is abundant. Days are warm and bright, and nights are clear and

cool. The first freezing temperature normally occurs late in September, and hard freezes occur in the latter part of October. Winter is at hand when the average temperature falls to the freezing point about the end of November. The cool dry weather of late fall cures the range grass, and pasture is good for some months after the grasses stop growing. Cattle are commonly pastured on the cured grasses through December, and in favorable years they may be pastured as late as February. During winter grazing, use of a protein supplement is advisable. In this way hay is conserved so that it can be used just before calving when it is most beneficial.

Shown in the list that follows are estimates, in inches, of the monthly amounts of potential evapotranspiration, as computed by the Thornthwaite method. Evapotranspiration is the amount of water removed from the soil by vegetation, plus that lost through evaporation. Because mean temperatures for December, January, and February are below 32°, evapotranspiration is not estimated for these months.

March	0.31	August	5.30
April	1.59	September	3.30
May	3.19	October	1.64
June	4.84	November	0.17
July	5.98		

Transportation

The nearest railroad facilities to McPherson County are in adjacent counties. Railroad stations are located to the east at Stapleton in Logan County, to the north at Mullen in Hooker County, and to the south at North Platte in Lincoln County.

The county is served by a sparse network of roads consisting of two State highways, a county road, and many smaller roads. State Highway 92 runs east to west through the towns of Ringgold, Tryon, and Flats. State Highway 97 crosses the county from north to south. It runs into State Highway 92 just east of Tryon and continues north from Tryon to the county line. An oiled county road runs from north to south in the eastern part of the county to State Highway 92 at Ringgold. Narrow oiled roads, graveled roads, and graded earth roads connect this network with most ranches.

Settlement and Development

The area that is now McPherson County was first settled when cattlemen arrived during the late 1870's. They grazed cattle on open range until it was taken by homesteaders. The homesteaders organized the county in 1887, and settlement continued until the 1920's.

Most of the homesteaders were farmers from the east and south. They knew intensive farming but had little knowledge of ranching. These farmers cultivated the better soils, mainly to grain that was used to feed hogs, chickens, and a few cows. A few milk cows were grazed on the rougher and sandier areas.

For a few years crop yields were good, and the settlers lived quite well. But the natural fertility of the soils soon declined, and farming became unprofitable. According to State statistics, from 1931 to 1959, hogs on farms decreased from 5,440 to 1,722 and milk cows decreased from 1,800 to 500. In the same period, the cultivated areas decreased from 37,645 to 10,400 acres.

The homesteaders plowed many areas that were suitable for cultivation. As they continued cultivation, however, and did not use practices to control erosion, the better soils soon became unfit for further cultivation. According to State statistics, 25 percent of the rye seeded in 1940 was abandoned before the harvest. This percentage increased to 35 percent by 1950 and to more than 69 percent by 1960. Many homesteaders sold their land and left the county.

The size of units increased, and ranching began to replace farming. According to the Census of Agriculture, the average unit increased from 1,621 acres in 1930, to 1,689 acres in 1940, and to 3,013 in 1959. By 1964, the average size of a unit decreased to 2,850 acres.

The trend from farming to ranching began in the 1920's. It was speeded by the severe drought in the 1930's, and it continues today, though small areas are farmed on most ranches. Most of this farming is in the eastern and southwestern parts of the county.

McPherson County remains primarily a ranching county. The main enterprise is raising feeder cattle, though breeding purebred cattle is also important.

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Glossary

Alkali soils. A soil with either so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or higher) that the growth of most crop plants is reduced.

Alkaline soil. Any soil that is alkaline in reaction. See Reaction.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Blowout. An area of blown-out land. The wind blows loose material, generally sand, from spots and deposits it over larger areas. The conspicuous feature of a blowout is the hole or depression from which the sand was blown.

Calcareous soil. Soil containing sufficient calcium carbonate (in many places with magnesium carbonate) to effervesce visibly when treated with cold dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Consistence, soil. The combination of properties of soil material that determine its resistance to crushing and its ability to be molded or changed in shape. Consistence varies with difference in moisture content; thus, a soil aggregate or clod may be hard when dry and plastic when wet. Terms used to describe consistence are—

Friable.—When moist, soil material crushes easily under gentle pressure between thumb and forefinger and coheres when pressed together. Friable soils are easily tilled.

Firm.—When moist, soil material crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable. Firm soils generally are difficult to till.

Hard.—When dry, soil material is moderately resistant to pressure; can be broken in the hands without difficulty but is barely breakable between thumb and forefinger.

Indurated.—Soil material is hard and brittle; will not soften when moisture is applied.

Loose.—Soil material is noncoherent when moist or dry. Loose soils are generally coarse textured and easily tilled.

Plastic.—When wet, soil material retains an impressed shape but is deformed by moderate pressure. Plastic soils are high in clay and are difficult to till.

Sticky.—When wet, soil material adheres to thumb and forefinger when pressed; normally very cohesive when dry.

Soft.—Soil material very weakly coherent and fragile; when dry, breaks to powder or to grains under slight pressure.

Horizon, soil. A layer of soil apparently parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon. The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon. The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has (1) distinctive characteristics caused by the accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon. The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer. Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Mottled. Irregularly marked with spots of different color that vary in number and size. Mottling in soils normally indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notations. Symbols used in a system that describes color by three variables—hue, value, and chroma. For example, a notation of 10YR 6/4 denotes a color with a hue of 10YR, value of 6, and chroma of 4, or in words, light yellowish brown.

Parent material. The material from which soil developed.

Percolation. The downward flow of water in saturated or nearly saturated soil.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms that define permeability and the equivalent percolation rates in inches per hour are as follows: Very slow—less than 0.05; slow—0.05 to 0.20; moderately slow—0.20 to 0.80; moderate—0.80 to 2.50; moderately rapid—2.50 to 5.00; rapid—5.00 to 10.00; and very rapid—more than 10.00.

Profile, soil. A vertical section of the soil through all horizons and extending into the material that has been changed little if any by soil-forming processes. See Horizon, soil.

Proper range use. Grazing range at an intensity that will maintain adequate cover for soil protection and that will permit maintenance or improvement in the quantity and quality of desirable herbage. Generally, not more than half of the vegetation that grew in a season should be used.

Reaction, soil. The degree of acidity or alkalinity of the soil expressed in pH values or in words. A pH of 7.0 indicates precise neutrality; one of less than 7.0 indicates acidity; and one of more than 7.0 indicates alkalinity.

Runoff. The part of precipitation upon a drainage area that is discharged from the area into stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching the streams is called ground water runoff or seepage flow from ground water.

Sand. Small rock or mineral fragments having a diameter of 0.05 millimeter to 2.0 millimeters. Also, the textural name of a soil that contains more than 85 percent sand and not more than 10 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and that have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular.* Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Winnowed. Sifted and sorted by wind. Strong winds remove clay, fine silt, and organic material from the soil and leave the coarser particles; consequently, the soil becomes sandier and more easily eroded.

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.]

[See table 1, p. 5, for approximate acreage and proportionate extent of the soils and table 2, p. 17, for predicted yields of cultivated crops. On page 20, windbreak groups are described and trees suitable for planting are listed. Engineering uses of soils are given in the section beginning on p. 22.]

Map symbol	Mapping unit	Described on page	Capability unit	Range site		Windbreak group
			Symbol	Name	Page	Name
AB	Anselmo and Bridgeport soils.	6	IIIe–3	Sandy	14	Slightly Sandy
AD	Anselmo-Dunday loamy fine sands.	6	IVe–5	Sandy	14	Slightly Sandy
B	Blown-out land	7	VIe–5	Sands	15	Very Sandy
Du	Dunday loamy fine sand.	8	IVe–5	Sandy	14	Slightly Sandy
2Du	Dunday loamy fine sand, loamy substratum.	9	IVe–5	Sandy	14	Slightly Sandy
Ea	Elsmere loamy fine sand.	10	IVw–5	Subirrigated	14	Moderately Wet
Eb	Elsmere fine sand	10	VIw–5	Subirrigated	14	Moderately Wet
Gn	Gannett sandy loam.	11	Vw–3	Subirrigated	14	Moderately Wet
2Gn	Gannett sandy loam, ponded.	12	Vw–1	Wet Land	14	Wet
M	Marsh	12	VIIIw–1			
Va	Valentine fine sand, level.	13	VIe–5	Sandy	14	Very Sandy
VaC	Valentine fine sand, rolling.	13	VIe–5	Sands	15	Very Sandy
VaD	Valentine fine sand, hilly.	13	VIIe–5	Choppy Sands	16	Very Sandy

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