SOIL SURVEY

Oklahoma County, Oklahoma

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Issued February 1969

Major fieldwork for this soil survey was done in the period 1956–64. Soil names and descriptions were approved in 1965. 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 Oklahoma Agricultural Experiment Station as a part of the technical assistance furnished to the Oklahoma County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY of Oklahoma County, Okla. contains information that can be applied in managing farms, ranches, and woodlands; 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 Oklahoma 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 it also lists the capability units, range sites, or any other group in 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.

Farmers and those who work with farmers can learn about use and management of the soils in the soil descriptions and in the discussions of the range sites and woodland suitability groups.

Those interested in woodland can refer to the section "Management of Soils for Windbreaks and Post Lots," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others concerned with wildlife will find information about soils and wildlife in the section "Wildlife and Fish."

Ranchers and others interested in range can find, under "Management of Soils for Range," groupings of the soils according to their suitability for range, and also the plants that grow on each range site.

Community planners and others concerned with suburban development can read about the soil properties that affect the choice of homesites, industrial sites, schools, and parks in the section "Nonfarm Uses of Soils."

Engineers and builders will find under "Use of Soils in Engineering" tables that give estimates of 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 Oklahoma County may be especially interested in the section "General Soil Map," where broad patterns of soils are described.

Cover picture: Raising beef cattle is the most important farming enterprise in Oklahoma County. These cattle are on Norge loam, 1 to 3 percent slopes, an excellent soil for forage plants.

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Contents

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SOIL SURVEY OF OKLAHOMA COUNTY, OKLAHOMA

BY CARL F. FISHER AND JOHN V. CHELF, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, IN COOPERATION WITH THE OKLAHOMA AGRICULTURAL EXPERIMENT STATION

OKLAHOMA COUNTY is in the central part of Oklahoma (fig. 1). It has a total land area of 705 square miles, or 451,200 acres. Oklahoma City is the county seat and the largest city in the State. Other towns are Arcadia, Edmond, Bethany, Harrah, and Nicoma Park. In 1960, the county had a population of 439,506, of which less than 1 percent lived on farms.

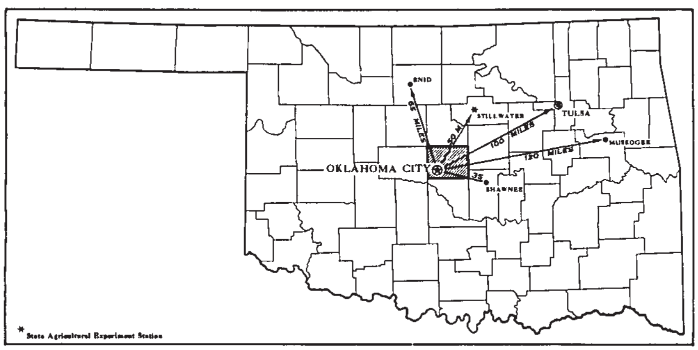

Figure 1.—**Location of Oklahoma County in Oklahoma.**

The county is part of the Central Lowland physiographic province. It has a subhumid climate, and an average annual rainfall of 31.93 inches. Elevations range from about 1,300 feet in the northwestern part to 850 feet in the southeastern part. Oklahoma City is 1,194 feet above sea level. The North Canadian River, the largest stream, flows across the county.

Homesteaders who came from the Northern States settled in the area that is now Oklahoma County after the area was opened in 1889. Farming was the main occupation and is still one of the principal sources of income. The main farm enterprises are the growing of small grains, mainly winter wheat, and the raising of livestock. Of the total farm income in 1964, the sale of livestock and livestock products accounted for about 65 percent and the sale of crops, about 35 percent. Most of the farmland in the eastern part of the county is in pastures of tame and native grasses. The western part of the county marks the eastern border of the main wheat-growing area of Oklahoma. In 1964, there were about 1,102 farms in Oklahoma County, and their average size was about 214 acres.

Most of the farmland in the county is on uplands consisting of loamy soils that are well drained or somewhat excessively drained. A considerable acreage is made up of loamy soils on bottom lands. Flooding is a hazard on some of the soils on bottom lands, though the total acreage of soils in the county that require drainage is relatively small. Also small is the acreage of clayey soils.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Oklahoma 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 a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind 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, and other characteristics that affect management.

The five soil associations in Oklahoma County are described briefly in this section. More information about the individual soils in each soil association can be obtained from the detailed soil map at the back of this survey and from the section "Descriptions of the Soils."

1. Darnell-Stephenville Association

Shallow and deep, gently sloping to strongly sloping, loamy soils on wooded uplands

This association consists of shallow and deep soils on wooded uplands in the eastern two-thirds of the county. These soils are mostly gently sloping to moderately sloping, but they are strongly sloping in places. This association covers about 177,000 acres, or about 45 percent of the farmland in the county. Figure 2 shows a typical area of soil association 1.

The Darnell soils make up about 56 percent of this association; the Stephenville soils, 31 percent; and minor soils, the remaining 13 percent. The chief minor soils are the closely intermingled Vernon and Lucien soils and the Noble, Konawa, and Dougherty soils.

The Darnell soils have a reddish-brown or brown surface layer that is generally fine sandy loam. The surface layer

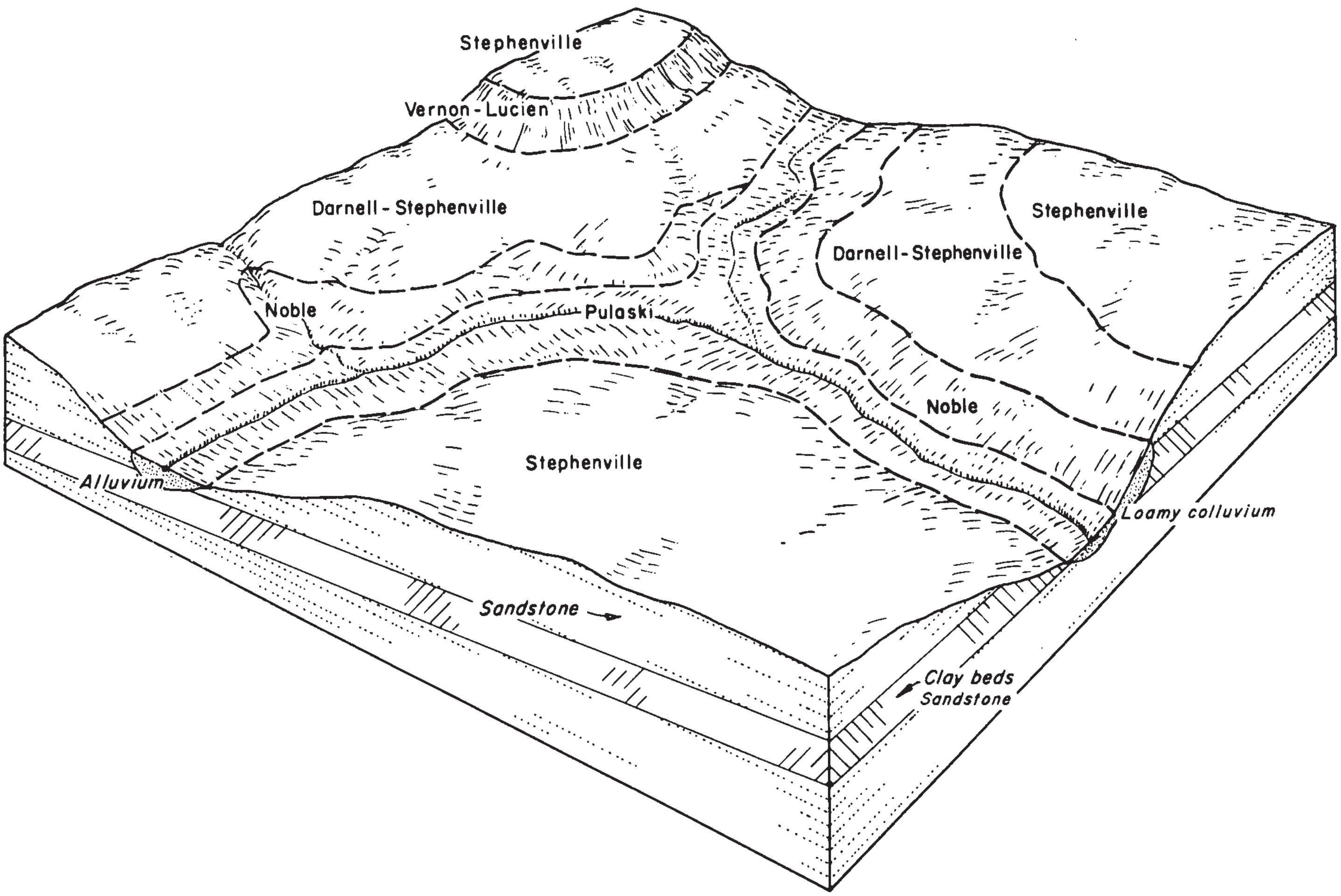

Figure 2.—**Typical pattern of soils in soil association 1.**

is about 3 inches thick and is underlain by 6 to 12 inches of reddish-yellow fine sandy loam. The underlying material is sandstone.

The Stephenville soils have a surface layer of grayish-brown or light-brown fine sandy loam that is 9 to 20 inches thick. The subsoil is sandy clay loam and ranges from 19 to 31 inches in thickness. The underlying material is sandstone.

The soils of this association are well drained to somewhat excessively drained. They have moderate to moderately rapid permeability.

About 70 percent of this association lies idle or is used for native range and wildlife habitat. In cultivated areas winter wheat is the main cash crop on most farms. Paved roads or other roads that have a firm surface follow most section lines.

2. Renfrow-Vernon-Bethany Association

Deep and shallow, nearly level to sloping, loamy and clayey soils on prairie uplands

This association consists of deep and shallow, loamy and clayey soils on uplands. These soils are mainly nearly level to sloping, but a few areas are moderately steep. The largest areas of this association are in the northwestern part of the county, and smaller areas occur in the southwestern part (fig. 3). This association covers 95,000 acres, or about 24 percent of the farmland in the county.

The Renfrow soils make up about 46 percent of this association; the Vernon soils, about 22 percent; and the Bethany soils, about 7 percent. The remaining 25 percent consists of minor soils. The chief minor soils are Zaneis soils, Breaks-Alluvial land complex, and Eroded clayey land.

The Renfrow soils have a reddish-brown or dark-brown clay loam surface layer that is 8 to 12 inches thick. The clay subsoil ranges from 20 to 35 inches in thickness and is underlain by fine-textured sediments from clay and shale.

The Vernon soils have a reddish-brown or red clay loam or clay surface layer that is 6 to 10 inches thick. The subsoil ranges from clay loam to clay. It ranges from 6 to 12 inches in thickness but in most places is 7 to 9 inches. These soils are calcareous throughout the profile.

The Bethany soils have a dark grayish-brown or dark-brown silt loam surface layer that is 11 to 18 inches thick. The subsoil is brown or dark grayish brown and is 30 inches thick, or more. It is silty clay loam in the upper part and light clay in the lower part. The subsoil grades to firm, calcareous, loamy material that is difficult for plant roots to penetrate.

The dominant soils of this association are well drained to

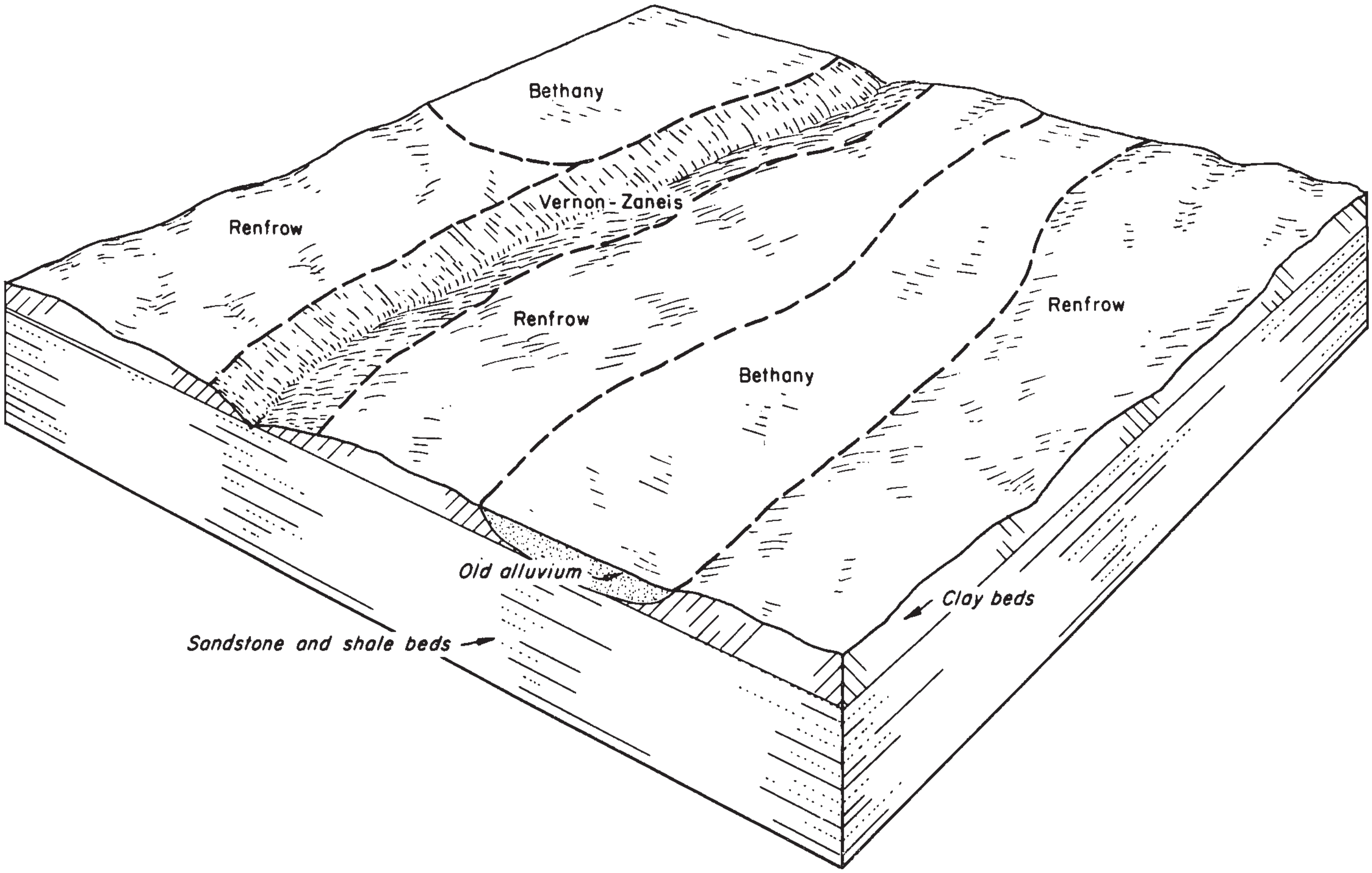

Figure 3.—Typical pattern of soils in soil association 2.

somewhat excessively drained. They have slow to very slow permeability.

Most of this association is cultivated, and the rest is in native grass. Winter wheat is the main cash crop grown on most farms. The soils are well suited to farming and respond favorably to good management. Paved roads or other roads that have a firm surface follow most section lines.

3. Dale-Canadian-Port Association

Deep, nearly level, loamy soils on low benches along the North Canadian River and other large streams

This association consists of deep, loamy, nearly level soils that formed in alluvium. These soils are mainly on low benches along the North Canadian River and in smaller areas along other large streams in the county. Some areas are subject to occasional flooding. This association covers about 64,000 acres, or about 16 percent of the farmland in the county.

The Dale soils make up about 14 percent of this association; the Canadian soils, about 23 percent; and the Port soils, about 30 percent. Minor soils occupy the remaining 33 percent. They are mainly the Pulaski, Crevasse, and Miller soils and Broken alluvial land.

The Dale soils have a very dark grayish-brown or brown silty clay loam surface layer about 12 inches thick. The subsoil, also about 12 inches thick, is dark grayish-brown silty clay loam. The underlying material consists of loamy alluvium.

The Canadian soils have a surface layer of dark grayish-brown or brown fine sandy loam about 15 inches thick. The subsoil is brown or dark-brown fine sandy loam. The underlying material is loamy alluvium.

The Port soils have a reddish-brown or dark reddish-brown loam or clay loam surface layer about 10 inches thick. Below the surface layer is about 20 inches of reddish-brown loam and red light clay loam. The underlying material consists of loamy alluvium.

The soils of this association are well drained. They have moderate to moderately rapid permeability.

Most of this association is cultivated. The soils are well suited to farming and can be used for all crops commonly grown in the county.

4. Dougherty-Norge-Teller Association

Deep, gently sloping to strongly sloping or hummocky, sandy and loamy soils on wooded and prairie uplands

This association consists of gently sloping to strongly sloping or hummocky, sandy and loamy soils. These soils are on uplands in the east- to west-central part of the county. The association occupies about 35,500 acres, or about 9 percent of the farmland in the county.

The Dougherty soils make up about 30 percent of this association; the Norge soils, about 22 percent; and the Teller soils, about 12 percent. Minor soils make up the remaining 36 percent and are chiefly the Konawa and Vanoss soils and Eroded loamy land.

The Dougherty soils have a surface layer of grayish-brown or dark grayish-brown and light yellowish-brown, loose loamy fine sand that is 20 to 30 inches thick. The subsoil is red or yellowish-red to reddish-yellow, strongly acid or medium acid sandy clay loam that is 23 to 37 inches thick and grades to coarse sandy loam. The underlying material consists of deep sand.

The Norge soils have a reddish-brown or brown, loamy surface layer 9 to 16 inches thick. The subsoil is about 38 inches thick. The upper part is reddish-brown light clay loam; the lower part is reddish-brown to red silty clay loam or clay loam. The underlying material consists of neutral to mildly alkaline, loamy and silty material that is moderately difficult for plant roots to penetrate.

The Teller soils have a surface layer of brown, reddish-brown, or dark reddish-brown fine sandy loam. The subsoil ranges from 24 to 40 inches in thickness. In its upper part the subsoil is reddish-brown light clay loam. The lower part is yellowish-red or red to dark-red heavy loam to clay loam. The underlying material consists of slightly acid to neutral loamy, sandy, and gravelly material that is easily penetrated by roots.

The soils in this association are well drained. They have moderate to slow permeability.

About one-half of this association is cultivated. The rest is used for native grass or improved pasture, or it lies idle. Winter wheat is the main cash crop on most farms. The soils in this association are generally well suited to farming and respond favorably to good management. Paved roads or other roads that have a firm surface follow most section lines.

5. Zaneis-Chickasha Association

Deep, gently sloping to moderately sloping, loamy soils on prairie uplands

This association consists of deep, gently sloping to moderately sloping, loamy soil on uplands. It occurs in small areas scattered throughout the county. The association occupies about 23,600 acres, or about 6 percent of the farmland in the county.

The Zaneis soils make up about 65 percent of the association; and the Chickasha soils, about 11 percent. Minor soils account for the remaining 24 percent. They are chiefly Grant and Nash soils.

The Zaneis soils have a surface layer of brown, dark-brown, or reddish-brown loam 6 to 10 inches thick. The subsoil ranges from 20 to 40 inches in thickness. In the upper part the subsoil is reddish-brown light clay loam or clay loam. The lower part is reddish-brown to red or yellowish-red clay loam or heavy clay loam. The underlying material is sandstone.

The Chickasha soils have a surface layer of brown or dark-brown loam 6 to 10 inches thick. The subsoil ranges from 28 to 40 inches in thickness. In the upper part, the subsoil is dark-brown light clay loam or clay loam. The lower part is dark-brown or strong-brown to yellowish-brown, slightly acid to neutral clay loam or sandy clay loam. The underlying material is sandstone.

The soils in this association are well drained. They have moderate or slow permeability.

Most of this association is cultivated. Winter wheat and grain sorghum are the main cash crops grown on most farms. The soils are good for farming and respond favorably to good management. Paved roads or other roads that have a firm surface follow most section lines.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Oklahoma 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. Port and Renfrow, 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, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in the 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. Port clay loam and Port loam are two soil types in the Port 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, Norge loam, 1 to 3 percent slopes, is one of several phases of Norge loam, a soil type that ranges from gently sloping to strongly sloping.

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 woodlands, buildings, field borders, trees, and other 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, Vernon-Zaneis complex, 3 to 5 percent slopes. 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 Broken alluvial land or Breaks-Alluvial land complex 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 yield 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 such a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil surveys. On basis of the 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.

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

Soil	Acres	Percent
Bethany silt loam, 0 to 1 percent slopes	7, 100	1. 6
Breaks-Alluvial land complex	12, 500	2. 8
Broken alluvial land	1, 800	. 4
Canadian fine sandy loam	11, 600	2. 6
Canadian-Dale complex, undulating	4, 400	1. 0
Chickasha loam, 1 to 3 percent slopes	2, 800	. 6
Crevasse loamy fine sand	1, 300	. 3
Crevasse soils	4, 600	1. 0
Dale silty clay loam	7, 700	1. 7
Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes	97, 200	21. 2
Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded	57, 000	12. 7
Dougherty loamy fine sand, hummocky	10, 800	2. 4
Eroded clayey land	2, 000	. 4
Eroded loamy land	8, 500	1. 9
Grant silt loam, 1 to 3 percent slopes	400	. 1
Konawa loamy fine sand, undulating	2, 700	. 6
Lela clay	700	. 1
Miller clay	1, 100	. 2
Miller-Slickspots complex	500	. 1
Nash loam, 3 to 8 percent slopes, eroded	800	. 2
Noble fine sandy loam, 3 to 8 percent slopes	6, 200	1. 4
Norge loam, 1 to 3 percent slopes	4, 300	1. 0
Norge loam, 3 to 5 percent slopes	2, 600	. 6
Norge loam, 4 to 8 percent slopes, eroded	500	. 1
Norge-Slickspots complex, 0 to 3 percent slopes	600	. 1
Port clay loam	5, 200	1. 2
Port loam	14, 100	3. 1
Pulaski fine sandy loam	2, 400	. 5
Pulaski soils, wet	8, 400	1. 9
Renfrow clay loam, 1 to 3 percent slopes	44, 000	9. 8
Renfrow-Slickspots complex, 1 to 3 percent slopes, eroded	800	. 2
Stephenville fine sandy loam, 1 to 3 percent slopes	3, 400	. 8
Stephenville fine sandy loam, 3 to 5 percent slopes	9, 700	2. 1
Stephenville fine sandy loam, 3 to 5 percent slopes, eroded	3, 900	. 9
Teller fine sandy loam, 1 to 3 percent slopes	1, 200	. 3
Teller fine sandy loam, 3 to 5 percent slopes	2, 600	. 6
Vanoss silt loam, 0 to 1 percent slopes	1, 800	. 4
Vernon-Lucien complex, 5 to 15 percent slopes	10, 000	2. 2
Vernon-Zaneis complex, 3 to 5 percent slopes	27, 100	6. 0
Zaneis loam, 1 to 3 percent slopes	2, 300	. 5
Zaneis loam, 3 to 5 percent slopes	8, 500	1. 9
Farmland	395, 100	87. 1
Oklahoma City and other nonfarmland	56, 100	12. 4
Total	451, 200	100. 0

Descriptions of the Soils

This section describes the soil series and mapping units in Oklahoma 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, the sequence of layers beginning at the surface and continuing downward to depths beyond which 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.

Each mapping unit suitable for cultivation contains suggestions on how it can be managed. Management of soils under native grasses, however, is discussed in the subsection "Management of Soils for Range." Suitability of the soils for trees and shrubs used in windbreaks and for post lots is given in the subsection "Management of

Soils for Windbreaks and Post Lots." Behavior of the soils when used as sites for structures or as material for construction is discussed in the subsection "Use of Soils in Engineering."

Bethany Series

The Bethany series consists of deep, dark-colored, nearly level soils on uplands. These soils are in the northwestern and southwestern parts of the county.

In a typical profile, the surface layer is dark grayish-brown, slightly acid silt loam about 14 inches thick. This layer is of granular structure.

The subsoil is about 43 inches thick. It contains less clay and is less compact in its upper part than its lower part. The upper part is dark grayish-brown silty clay loam that has moderate, medium, subangular blocky structure. The lower part is brown light clay of strong to moderate, medium, blocky structure.

The underlying material is brown light clay that is mottled firm, limy, and difficult for plant roots to penetrate.

Bethany soils are naturally well drained. Internal drainage is medium, and permeability is slow. Water-holding capacity and natural fertility are high.

Almost all of the acreage of Bethany soils is cultivated. These soils are suited to small grains, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most widely grown.

Typical profile of Bethany silt loam, 0 to 1 percent slopes, in a cultivated field (east side of road, about 1,000 feet north and 100 feet east from the southwest corner of section 28, T. 11 N., R. 4 W.):

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; clear boundary; horizon 6 to 10 inches thick.

A12—6 to 14 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; clear boundary; horizon 5 to 10 inches thick.

B1—14 to 18 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; neutral; clear boundary; horizon 3 to 8 inches thick.

B2t—18 to 40 inches, brown (10YR 5/3) light clay, dark brown (10YR 4/3) when moist; strong, medium, blocky structure; very hard when dry, very firm when moist; thick, complete clay films on ped faces; mildly alkaline; gradual boundary; horizon 12 to 26 inches thick.

B3—40 to 57 inches, brown (10YR 5/3) light clay, dark brown (10YR 4/3) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist; moderately alkaline; many fine segregated concretions of calcium carbonate; iron and manganese pellets common; gradual boundary; horizon 15 to 20 inches thick.

C—57 to 64 inches +, brown (7.5YR 5/4) light clay with distinct common, fine and coarse mottles of reddish brown (5YR 4/4); dark brown (7.5YR 4/4) when moist; massive; very hard when dry, very firm when moist; calcareous.

The Ap and A12 horizons are silt loam in most places, but there is some loam in tilled areas. The A12 horizon ranges from dark grayish brown to dark brown in hues of 10YR and 7.5YR. The B2t horizon ranges from dark grayish brown to brown in a hue of 10YR. Its texture is heavy silty clay loam and light clay. Depth to the B2t horizon ranges from 14 to 24 inches.

Bethany soils have a more clayey B2t horizon than Vanoss and Chickasha soils.

Bethany silt loam, 0 to 1 percent slopes (BeA).—This soil has the profile described as typical for the Bethany series. It absorbs water well and releases it readily to crops. Tillage is moderately easy.

This is one of the most desirable soils in the county for small grains, and it is well suited to the other crops most commonly grown. All of it, except for a few small areas in native grass, is cultivated. Winter wheat is the main crop, but other small grains, sorghums, cotton, alfalfa, and grasses are also grown.

Management is needed for maintaining soil structure and fertility. All crop residue should be returned to the soil, but excessive tillage should be avoided. Small grains can be grown continuously if crop residues are returned to the soil and adequate fertilizer is applied. (Capability unit I–2; Loamy Prairie range site)

Breaks-Alluvial Land Complex

Breaks-Alluvial land complex (Bk) consists of small nonarable valleys cut into the smoother uplands along the upper reaches of intermittent streams. The sides of the valleys are sloping to steep. Areas of this complex range from 100 to 300 feet in width but are 50 to 150 feet wide in most places.

The soil material on the valley sides varies widely, but in most places is loamy in the surface layer and loamy to clayey in the subsoil and substratum. Color ranges from grayish brown and dark brown to reddish brown, depending on the color of associated soils in the surrounding uplands. Depth to bedrock of sandstone, shale, or both ranges from less than 10 inches to more than 5 feet but is greater than 3 feet in most places. The soil material in the valley floor is loamy, brown to reddish brown, and generally calcareous. Slopes dominantly range from 0 to 12 percent. The vegetation on the valley sides consists mostly of short grasses, though mid grasses grow in areas of the less clayey soils. In other areas, the vegetation on the valley sides consists mostly of tall grasses and some trees found in local areas. This land type is used mostly for permanent pasture. (Capability unit VIe–1; Breaks are in the Red Clay Prairie range site, and Alluvial land is in the Loamy Bottom Land range site)

Broken Alluvial Land

Broken alluvial land (Br) consists of reddish-brown, friable, loamy alluvium. It lies in a narrow strip along the sides of streams that have cut deep, wide channels. The banks average 10 feet in height, but the steep banks are 15 to 25 feet high. The stream channels range from 60 to 100 feet in width and are wider in the bends of the creeks. Slopes range from 2 to 20 percent.

This land supports a thick stand of trees, mainly elm, cottonwood, hackberry, and pecan. The undergrowth is mixed and includes some shrubs and tall grasses.

This land is suitable for native grasses used for grazing. It is also suitable as a habitat for wildlife.

Further erosion of streambanks can be controlled by avoiding overgrazing and clearing of trees and by preventing fires. (Capability unit Vw–1; Loamy Bottom Land range site)

Canadian Series

The Canadian series consists of deep, dark-colored, nearly level to undulating soils. These soils are on alluvium in the valley of the North Canadian River.

In a typical profile, the surface layer is dark grayish-brown, slightly acid fine sandy loam about 15 inches thick. It has granular structure and is easily tilled.

The subsoil is about 15 inches thick. It contains a little more clay in its upper part than in its lower. The subsoil is brown fine sandy loam of moderate, fine, granular structure.

The underlying material is loamy alluvium. It is very friable, is calcareous, and is easily penetrated by plant roots.

Canadian soils are well drained. Internal drainage is medium, and permeability is moderately rapid. Water-holding capacity is moderate. These soils are about medium in natural fertility but, in tilled areas, are susceptible to soil blowing.

Most of the acreage of Canadian soils is cultivated. These soils are suited to small grains, grain sorghums, cotton, alfalfa, and grasses. Alfalfa and winter wheat are the crops most widely grown.

Typical profile of Canadian fine sandy loam in a cultivated field on 0 to 1 percent slopes (west side of road, about 500 feet north and 50 feet west from the southeast corner of section 21, T. 13 N., R. 1 W.):

A1—0 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; gradual boundary; horizon 11 to 18 inches thick.

B2—15 to 30 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; moderate, fine granular structure; soft when dry, very friable when moist; slightly acid; gradual boundary; horizon 10 to 20 inches thick.

C—30 to 60 inches +, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; calcareous; thinly stratified sand, silt, and clay.

The A1 horizon is silt loam in some small areas. Its color ranges from dark gray to brown in hues of 10YR and 7.5YR. The B2 horizon ranges from brown to dark brown in hues 10YR and 7.5YR. The C horizon ranges from pale brown to yellowish brown in a hue of 10YR and from brown to dark brown in a hue of 7.5YR. In texture, the C horizon ranges from fine sandy loam to loamy fine sand.

The Canadian soils are lighter colored and much less clayey than Dale and Lela soils. They are less sandy than Crevasse soils.

Canadian fine sandy loam (Ca).—This nearly level soil is on bottom lands of river valleys. It has the profile described as typical for the Canadian series. Included in mapping were small areas of Dale silty clay loam.

Small areas of this Canadian soil are flooded occasionally for short periods. These floods cause little damage, but runoff from higher land washes away the soil material in some places and deposits sediments in others.

Most of this soil is used intensively for small grains, alfalfa, sorghums, and cotton. A few areas are in native grasses. Winter wheat is the main crop.

Management is needed mainly for controlling soil blowing and maintaining soil structure and fertility. Many kinds of cropping systems are suitable. Sown crops can be grown continuously if fertilizer is added and stubble-mulch tillage is used. (Capability unit I–3; Loamy Bottom Land range site)

293-288—69——2

Canadian-Dale complex, undulating (CdB).—This complex is made up mostly of Canadian fine sandy loam and Dale silty clay loam, but there are also small areas of Crevasse fine sand. These soils are in such an intricate pattern that it is impractical to map each soil separately.

The Canadian soils have a profile like that described as typical for the Canadian series. They occupy the ridges of the undulating relief and make up about 65 to 75 percent of the areas mapped. The Dale soils have a profile like that described as typical for the Dale series. They occupy the swalelike areas in the undulating relief and make up 25 to 35 percent of the areas mapped. Small areas of Crevasse loamy fine sand also occur in swalelike areas. These areas make up 5 to 10 percent of this complex.

The soils in this complex are medium to high in fertility and easy to till. They have good water-holding capacity.

Nearly all of this complex is cultivated. Tillage and management are the same in all areas, though the cropping system used may vary. Alfalfa, winter wheat, grain sorghums, cotton, and grasses are most commonly grown. A suitable cropping system, if crop residues are returned, is continuous small grains with fertilization. (Capability unit IIe–4; Loamy Bottom Land and range site)

Chickasha Series

The Chickasha series consists of deep, dark-colored, loamy soils that are gently sloping. These soils are on uplands mostly in the southeastern part of the county.

In a typical profile the surface layer is dark-brown or brown loam about 8 inches thick (fig. 4). This layer has granular structure, is medium acid, and is easy to till.

The subsoil is about 34 inches thick. It contains less clay and is less compact in the upper part than in the middle part. The upper part is dark-brown light clay loam that has moderate, medium, granular structure. The middle part is dark-brown clay loam that is medium acid and has moderate, medium, subangular blocky structure. The lower part is strong-brown sandy clay loam.

The underlying material is thin, firm, slightly acid, loamy material that is moderately difficult for plant roots to penetrate. Partly weathered sandstone underlies the loamy material about 48 inches from the surface.

Chickasha soils are naturally well drained. Internal drainage is medium, and permeability is moderate. Water-holding capacity is moderate to high and natural fertility is high.

Most of the acreage of Chickasha soils is cultivated. The soils are suited to small grains, grain sorghums, cotton, legumes, and grasses. Winter wheat is the main crop.

Typical profile of Chickasha loam, 1 to 3 percent slopes, in a cultivated field (west side of road, about 1,500 feet south and 100 feet west from the northeast corner of section 34, T. 12 N., R. 1 E.):

A1—0 to 8 inches, dark-brown (7.5YR 4/4) loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; medium acid; gradual boundary; horizon 6 to 10 inches thick.

Figure 4.—**Profile of Chickasha loam.**

B1—8 to 16 inches, dark-brown (7.5YR 4/4) light clay loam; dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; medium acid; gradual boundary; horizon 5 to 10 inches thick.
B2t—16 to 26 inches, dark-brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; medium acid; gradual boundary; horizon 8 to 15 inches thick.
B3—26 to 42 inches, strong-brown (7.5YR 5/8) sandy clay loam, strong brown (7.5YR 5/6) when moist; moderate, medium, granular structure; hard when dry, friable when moist; slightly acid; gradual boundary; horizon 15 to 25 inches thick.
C—42 to 60 inches +, yellowish-red (5YR 5/8) sandy loam, yellowish red (5YR 4/8) when moist; slightly acid; partly weathered sandstone in lower part.

The color of the A1 and B1 horizons ranges from brown to dark brown in hues of 7.5YR and 10YR. The B1 horizon ranges from light clay loam to clay loam. The B2t horizon ranges from brown to dark brown in a hue of 7.5YR, and from clay loam to sandy clay loam. The B3 horizon ranges from strong brown to yellowish brown in hues of 7.5YR and 10YR. The C horizon has hues of 5YR and 7.5 YR.

The Chickasha soils are more brownish and less reddish than the Zaneis, Norge, and Teller soils. The Chickasha soils are less silty, more acid, and have a thinner solum than Vanoss soils.

Chickasha loam, 1 to 3 percent slopes (ChB).—The profile of this soil is the one described as typical for the series. This soil is one of the more desirable soils of the uplands for small grains, and winter wheat is the principal crop. It is also suitable for sorghum and cotton. Except for a few small areas in native grass, all of it is cultivated.

Small grains can be grown continuously on this soil if stubble-mulch tillage is used. Crop residue should be returned to the soil, and excessive tillage ought to be avoided. Terracing and contour farming are essential where row crops are grown. By cultivating on the contour and sodding or seeding waterways, erosion can be reduced and excess water removed. Light applications of fertilizer are beneficial. (Capability unit IIe-1; Loamy Prairie range site)

Crevasse Series

The Crevasse series consists of brown, nearly level soils on sandy alluvium. These soils occupy part of the flood plain along the North Canadian River.

In a typical profile, the surface layer is brown, calcareous loamy fine sand about 10 inches thick. This layer has weak, fine, granular structure and is easily tilled.

Below the surface layer is about 8 inches of light brownish-gray, calcareous loamy fine sand that is weakly stratified.

The underlying material is well-stratified alluvium of fine sand texture. It is calcareous and easily penetrated by plant roots.

Crevasse soils are well drained. Internal drainage and permeability are rapid. Water-holding capacity is low. These soils are low in natural fertility and are subject to frequent flooding.

Almost all the acreage of Crevasse soils is in native grasses.

Typical profile of Crevasse loamy fine sand in a pasture of native grass (south side of road, about 1,800 feet north and 200 feet west from the southeast corner of section 18, T. 13 N., R. 1 W.):

A1—0 to 10 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; gradual boundary; horizon 8 to 16 inches thick.
AC—10 to 18 inches, light brownish-gray (10YR 6/2) loamy fine sand, brown (10YR 5/3) when moist; nearly structureless; loose; stratified; calcareous; gradual boundary; horizon 6 to 12 inches thick.
C—18 to 34 inches +, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) when moist; structureless; calcareous.

The A1 horizon is mostly loamy fine sand but is fine sand or light fine sandy loam in some areas. The color of the A1 horizon ranges from brown or grayish brown to dark brown in a hue of 10YR. The AC horizon ranges from light brownish gray to yellowish brown or dark grayish brown in a hue of 10YR. Depth to fine sand or sand ranges from 15 to 25 inches.

Crevasse soils have a thinner, more sandy solum than Canadian soils.

Crevasse loamy fine sand (Cr).—This nearly level soil is on the flood plain, where it is closely associated with Canadian soils. Its profile is the one described as typical for the Crevasse series.

Most of this soil is in native grass, but small grains, sorghums, and cotton are suitable crops. This soil is seldom tilled, however, because soil blowing is a hazard. Flooding is infrequent, but the soil remains wet for long periods after flooding and after heavy rains.

If this soil is tilled, management is needed to control soil blowing and maintain fertility. Small grains can be grown continuously if a legume mixture, such as rye and vetch, is seeded and all crop residue is returned to the soil. (Capability unit IIIe-7; Sandy Bottom Land range site)

Crevasse soils (Cv).—These soils are on the flood plain along the North Canadian River where flooding is frequent. The surface layer of these soils ranges from fine sand to clay loam and is underlain by stratified sand. Range is the chief use. (Capability unit Vw-2; Sandy Bottom Land range site)

Dale Series

The Dale series consists of deep, loamy, nearly level soils on benches along the North Canadian River.

In a typical profile, the surface layer is very dark grayish-brown or brown silty clay loam that is neutral and about 12 inches thick. This layer has granular structure.

The subsoil is about 12 inches thick. It is a dark grayish-brown silty clay loam that has moderate, medium, granular structure.

The underlying material is brown loamy alluvium that is easily penetrated by plant roots.

The Dale soils are well drained and have medium internal drainage. Their water-holding capacity is high. Natural fertility is high.

Most of the acreage of Dale soils is cultivated to small grains, cotton, sorghums, alfalfa, and native grasses (fig. 5). Winter wheat is the crop most widely grown.

Profile of Dale silty clay loam in a cultivated field on slopes of 0 to 1 percent (east side of road, about 1,400 feet south and 200 feet east of northwest corner of section 33, T. 12 N., R. 2 W.):

A1—0 to 12 inches, very dark grayish-brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; hard when dry, firm when moist; neutral; gradual boundary; horizon 8 to 14 inches thick.

B2—12 to 24 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; hard when dry, firm when moist; slightly acid; gradual boundary; horizon 10 to 20 inches thick.

C—24 to 48 inches +, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) when moist; weak, fine, granular structure; soft when dry, friable when moist; neutral.

Figure 5.—**Grain sorghum on Dale silty clay loam.**

The A1 horizon ranges from very dark grayish brown to brown in a hue of 10YR. The B2 horizon ranges from brown to dark grayish brown in hues of 10YR and 7.5YR. The texture ranges from silt loam to silty clay loam. The C horizon is brown to dark brown in hues of 10YR and 7.5YR. For several feet, the texture of the C horizon is a loam to clay loam.

Dale soils contain less clay than Lela soils and are darker colored and contain less clay than Canadian soils.

Dale silty clay loam (Dl).—Small areas of this nearly level soil are occasionally flooded for short periods. These floods cause little damage, but runoff from nearby higher land may erode some areas and deposit new sediment in other places. The profile of this soil is the one described as typical for the series.

This soil is suitable for intensive farming, though tillage is somewhat difficult. The main crops are small grains, mostly winter wheat, alfalfa, sorghums, cotton, and grasses. An example of a suitable cropping system is 6 years of small grains and 2 years of legumes or grasses. (Capability unit I–1; Loamy Bottom Land range site)

Darnell Series

The Darnell series consists of shallow, brown, loamy soils that are gently sloping to strongly sloping. These soils occur on uplands in the eastern two-thirds of the county.

In a typical profile, the surface layer is brown fine sandy loam that is medium acid and about 3 inches thick. This layer has weak granular structure.

The subsoil, about 9 inches thick, is reddish-yellow fine sandy loam that is medium acid.

The underlying material is red sandstone that is very hard when dry. Plant roots enter this rock along and in joints, fractures, and bedding planes, but the roots do not penetrate deeply.

Darnell soils are somewhat excessively drained, have rapid runoff, and have moderately rapid permeability. Water-holding capacity and natural fertility are low. These soils are susceptible to water erosion if they are not managed well.

Nearly all of the acreage of Darnell soils is in a mixture of native woods and grasses and is used for grazing. These soils are not suitable for cultivation.

Typical profile of a Darnell fine sandy loam on a slope of 5 to 12 percent, in a cleared area (north side of road, about 300 feet west and 100 feet north from the southeast corner of section 25, T. 11 N., R. 1 E.):

A1—0 to 3 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 4/2) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; medium acid; clear boundary; horizon 2 to 6 inches thick.

B2—3 to 12 inches, reddish-yellow (5YR 6/6) light fine sandy loam, yellowish red (5YR 5/6) when moist; massive; soft when dry, very friable when moist; medium acid; gradual boundary; horizon 6 to 12 inches thick.

R—12 to 18 inches +, red (10R 5/6) weakly cemented sandstone, red (10R 4/6) when moist; slightly acid; very hard when dry, and this hardness prohibits digging.

The A1 horizon ranges from brown to light brown in a hue of 7.5YR. The B2 horizon is reddish yellow to yellowish red in a hue of 5YR, and its texture is light fine sandy loam or fine sandy loam. Depth to the R horizon ranges from 10 to 20 inches.

The Darnell soils are more sandy than Vernon soils.

Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes (DsE).—This mapping unit occurs on uplands and consists mainly of Darnell and Stephenville soils. It also contains small areas of Vernon, Dougherty, and Konawa soils, each of which make up about 3 percent of the mapped areas. Also included are areas that have slopes of 20 percent. The Darnell and Stephenville soils occur in such an intricate pattern that it is impractical to map each kind of soil separately.

The Darnell soils have a profile like the one described as typical for the Darnell series. They generally occur at higher elevations than Stephenville soils and make up about 55 to 65 percent of the mapping unit. The Stephenville soils have a profile like that described as typical for the Stephenville series. They occupy about 35 to 45 percent of the mapping unit.

All of this mapping unit is in a mixture of native woods and grasses and is used for grazing and as wildlife habitats.

The Darnell soils are not suitable for cultivation, but they support a dense stand of blackjack and post oaks and some native grasses. Tame pasture has been established in some areas where trees have been cleared. Brush control and fertilizer are needed to maintain tame pasture. The deeper Stephenville soils of this unit are better suited to tame pasture than the shallow Darnell soils. (Capability unit VIe–2; the Darnell soils are in the Shallow Savannah range site and the Stephenville soils are in the Sandy Savannah range site)

Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded (DtE3).—This complex is made up mostly of Darnell and Stephenville soils. These soils are in such an intricate pattern that it is impractical to map each kind of soil separately. Nearly all of this complex was formerly cultivated but now lies idle. Many V-shaped gullies that are 3 to 15 feet deep and 10 to 40 feet wide form a network of small drains that cut into the side slopes. Colluvial fans have formed on the foot slopes at the outlets of the drains. Sandstone crops out in places.

These soils generally lie idle or support a thin stand of poor-quality grasses. Management of this complex is difficult, slow, and expensive. Some areas have been planted to tame pasture grasses, such as bermudagrass, weeping lovegrass, and King Ranch bluestem. The gullies need to be shaped and sodded with bermudagrass. The eroded areas between the gullies should be sprigged or planted to native or tame grasses. The revegetated areas can be used for grazing after the grasses are well established. (Capability unit VIe–6; the Darnell soils are in the Eroded Shallow Savannah range site, and the Stephenville soils are in the Eroded Sandy Savannah site)

Dougherty Series

The Dougherty series consists of deep, hummocky, sandy soils. These soils are on uplands in the eastern two-thirds of the county.

The surface layer is grayish-brown, neutral loamy fine sand about 4 inches thick. The next layer to a depth of 22 inches is light yellowish-brown loamy fine sand. Both layers are easily tilled.

The subsoil is about 28 inches thick. The upper part is a yellowish-red sandy clay loam that is strongly acid and has weak, medium, subangular blocky structure. The lower part is similar to the upper part but is massive and contains less clay.

The underlying material is coarse sandy loam that grades into deep fine sand. The fine sand has been partly reworked by wind. The sandy loam material is loose, medium acid, and easily penetrated by plant roots.

Dougherty soils are well drained. Internal drainage is medium, permeability is moderate, and water-holding capacity is moderate. These soils are low in natural fertility and are susceptible to water and wind erosion.

Less than one-fourth of the acreage of Dougherty soils is cultivated. Suitable crops are sorghums and legumes. Native grasses and orchard trees grow well on these soils.

Typical profile of Dougherty loamy fine sand, hummocky, in native woods and grasses (north side of road, about 400 feet west and 100 feet north from the southeast corner of section 11, T. 12 N., R. 1 E.) :

A1—0 to 4 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; clear boundary; horizon 4 to 8 inches thick.

A2—4 to 22 inches, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; massive; soft when dry, very friable when moist; slightly acid; clear, smooth boundary; horizon 15 to 25 inches thick.

B2t—22 to 40 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium, subangular blocky structure with clay films on ped faces; very hard when dry, friable when moist; strongly acid; diffuse, smooth boundary; horizon 15 to 25 inches thick.

B3—40 to 50 inches, reddish-yellow (5YR 6/8) light sandy clay loam, yellowish red (5YR 5/8) when moist; massive; hard when dry, friable when moist; strongly acid; diffuse, smooth boundary; horizon 8 to 12 inches thick.

C—50 to 55 inches +, red (2.5YR 5/8) coarse sandy loam, red (2.5YR 4/8) when moist; massive; medium acid; grades into deep fine sand.

The A1 horizon is fine sand in some cultivated areas. Color of the A1 horizon ranges from brown or dark brown to dark grayish brown in a hue of 10YR. The A2 horizon ranges fom light brown to light yellowish brown in hues of 7.5YR and 10YR. Texture is loamy fine sand or fine sand. The B2t horizon ranges from red to yellowish red in hues of 2.5YR and 5YR. Texture ranges from heavy fine sandy loam to sandy clay loam.

The Dougherty soils have a more sandy A1 horizon than Teller soils, and, unlike them, have a distinct light-colored A2 horizon. The solum of Dougherty soils is thicker than that of Stephenville soils, which have an R horizon. Dougherty soils have a thicker A horizon than Konawa soils.

Dougherty loamy, fine sand, hummocky (DuC).—Most of this soil is on large ridges or on low, rounded, sandy rises within or bordering areas of Konawa loamy fine sand, undulating. The profile of this soil is the one described as typical for the Dougherty series. Included in mapping were areas of Stephenville fine sandy loam, Konawa loamy fine sand, and of Teller fine sandy loam, each of which make up 3 to 5 percent of the mapped areas.

Nearly all of this soil is covered by a mixed sand of blackjack oak and native grasses. Grasses are better suited than cultivated crops, but a few areas are used for sown crops, sorghums, annual legumes, and grasses.

Unless this soil is well protected, especially where cultivated, it is susceptible to severe water erosion and soil blowing. Sown crops can be grown continuously if stubble-mulch tillage and fertilizer are used. Crop response to management is good. (Capability unit IVe–2; Deep Sand Savannah range site)

Eroded Clayey Land

Eroded clayey land (Es) consists of soils that have been eroded to the extent that almost all of the original surface layer has been removed. The plow layer is clay or clay loam that is essentially from the subsoil or other underlying layer. Gullies are common. Most of them are less than 5 feet deep, but a few on the steeper slopes are deeper. Between the gullies and within severely eroded areas are less eroded patches. Slopes are generally 2 to 5 percent, but they are steeper in small areas near and along drainageways.

This land type supports a thin stand of poor-quality native grasses, and it ought to be reseeded to desirable native grasses. Reestablishing vegetation, however, is more difficult on this land than on Eroded loamy land. (Capability unit VIe–3; Eroded Clay range site)

Eroded Loamy Land

Eroded loamy land (Et) consists of soils that have been eroded to the extent that nearly all of the original surface layer has been removed. The plow layer consists essentially of loamy material that is from the subsoil or other underlying layers. Gullies are common, and many of them are more than 5 feet deep. Between the gullies or within the severely eroded areas are less eroded patches. This land type generally has slopes of 2 to 5 percent, but it is steeper in small areas near drainageways.

This land type supports a thin stand of poor-quality native grasses. It ought to be reseeded to desirable native or tame grasses. Because the surface soil is loamy, this land is easier to revegetate than Eroded clayey land. (Capability unit VIe–4; Loamy Prairie range site)

Grant Series

The Grant series consists of deep, gently sloping, reddish-brown, loamy soils. These soils are on uplands in the southwestern part of the county.

In a typical profile, the surface layer is reddish-brown silt loam about 10 inches thick. This layer is neutral, has granular structure, and is easily tilled.

The subsoil is about 32 inches thick. The upper part is reddish-brown, neutral heavy silt loam that has moderate, medium, granular structure. The middle and lower parts are red, slightly acid heavy silt loam that has granular structure.

The underlying material is soft sandstone. Along joints and bedding planes, the sandstone is hard and neutral or limy. Penetration of plant roots is difficult.

Grant soils are naturally well drained. Internal drainage is medium, permeability is moderate, and water-holding capacity is moderate to high. These soils are high in natural fertility but are susceptible to water erosion where they are tilled.

Most of the acreage of Grant soils is cultivated. These soils are suited to small grains, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most widely grown.

Typical profile of Grant silt loam, 1 to 3 percent slopes, in a formerly cultivated field (east side of road, about

1,300 feet north and 100 feet east from the southwest corner of section 18, T. 11 N., R. 4 W.) :

A1—0 to 10 inches, reddish-brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 12 inches thick.

B1—10 to 20 inches, reddish-brown (2.5YR 4/4) heavy silt loam, dark reddish brown (2.5YR 3/4) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 12 inches thick.

B2t—20 to 30 inches, red (2.5YR 4/6) heavy silt loam, dark red (2.5YR 3/6) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; weak, patchy clay films on ped faces; slightly acid; gradual boundary; horizon 8 to 14 inches thick.

B3—30 to 42 inches, red (2.5YR 4/6) silt loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 4 to 14 inches thick.

R—42 inches +, red (2.5YR 5/8), partly weathered, soft sandstone, red (2.5YR 4/8) when moist; slightly acid.

The texture of the A1 horizon is loam in some small areas. Its color ranges from reddish brown to dark reddish brown in hues of 2.5YR and 5YR. The B1, B2t, and B3 horizons range from reddish brown to red in hues of 5YR and 2.5YR. The B2t horizon is heavy silt loam or light silty clay loam. Depth to sandstone ranges from about 36 to 48 inches.

Grant soils contain less clay in the B2t horizon than Renfrow soils but are more strongly developed and contain more clay throughout the profile than Nash soils. Grant soils contain more silt and less sand than Teller soils.

Grant silt loam, 1 to 3 percent slopes (GrB).—This soil is on uplands. Its profile is the one described as typical for the Grant series. Included in mapping were small areas of Nash and Norge soils. Nash loam makes up 5 to 7 percent of the mapped areas and Norge loam makes up 2 to 3 percent.

This is a desirable soil for farming. All of it, except for a few small areas in native grasses, is tilled. Winter wheat is the principal crop, but barley, oats, sorghums, cotton, and grasses are also grown.

Management is needed that provides terraces, contour tillage, and legumes and fertilizer used in the cropping system. Small grains can be grown year after year if stubble-mulch tillage is used. Terracing and contour farming are essential where row crops are grown. Sodding or seeding waterways allows safe removal of excess water by reducing erosion. (Capability unit IIe-1; Loamy Prairie range site)

Konawa Series

The Konawa series consists of deep, wooded, sandy soils that are undulating or gently sloping. These soils are on uplands in the west-central part and the eastern two-thirds of the county.

In a typical profile, the surface layer is about 5 inches thick and consists of brown loamy fine sand that is neutral and easily tilled (fig. 6). The subsurface layer, about 9 inches thick, is light yellowish-brown loamy fine sand.

The subsoil is about 38 inches thick. The upper part is yellowish-red sandy clay loam that is medium acid and has weak, medium, subangular blocky structure. The lower part is similar to the upper part but contains less clay and is massive.

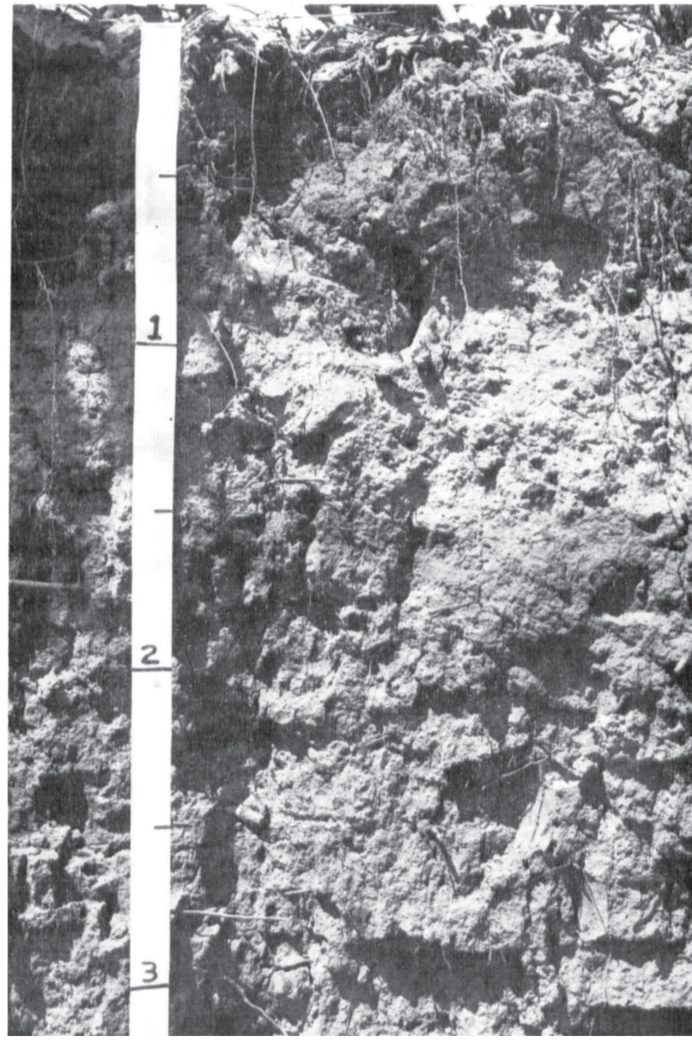

Figure 6.**—Soil profile of Konawa loamy fine sand.**

The underlying material is red coarse sandy loam that grades into fine sand. The fine sand has been partly reworked by wind. The underlying material is loose, medium acid, and easily penetrated by plant roots.

Konawa soils are well drained. Internal drainage is medium, and permeability is moderate. Water-holding capacity is moderate, and natural fertility is low. Water and wind erosion are likely, particularly in cultivated areas.

About one-third of the acreage of Konawa soils is cultivated. Suitable crops are small grains, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most commonly grown.

Typical profile of Konawa loamy fine sand, undulating, in cultivated field (north side of road, about 2,400 feet east and 200 feet north from the southwest corner of section 9, 12 N., R. 1 E.) :

Ap—0 to 5 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; clear boundary; horizon 3 to 8 inches thick.

A2—5 to 14 inches, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) when moist; massive; soft when dry, very friable when moist;

slightly acid; clear, smooth boundary; horizon 4 to 15 inches thick.

B2t—14 to 36 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium, subangular blocky structure; clay films on ped faces; very hard when dry, friable when moist; medium acid; diffuse, smooth boundary; horizon 15 to 30 inches thick.

B3—36 to 52 inches, yellowish-red (5YR 5/6) light sandy clay loam, yellowish red (5YR 4/6) when moist; massive; hard when dry, friable when moist; medium acid; diffuse, smooth boundary; horizon 12 to 20 inches thick.

C—52 to 60 inches +, red (2.5YR 5/8) coarse sandy loam, red (2.5YR 4/8) when moist; massive; slightly hard when dry, friable when moist; medium acid; grades into fine sand with depth.

The Ap or A1 horizon ranges from pale brown to dark brown in a hue of 10YR. The A2 horizon ranges from light brown in a hue of 7.5YR to light yellowish brown and yellowish brown in a hue of 10YR. Its texture is fine sand or loamy fine sand. The B2t horizon ranges from red to yellowish red in hues of 2.5YR. It ranges from heavy fine sandy loam to sandy clay loam.

Konawa soils have a thinner A horizon than Dougherty soils.

Konawa loamy fine sand, undulating (KoB).—This soil occurs on sandy uplands and borders areas of Dougherty loamy fine sand, hummocky. It has the profile described as typical for the Konawa series. The native vegetation consists of a mixed stand of blackjack oak and native grasses.

This soil is loose, friable, and easily tilled. It is subject to moderate or severe soil blowing if the plant cover is not adequate. Natural fertility is low, but crops respond readily to good management. About one-third of this soil is cultivated. The principal crops are small grains, mainly winter wheat, but sorghums, cotton, legumes, grasses, and some orchard crops are also grown.

Management is needed that provides a plant cover during winter and spring so as to protect the soil from wind and water erosion. Also, legumes ought to be included in the cropping system, and fertilizer, minimum tillage, and stripcropping should be used. A suitable cropping system is 3 years of row crops and 3 years of sown crops if all residue from the row crops is returned to the soil, and for the sown crops stubble-mulch tillage is used. (Capability unit IIIe-6; Deep Sand Savannah range site)

Lela Series

In the Lela series are deep, dark-colored, nearly level soils on clayey alluvium. These soils occupy part of the flood plain along the North Canadian River. The water table is generally at a depth of 60 inches or more but fluctuates according to the amount of flooding or rainfall.

In cultivated areas, the plow layer is very dark gray, neutral clay about 8 inches thick. It is underlain by about 32 inches of very dark grayish-brown, slightly alkaline clay.

At a depth of about 40 inches is calcareous clay that is massive. This massive clay extends to a depth of 60 inches or more.

The underlying material is fine-textured, calcareous alluvium that resists penetration of plant roots.

Lela soils are somewhat poorly drained. Internal drainage is slow, and permeability is very slow. Water-holding capacity is high. These soils are high in natural fertility and subject to infrequent flooding that lasts for only a short time. Large cracks appear at the surface when these soils dry.

Most of the acreage of Lela soils is cultivated. These soils are suited to alfalfa, small grains, sorghums, cotton, and grasses. Alfalfa and winter wheat are the main crops.

Typical profile of Lela clay in a cultivated field (east side of road, about 2,400 feet north and 100 feet east from the southwest corner of section 13, T. 12 N., R. 1 E.):

Ap—0 to 8 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) when moist; moderate, fine, granular structure; very hard when dry, firm when moist; neutral; gradual boundary; horizon 6 to 10 inches thick.

AC—40 to 60 inches +, reddish-brown (2.5YR 4/4) clay, dark very dark brown (10YR 2/2) when moist; massive; very hard when dry, firm when moist; slightly alkaline; diffuse boundary; horizon 25 to 40 inches thick.

AC—40 to 60 inches +, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) when moist; massive; very hard when dry, firm when moist; calcareous.

The color of the A12 horizon ranges from very dark grayish brown to black in a hue of 10YR. The AC horizon ranges from reddish brown to dark reddish brown in hues of 2.5YR and 5YR. Color and texture vary somewhat throughout the profile, especially in the AC horizon, because sediments are deposited during floods.

Lela soils are darker colored and contain more clay than the Dale and Canadian soils.

Lela clay (Lc).—This nearly level soil is on flood plains. In addition to the flooding from the North Canadian River, small areas are occasionally flooded by water from adjoining uplands. The floods last for only a short time and cause little damage, but sediments are deposited and areas are ponded. This soil has the profile described as typical for the Lela series.

This clay is moderately wet and difficult to till. It is better suited to close-growing crops than to row crops, though row crops can be grown. Alfalfa and winter wheat are the main crops, but in some years sorghums are grown.

Management is needed mainly to control wetness and to maintain soil structure. Shallow surface drains are generally sufficient for controlling wetness. A suitable cropping system that helps to maintain soil structure is 2 years of row crops and 6 years of small grains. Crop residue must be returned to the soil. (Capability unit IIIw-1; Heavy Bottom Land range site)

Lucien Series

The Lucien series consists of shallow, reddish-brown, loamy soils that are sloping to moderately steep. These soils are on uplands in the eastern part of the county.

In a typical profile, the surface layer is reddish-brown, slightly acid fine sandy loam about 4 inches thick. This layer has moderate, fine, granular structure.

Below the surface layer is about 11 inches of reddish-brown loam. This layer has weak, fine, granular structure.

The underlying material is sandstone that is medium acid and difficult for plant roots to enter.

Lucien soils are somewhat excessively drained. Internal drainage is medium, and permeability is moderate. Water-holding capacity is moderate to low. The soils are low in natural fertility, and they erode readily if they are tilled.

Nearly all the acreage of Lucien soils is native grasses and is used for grazing. These soils are not suitable for cultivation.

In this county Lucien soils are mapped only in a complex with Vernon soils.

Typical profile of Lucien fine sandy loam in a pasture of native grasses (north side of road, about 400 feet east and 100 feet north from the southwest corner of section 5, T. 14 N., R. 1 E.):

A1—0 to 4 inches, reddish-brown (2.5YR 4/4) fine sandy loam, dark reddish brown (2.5YR 3/3) when moist; moderate, fine, granular structure; soft when dry, friable when moist; slightly acid; gradual boundary; horizon is 4 to 8 inches thick.

AC—4 to 15 inches, reddish-brown (2.5YR 4/4) loam, dark reddish brown (2.5YR 3/3) when moist; weak, fine, granular structure; soft when dry, very friable when moist; few, fine roots and pores; medium acid; gradual boundary; horizon is 4 to 12 inches thick.

R—15 to 18 inches +, red (2.5YR 4/6) sandstone, dark red (2.5YR 3/6) when moist; medium acid; extremely hard when dry.

The A1 horizon is loam in some places. Color of the A1 horizon is reddish brown or dark reddish brown in hues of 2.5YR and 5YR. The AC horizon is reddish brown or red in a hue of 2.5YR and ranges from fine sandy loam to loam. The depth to sandstone ranges from 6 to 20 inches.

Lucien soils have less depth to sandstone than the Nash soils and are sandier than the Vernon.

Miller Series

The Miller series consists of deep, fine-textured, calcareous soils that are nearly level. These soils are on bottom lands along Deep Fork in the northeastern part of the county.

In a typical profile, the surface layer is reddish-brown clay about 8 inches thick. This layer has moderate, medium, subangular blocky structure.

Below the surface layer to a depth of more than 44 inches is dark reddish-brown heavy clay that is calcareous and massive.

The underlying material is fine-textured, calcareous alluvium that resists penetration of plant roots.

Miller soils are somewhat poorly drained. Internal drainage is slow, permeability is very slow, and water-holding capacity is high. These soils are moderately high in natural fertility, but they are subject to occasional, shallow flooding that lasts for only a short time. Large cracks appear at the surface when these soils dry.

Most of the acreage of Miller soils is cultivated. These soils are suited to alfalfa, small grains, sorghums, cotton, and grasses. Alfalfa and winter wheat are the main crops.

Typical profile of Miller clay in a cultivated field (west side of road, about 1,000 feet north and 100 feet west from the southeast corner of section 11, T. 14 N., R. 1 E.):

A1—0 to 8 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; calcareous; gradual boundary; horizon 6 to 12 inches thick.

AC—8 to 44 inches +, dark reddish-brown (2.5YR 3/4) heavy clay, dark red (2.5YR 3/6) when moist; massive; very hard when dry, very firm when moist; calcareous.

The A1 horizon is silty clay loam in some small areas. Its color is reddish brown or dark reddish brown in hues of 5YR and 2.5YR. The AC horizon is dominantly clay or heavy clay. It is dark reddish brown or dark red in a hue of 2.5YR. In the lower horizon color and texture vary somewhat because sediment is deposited during floods.

Miller soils are more clayey than the Port and Pulaski soils and, unlike them, are calcareous in the A1 horizon.

Miller clay (Mc).—This soil is nearly level and on bottom lands. Small areas may be flooded for short periods by Deep Fork or by water draining from the nearby uplands. These floods cause little damage, but they deposit new sediments and leave shallow wet areas in the fields. The profile of this soil is the one described as typical for the Miller series.

This soil is clayey, moderately wet, and difficult to till. Close-growing crops are better suited than row crops, though row crops can be grown. Alfalfa and winter wheat are the main crops, but sorghums, cotton, and grasses are also grown.

Management is needed mainly to control wetness and to maintain soil structure. Shallow surface drains are generally sufficient for drainage. A suitable cropping system that helps to maintain soil structure is 2 years of row crops and 6 years of small grains. All crop residue must be returned to the soil. (Capability unit IIIw-1; Heavy Bottom Land range site)

Miller-Slickspots complex (Ms).—This complex consists of Miller clay and slickspots. Miller clay makes up 70 to 90 percent of this complex, and slickspots make up 10 to 20 percent. The Miller soil has a profile like the one described as typical for the Miller series.

The slickspots have a clay surface layer on which a hard, glazed, whitish crust forms when the soil drys after a rain. This crust is ¼ to 1 inch thick. Below the crust the surface layer, when dry, ranges from reddish brown to brown. The subsoil is clay and, when dry, ranges from red to brown. Slickspots are calcareous throughout the profile.

The soils of this mapping unit are droughty and difficult to till. Most areas are used for permanent pastures of native or other grasses, mostly bermudagrass, but winter wheat and some alfalfa are also grown.

Although tillage and management are the same on all of this unit, crops grow better on Miller soils than on slickspots. Sown crops can be grown year after year if stubble mulching is used and minimum tillage is to a depth of 4 inches. (Capability unit IVs-1; Miller soils are in Heavy Bottom Land range site, and slickspots are in Alkali Bottom Land range site)

Nash Series

The Nash series consists of moderately deep, sloping, loamy soils. These soils are on uplands in the southwestern part of the county.

In a typical profile the surface layer is reddish-brown loam about 9 inches thick. This layer is slightly acid, has granular structure, and is easy to till.

The subsoil is about 21 inches thick. The upper part is red loam that is neutral and has moderate, medium, granular structure. The lower part is also red, neutral loam but has weak, fine, granular structure.

The underlying material is soft sandstone. Along the joints and bedding planes of this sandstone, the material is hard, neutral or limy, and difficult for plant roots to penetrate.

Nash soils are well drained. Internal drainage is medium, permeability is moderately rapid, and water-holding capacity is moderate. These soils are moderately high in natural fertility but are susceptible to water erosion when they are tilled.

Most of the acreage of Nash soils is cultivated. These soils are suited to small grains, sorghums, cotton, legumes, and grasses, and winter wheat is the main crop.

Typical profile of Nash loam, 3 to 8 percent slopes, eroded, in a cultivated field (east side of road, about 1,000 feet south and 100 feet east from the northwest corner of section 32, T. 11 N., R. 4 W.):

A1—0 to 9 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; slightly acid; gradual boundary; horizon 6 to 12 inches thick.

B2—9 to 20 inches, red (2.5YR 4/6) loam, dark red (2.5YR 3/6) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 10 to 16 inches thick.

B3—20 to 30 inches, red (2.5YR 4/6) loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; neutral; gradual boundary; horizon 8 to 14 inches thick.

R—30 to 40 inches +, red soft sandstone (2.5YR 4/6), dark red (2.5YR 3/6) when moist; about neutral.

The color of the A1 horizon ranges from reddish brown to dark reddish brown in hues of 5YR and 2.5YR. The B2 horizon ranges from red or dark red to reddish brown in hues of 2.5YR and 5YR. The texture of the B2 horizon ranges from fine sandy loam to loam. The sandstone is weakly consolidated and begins 24 to 36 inches from the surface.

Nash soils are not so deep as the Grant and Teller soils and have a less clayey subsoil.

Nash loam, 3 to 8 percent slopes, eroded (NaC2).—This soil is on uplands. Its profile is the one described as typical for the Nash series. Included in mapping were small areas of Grant silt loam that make up 3 to 5 percent of mapped areas.

Most of this soil is tilled, but a few small areas are in native grasses. Commonly grown are small grains, mostly winter wheat, and sorghums, legumes, and grasses.

Management is needed for controlling water and wind erosion and for maintaining fertility. Erosion can be reduced by terraces and contour cultivation. Legumes ought to be included in the cropping system, and fertilizer added to this soil. A cropping system consisting of sown crops, such as small grains, is suitable if crop residue is returned to the soil and terracing and contour farming are used. (Capability unit IVe–1; Loamy Prairie range site)

Noble Series

The Noble series consists of deep, moderately sloping to sloping, reddish-brown soils. These soils are on uplands in the eastern part of the county.

In a typical profile, the surface layer is reddish-brown fine sandy loam that is slightly acid and about 8 inches thick.

The subsoil, about 10 inches thick, is reddish-brown fine sandy loam. This layer has weak, fine, granular structure and is slightly acid.

The underlying material is red, slightly acid fine sandy loam. This material is colluvium that is easily penetrated by plant roots.

Noble soils are somewhat excessively drained. Internal drainage is rapid, permeability is moderately rapid, and water-holding capacity is low. These soils are low in natural fertility and are subject to soil blowing and severe water erosion where they are cultivated.

Most of the acreage of Noble soils is in permanent pasture of native grasses, but small areas lie idle. These areas were once tilled and are now severely eroded.

Typical profile of Noble fine sandy loam, 3 to 8 percent slopes, in a formerly cultivated field (east side of road, about 200 feet north and 100 feet east, from the southwest corner of section 15, T. 14 N., R. 1 E.):

A1—0 to 8 inches, reddish-brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) when moist; weak, fine, granular structure; soft when dry, friable when moist; slightly acid; gradual boundary; horizon 6 to 12 inches thick.

B2—8 to 18 inches, reddish-brown (2.5YR 5/4) fine sandy loam, reddish brown (2.5YR 4/4) when moist; weak, fine, granular structure; soft when dry, friable when moist; slightly acid; gradual boundary; horizon 6 to 12 inches thick.

C—18 to 42 inches +, red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) when moist; nearly structureless; loose; slighty acid.

The A1 horizon is loamy fine sand in some tilled areas. It is reddish brown or dark reddish brown in hues of 5YR and 2.5YR. The B2 and C horizons are dominantly reddish brown, dark reddish brown, red or dark red in a hue of 2.5YR. These horizons are mainly fine sandy loam, but they range to loamy fine sand and fine sand in some places. Reaction of the profile is medium acid or slightly acid.

Noble soils lack the stratified C horizon of the Pulaski soils. The weak B2 horizon in the Noble soils has not formed in the Pulaski soils.

Noble fine sandy loam, 3 to 8 percent slopes (NbC).—This soil is on uplands. Its profile is the one described as typical for the Noble series. Included in mapping were small areas of Darnell and Stephenville fine sandy loam that make up about 5 to 7 percent of the mapped areas. Also included were areas of Pulaski fine sandy loam that make up 2 or 3 percent of the mapped areas.

Nearly all of this soil is in permanent pasture consisting of native grasses. Small grains, such as winter wheat, oats, and rye, are grown and are well suited. Legumes and grasses are also well suited.

If this soil is cultivated, management is needed to control erosion and to maintain fertility. Erosion can be reduced by terraces, contour farming, stripcropping, and use of crop residue. The cropping system ought to include legumes, fertilizer, or crops that produce a large amount of residue. Sown crops can be grown if crop residue is used for soil improvement and if stubble mulching, stripcropping, and contour tillage are practiced. (Capability unit IVe–5; Sandy Savannah range site)

Norge Series

The Norge series consists of deep, gently sloping to strongly sloping soils. These soils are on uplands in the west-central part of the county.

In a typical profile, the surface layer is about 12 inches thick and consists of reddish-brown loam that is slightly acid and easy to till. This layer has granular structure.

The subsoil, 48 inches or more thick, contains less clay and is more friable in the upper part than in the lower. The upper part is reddish-brown light clay loam that has moderate, medium and strong, granular structure. The subsoil from 16 to 40 inches is reddish-brown clay loam of weak to moderate, subangular blocky structure. Below 40 inches the subsoil consists of clay loam that is mildly alkaline and moderately difficult for plant roots to penetrate.

Norge soils are well drained. They have medium internal drainage, slow permeability, and moderate to high water-holding capacity. These soils are high in natural fertility but are subject to both wind and water erosion where tilled.

Most of the acreage of Norge soils is cultivated. These soils are suited to small grains, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most widely grown.

A typical profile of Norge loam, 1 to 3 percent slopes, in a cultivated field on west side of road (about 1,800 feet north and 150 feet west of the southeast corner of section 2, T. 14 N., R. 4 W.):

Ap—0 to 8 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; hard when dry, friable when moist; slightly acid; clear boundary; horizon 6 to 10 inches thick.

A12—8 to 12 inches, reddish-brown (5YR 4/4) heavy loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; slightly acid; gradual boundary; horizon 3 to 6 inches thick.

B1—12 to 16 inches, reddish-brown (5YR 4/4) light clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; hard when dry, friable when moist; neutral; gradual boundary; horizon 4 to 8 inches thick.

B21t—16 to 32 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; thin, patchy clay films on ped faces; neutral; gradual boundary; horizon 12 to 20 inches thick.

B22t—32 to 40 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist; few, thin, patchy clay films on ped faces; neutral; gradual boundary; horizon 6 to 12 inches thick.

B3—40 to 50 inches +, red (2.5YR 4/8) clay loam, red (2.5YR 4/6) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist; few, small pebbles; many, small, black concretions; mildly alkaline.

The A horizon is generally loam, but it is fine sandy loam in small areas. Color ranges from reddish brown to brown in hues of 5YR and 7.5YR. The B horizon ranges from dark reddish brown or reddish brown to red in hues of 5YR and 2.5YR. The B21t horizon ranges from clay loam to heavy clay loam.

Norge soils contain more clay in their subsoil than Teller and Grant soils and less clay than Renfrow soils.

Norge loam, 1 to 3 percent slopes (NoB).—This soil is on uplands in the west-central part of the county. Its profile is the one described as typical for the series. This soil occurs with Renfrow, Grant, and Teller soils. Included in the mapping were small areas of Renfrow clay loam that make up about 5 percent of the mapped areas. Smaller areas of Teller fine sandy loam were also included.

This soil is moderately easy to till, but in tilled areas it is susceptible to water erosion. Natural fertility is high, and water-holding capacity is moderate.

Except for a few small areas in native grass, all of this soil is cultivated. Winter wheat is the main crop, but barley, oats, cotton, and grasses are also grown.

The management needed provides fertilizer, legumes, or crops that produce a large amount of residue. Small grains can be grown continuously if stubble-mulch tillage is used. Terracing and contour farming are essential where row crops are grown. Sodding or seeding waterways allows safe removal of excess water. (Capability unit IIe–1; Loamy Prairie range site)

Norge loam, 3 to 5 percent slopes (NoC).—This moderately sloping soil is on uplands in the west-central part of the county. Its surface layer ranges from 6 to 12 inches in thickness and is generally thinner than that in the profile described as typical for the series. This soil occurs with other Norge soils and with Zaneis soils. Included in the mapping were areas of Zaneis loam that make up about 3 percent of the mapped areas, of Teller fine sandy loam that make up about 5 percent, and of Norge loam, 4 to 8 percent slopes, eroded, that is of minor extent.

This soil is moderately easy to till, but in tilled areas it is subject to water erosion. It has high natural fertility.

Crops suited to and commonly grown on this soil are winter wheat, sorghums, cotton, legumes, and grasses. Sown crops are better suited than row crops.

Management is needed that provides fertilizer or legumes and crops that produce a large amount of residue. If stubble-mulch tillage is used, a small grain can be grown continuously. Terracing and contour farming are essential if row crops are grown. (Capability unit IIIe–1; Loamy Prairie range site)

Norge loam, 4 to 8 percent slopes, eroded (NoC2).—This soil is on short side slopes or in other small, irregularly shaped upland areas in the west-central part of the county. Because this soil is eroded, its surface layer is less than 6 inches thick. In most places the plow layer consists of a mixture of surface layer and subsoil. Included with this soil in mapping are areas that have a clay loam surface layer and small areas of Zaneis loam.

Crops suited to and commonly grown on this soil include winter wheat and other small grains and sorghums, legumes, and grasses. Native grasses or tame grasses are better suited than cultivated crops.

Management is needed that controls both water and wind erosion and maintains fertility. This management ought to provide legumes or additions of fertilizer, sown crops that produce large amounts of residue, and terracing and contour farming. (Capability unit IVe–4; Loamy Prairie range site)

Norge-Slickspots complex, 0 to 3 percent slopes (NsB).—Norge loam makes up 65 to 85 percent of this complex, and slickspots, 10 to 25 percent. About 10 to 25 percent consists of soils that are transitional between Norge soil and slickspots.

The Norge soil has a profile like the one described as typical for the series. Slickspots have a surface layer of grayish-brown to yellowish-brown loam to clay loam that is 2 to 10 inches thick. This layer is calcareous or noncalcareous and is abruptly underlain by a weak, blocky to massive clay loam to clay subsoil.

In the severely affected areas, the slickspots are generally saline or alkali, or both, from a considerable depth in the soils to the surface. In less affected areas the surface layer is generally neither saline nor alkali, but at some depth the subsoil generally is saline, alkali, or both. A glazed, whitish, hard crust, ¼ to 1 inch thick, forms when these slickspots dry after a rain. The slickspots occur as nearly circular to irregularly shaped areas ¼ acre to 3 acres in size.

The transitional soils have a loam to clay loam surface layer 10 to 15 inches thick. An abrupt to gradual boundary is between the surface layer and a layer of massive or weak blocky clay to clay loam. The surface does not crust as it does on the slickspots, but the layer of clay to clay loam is harder and more compact than the subsoil in the Norge loam.

Nearly all of this mapping unit is cultivated, and winter wheat is the main crop. Commonly, crop yields on the slickspots are low.

Intensive management is needed for improving soil structure, reducing crusting and salinity, and controlling water erosion. Some of these practices are seeding legumes, adding fertilizer, using sown crops or crops that produce a large amount of residue, practicing minimum tillage to a depth of about 4 inches, and vegetating the waterways. With such management, small grains can be grown continuously. Terracing and contour farming are not essential. (Capability unit IIIs–1; Norge soil is in the Loamy Prairie range site, and the slickspots are in the Slickspot range site)

Port Series

The Port series consists of deep, reddish-brown, nearly level soils on bottom lands in the northwestern and northeastern parts of the county. These soils are subject to occasional flooding.

In a typical profile, the surface layer is reddish-brown loam about 10 inches thick. This layer ranges from about neutral to slightly acid. Structure is granular.

Below the surface layer is reddish-brown, neutral loam about 20 inches thick. This layer has weak, fine, granular structure.

The underlying material also has weak, fine, granular structure. This material is red, weakly stratified, calcareous light clay loam. It is friable alluvium, but it somewhat resists penetration of roots.

Port soils are naturally well drained. Internal drainage is medium, permeability is moderate, and water-holding capacity is high. Natural fertility is high.

Most of the acreage of Port soils is cultivated. These soils are suited to small grains, sorghums, cotton, alfalfa, and grasses. Winter wheat and alfalfa are the main crops.

Typical profile of Port loam in a cultivated field (west side of road, about 2,640 feet south and 100 feet west from the northeast corner of section 29, T. 14 N., R. 1 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 8 to 12 inches thick.

AC—10 to 30 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; neutral; gradual boundary; horizon 8 to 25 inches thick.

C—30 to 54 inches +, red (2.5YR 5/6) light clay loam, red (2.5YR 4/6) when moist; weak, fine, granular structure; weakly stratified; calcareous.

The A1 horizon is clay loam in some areas, and there are also small areas of silt loam. This horizon is reddish brown, red, or dark reddish brown in hues of 2.5YR and 5YR. The AC and C horizons become more reddish as depth increases. The C horizon is neutral or calcareous. The AC and C horizons are mostly loam or light clay loam, but they are weakly stratified. In places more sandy strata alternate with more clayey ones. Below a depth of 54 inches, the strata are loamy and calcareous.

Port soils have a darker A1 horizon than Pulaski soils. Also, they are likely to be flooded less frequently. Port soils have a more reddish A1 horizon than Lela soils and a less clayey substratum.

Port clay loam (Pc).—This nearly level soil occurs with Port loam on bottom lands along some of the larger streams in the county. It has a profile similar to the one described as typical for the Port series, except that it is clay loam throughout the profile. Included in mapping were small areas of Port loam that make up 5 to 8 percent of areas mapped.

All of this soil, except for a few small areas in native grasses, is cultivated. It is suitable for intensive cultivation and can be used for most crops grown in the county, including winter wheat, alfalfa, sorghums, and cotton. Winter wheat and alfalfa are the principal crops. Tillage is moderately difficult.

Management is needed to maintain soil structure and fertility and to protect crops from damaging floods. The cropping system ought to provide crops that produce large amounts of residue, which are returned to the soil. Also beneficial are legumes or fertilizers and cover crops. Sown crops can be grown year after year if crop residue is used. (Capability unit IIw–1; Loamy Bottom Land range site)

Port loam (Po).—This soil is nearly level and borders some of the larger streams. It occurs with Port clay loam and Pulaski fine sandy loam. Its profile is the one described as typical for the Port series. Included in mapping are small areas of Pulaski fine sandy loam that make up 5 to 7 percent of the mapped areas.

This is one of the most desirable soils on bottom lands for farming. It is easily tilled. All of it, except for a few small areas in native grasses, is cultivated. Suitable crops include winter wheat, alfalfa, sorghums, cotton, and almost all other crops grown in the county. Winter wheat and alfalfa are the principal crops.

Management is needed to maintain soil structure and fertility and to protect crops from damaging floods. The cropping system ought to provide crops that produce large amounts of residue that is returned to the soil. Also beneficial are fertilizers and cover crops. Sown crops can be grown year after year if the residue is used. (Capability unit IIw–1; Loamy Bottom Land range site)

Pulaski Series

The Pulaski series consists of deep, dark-red to reddish-brown, loamy soils that are nearly level. These soils are on bottom lands along most of the larger streams. They are subject to occasional flooding.

In a typical profile, the surface layer is red slightly acid fine sandy loam that is about 18 inches thick. This layer has weak, fine, granular structure and is easily tilled.

Below the surface layer is reddish-brown, friable fine sandy loam about 17 inches thick. This layer has weak, fine, granular structure.

The underlying material is red, slightly acid loamy fine sand that is almost structureless. This material is alluvium that is easily penetrated by roots.

Pulaski soils are well drained or poorly drained. They are poorly drained where there are no natural drainage channels. Internal drainage is medium, permeability is moderately rapid, and water-holding capacity is moderate. Natural fertility is moderately high.

Most of the larger areas of Pulaski soils are cultivated. These soils are suited to small grains, alfalfa, cotton, sorghums, and grasses. Alfalfa and winter wheat are the crops most widely grown. The wet phase of Pulaski soils is not suitable for cultivated crops.

Typical profile of Pulaski fine sandy loam in a cultivated field (north side of road, about 1,400 feet east and 100 feet north from the southwest corner of section 27, T. 13 N., R. 1 E.):

A1—0 to 18 inches, red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly acid; gradual boundary; horizon 12 to 24 inches thick.

AC—18 to 35 inches, reddish-brown (2.5YR 5/4) fine sandy loam, dark reddish brown (2.5YR 3/4) when moist; weak, fine, granular structure; slightly acid; gradual boundary; horizon 14 to 20 inches thick.

C—35 to 42 inches +, red (2.5YR 5/6) loamy fine sand, red (2.5YR 4/6) when moist; nearly structureless; loose; weakly stratified; slightly acid.

The A1 horizon is dominantly fine sandy loam but is loamy fine sand in some small areas. It ranges from red or dark red to reddish brown in a hue of 2.5YR. The AC horizon is mostly reddish brown or red in a hue of 2.5YR. Its texture is mainly fine sandy loam but includes thin strata of loamy sand. Depth to loose, stratified loamy fine sand ranges from 30 to 50 inches. The C horizon is yellowish red in some places. In some places a IIC horizon is present. It is very dark brown or black, calcareous silt loam to silty clay loam.

Pulaski soils have a redder A1 horizon than Port soils and are not so deep over stratified sand. Also, Pulaski soils are more frequently flooded.

Pulaski fine sandy loam (Ps).—This soil is nearly level and occupies flood plains, mostly in association with Port soils. It has the profile described as typical for the Pulaski series. Included in mapping were small areas of Port loam and Port clay loam that make up 5 to 10 percent of the mapped areas.

Most of this soil is cultivated, and the rest is in native grass for permanent pasture. This soil is well suited to cultivated crops such as winter wheat, alfalfa, sorghums, and cotton. Alfalfa and winter wheat are the principal crops.

Management is needed to maintain soil structure and fertility and to protect crops from damaging floods. The cropping system ought to include crops that produce a large amount of residue that is returned to the soil. Also beneficial are legumes or fertilizers and cover crops. Sown crops can be grown year after year if the residue is used. (Capability unit IIw–1; Loamy Bottom Land range site)

Pulaski soils, wet (Pw).—This mapping unit consists of loamy soils derived from noncalcareous alluvium, most of which washed in from nearby uplands. The soils are dark red in the surface layer and yellowish red in the substratum. They are subject to frequent flooding during which fresh sediments are deposited. Drainage is poor, and the water table is at or near the surface for most of the year. There are no channels for natural drainage.

All of this land type is in grasses and trees. It is used for permanent pasture. Willow and cottonwood trees are common. Bermudagrass is a common tame pasture grass. The native grasses include switchgrass, wildrye, and sand bluestem. (Capability unit Vw–3; Subirrigated range site)

Renfrow Series

The Renfrow series consists of deep, gently sloping, reddish-brown soils of the uplands. These soils are mostly in the northwestern and southwestern parts of the county.

In a typical profile, the surface layer is reddish-brown clay loam that is slightly acid, is about 10 inches thick, and has granular structure. This layer is difficult to till and overlies a claypan subsoil.

The subsoil is about 26 inches thick. It contains slightly more clay and is more compact in the upper part than in the lower. The upper part is reddish-brown clay that has weak, medium, blocky structure. The lower part is red, calcareous clay that is massive.

The underlying material is red clay that is underlain by partly weathered, calcareous shale and clay that resists penetration of plant roots.

Renfrow soils are naturally well drained. Internal drainage is medium, and permeability is very slow. Water-holding capacity is high. The soils are high in natural fertility but are susceptible to water erosion in sloping fields.

Most of the acreage of Renfrow soils is cultivated. These soils are suited to small grains, sorghums, legumes, and grasses. Winter wheat is the main crop.

Typical profile of Renfrow clay loam, 1 to 3 percent slopes, in a cultivated field (north side of road, about 300 feet west and 200 feet north, from the southeast corner of section 6, T. 14 N., R. 4 W.):

A1—0 to 10 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; clear boundary; horizon 8 to 12 inches thick.

B2t—10 to 26 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) when moist; weak, medium, blocky structure; very hard when dry, firm when moist; neutral; gradual boundary; horizon 12 to 20 inches thick.

B3—26 to 36 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; massive; very hard when dry, firm when moist; calcareous; many, small lime concretions; gradual boundary; horizon 8 to 15 inches thick.

C—36 to 44 inches, red (2.5YR 5/6) clay, red (2.5YR 4/6) when moist; massive; very hard when dry, firm when moist; calcareous; gradual boundary; horizon 6 to 10 inches thick.

R—44 to 54 inches +, red (2.5YR 5/8), weathered, calcareous shale and clay.

The A1 horizon is clay loam in most places but is silt loam in small areas. Both the A1 horizon and B2t horizon are reddish brown or dark reddish brown in hues of 2.5YR and 5YR. The B3 and C horizons become more reddish as depth increases.

The Renfrow soils have a thicker, more developed solum than Vernon soils. They have a more clayey B2t horizon than that in Grant soils.

Renfrow clay loam, 1 to 3 percent slopes (RfB).—This soil is on uplands. It has the profile described as typical for the series. Included in mapping were small areas of Bethany silt loam that make up 2 percent of the mapped areas. This is one of the more extensive soils of the uplands for growing small grains. All of it, except for a few small areas in native grasses, is cultivated. Winter wheat is the principal crop, but sorghums, legumes, and grasses are also grown.

Management is needed to control runoff, to maintain structure, and to maintain a good content of moisture. Tillage is difficult on this soil and it should be avoided soon after rains. The cropping system ought to provide legumes, fertilizer, or crops that produce a large amount of residue. Growing soil-depleting crops more than 4 consecutive years is not advisable. Terracing and contour farming are essential where row crops are grown. Small grains can be grown year after year if the residue and fertilizer are used. (Capability unit IIIe–5; Claypan Prairie range site)

Renfrow-Slickspots complex, 1 to 3 percent slopes, eroded (RsB2).—Renfrow clay loam, eroded, makes up 65 to 90 percent of this complex, and slickspots, 10 to 30 percent.

About 10 to 30 percent consists of soils that are transitional between Renfrow soils and slickspots.

The Renfrow soil has a profile similar to the one described as typical for the Renfrow series. The surface layer, however, is generally less than 8 inches thick, and the plow layer is a mixture of surface layer and subsoil in about 30 percent of the acreage. The slickspots have a red to brown clay loam to clay surface layer that is abruptly underlain by a massive to weak blocky clay subsoil. Slickspots occur as nearly circular to irregularly shaped areas ¼ acre to 2 acres in size. In the severely affected areas, they generally are saline, alkali, or both, from a considerable depth to the surface. In less affected areas, the surface layer is generally neither saline nor alkali, but the subsoil generally is saline, alkali, or both. A glazed, whitish, hard crust ¼ to more than 1 inch thick, forms when the slickspots dry after a rain.

The transitional soils have a clay loam surface layer 6 to 12 inches thick. An abrupt boundary is between the surface layer and a layer of massive or weak blocky clay. The surface does not crust as it does on the slickspots, but the layer of clay is dense and harder than that in the subsoil of Renfrow clay loam.

Nearly all of this mapping unit is cultivated, and winter wheat is the main crop. Near crop failures are common on the slickspots.

Intensive management is needed for improving soil structure, reducing crusting and salinity, and controlling water erosion. Some suitable practices are seeding legumes, adding fertilizer, using sown crops or crops that produce a large amount of residue, practicing minimum tillage to a depth of about 4 inches, and vegetating the waterway. If management is good, small grains can be grown year after year. (Capability unit IVs-2; Renfrow soil is in the Claypan Prairie range site, and the slickspots are in the Slickspot range site)

Stephenville Series

The Stephenville series consists of loamy soils that are gently sloping to strongly sloping (fig. 7). These soils are on timbered uplands in the eastern two-thirds of the county.

In a typical profile, the surface layer is about 14 inches thick and consists of fine sandy loam that is neutral to medium acid and is easy to till. It is grayish brown in the upper few inches and light brown below. This layer has weak, fine, granular structure or is massive.

The subsoil is about 26 inches thick. The upper part is yellowish-red sandy clay loam that has weak, fine, subangular blocky structure and is medium acid. The lower part is red sandy clay loam that is massive.

The underlying material is light-red sandstone that is medium acid.

Stephenville soils are well drained. They have medium internal drainage, moderate permeability, and moderate water-holding capacity. Natural fertility is low, and in tilled areas wind or water erosion, or both, are likely.

The Stephenville soils are mostly in native grasses used as permanent pasture, but small grains, mainly winter wheat, sorghums, and legumes are also grown.

Typical profile of Stephenville fine sandy loam, 1 to 3 percent slopes, in a native-grass pasture on north side of road (about 2,400 feet west and 400 feet north from the southeast corner of section 25, T. 11 N., R. 1 E.) :

***Figure 7.*—Profile of Stephenville fine sandy loam.**

A1—0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; neutral; clear boundary; horizon 3 to 6 inches thick.

A2—4 to 14 inches, light-brown (7.5YR 6/4) light fine sandy loam, dark brown (7.5YR 4/4) when moist; massive; soft when dry, friable when moist; medium acid; clear boundary; horizon 6 to 14 inches thick.

B2t—14 to 26 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, fine, subangular blocky structure; hard when dry, firm when moist; medium acid; gradual boundary; horizon 7 to 15 inches thick.

B3—26 to 40 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; massive; hard when dry, friable when moist; medium acid; gradual boundary; horizon 12 to 16 inches thick.

R—40 to 45 inches +, light-red (2.5YR 6/6) soft sandstone, red (2.5YR 4/6) when moist; medium acid.

The A2 horizon ranges from light fine sandy loam to loamy fine sand and is light yellowish brown, light brown, or brown.

The color of the B2t and B3 horizons is dominantly red in a hue of 2.5YR and 5YR. The B2t and B3 horizons are both sandy clay loam, but the B3 horizon is slightly sandier than the B2t. Depth to the R horizon ranges from 28 to 48 inches.

The Stephenville soils have a less sandy A1 horizon and a thinner solum than Dougherty soils. They have a thicker solum than the shallow Darnell soils, which range from 10 to 20 inches in thickness.

Stephenville fine sandy loam, 1 to 3 percent slopes (StB).—This soil is on uplands in the eastern two-thirds of the county, where it occurs closely with the Darnell soils. Its profile is the one described as typical of the Stephenville series. The native vegetation consists of a dense stand of blackjack oak and some tall grasses.

This soil is easy to till. In tilled areas it is subject to water erosion and to moderate soil blowing.

Although most crops suited to the county can be grown on this soil, the acreage under cultivation is decreasing and that used for native grasses and tame pasture, especially bermudagrass, is increasing. In cultivated areas the main crops are small grains, commonly winter wheat, and sorghums and legumes.

Management is needed for controlling erosion and maintaining fertility and soil structure. This management ought to provide fertilizer, legumes, or crops that produce a large amount of residue. Small grains can be grown continuously if stubble-mulch tillage is used. Terracing and contour farming are needed to help conserve soil and water. (Capability unit IIe-3; Sandy Savannah range site)

Stephenville fine sandy loam, 3 to 5 percent slopes (StC).—This soil is on uplands in the eastern part of the county. The surface layer is thinner than that in the profile described as typical for the series. In tilled areas the surface layer ranges from 10 to 14 inches in thickness. This soil occurs with Darnell, Konawa, and Dougherty soils. Included in mapping were areas of Konawa loamy fine sand, undulating, that make up 7 to 10 percent of the mapped areas and of Darnell soils that make up about 3 to 5 percent.

This soil is easy to till but is subject to water erosion and to moderate soil blowing.

This soil is suited to most cultivated crops grown in the county. About half of it is cultivated to small grains, mainly winter wheat, but sorghums, legumes, and other crops are also grown.

Management is needed for controlling erosion and maintaining soil structure. This management ought to provide fertilizer, legumes, or crops that produce a large amount of residue. An example of a suitable cropping system is small grains grown continuously under stubble-mulch tillage. Terracing and contour farming are needed to conserve soil and water. (Capability unit IIIe-3; Sandy Savannah range site)

Stephenville fine sandy loam, 3 to 5 percent slopes, eroded (StC2).—This soil occurs on uplands in the eastern part of the county. In about 2 percent of the cultivated acreage, nearly all of the surface layer has been lost through erosion. In about 10 to 15 percent, the plow layer consists of a mixture of all of the surface layer and the upper part of the subsoil. In the less eroded areas the surface layer is 6 to 12 inches thick. Many rills occur, and there are a few gullies that cannot be crossed by farm equipment. This soil occurs with Dougherty and Darnell soils.

This soil is subject to severe water erosion and moderate soil blowing. It is more difficult to till than uneroded Stephenville soils and is not so well suited to crops.

About one-third of this soil is cultivated, and winter wheat is the most common crop. Small grains, sorghums, legumes, and grasses also are suited.

Management is needed that controls erosion and maintains fertility. This management ought to provide fertilizer, legumes, and crops that produce a large amount of residue. An example of a suitable cropping system is 2 years of row crops, 4 years of sown crops, and 2 years of legumes or grasses. Needed with this system are stubble mulching, terracing, and contour farming. In addition, all crop residue should be returned to the soil. (Capability unit IIIe-4; Sandy Savannah range site)

Teller Series

The Teller series consists of deep, brown, loamy soils that are gently sloping to moderately sloping. These soils are on uplands in the east-central part of the county.

In a typical profile, the surface layer is brown fine sandy loam that is slightly acid and about 8 inches thick. This layer has granular structure.

The subsoil is light clay loam about 28 inches thick. Structure is moderate, medium, and granular. The subsoil contains more clay in the lower part than in the upper part. It is reddish brown in the upper part and red in the lower part.

The underlying material is loamy and is easily penetrated by plant roots.

Teller soils are naturally well drained. Internal drainage is medium, and permeability and water-holding capacity are moderate. These soils are moderately high in natural fertility, but tilled areas are susceptible to both water erosion and soil blowing.

Less than half the acreage of Teller soils is cultivated. These soils are suited to small grains, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most widely grown.

Typical profile of Teller fine sandy loam, 1 to 3 percent slopes, in a pasture of native grasses (east side of road, about 1,300 feet north and 100 feet east from the southwest corner of section 20, T. 13 N., R. 1 W.):

A1—0 to 8 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; horizon 6 to 10 inches thick.

B1—8 to 14 inches, reddish-brown (5YR 4/4) light clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium and coarse, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 4 to 12 inches thick.

B2t—14 to 36 inches, red (2.5YR 4/6) light clay loam, dark red (2.5YR 3/6) when moist; moderate, medium, granular stucture; hard when dry, firm when moist; slightly acid; gradual boundary; horizon 12 to 24 inches thick.

C—36 to 48 inches +, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) when moist; massive; hard when dry, firm when moist; slightly acid.

The A1 horizon is mainly fine sandy loam in most areas, but the plow layer is loamy fine sand in some tilled areas. The A1 horizon is brown, reddish brown, or dark reddish brown in hues of 7.5YR and 5YR. The B2t horizon is yellowish red or dark red in hues of 5YR and 2.5YR. It ranges from heavy loam to clay loam. The C horizon ranges from fine sandy loam to clay loam. It is yellowish red or red in hues of 5YR and 2.5YR.

A few, small spots of coarse sand and gravel crop out at the surface.

Teller soils contain more sand and less silt than Grant soils. The B2t horizon of Teller soils contains less clay than that of Norge soils.

Teller fine sandy loam, 1 to 3 percent slopes (TfB).—This soil is on uplands. Its profile is the one described as typical for the Teller series. Included in mapping were small areas of Vanoss silt loam and Stephenville fine sandy loam, each of which make up 3 to 5 percent of the mapped areas.

This soil is easily tilled but is subject to water erosion and slight soil blowing. If erosion is controlled, this soil is suitable for intensive cultivation. All of it, except for a few small areas in native grasses, is cultivated. Suitable crops include small grains, sorghums, cotton, legumes, and most other crops grown in the county. Winter wheat is the principal crop.

Management is needed mainly for controlling erosion, and for maintaining soil structure and fertility. The cropping system ought to provide fertilizer, legumes, or crops that produce a large amount of residue. Row crops can be grown for 6 years followed by 2 years of legumes or grasses if terracing and contour farming are used. (Capability unit IIe-2; Sandy Prairie range site)

Teller fine sandy loam, 3 to 5 percent slopes (TfC).—This soil is moderately sloping. It occurs on uplands in the east-central part of the county. The surface layer of this soil ranges from 5 to 8 inches in thickness. It has been thinned by erosion or was never quite so thick as the surface layer in the profile described as typical for the Teller series.

This soil is easily tilled but is subject to water erosion and slight to moderate soil blowing. If erosion is controlled, it is well suited to cultivated crops. Suitable crops include small grains, mainly winter wheat, sorghums, cotton, legumes, and most other crops grown in the county.

Management is needed to control erosion and to maintain fertility. Terracing and contour farming can be used to control erosion. The cropping system ought to provide crops that produce a large amount of residue so that it can be returned to the soil. Also needed are legumes or fertilizer and cover crops. When these measures are applied, row crops can be grown for 3 years and then followed by 3 years of sown crops. (Capability unit IIIe-2; Sandy Prairie range site)

Vanoss Series

The Vanoss series consists of deep, dark-brown, loamy soils that are nearly level. These soils are on uplands in the western part of the county.

In a typical profile, the surface layer is dark-brown silt loam that is slightly acid and about 8 inches thick (fig. 8). This layer has granular structure and is easily tilled.

The subsoil is 42 inches or more thick. The upper part, about 8 inches thick, is a dark grayish-brown heavy silt loam that has moderate, medium and coarse, granular structure. The middle part is about 26 inches thick and consists of dark-brown light silty clay loam and silty clay loam that has granular structure. The lower part is brown silty clay loam that also has granular structure.

The underlying material is firm, neutral, loamy material that is moderately difficult for plant roots to penetrate.

Figure 8.—**Profile of Vanoss silt loam.**

Vanoss soils are naturally well drained. Internal drainage is medium, permeability is moderate, and water-holding capacity is moderate to high. Natural fertility is high.

Most of the acreage of Vanoss soils is cultivated. These soils are suited to small grains, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most widely grown.

Typical profile of Vanoss silt loam, 0 to 1 percent slopes, in a cultivated field (east side of road, about 1,300 feet south from the center of section 7, T. 12 N., R. 4 W.):

A1—0 to 8 inches, dark-brown (10YR 4/3) silt loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 6 to 10 inches thick.

B1—8 to 16 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary; horizon 6 to 10 inches thick.

B21t—16 to 24 inches, dark-brown (7.5YR 4/2) light silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium and coarse, granular structure; hard when dry, firm when moist; neutral; gradual boundary; horizon 6 to 10 inches thick.

B22t—24 to 42 inches, dark-brown (7.5YR 4/2) silty clay loam with few, fine, faint mottles of yellowish brown, dark brown (7.5YR 3/2) when moist; strong, coarse, granular structure; hard when dry, firm when moist; neutral; gradual boundary; horizon 14 to 20 inches thick.

B3—42 to 50 inches +, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/2) when moist; moderate, medium, granular structure; hard when dry, firm when moist; neutral.

The A1 horizon is silt loam in most places but is loam in some small areas. The B1 horizon ranges from heavy silt loam to silty clay loam.

Vanoss soils are darker colored than Norge and Teller soils. They have a more friable and less clayey subsoil than Bethany soils.

Vanoss silt loam, 0 to 1 percent slopes (VaA).—This soil is on uplands. Its profile is the one described as typical for the Vanoss series. This soil absorbs water well and releases it readily to crops. Tillage is moderately easy. Included in mapping were small areas of Norge loam that make up about 5 to 7 percent of the mapped areas and of Bethany silt loam that make up about 3 percent.

This soil is well suited to the crops commonly grown in the county. All of it, except for a few small areas in native grass, is cultivated. Winter wheat is the main crop and grows well as do other small grains and sorghums, cotton, alfalfa, and grasses.

Management is needed for maintaining fertility and soil structure. All crop residue should be returned to the soil, and excessive tillage should be avoided. Small grains can be grown continuously if crop residues are returned to the soil and adequate fertilizer is added. Where row crops are grown, contour tillage is essential. (Capability unit I–2; Loamy Prairie range site)

Vernon Series

The Vernon series consists of shallow, reddish-brown, moderately sloping to moderately steep soils. These soils are on uplands in the eastern part of the county.

The surface layer is reddish-brown, calcareous clay loam that is about 6 inches thick and is difficult to till.

The subsoil consists of red clay about 9 inches thick. This layer has moderate, medium, granular structure.

The underlying material is partly weathered shale, clay, and siltstone. This material is limy, very hard, and difficult for plant roots to penetrate.

Vernon soils are somewhat excessively drained. Internal drainage is medium, permeability is very slow, and water-holding capacity is high. The soils are medium to low in natural fertility, and they erode severely if they are tilled.

Vernon soils are used for native grasses, or lie idle. The stands of grasses are of poor quality. The idle areas generally include areas that were formerly tilled, and they are now severely eroded.

Typical profile of Vernon clay loam, 3 to 5 percent slopes, in a pasture of native grasses (east side of road, about 500 feet north and 50 feet east from the southwest corner of section 27, T. 14 N., R. 4 W.):

A1—0 to 6 inches, reddish-brown (2.5YR 4/4) clay loam, dark red (2.5YR 3/6) when moist; moderate, fine, granular structure; hard when dry, firm when moist; calcareous; gradual boundary; horizon 6 to 10 inches thick.

B2—6 to 15 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; moderate, medium, granular structure; hard when dry, firm when moist; calcareous; gradual boundary; horizon 6 to 12 inches thick.

C—15 to 25 inches +, red (2.5YR 4/8) shale, clay, and siltstone of the red beds, dark red (2.5YR 3/6) when moist.

The A1 horizon is mostly clay loam but is clay and silty clay loam in some areas. The A1 and B2 horizons are reddish brown or red in hues of 5YR and 2.5YR. The texture of the B2 horizon ranges from clay loam to clay. Depth to red beds ranges from 10 to 25 inches.

Vernon soils have a more clayey profile than Lucien and Darnell soils. Unlike Renfrow soil, Vernon soils are calcareous at the surface, lack a B2t horizon, and have a thin solum.

Vernon-Lucien complex, 5 to 15 percent slopes (VlE).—Vernon soils make up 65 to 75 percent of this complex, and Lucien soils make up about 25 to 35 percent. Small areas of Darnell soils are also included. These soils occur in such an intricate pattern that it is impractical to map each kind of soil separately. This complex is on uplands. Each kind of soil has a profile similar to that of its respective series.

All of this complex is in native grasses, mostly little bluestem, sideoats grama, and blue grama. A few blackjack trees grow on Lucien soils. (Capability unit VIe–5; Vernon soils are in the Red Clay Prairie range site, and Lucien soils are in the Shallow Prairie range site)

Vernon-Zaneis complex, 3 to 5 percent slopes (VzC).—This complex is mainly on uplands in the northwestern part of the county. It consists of about 70 to 80 percent Vernon clay loam, 15 to 25 percent Zaneis loam, and about 5 percent Renfrow clay loam. These soils occur in such an intricate pattern that it is impractical to map each kind of soil separately. Each kind of soil has a profile similar to the one described as typical for its respective series.

This complex is better suited to grasses in permanent pasture than to cultivated crops. About 65 percent of it is in native grasses. The more productive grasses include big bluestem, little bluestem, sideoats grama, and blue grama. The principal crops are wheat, oats, and other small grains, but sorghums and legumes are also grown. Winter wheat is the main crop.

Management includes controlling water erosion and maintaining soil structure and content of moisture. The cropping system ought to provide crops that produce a large amount of residue that is returned to the soil. Also needed are legumes or fertilizers. Terraces and contour farming can be used to help reduce the loss of soil and water. Row crops should not be grown, but sown crops can be grown for 2 years followed by legumes for 2 years if stubble mulching and contour tillage are used. (Capability unit IVe–3; Vernon soils are in the Red Clay Prairie range site, and Zaneis soils are in the Loamy Prairie range site)

Zaneis Series

The Zaneis series consists of deep, gently sloping to moderately sloping, loamy soils. These soils are on uplands in the north-central part of the county.

The surface layer is dark-brown loam that has granular structure and is about 9 inches thick (fig. 9). This layer is moderately easy to till.

The subsoil is about 39 inches thick. The upper part is reddish-brown light clay loam and has moderate, medium,

Figure 9.—Soil profile of Zaneis loam.

granular structure. The middle part is a reddish-brown clay loam that has weak, medium, prismatic structure that grades to moderate, medium, subangular blocky structure, and the lower part is yellowish-red heavy clay loam that has moderate, medium, subangular blocky structure.

The underlying material is soft, fine-grained sandstone that is difficult for plant roots to enter.

Zaneis soils are naturally well drained. Internal drainage is medium, permeability is slow, and water-holding capacity is high. Natural fertility is moderately high.

Zaneis soils are used mostly for cultivated crops. These soils are suited to wheat, oats, barley, sorghums, cotton, legumes, and grasses. Winter wheat is the crop most commonly grown.

Typical profile of Zaneis loam, 3 to 5 percent slopes, in a meadow (south side of road, about 1,700 feet east and 100 feet south from the northwest corner of section 6, T. 14 N., R. 2 W.):

A1—0 to 9 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; medium acid; gradual boundary; horizon 6 to 10 inches thick.

B1—9 to 15 inches, reddish-brown (5YR 4/3) light clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard when dry, firm when moist; common fine roots and pores; medium acid; gradual boundary; horizon 4 to 8 inches thick.

B21t—15 to 24 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; weak, medium, prismatic structure that grades to moderate, medium, subangular blocky structure; hard when dry, firm when moist; many fine roots and pores; slightly acid; gradual boundary; horizon 6 to 10 inches thick.

B22t—24 to 48 inches, yellowish-red (5YR 5/6) heavy clay loam, yellowish red (5YR 4/6) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; slightly acid; diffuse boundary on sandstone; horizon 15 to 30 inches thick.

R—48 inches +, red (2.5YR 4/6) fragments of soft, partly weathered, fine-grained sandstone, dark red (2.5YR 3/6) when moist; massive; neutral.

The A1 horizon is dominantly loam but is silt loam in some small areas. It is dark brown or reddish brown in hues of 7.5YR and 5YR. In some places, the B1 and B21t horizons are dark reddish brown in a hue of 5YR. The B22t horizon is clay loam or heavy clay loam. Its color is reddish brown or red in a hue of 2.5YR in some places.

The Zaneis soils are more reddish than Vanoss and Chickasha soils.

Zaneis loam, 1 to 3 percent slopes (ZaB).—This soil is on uplands in the north-central part of the county. Its profile is like the one described as typical for the series. Included in mapping were areas of Chickasha loam that make up about 5 to 10 percent of the areas mapped.

This soil is desirable for farming and is suited to most crops grown in the county. All of it, except for a few small areas in native grass, is cultivated. Winter wheat is the principal crop.

Management is needed for controlling water erosion and for maintaining soil structure and fertility. The cropping system ought to provide legumes, fertilizer, or crops that produce a large amount of residue. All residue should be returned to the soil. Terracing and contour farming are essential where row crops are grown. By cultivating on the contour and sodding or seeding waterways, erosion can be reduced and excess water safely removed. Small grains can be grown year after year if stubble-mulch tillage and fertilizers are used. (Capability unit IIe-1; Loamy Prairie range site)

Zaneis loam, 3 to 5 percent slopes (ZaC).—This soil is on uplands with Zaneis loam, 1 to 3 percent slopes. Its profile is the one described as typical for the Zaneis series.

This soil is moderately easy to till, but in tilled areas it is subject to water erosion. It has high natural fertility.

Most of this soil is cultivated, and winter wheat is the principal crop. Also grown are sorghums, cotton, legumes, and grasses.

Management is needed for controlling water erosion and for maintaining soil structure and fertility. The cropping system ought to provide crops that produce a large amount of residue that is returned to the soil. Also needed are legumes or fertilizer. If stubble-mulch tillage and fertilizers are used, small grains can be grown year after year. Terracing and contour farming are essential where row crops are grown. (Capability unit IIIe-1; Loamy Prairie range site)

Use and Management of the Soils

About one-third of the farmland in Oklahoma County is used to produce tilled crops and tame pasture, and most of the rest is range. This section tells how the soils can be used for those main purposes, and for windbreaks and post lots, for wildlife, and in building roads, farm ponds, and other engineering structures. Also, a table lists soil features that adversely affect use of soils for nonfarm purposes.

Soil Management and Predicted Yields

First described in the following pages are general guidelines for managing soils used for tilled crops and tame pasture. Then, predicted yields of crops and pasture are listed, and the system of capability classification used by the Soil Conservation Service is explained. Those who wish to know the capability classification of a soil can refer to the "Guide to Mapping Units" at the back of this survey. Those desiring detailed information about the management of soils can turn to the section "Descriptions of the Soils."

Managing soils for tilled crops and tame pasture [1]

Wheat, mainly winter wheat, is the most extensive crop grown in Oklahoma County. Other important crops are barley, rye, oats, sorghums, alfalfa, and corn. Corn and alfalfa are grown on the bottom lands and on the deep, nearly level soils of the uplands.

On the soils used for crops, management is needed for controlling erosion, maintaining the supply of organic matter, improving or maintaining tilth, and conserving moisture. In some places surface crusting also requires attention.

The most effective way of controlling erosion on the soils in this county is using a carefully chosen set of practices. Suitable practices are growing a winter cover crop; keeping crop residue on or near the surface; tilling at a minimum; stripcropping; growing grasses, legumes, or both in a long-term rotation with tilled crops; construct-

[1] By M. D. GAMBLE, conservation agronomist, Soil Conservation Service.

TABLE 2.—*Predicted average acre yields of principal*

[Yields in columns A are those obtained under ordinary management; those in columns B are obtained

Soil	Wheat		Oats		Barley		Corn	
	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Bethany silt loam, 0 to 1 percent slopes	20	30	35	50	35	48	22	40
Canadian fine sandy loam	21	32	35	55	35	55	40	65
Canadian-Dale complex, undulating	21	30	35	50	35	50	38	56
Chickasha loam, 1 to 3 percent slopes	16	26	25	40	25	40	20	30
Crevasse loamy fine sand	8	14	24	32	24	32	--------	--------
Dale silty clay loam	22	32	40	55	40	55	40	65
Dougherty loamy fine sand, hummocky	10	14	20	30	20	30	--------	--------
Grant silt loam, 1 to 3 percent slopes	19	27	30	42	25	42	26	40
Konawa loamy fine sand, undulating	12	18	25	35	25	35	15	30
Lela clay	12	20	25	36	25	36	--------	--------
Miller clay	16	22	25	40	25	40	--------	--------
Miller-Slickspots complex	6	16	15	26	15	26	--------	--------
Nash loam, 3 to 8 percent slopes, eroded	10	12	15	22	15	22	--------	--------
Noble fine sandy loam, 3 to 8 percent slopes	10	16	16	28	16	28	--------	--------
Norge loam, 1 to 3 percent slopes	19	27	30	42	27	42	26	40
Norge loam, 3 to 5 percent slopes	16	25	25	38	25	38	20	37
Norge loam, 4 to 8 percent slopes, eroded	12	18	20	32	20	31	--------	--------
Norge-Slickspots complex, 0 to 3 percent slopes	11	16	22	35	22	35	--------	--------
Port clay loam	22	32	40	55	35	45	40	65
Port loam	22	32	40	55	38	50	40	65
Pulaski fine sandy loam	12	24	25	40	25	40	20	45
Renfrow clay loam, 1 to 3 percent slopes	14	20	25	40	22	38	--------	--------
Renfrow-Slickspots complex, 1 to 3 percent slopes, eroded	7	15	16	24	16	24	--------	--------
Stephenville fine sandy loam, 1 to 3 percent slopes	12	18	25	35	25	35	15	30
Stephenville fine sandy loam, 3 to 5 percent slopes	10	16	22	30	22	30	15	26
Stephenville fine sandy loam, 3 to 5 percent slopes, eroded	8	12	18	24	18	24	--------	--------
Teller fine sandy loam, 1 to 3 percent slopes	16	25	27	40	25	37	20	40
Teller fine sandy loam, 3 to 5 percent slopes	14	23	25	38	22	35	18	37
Vanoss silt loam, 0 to 1 percent slopes	20	32	35	55	35	55	30	50
Vernon-Zaneis complex, 3 to 5 percent slopes	10	16	15	30	15	20	--------	--------
Zaneis loam, 1 to 3 percent slopes	16	26	25	40	25	40	20	30
Zaneis loam, 3 to 5 percent slopes	14	24	23	38	21	33	--------	--------

[1] Animal-unit-months is the number of months during a year that 1 acre will provide grazing for 1 animal, or 1,000 pounds of live weight; or it is the number of months times the number of animal units. For example, 1 acre of Pulaski fine sandy loam in a

ing terraces; farming on the contour; keeping waterways in sod; and applying lime and fertilizer, where needed.

The cropping system selected has much to do with the success of management. Under a good system, the soil can be kept in good tilth and protected from erosion. Also, weeds, insects, and plant diseases can be controlled. Growing crops that produce a large amount of residue is also part of a good cropping system. Crops other than legumes can be used for this purpose. If small grains are grown and the straw is left as residue, it is frequently necessary to add nitrogen so as to hasten the decomposition of the straw. This, however, is not a substitute for adding nitrogen as plant food for better growth of crops.

In the large acreage of tame pasture in the county, bermudagrass is the most important warm-season plant. Some pastures are overseeded with bighop clover, Ladino clover, hairy vetch, or other legumes. A good mixture for farm-season pasture is 60 to 80 percent grass and 20 to 40 percent legumes. In other kinds of pasture, production of forage is maintained by applying fertilizer.

Fertilizer is generally needed for establishing perennial pasture plants. A soil test will indicate deficiencies in plant nutrients. From this information, a fertilizer program can be planned by considering the kind of pasture and the production desired. Production can be maintained for a long period if grazing is regulated and brush and weeds are controlled.

Predicted yields

Table 2 shows predicted long-term average yields of important crops and of tame pasture. The crops are wheat, oats, barley, corn, sorghums, cotton, and alfalfa. Yields are given for two levels of management. The predictions are averages for a period long enough to include both dry and wet years. When the moisture supply is favorable, yields are generally higher than those predicted. They are lower when moisture is unfavorable. Crop failures were included when the average yields were estimated.

The yields in table 2 are based partly on records kept by the Oklahoma Agricultural Experiment Station on fertility studies, crop variety tests, and crop rotation

crops and tame pasture under dryland farming

under improved management. Absence of yield indicates crop is not commonly grown on the soil]

Grain sorghum		Forage sorghum		Cotton		Alfalfa		Tame pasture [1] Common bermudagrass		Tame pasture [1] Improved bermudagrass	
A	B	A	B	A	B	A	B	A	B	A	B
Bu.	*Bu.*	*Tons*	*Tons*	*Lbs.*	*Lbs.*	*Tons*	*Tons*	*Animal-unit-months* [1]	*Animal-unit-months* [1]	*Animal-unit-months* [1]	*Animal-unit-months* [1]
26	42	2.2	3.2	290	375	1.5	2.5	3.0	6.0	4.2	6.5
34	44	2.5	3.5	315	400	2.2	3.0	4.5	6.0	6.0	8.5
32	44	2.5	3.5	300	400	2.5	3.0	4.6	6.5	6.0	8.5
28	38	2.2	3.2	250	350	1.5	2.5	3.5	5.8	5.0	7.0
20	30	1.5	2.0			1.2	2.8	4.0	5.5	4.5	5.0
34	46	3.2	4.0	400	500	3.0	3.8	5.5	6.6	6.0	8.5
16	26	1.4	2.4					2.0	4.5		
28	40	2.4	3.2	300	375	1.5	2.3	3.0	5.5	3.5	6.5
22	32	2.0	3.0	200	300	1.0	2.0	2.0	4.5	3.5	5.5
25	40	1.5	2.5			1.0	2.0	3.5	5.0		
25	42	1.2	2.2			1.2	2.8	3.5	5.0	4.5	5.0
16	27							2.0	3.5		
								1.8	3.0		
								3.4	4.4	4.0	5.5
28	40	2.3	3.3	300	375	1.5	2.5	4.2	6.2	5.5	7.0
26	38	2.0	3.0	200	325	1.2	2.2	3.5	5.5	4.5	6.5
								2.0	3.5		
20	30	1.8	2.2	160	225			2.0	3.5		
35	52	3.0	4.0	350	500	2.8	4.0	5.5	7.0	6.0	8.5
35	52	3.0	4.0	350	500	2.5	4.0	5.5	7.0	6.0	8.5
20	45	2.5	3.5	220	300	1.8	3.2	4.5	6.5	5.0	8.0
20	30	1.4	2.0					2.0	3.5		
22	32	2.0	3.0	200	300			2.8	5.6	4.0	6.0
20	26	1.5	2.5					2.1	5.0	3.5	5.5
18	24	1.2	2.2					2.0	4.5	2.5	5.0
28	40	2.3	3.3	225	350	1.5	2.5	4.2	6.0	5.0	7.0
26	38	2.0	3.0	200	325	1.2	2.2	3.4	5.4	4.0	6.5
30	42	2.5	3.5	290	390	1.7	2.7	5.0	6.0	6.0	8.0
28	38	2.2	3.2	225	370	1.2	2.0	3.5	5.0	4.0	6.0
26	36	2.0	3.0	170	260			3.2	4.3	3.5	5.5

pasture of improved bermudagrass under improved management will provide grazing for 4 animals for 2 months and is rated 8 animal-unit-months.

and tillage trials. These experiments have been conducted for many years on both permanent and experimental sites and on farmers' plots. The records provide an excellent source of information for estimating long-term average yields on a number of soils.

The soil scientists who made this survey obtained other data on yields at specific levels of management when they interviewed farmers and observed fields of crops. If enough data for a certain soil were not obtained, estimates were made by comparing the soil with similar soils for which ample data were available.

The yields shown in columns A are those that can be expected under common management, or management practiced by a substantial number of farmers in the county. Common management normally provides (1) proper rates of seeding, timely dates of planting, and efficient methods of harvesting; (2) control of weeds, insects, and plant diseases; (3) use of terraces and contour farming where needed; (4) small applications of lime and fertilizer on fields used for cash crops and where legumes are to be established; (5) widespread use of the moldboard plow and one-way disk plow.

The yields in columns B can be expected under improved management. Improved management includes the first four practices listed for common management plus (1) applications of lime and fertilizers in amounts indicated by soil tests, or suggested by local agricultural technicians; (2) use of adapted improved varieties of crops; (3) use of cover crops on sandy soils that tend to blow; (4) installation of surface drains where needed; (5) management of crop residue and tillage so as to control erosion, maintain soil structure, increase infiltration of water, and assist the emergence of seedling.

Capability classification

In the "Guide to Mapping Units" at the back of this survey the soils of Oklahoma County have been classified according to their suitability for most kinds of farming. This classification is based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops having special requirements. The soils are classified according to degree and kinds of permanent limitation, but without consideration of major and generally expensive land forming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible major reclamation.

In this system all soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest grouping, are designated by Roman numerals, I through VIII. The numerals, which indicate progressively greater limitations and narrower choices for practical use, are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have some limitations that reduce the choice of plants or require moderate conservation practices.

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

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

Class V soils are subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI soils 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.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife. (None in Oklahoma County.)

Class VIII soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in Oklahoma County.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows 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 United States, but not in Oklahoma County, shows 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 limitations. Class V can contain, at the most, only subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are 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. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

Management of Soils for Range [2]

The raising of livestock is one of the most important farm enterprises in Oklahoma County. Approximately 150,000 acres is natural grassland or range, of which about 35,000 is pastured woodland containing some scrubby post and blackjack oaks and associated hardwoods. Most of the range is in the eastern part of the county, but areas are

[2] By C. E. KINGERY, range conservationist, Soil Conservation Service.

scattered throughout. The U.S. Census of Agriculture reported that, in 1964, farms and ranches carried 25,247 cows and calves.

The numbers and kinds of livestock on farms and ranches in the county constantly change as the metropolitan area of Oklahoma City expands. Because of the livestock market in Oklahoma City, stocker and feeder operations in the county are numerous.

Range sites and condition classes

A range site is a distinctive kind of rangeland that is sufficiently uniform in climate, soil, and elevation to produce a particular kind of climax vegetation. In the same pasture area, there may be several range sites, each of which requires different stocking rates and different management practices. These practices include fencing, locating salting and watering places, determining the period of grazing, deciding on the number and kind of livestock, and controlling brush.

The soils on any one range site produce the same climax vegetation. Climax vegetation is the combination of plants that originally grew on the site. It is generally the most productive vegetation for the site, and it will maintain itself under conditions similar to those that existed before the site was cultivated or heavily grazed.

On the sites where grazing is intense, important changes in kinds and amounts of vegetation take place. Continuous excessive grazing alters the original plant cover and lowers productivity. The livestock seek out the more palatable and nutritious grasses, and under heavy grazing, these choice plants, or *decreasers*, are weakened and gradually eliminated. The choice plants are replaced by less palatable plants, or *increasers*. If heavy grazing continues, even these increasers are weakened and the site is eventually occupied by less desirable grasses and weeds, which are called *invaders*.

The downward trend in range vegetation is generally continuous under heavy grazing and can be expressed as range condition. Four classes of range condition are recognized. Range is in *excellent* condition if 76 to 100 percent of the plant cover consists of the original vegetation. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if the percentage is 25 or less. If range is in poor condition, most of the vegetation is made up of weak increasers and invaders.

Changes from an excellent to a poorer range condition generally take place gradually, and the signs that the vegetation is becoming less vigorous are often overlooked. Plant growth that is encouraged by favorable rainfall may appear to be improving when actually the long-term trend is toward a less desirable cover. On the other hand, rangeland in good or excellent condition may appear to be in poor condition because of drought or a season of close grazing. Under normal moisture conditions and proper stocking rates, this range will quickly recover its vigorous growth of grasses.

Fires sweep the prairies occasionally and damage the vegetation, though the effects are only temporary. At times fires improve the stand of grass by eliminating heavy accumulations of litter and by destroying some woody sprouts. Where fire destroys woody sprouts on the savannah sites, a better balance between brush and grass is maintained.

Descriptions of range sites

The soils of Oklahoma County have been grouped into range sites according to their ability to produce similar kinds and amounts of climax vegetation. The description of each range site gives the more important characteristics of the soils and the names of the principal plants. Also given is the estimated total annual yield of herbage on the site in excellent condition when moisture is favorable and when it is unfavorable. To find the names of the soils in any given unit, refer to the "Guide to Mapping Units" at the back of this survey.

ALKALI BOTTOM LAND RANGE SITE

Only the slickspots in Miller-Slickspots complex are in this range site. These slickspots are affected by alkali, take in water very slowly, and are droughty. They are on bottom lands.

Among the native plants that grow on this site are switchgrass, alkali muhly, and inland saltgrass.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 3,200 pounds per acre in years of favorable moisture and 1,800 pounds per acre in years of unfavorable moisture.

CLAYPAN PRAIRIE RANGE SITE

This range site consists of soils underlain by compact clay. This clay somewhat restricts the movement of water and the growth of plants.

Blue grama, buffalograss, and unpalatable weeds increase greatly if this site is continuously and heavily overgrazed. Annual three-awn is a particularly undesirable invader in overgrazed areas.

Where this site is in excellent condition (fig. 10), the estimated annual yield of air-dry herbage is 4,000 pounds per acre in years of favorable moisture and 2,000 pounds per acre in years of unfavorable moisture.

DEEP SAND SAVANNAH RANGE SITE

In this range site are undulating and hummocky loamy fine sands on which grasses grow moderately well. These soils have moderate water-holding capacity, though they readily release moisture to plants.

Tall grasses intermingled with trees and other woody plants grow on this site, mainly because their roots can penetrate deeply.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage, except for trees and brush, is 3,800 pounds per acre in years of favorable moisture and 1,900 pounds per acre in years of unfavorable moisture.

ERODED CLAY RANGE SITE

Eroded clayey land—the only mapping unit in this range site—consists of formerly cultivated fields. This land is so eroded that it produces little forage.

On this site the range plants are similar to those on the Claypan Prairie range site, though much sparser. In many places silver bluestem, annual three-awn, splitbeard bluestem, and other grasses invade.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 1,400 pounds per acre in years of favorable moisture and 800 pounds per acre in years of unfavorable moisture.

Figure 10.—**Renfrow soils on Claypan Prairie range site in excellent condition.**

ERODED SANDY SAVANNAH RANGE SITE

This range site consists of soils that have a fine sandy loam surface layer. These soils were formerly cultivated and are now severely eroded. Many deep, uncrossable gullies have formed. The soil between the gullies is deep in some places and supports a fairly good growth of grasses, but in most places grasses grow poorly.

Because the soils are eroded, it is hazardous to prepare a clean seedbed before grasses are seeded. Many areas, however, have been restored by broadcast seeding and natural revegetation. Among the plants that grow on this site are little bluestem, indiangrass, purpletop, purple lovegrass, jointtail grass, splitbeard bluestem, and silver bluestem. Splitbeard bluestem, silver bluestem, and other less desirable grasses are commonly reduced if little bluestem, indiangrass, and other decreasers are encouraged by good management.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage, except for trees and brush, is 2,500 pounds per acre in years of favorable moisture and 1,700 pounds per acre in years of unfavorable moisture.

ERODED SHALLOW SAVANNAH RANGE SITE

This range site consists of shallow soils that were formerly cultivated and are now severely eroded. Sandstone generally is near the surface, but it is exposed in many places (fig. 11). Grasses grow only fairly well.

On this site little bluestem, splitbeard bluestem, and indiangrass are common. Legumes are plentiful and include Stuevis lespedeza, roundhead lespedeza, and prairie-clover.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage, except for trees and brush, is 1,700 pounds per acre in years of favorable moisture and 1,000 pounds per acre in years of unfavorable moisture.

HEAVY BOTTOM LAND RANGE SITE

In this range site are nearly level deep clays on bottom lands. These soils are somewhat poorly drained. Much of the time they are wet, but they are droughty during summer.

On this site many of the climax plants, mainly wildryes, uniolas, sedges, and rushes, grow during the cool season. When the better drained areas are in excellent condition, switchgrass, prairie cordgrass, big bluestem, and Florida paspalum are abundant. Grasses, legumes, and forbs make up about 70 to 80 percent of the plant cover when the range is in excellent condition, and American elm, pecan, walnut, poison-ivy, indigobush, and other woody plants make up the rest. In areas in poor condition, the abundant plants

Figure 11.—**Severely eroded Darnell soils in the Eroded Shallow Savannah range site. The light-colored area in the foreground is sandstone.**

include sumpweed, buffalograss, meadow dropseed, ragweeds, windmillgrass, and woody increasers. Among the invaders are hawthorn, persimmon, and honeylocust.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 5,500 pounds per acre in years of favorable moisture and 2,500 pounds per acre in years of unfavorable moisture.

LOAMY BOTTOM LAND RANGE SITE

This range site consists of deep, dark, loamy soils on bottom lands. It is one of the highest producing range sites in the county.

If this site is in excellent condition, vegetation consists of a mixture of tall grasses and woody plants. Among the tall grasses are eastern gamagrass, prairie cordgrass, big bluestem, switchgrass, broadleaf uniola, and wildryes. The woody plants include pecan, walnut, indigobush, and trumpet vine. In areas in excellent condition, grasses cover about 75 percent and woody plants cover the rest.

The condition of the range declines to poor in some areas that have been cultivated and then abandoned because of flooding. In these areas the plant mixture consists mainly of johnsongrass, bermudagrass, pecan sprouts, trumpet vine, seacoast sumpweed, marestail, ragweeds, white snakeroot, and persimmon. There are also some indiangrass, big bluestem, switchgrass, and purpletop.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 8,500 pounds per acre in years of favorable moisture and 4,500 pounds per acre in years of unfavorable moisture.

LOAMY PRAIRIE RANGE SITE

This range site consists of nearly level to gently rolling soils. These soils generally have a loam or silt loam surface layer that is granular and porous. They are permeable to water, are easily penetrated by roots, and have good capacity for storing moisture.

This is the most productive range site in the uplands. In areas in excellent condition, the climax vegetation is about 80 percent decreaser grasses, about 5 percent legumes and forbs, and about 15 percent increasers. The decreaser grasses are mainly big bluestem, little bluestem, indiangrass, and switchgrass. The legumes and forbs include tickclover, leadplant, gayfeathers, and sunflower. Among the increasers are sideoats grama, tall dropseed, meadow dropseed, wild-indigo, and heath aster.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 5,000 pounds per acre in years of favorable moisture and 2,500 pounds per acre in years of unfavorable moisture.

RED CLAY PRAIRIE RANGE SITE

This range site consists of clayey rolling soils on uplands. These soils absorb water slowly where the surface is protected by grasses. Careful management of grazing is needed so that the plant cover remains and protects the soils from erosion.

Little bluestem is the main decreaser on this site, and sideoats grama, meadow dropseed, and hairy grama are the main increasers. Other decreasers are legumes and forbs, including catclaw sensitivebrier, groundplum, scurfpea, trailing ratany, and Lambert crazyweed. Decreasers make up about 70 percent of the total vegetation.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 2,700 pounds per acre in years of favorable moisture and 1,600 pounds per acre in years of unfavorable moisture.

SANDY BOTTOM LAND RANGE SITE

This range site consists of deep sandy soils on bottom lands that are subject to frequent or occasional flooding. In some low swales, these soils are subirrigated.

In most places forage plants grow fairly well. Plant roots penetrate deeply, and the supply of moisture is generally favorable. Plant growth is less, however, in the more sandy, hummocky areas.

On this site sand bluestem, switchgrass, and little bluestem are common. Among the woody plants that invade are willow, saltcedar, and cottonwood trees. Johnsongrass and bermudagrass are the most common invader grasses.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 3,800 pounds per acre in years of favorable moisture and 2,000 pounds per acre in years of unfavorable moisture.

SANDY PRAIRIE RANGE SITE

This range site occurs mostly in cultivated areas. It consists of soils that have a fine sandy loam surface layer. The subsoil is somewhat finer textured and slows the penetration of water. Prairie vegetation is most common, but some woody plants grow and increase if the range is not managed well.

Big bluestem, little bluestem, and indiangrass are the principal grasses. Woody plants include elm, coralberry, and oak. In some areas, hawthorn has invaded this site.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 4,800 pounds per acre in years of favorable moisture and 2,800 pounds per acre in years of unfavorable moisture.

SHALLOW PRAIRIE RANGE SITE

This range site consists of loamy soils that are shallow over sandstone. In most places sandstone is at or near the surface. Grasses grow fairly well on this site but are somewhat restricted by the sandstone. Areas of this site are closely intermingled with those of the Red Clay Prairie site.

Decreaser plants that are abundant where this site is in excellent condition are little bluestem, big bluestem, indiangrass, wildryes, tall dropseed, catclaw sensitivebrier, and perennial sunflowers. Increasers make up about 30 percent of the climax vegetation if the range is in excellent condition. Important increasers are sideoats grama, meadow dropseed, hairy grama, jointtail, heath aster, coralberry, and sumacs.

On mismanaged range, invaders and increasers are abundant. They are annual bromes, three-awns, splitbeard bluestem, broomsedge bluestem, ragweeds, broomweed, persimmon, coralberry, sumacs, goldenrod, hairy grama, sideoats grama, and silver bluestem.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 3,000 pounds per acre in years of favorable moisture and 1,500 pounds per acre in years of unfavorable moisture.

SANDY SAVANNAH RANGE SITE

This range site consists of gently sloping to strongly sloping fine sandy loams. These soils support a mixture of tall grasses and woody plants.

Where this site is in excellent condition, about 80 percent of the plant cover consists of decreasers, and the rest is increasers. Important decreasers are little bluestem, big bluestem, indiangrass, and switchgrass. Among the increasers are purpletop, Scribner panicum, goldenrods, asters, and perennial sunflowers.

Heavy, prolonged grazing or fire and heavy grazing thin out the grasses and forbs and release space for invaders, particularly woody plants. Areas that have never been cultivated or that are in poor or fair condition appear to have a thick stand of post oak and blackjack oak. Normally, however, there is also a thin stand of little bluestem, broomsedge, bluestem, annual three-awn, ragweeds, and croton, but only traces of other original decreasers. In formerly cultivated fields in poor or fair range condition, the forage plants are of low value. These plants include oldfield, three-awn, splitbeard bluestem, silver bluestem, and partridge-pea, but little bluestem, indiangrass, purpletop, and other decreasers are returning.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage, except for trees and brush, is 4,500 pounds per acre in years of favorable moisture and 2,500 pounds per acre in years of unfavorable moisture.

SHALLOW SAVANNAH RANGE SITE

This site consists of gently to strongly sloping, shallow soils that have low available water-holding capacity. Horizontal beds of sandstone are near the surface and limit the penetration of roots. Desirable forage plants are scarce, but woody plants grow in the cracks in the rocks and in deep pockets of soil. This site is closely intermingled with the Sandy Savannah range site.

Post oak, blackjack oak, and some hickory grow in open stands where this site is in excellent condition. Trees make up about 25 percent of the plant composition, and grasses, legumes, and forbs make up 75 percent. The main grasses are little bluestem, sideoats grama, indiangrass, switchgrass, and big bluestem. When the condition of this site declines to poor, the grasses thin out and are replaced by oak sprouts and weeds. The site then appears to be woodland consisting of post oak and blackjack oak sprouts.

Where this range site is in excellent condition, the estimated annual yield of air-dry herbage, except for trees and brush, is 3,200 pounds per acre in years of favorable moisture and 1,400 pounds per acre in years of unfavorable moisture.

SLICKSPOT RANGE SITE

This range site consists of slickspots, sometimes called alkali spots. The site is closely intermingled with the Loamy Prairie and Claypan Prairie range sites. The vegetation on the Slickspot range site differs markedly from that on surrounding sites.

The principal climax plants are tall dropseed, switchgrass, blue grama, and yellow neptunia. Inland saltgrass is a common increaser grass, and western ragweed is the main increaser forb.

Where this site is in excellent condition, the estimated annual yield of air-dry herbage is 1,800 pounds per acre in years of favorable moisture and 800 pounds per acre in years of unfavorable moisture.

SUBIRRIGATED RANGE SITE

Pulaski soils, wet, are the only soils in this range site. These soils occur on bottom lands and are frequently flooded. Growth of grasses is increased by the high water table but is reduced when streams overflow and deposit fresh material. Also, growth of grasses is reduced when willow, cottonwood, and other woody plants invade.

The more important forage plants are switchgrass, American bulrush, indiangrass, and common reedgrass.

When this site is in excellent condition, the estimated annual yield of air-dry herbage is 1,800 pounds per acre in years of favorable moisture and 6,000 pounds per acre in years of unfavorable moisture.

Management of Soils for Windbreaks and Post Lots [3]

The rapid settlement growth of Oklahoma City has nearly eliminated trees of value that may have grown on the bottom lands of the North Canadian River and its main tributaries. Some willow and cottonwood grow on bottom lands, and some tamarisk grows on the sand bars. These trees are mostly on Crevasse soils. A few Osage-orange grow on the finer textured soils on bottom lands. Also growing along and near the North Canadian River are elm, hackberry, walnut, sycamore, and several of the bottom-land oaks. A few remnants of hardwood stands remain along the river near the eastern edge of the county.

A low scrubby growth consisting of post oak, blackjack oak, and a few hickory trees occur on the sandy and loamy uplands on the Darnell, Stephenville, Noble, Dougherty, Konawa soils, and other soils. On these soils, redcedar grows singly and in a few small groves.

Some of the industries that use wood are in and around Oklahoma City, but almost all of the wood is supplied from outside of the county. Some firewood is cut within the county, but most of it is shipped from counties nearby. Cutting and hauling this wood are fairly profitable, but most of the firewood is being depleted as the timber stands

[3] By CHARLES P. BURKE, woodland conservationist, Soil Conservation Service.

are clear cut for nonfarm development or for clearing farmland.

Windbreaks and post lots

The most useful trees and shrubs in Oklahoma County are those planted in windbreaks. Windbreaks are needed because trees are not plentiful, the wind is sometimes strong, and the temperature may be extreme. Trees are also planted in post lots.

The three kinds of windbreaks used in the county are farmstead windbreaks, field windbreaks, and windbreaks used to protect areas of expansion near Oklahoma City.

Farmstead windbreaks protect buildings, feedlots, driveways, and other areas around the farmstead. They also contribute to human comfort, reduce heating bills, save livestock feed, and control drifting snow. Farmstead windbreaks are much more numerous in the county than field windbreaks. Field windbreaks are those in which trees are planted to protect cultivated fields from soil blowing.

Windbreaks are planted to protect areas of expansion near Oklahoma City where this expansion is planned or seems probable. The purpose of these windbreaks is to protect farm subdivisions, as well as streets, water and sewage lines, and other facilities. Unless the location of these facilities is known, the windbreaks can be a liability if they are not correctly located.

Osage-orange and eastern redcedar are the only trees native to the county that make durable posts. Because these trees are scarce in the county, they or other trees must be planted in post lots. The main trees suitable for this purpose are black locust, catalpa, and Osage-orange. Black locust grows well on many kinds of soils, but the soils suited to catalpa are few. Osage-orange grows best on the finer textured soils of the bottom lands. All of these trees grow well if they are planted on suitable soils, are clear cut at 8- to 10-year intervals, and their sprouts are managed so as to promote sustained yields. Protection from fire and elimination of grazing are essential. Generally, trees suitable for post lots are not suitable for windbreaks. Also, the effectiveness of a windbreak is reduced if any of its trees are cut for posts.

Assistance in planning windbreaks and plantings in post lots can be obtained from the Soil and Water Conservation District, the county extension director, the State Forestry Division, and the Soil Conservation Service.

Descriptions of woodland suitability groups

The soils in Oklahoma County have been placed in woodland suitability groups according to their characteristics that affect the growth of trees. All the soils in a 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 described in the following paragraphs. 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.

WOODLAND SUITABILITY GROUP 1

This woodland suitability group consists of deep, nearly level to gently sloping soils on bottom lands and uplands. These soils are well drained, have high to moderate capacity for storing moisture, and have slow to moderate runoff. They are in the Canadian, Dale, Crevasse, Konawa, Port, Pulaski, Stephenville, and Teller series. They make up about 14 percent of the farmland in the county.

The soils of this group are good to excellent for growing trees in field and farmstead windbreaks and post lots.

Tall trees suitable for windbreaks are Siberian elm, cottonwood, and sycamore. Elm grows best in the loams, clay loams, silt loams, and fine sandy loams and may reach a height of 60 to 70 feet in 20 years. Cottonwood and sycamore are more suited to coarser textured soils. Cottonwood grows to a height of 85 to 90 feet in 20 years, but sycamore seldom grows higher than 75 feet in that period.

Russian mulberry can be used as a tree of intermediate height. It makes an excellent shrub if it is spaced 4 to 5 feet in rows and is top pruned.

Evergreens suitable for farmstead windbreaks are Austrian pine, ponderosa pine, eastern redcedar, and some strains of the seedling (nongrafted) form of Chinese arborvitae. They can be used either as the tall trees or as the lower trees in front of tall trees. Austrian pine and ponderosa pine, however, seldom grow to a height of more than 20 to 30 feet in 20 years, but redcedar and arborvitae may grow 5 feet taller in that period.

Black locust, catalpa, and Osage-orange grow at least fairly well on the soils of this group. Osage-orange is best suited to the clay loams, and catalpa should be grown only on the loams and fine sandy loams. Black locust is fairly well suited to all of the soils.

WOODLAND SUITABILITY GROUP 2

This woodland suitability group consists of deep, nearly level to moderately steep, medium-textured and coarse-textured soils on bottom lands and uplands. These soils are well drained and have rapid to slow permeability. They belong to the Bethany, Chickasha, Crevasse, Doughtery, Grant, Noble, Norge, Pulaski, Stephenville, Teller, Vanoss, and Zaneis series. Also in this group are Breaks-Alluvial land complex, Norge-Slickspots complex, and Broken alluvial land. The soils of this group make up about 46 percent of the farmland of the county.

These soils are fair for field windbreaks and fair to good for farmstead windbreaks. Only the Crevasse and Noble soils and Broken alluvial land are suitable for post lots.

The soils of this group do not have so favorable moisture content in the subsoil as do the soils in group 1. Suitable as tall trees in windbreaks are Siberian elm, cottonwood, and sycamore. These trees grow best on bottom lands or on the loamy fine sands of uplands. Adapted evergreens include Austrian pine, ponderosa pine, eastern redcedar, and some strains of the seedling (nongrafted) form of Chinese arborvitae, but redcedar and arborvitae survive better and grow more vigorously than the others. All of the trees make 10 to 15 percent less growth in 20 years than they do on the soils of group 1. Black locust is superior to other species grown for posts on these soils.

WOODLAND SUITABILITY GROUP 3

This woodland suitability group consists of deep, moderately deep, and shallow soils that are gently sloping to strongly sloping. These soils are moderately coarse textured to moderately fine textured. Some of the soils are eroded. In the group are Darnell, Nash, Norge, Renfrow, and Stephenville soils and Renfrow-Slickspots and Vernon-Zaneis complexes. These soils make up about 20 percent of the farmland in the county.

The soils in this group are generally unsuitable for field windbreaks or post lots. They are suitable for farmstead windbreaks where tall trees are not needed and where the trees can be watered in droughty periods with the water supplying the farm.

Trees suitable for farmstead windbreaks on the soils of this group are Siberian elm, Russian mulberry, eastern redcedar, and some strains of Chinese arborvitae. These trees grow much slower on the soils of this group than they do on those of groups 1 and 2. Also, more cultivation and more watering are needed.

WOODLAND SUITABILITY GROUP 4

The soils in this woodland suitability group range from shallow to deep and from nearly level to moderately steep. They are noneroded or severely eroded. These soils make up about 20 percent of the farmland in the county. In this group are Lela and Miller soils, Darnell-Stephenville, Miller-Slickspots, and Vernon-Lucien complexes, and Eroded clayey land and Eroded loamy land.

These soils are not suitable for tree plantings in windbreaks or post lots. The survival and growth of trees are limited by many adverse characteristics, mainly salinity, erosion, and shallowness.

Wildlife and Fish [4]

The main areas of wildlife habitat in Oklahoma County are the prairies, the timbered uplands, and the timbered bottom lands. The prairies are in the western one-third of the county, and the timbered uplands are in the eastern two-thirds. The timbered bottom lands occur as narrow bands on both sides of the North Canadian River and Deep Fork. They are also along other large streams and along some drainageways.

Important kinds of wildlife in the county are bobwhite quail, mourning dove, fox squirrel, deer, cottontail and jack rabbit, mink, opossum, skunk, muskrat, and beaver. Small flocks of Rio Grande wild turkey have been released in the county and appear to be successfully established. Predatory animals include coyote, bobcat, red fox, and gray fox. Predatory birds are mostly many kinds of hawks and owls. They are protected by law because they help to control harmful rodents. The large lakes in the county attract waterfowl during the migration season. Many kinds of songbirds live in the county during all seasons. They are protected because of their esthetic value and because they help control some of the harmful insects.

Where habitat is adequate and reproduction of wildlife is normal, most kinds of game can be hunted each year and still maintain their numbers. Bobwhite quail is the most popular game bird. Mourning dove is hunted in stubble fields, in weed fields, and around ponds, but the number of dove taken is limited. These birds migrate locally because the weather is warm during the hunting season. Squirrel hunting is popular in the more heavily wooded areas. Coyote are hunted for sport, but only a few pelts are sold. A few opossum, skunk, muskrat, and mink are trapped for their pelts. Mink is the most valuable furbearer in the county. Hunting waterfowl is important around Lake Hefner and around some of the farm ponds that contain food plants.

Fish in the larger streams include black and white bass, channel, bullhead, and flathead catfish, crappie, carp, buffalo, and species of small sunfish and of minnows. Also, fish have been stocked in many farm ponds and in lakes that have been built for watering livestock and for recreation (fig. 12). A moderate to large amount of bass and channel catfish can be produced where drainage is from a well-vegetated watershed, water is fertile, and a reasonably stable water level is maintained. Most fishing in the county is in Hefner, Overholser, and Hiwassee Lakes and in farm ponds. Bass, bluegill, and channel catfish for stocking suitable ponds are available from Federal and State fish hatcheries.

A convenient way to discuss different kinds of wildlife habitat in the county is by soil associations. The soil associations in this county are described in the section "General Soil Map."

The Darnell-Stephenville association (1) makes up about 45 percent of the farmland in the county. Because of the strong slopes and low fertility, only about 30 percent of the acreage is cultivated. Much of the area is covered with dense stands consisting of post oak, blackjack oak, and oak and hickory. Many areas that were formerly cultivated have reverted naturally to grasses or have been reseeded or sodded. Other areas have been invaded by trees and shrubby vegetation.

The varied plant cover of soil association 1 provides a good habitat for bobwhite quail, deer, furbearers, and other wildlife. Many areas can be easily managed so as to increase the number of wildlife. Some of the practices needed are selective clearing of brush, seeding of plants for wildlife food, and disturbing the soils so as to increase weeds. The closely intermingled Vernon and Lucien soils are not suitable for planting trees and shrubs, but they can be improved as wildlife habitat if they are disked or otherwise disturbed. Grazing of livestock needs to be controlled in this association so that enough cover is left for birds that nest on the ground.

The Renfrow-Vernon-Bethany association (2) makes up about 24 percent of the farmland in the county. Because most of this acreage is cultivated, only a few areas of food and cover are available for wildlife. Wheat is the main crop, and its stubble provides food for mourning doves during a short period in summer. Migrating geese feed on fall-planted wheat. Deer and bobwhite quail feed on the wheat that is adjacent to their cover, which is generally along streams and drainageways. Trees and shrubs can be planted to create wildlife habitat, or to supplement that existing, if the more permeable soils in this association are selected. These plantings must be cultivated and protected until they are established.

The Dale-Canadian-Port association (3) makes up about 16 percent of the farmland in the county. Intensive cultivation of the deep, fertile soils on benches has eliminated much of the desirable wildlife habitat, though some remain in parts of the flood plains that are not desirable for cultivation. The soils of this association are well adapted to many kinds of plantings for wildlife. Because these soils are deep and fertile and are subirrigated in places, plants grow rapidly and produce seed early.

The Dougherty-Norge-Teller association (4) makes up about 9 percent of the farmland in the county. About half of the acreage is cultivated, and the rest is in native grass, is pastured, is idle, or is in many kinds of woody plants.

[4] By JEROME F. SYKORA, biologist, Soil Conservation Service.

Figure 12.—**This small lake on Norge soils provides water for livestock and excellent fishing and other recreation.**

This diversified use of the soils provides food and cover for many kinds of wildlife. Also, the natural habitat can easily be improved so as to increase wildlife. Among the practices needed are plantings for food, disturbing the soil so as to increase weeds, and selective clearing in the densely wooded areas.

The Zaneis-Chickasha association (5) makes up about 6 percent of the farmland in the county, most of which is cultivated. Winter wheat and grain sorghum are the main crops. Plantings for wildlife can be made on the soils of this association. If woody plants are to be established, however, cultivation, additions of fertilizer, and protection from fire and livestock are required.

In association 3, ponds of the pit type (fig. 13) can be constructed in the Pulaski and Crevasse soils because these soils have a high water table that will maintain a constant level of water. In associations 1 and 4, however, the water level of ponds in the more permeable or excessively drained soils is not constant enough for fish production. Production of fish in association 2 is small because the soils are highly dispersed and the waters are turbid. Channel catfish and bullhead tolerate turbid waters, but their production is limited.

Use of Soils in Engineering [5]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. The properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Also important are topography, depth to water table, and depth to bedrock.

Information in the survey can be used to—

1. Make soil and land use studies that will aid in selecting and developing sites for industries, businesses, residences, and recreational areas.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversion terraces.

[5] By PETER A. RASMUSSEN, agricultural engineer, and WILLIAM E. HARDESTY, civil engineer, Soil Conservation Service.

Figure 13.—**A pit reservoir used to water livestock and produce fish. The soil is Pulaski fine sandy loam.**

3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and from reports and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes.

With the use of the soil map for identification, the engineering interpretations in this subsection can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or 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.

Much of the information in this subsection is given in tables 3, 4, and 5. In table 3 properties of the soils that are important to engineering are estimated. Table 4 indicates the suitability of the soils for various engineering uses. Table 5 contains test data for soils of eight series in the county.

In addition to this subsection, "Descriptions of the Soils," "Formation and Classification of Soils," and other sections of the survey are useful to engineers. Some of the terms used by the soil scientists may be unfamiliar to engineers, and some terms have a special meaning in soil science. These terms, as well as other terms used in this soil survey, are defined in the Glossary, and some of them are explained in detail in the "Soil Survey Manual" (*6*) [6].

[6] Italic numbers in parentheses refer to Literature Cited, p. 551.

Engineering classification systems

Two systems of classifying soils are in general use among engineers. One is the system approved by the American Association of State Highway Officials (AASHO) (*1*), and the other is the Unified system adopted by the Corps of Engineers, U.S. Army (*8*). Both systems are used in this survey and are explained in the following paragraphs. The explanations are taken largely from the "PCA Soil Primer" (*3*).

AASHO classification system.—Most highway engineers classify soils according to the AASHO system. In this system, soils are placed in seven principal groups. The groups range from A–1, consisting of gravelly soils of high-bearing capacity, to A–7, consisting of clay soils that have low strength when wet. Within each group, the relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. For the soils tested, the group index numbers are shown in table 5 in parentheses following the soil group symbol. The estimated AASHO classification of the soils in the county, without group index numbers, is given in table 3.

Unified classification system.—In the Unified classification system, the soils are grouped on the basis of their texture and plasticity and their performance as material for engineering structures. Soil material is divided into 15 classes. Eight classes (GW, GP, GM, GC, SW, SP, SM, and SC) are for coarse-grained material; six classes (ML, CL, OL, MH, CH, and OH) are for fine-grained material; and one class (Pt) is for highly organic material. The clean sands are identified by the symbols SW and SP; sands mixed with fines of silt and clay are identified by the symbols SM and SC; silts and clays that have a low liquid limit are identified by the symbols ML and CL; and silts and clays that have a high liquid limit are identified by the symbols MH and CH. The tested soils are classified according to the Unified system in table 5, and the classification for the soils that were not tested is estimated in table 3.

Estimated engineering properties of soils

Table 3 provides estimates of some properties of soils that affect engineering. The estimates are for a modal profile or for a profile typical of the soil series or soil type. For the soils in the county that were tested, estimates in table 3 are based on the test data listed in table 5. For the other soils, estimates are based on test data obtained from similar soils in this county and in other counties, and on past experience in engineering. Since the estimates are for typical profiles, variations from the estimates may be considerable. Following are explanations of the columns in table 3.

Hydrologic soil groups are groups of soils having similar rates of infiltration, when wetted, and similar rates of water transmission within the soil. Four such groups currently are recognized.

Soils in group A have a high infiltration rate, even when thoroughly wetted. They have a high rate of water transmission and low runoff potential. The soils of this group are deep, are well drained or excessively drained, and consist chiefly of sand, gravel, or both.

Soils in group B have a moderate infiltration rate when thoroughly wetted. Their rate of water transmission and their runoff potential are moderate. These soils are moderately deep or deep and moderately well drained or well drained, and are of fine texture to moderately coarse texture.

Soils of group C have a slow infiltration rate when thoroughly wetted. Their rate of water transmission is slow, and their potential runoff is high. These soils have a layer that impedes the downward movement of water, or they are moderately fine or fine textured and have a slow infiltration rate.

Soils of group D have a slow infiltration rate when thoroughly wetted. Their rate of water transmission is very slow, and runoff potential is very high. In this group are (1) clay soils with high shrink-swell potential; (2) soils with a permanent high water table; (3) soils with a claypan or clay layer at or near the surface; and (4) soils shallow over nearly impervious material.

Permeability relates to movement of water downward through undisturbed soils. The estimates in table 3 are for the soil as it occurs in place and are based on soil structure and porosity. Plowpans, surface crusts, and mechanically created restrictions on permeability are not considered in estimating permeability. Ratings are given for permeability in table 3 only for the least permeable layer. These ratings are expressed in inches per hour and are defined in the Glossary.

Available water capacity, in inches per inch of soil depth, is the approximate amount of capillary water in the soil when it is wet to field capacity. When the soil is at the wilting point of common plants, this amount of water will wet the soil to a depth of 1 inch without deeper percolation.

Reaction is expressed in terms of pH values. A pH of 4.5 to 5.0 indicates very strong acidity, and a pH of 9.1 or higher indicates very strong alkalinity.

Shrink-swell potential refers to the change in volume of a soil that results from a change in moisture content. Estimates are based on tests for volume change or on observation of other physical properties of the soil. For example, Miller soils have a clay profile and very high shrink-swell potential because they are very sticky when wet, and they shrink and crack a great deal when they dry. In contrast, the profile of Dougherty soils has low shrink-swell potential because they are nonplastic.

Engineering interpretations of soils

In table 4 the soils of Oklahoma County are rated according to their suitability as a source of topsoil, select material, and road fill. Also, pointed out are those features affecting suitability as sites for highways, farm ponds, drainage and irrigation systems, terraces and diversions, and waterways. The information in table 4 is based on the estimated engineering properties in table 3, the actual test data in table 5, and field experience with the soils.

The soils are not rated as a source of sand and gravel in table 4, but Crevasse soils are a source of sand for concrete and the Teller soils are a source of gravel for concrete. These gravel beds are generally at a depth of 4 to 10 feet and crop out at the surface in only a few places.

TABLE 3.—*Engineering*

Soil series and map symbol [1]	Hydrologic soil group	Depth from surface	Classification	
			USDA texture	Unified
		Inches		
Bethany (BeA)	C	0–6	Silt loam	ML, CL
		6–14	Silt loam	ML, CL
		14–64	Clay	CL, CH
Canadian (Ca, CdB) (For properties of the Dale soils in mapping unit CdB, refer to the Dale series.)	B	0–60	Fine sandy loam	SM, ML
Chickasha (ChB)	B	0–8	Loam	ML, CL
		8–26	Clay loam	CL
		26–42	Sandy clay loam	SC, CL
		42–60	Sandy loam	SC, CL
Crevasse (Cr)	A	0–18	Loamy fine sand	SM
		18–34	Fine sand	SM–SP
Crevasse (Cv)	A	0–10	(2)	(2)
		10–30	Fine sand	SM–SP
Dale (Dl)	C	0–24	Silty clay loam	CL
		24–48	Loam	ML, CL
Darnell (DsE, DtE3) (For properties of the Stephenville soils in mapping unit DtE3, refer to the Stephenville series.)	C	0–12	Fine sandy loam	SM, ML
		12–18	Sandstone	
Dougherty (DuC)	B	0–22	Loamy fine sand	SM
		22–50	Sandy clay loam	SC, CL
		50–55	Coarse sandy loam	SM
Eroded clayey land (Es)	D	0–40	Clay	CL, CH
Eroded loamy land (Et)	C	0–40	Clay loam	CL
Grant (GrB)	B	0–10	Silt loam	ML, CL
		10–30	Silt loam	CL
		30–42	Silt loam	ML, CL
		42	Soft sandstone	
Konawa (KoB)	B	0–14	Loamy fine sand	SM
		14–52	Sandy clay loam	SC, CL
		52–60	Coarse sandy loam	SM
Lela (Lc)	D	0–60	Clay	MH, CH
Lucien	C	0–15	Fine sandy loam and loam.	ML, CL
		15	Sandstone.	
Miller (Mc, Ms)	D	0–44	Clay	CH, MH
Nash (NaC2)	B	0–30	Loam	ML, CL
		30–40	Soft sandstone	
Noble (NbC)	B	0–42	Fine sandy loam	SM, ML
Norge (NoB, NoC, NoC2, NsB)	C	0–12	Loam	ML, CL
		12–50	Clay loam	ML, CL

See footnotes at end of table.

properties of soils

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH value*	
A-4	100	100	75-96		0.14	6.1-6.5	Low.
A-6	100	100	85-96	0.06-0.20	.17	6.1-6.5	Low to moderate.
A-6, A-7	100	100	90-98		.17	6.6-8.4	Moderate.
A-2, A-4	100	100	30-60	2.00-6.30	.12	6.1-8.4	Low.
A-4	100	100	55-85	0.63-2.00	.14	5.6-6.0	Low.
A-4, A-6	100	100	75-95		.14	5.6-6.0	Moderate.
A-6	100	100	40-60		.14	6.1-6.5	Low to moderate.
A-4	100	100	36-60		.12	6.1-6.5	Low.
A-2	100	100	20-35	>6.30	.07	7.4-8.4	Low.
A-3	100	100	5-10		.05	7.4-8.4	Low.
(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
A-3	100	100	5-10	0.20-6.30	.05	7.4-8.4	Low.
A-6	100	100	75-95	0.06-0.20	.17	6.1-7.3	Moderate.
A-4	100	100	55-85		.14	6.6-7.3	Low.
A-2, A-4	100	100	30-60	2.00-6.30	.12	5.6-6.0	Low.
						6.1-6.5	Low.
--------	--------	--------	--------	--------	--------		
A-2	100	100	20-35		.07	6.1-7.3	Low.
A-4	100	100	40-60	0.63-2.00	.14	5.1-5.5	Low.
A-2, A-4	100	100	30-45		.12	5.6-6.0	Low.
A-7	100	100	90-98	<0.06	.17	6.6-7.8	High.
A-4, A-6	100	100	60-95	0.63-2.00	.17	5.6-7.3	Moderate.
A-4	100	100	75-90		.14	6.6-7.3	Low.
A-4, A-6	100	100	75-90	0.63-2.00	.14	6.1-7.3	Low to moderate.
A-4	100	100	75-90		.14	6.1-6.5	Low.
--------	--------	--------	--------	--------	--------	--------	Low.
A-2	100	100	20-35		.07	6.1-7.3	Low.
A-4	100	100	40-60	0.63-2.00	.14	5.6-6.0	Low.
A-2, A-4	100	100	30-45		.12	5.6-6.0	Low.
A-7	100	100	90-100	<0.06	.17	6.1-8.4	Very high.
A-4	100	100	55-85	0.63-2.00	.14	5.6-6.5	Low.
A-7	100	100	90-98	<0.06	.17	7.4-8.4	Very high.
A-4	100	100	55-85	0.63-2.00	.14	6.1-7.3	Low.
--------	--------	--------	--------	--------	--------	--------	Low.
A-2, A-4	100	100	30-60	2.00-6.30	.12	6.1-6.5	Low.
A-4	100	100	55-85	0.06-0.20	.14	6.1-6.5	Low.
A-6, A-7	100	100	85-95	0.06-0.20	.17	6.6-7.8	Moderate.

TABLE 3.—*Engineering*

Soil series and map symbol [1]	Hydrologic soil group	Depth from surface	Classification	
			USDA texture	Unified
		Inches		
Port:				
Loam (Po)	B	0–30	Loam	ML, CL
		30–54	Clay loam	ML, CL
Clay loam (Pc)	C	0–40	Clay loam	ML, CL
Pulaski (Ps, Pw)	B	0–35	Fine sandy loam	SM, ML
		35–42	Loamy fine sand	SM
Renfrow (RfB, RsB2)	D	0–10	Clay loam	CL
		10–44	Clay	CL, ML
		44–54	Shale and clay	CL
Stephenville (StB, StC, StC2)	B	0–14	Fine sandy loam	SM
		14–40	Sandy clay loam	SM, SC
		40–45	Soft sandstone	---
Teller (TfB, TfC)	B	0–8	Fine sandy loam	SM
		8–14	Clay loam	SC, CL
		14–48	Clay loam	CL
Vanoss (VaA)	B	0–16	Silt loam	ML
		16–50	Silty clay loam	ML, CL
Vernon (VIE, VzC)	D	0–6	Clay loam	CL, ML
(For properties of the Lucien soil in mapping unit VIE and of the Zaneis soil in mapping unit VzC, refer to their respective series.)		6–15	Clay	MH, CH
		15	Shale beds.	
Zaneis loam (ZaB, ZaC)	C	0–9	Loam	ML, CL
		9–24	Clay loam	CL
		24–48	Clay loam	CL
		48	Soft sandstone	---

[1] Because they vary, properties were not estimated for Breaks-Alluvial land complex (Bk), Broken alluvial land (Br), and slickspots (Ms, NsB).
[2] Variable.

Topsoil is presumed fertile soil, or soil material ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens. The suitability of a soil as a source of topsoil depends largely on texture and depth. Topsoil material should be of a texture that permits working into a good seedbed, yet is clayey enough to resist erosion on strong slopes. The depth of suitable material determines whether or not it is economical to use the soil for topsoil.

The suitability rating for select material depends mainly on grain size and the content of silt and clay. Soils consisting mainly of sand are good material if a binder is added to increase cohesion. Clay soils, in contrast, are poor material because they compress under load but rebound when unloaded.

Road fill can be of almost any kind of soil material. Sandy clays and sandy clay loams are easy to place and to compact. Clays having high shrink-swell potential, however, require special compaction and close moisture control both during and after construction. Sands compact well but are difficult to confine in a fill. The ratings in table 4 reflect the various limitations and advantage of different kinds of soil material.

Engineering test data

Table 5 contains the test data for samples collected from selected soils and tested by the State Highway Department. The tests were made for the purpose of determining shrinkage, volume change, liquid limit, and plasticity index. A mechanical analysis of each sample was made so *properties of soils*—Continued

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
				Inches per hour	*Inches per inch of soil*	*pH value*	
A-4	100	100	55-85	0.63-2.00	.14	6.1-6.5	Low.
A-4, A-6	100	100	75-95	------	.17	7.4-7.8	Low to moderate.
A-4, A-6	100	100	75-95	0.05-0.20	.17	7.4-7.8	Low to moderate.
A-2, A-4	100	100	30-60	2.00-6.30	.12	6.1-6.5	Low.
A-2	100	100	15-35	------	.07	6.1-8.4	Low.
A-6	100	100	75-95	<0.05	.17	6.1-6.5	Moderate.
A-7	100	100	90-98	------	.17	6.6-7.8	High.
A-7	100	100	90-98	------	------	7.4-8.4	High.
A-2, A-4	100	100	20-40	0.63-2.00	.12	5.6-7.3	Low.
A-4	100	100	36-50	------	.14	5.6-6.0	Low.
------	------	------	------	------	------	5.6-6.0	Low.
A-2, A-4	100	100	30-50	------	.12	6.1-6.5	Low.
A-4, A-6	100	100	40-60	0.63-2.00	.14	6.1-6.5	Low to moderate.
A-6	100	100	75-95	------	.17	6.1-6.5	Moderate.
A-4	100	100	75-90	0.06-0.20	.14	6.1-6.5	Low.
A-4, A-6	100	100	85-95	------	.17	6.6-7.3	Moderate.
A-6, A-7	100	100	75-98	------	.17	7.4-8.4	Moderate.
A-7	100	100	90-99	<0.06	.17	7.4-8.4	High.
A-4	100	100	55-85	------	.14	5.6-6.0	Low.
A-6	100	100	75-95	0.06-0.20	.17	5.6-6.5	Moderate.
A-6, A-7	100	100	75-95	------	.17	6.1-6.5	Moderate to high.
------	------	------	------	------	------	------	Low.

that the percentage of the various-sized particles could be determined.

The columns headed "Shrinkage" list values for shrinkage limit and shrinkage ratio. As moisture is removed, the volume of a soil decreases, in direct proportion to the loss of moisture the shrinkage limit is reached. Beyond the shrinkage limit, more moisture may be removed, but the volume of the soil does not change. In general, the lower the number listed in table 5 for the shrinkage limit, the higher the content of clay.

The shrinkage ratio is the volume change, expressed as the percentage of the volume of dry soil material, divided by the loss of moisture caused by drying. This ratio is expressed numerically.

The field moisture equivalent (FME) is the minimum moisture content at which a smooth soil surface will not absorb any more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soils. The volume change from field moisture equivalent is the change in volume, expressed as a percentage of the dry volume, that takes place when the moisture content of the soil is reduced from the field moisture equivalent to the shrinkage limit.

In mechanical analysis, the soil components are sorted by particle size. Sand and other granular material are retained on the No. 200 sieve, but silt and clay materials pass through it. Clay is the fraction that passes the No. 200 sieve and is smaller than 0.002 millimeter in diameter. The material intermediate in size between that held on the No. 200 sieve and that having a diameter of 0.002 millimeter is called silt.

TABLE 4.—*Engineering*

Soil series and map symbol [1]	Suitability as source of— Topsoil	Select material	Road fill	Soil features affecting— Highway location
Bethany (BeA)	Good to fair to a depth of 1½ feet: Easily eroded on steep slopes.	Unsuitable	Poor: Moderate shrink-swell potential; unstable.	Moderate shrink-swell potential; very slow internal drainage; unstable.
Breaks-Alluvial land (Bk)	Poor: Limited quantity of material.	Poor: Inaccessible and too clayey.	Poor: Limited quantity of material; unstable.	Broken topography; unstable; highly plastic.
Broken alluvial land (Br)	Fair: Broken and on steep slopes; limited material.	Poor: Variable material	Poor: Low density; difficult to compact.	Broken topography; unstable when wet; frequently flooded.
Canadian (Ca)	Poor: Easily eroded on steep slopes.	Good	Good	Features favorable
Canadian-Dale (CdB)	Poor to good: Areas must be selected.	Unsuitable to good: Areas must be selected.	Poor to good: Selective borrow must be used.	Weak foundation in Dale soil.
Chickasha (ChB)	Good	Poor: Elastic material	Good to fair	Features favorable
Crevasse(Cr, Cv)	Poor: Too sandy	Good to fair: Lacks binder in some places.	Good if confined and slopes are stabilized.	Frequent flooding
Dale (Dl)	Good	Unsuitable: Too clayey	Poor: Unstable	Nearly level slopes; weak foundation.
Darnell-Stephenville (DsE, DtE3).	Poor: Limited quantity; easily eroded.	Good but limited in quantity.	Good but limited in depth to sandstone.	Sandstone at a depth of 1 to 4 feet.
Dougherty (DuC)	Poor: Low fertility; easily eroded.	Good	Good if entire profile is used.	Erodible soils
Eroded clayey land (Es)	Poor: Shallow, clayey material.	Unsuitable: Too clayey.	Poor: High shrink-swell potential; unstable.	Some steep slopes; highly plastic; numerous gullies.
Eroded loamy land (Et)	Poor: Low fertility	Unsuitable: Clay loam areas are too plastic.	Poor: Unstable	Some steep slopes; material unstable when wet.
Grant (GrB)	Fair: Easily eroded on steep slopes.	Poor: Highly elastic	Poor: Requires close control of moisture; unstable.	Unstable slopes; requires good drainage in foundation.
Konawa (KoB)	Poor: Low fertility; easily eroded.	Good	Good if entire profile is used.	Erodible soils
Lela (Lc)	Poor: Too clayey	Unsuitable: Highly plastic.	Very poor: Highly plastic; high volume change; unstable.	Highly plastic clay; poor drainage.

See footnote at end of table

interpretation of soils

Soil features affecting— Continued						
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Features favorable	Susceptible to cracking when dry; low shear strength.	Good drainage	Slow rate of intake; slow permeability.	Susceptible to ponding in channels.	Features favorable.
Good depth; possible seepage at abutment.	Shallow soil in some places; cracks when dry.	Good to excessive drainage.	Broken topography; nonarable land.	Broken topography; nonarable land.	Broken topography; nonarable land.
Flooding; broken topography.	Flooding; broken topography.	Frequent flooding	Frequent flooding; broken topography.	Frequent flooding; broken topography.	Frequent flooding; broken topography.
High rate of potential seepage; nearly level topography.	High rate of potential seepage; high erodibility.	Good drainage	Features favorable	Nearly level topography.	Nearly level topography.
High rate of potential seepage; nearly level topography.	Features favorable	Good drainage	Variable rate of intake.	Nearly level tography.	Nearly level topography.
Features favorable	Features favorable	Good drainage	Features favorable	Features favorable	Features favorable.
Sandy material; high water table.	High rate of seepage	Frequent flooding	Frequent flooding; low water-holding capacity; high rate of intake.	Nonarable soils; frequent flooding.	Nonarable soils; frequent flooding.
Features favorable for dug ponds.	Features favorable	Good drainage	Features favorable	Nearly level topography.	Nearly level topography.
Sandstone at a depth of 1 to 4 feet; high rate of seepage.	High rate of potential seepage and limited amount of material.	Good drainage to excessive.	Strong slopes; variable depths.	Shallow soils over sandstone.	Shallow, droughty soils.
High rate of seepage	High erodibility	Good drainage	Wind erosion; hummocky topography.	Hummocky topography; subject to wind erosion.	Soils subject to wind and gully erosion.
Depth to shale may be limited.	Unstable material; cracks when dry.	Good drainage	Nonarable land; severely eroded.	Nonarable land; severely eroded.	Vegetation hard to establish; little topsoil; numerous gullies.
Features favorable	Features favorable	Good drainage	Severely eroded land	Nonarable land; severely eroded.	Severely eroded land.
Features favorable	Features favorable	Good drainage	Features favorable	Features favorable	Features favorable.
High rate of seepage	High erodibility	Good drainage	Undulating topography; wind erosion.	Susceptible to wind erosion.	Susceptible to wind and gully erosion.
Features favorable for dug ponds.	Low stability; subject to severe cracking.	Somewhat poor drainage; very slow internal drainage.	Very slow rate of intake; very slow permeability; subject to severe cracking.	Nearly level topography.	Nearly level topography when dry.

TABLE 4.—*Engineering*

Soil series and map symbol [1]	Suitability as source of—			Soil features affecting—
	Topsoil	Select material	Road fill	Highway location
Miller (Mc)	Poor: Too clayey	Unsuitable: Highly plastic.	Very poor: Highly plastic; high volume change; unstable.	Highly plastic clay; poor drainage.
Nash (NaC2)	Fair: Easily eroded on steep slopes.	Poor: Elastic	Fair to good	Features favorable
Noble (NbC)	Poor: Easily eroded	Good	Good	Features favorable
Norge (NoB, NoC, NoC2)	Fair to good: Somewhat easily eroded on steep slopes.	Poor: Elastic	Fair to poor: Unstable.	Features favorable
Norge-Slickspots complex (NsB).	Fair to good: Easily eroded on steep slopes.	Poor: Elastic	Fair to poor: Unstable.	Unstable foundation
Port (Pc, Po)	Good where texture is clay loam.	Fair or unsuitable: Elastic; too clayey.	Fair to poor: Unstable.	Unstable material; subject to occasional flooding.
Pulaski (Ps)	Poor: Easily eroded	Good	Good if slopes are stabilized.	Frequent flooding
Pulaski soils (Pw)	Poor: High water table	Poor: High water table	Poor: High water table.	High water table
Renfrow (RfB)	Poor: Suitable material is shallow.	Unsuitable: Unstable and clayey.	Very poor: Unstable; high shrink-swell potential.	High shrink-swell potential; unstable.
Stephenville (StB, StC, StC2).	Poor: Easily eroded	Good	Good if profile is mixed.	Features favorable
Teller (TfB, TfC)	Poor to fair: Easily eroded.	Fair: Generally limited quantity of suitable material.	Good to fair	Features favorable
Vanoss (VaA)	Fair to good: Easily eroded on steep slopes.	Poor: Too elastic	Poor: Unstable	Unstable foundation
Vernon-Lucien (VlE)	Poor: Limited quantity and clayey.	Unsuitable: Too clayey	Very poor: Highly plastic clays; rock outcrops.	Moderately steep slopes; highly plastic clays; rock outcrops.
Vernon-Zaneis (VzC)	Poor: Limited quantity and too clayey.	Unsuitable: Mixed material, too clayey.	Poor: Unstable	Unstable foundation; highly plastic.
Zaneis (ZaB, ZaC)	Good to fair: Easily eroded on steep slopes.	Poor: Elastic	Fair to poor: Unstable.	Unstable foundation

[1] Because the areas vary, interpretations were not made for Miller-Slickspots complex (Ms) and for Renfrow-Slickspots complex, 1 to 3 percent slopes, eroded (RsB2).

interpretations of soils—Continued

Soil features affecting— Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Features favorable for dug ponds.	Low stability; subject to severe cracking.	Somewhat poor drainage; very slow internal drainage.	Very slow rate of intake; very slow permeability.	Nearly level to depressional topography.	Nearly level to depressed topography; cracks when dry.
Sandstone at a depth of about 2½ feet.	Features favorable	Good drainage	Features favorable, except on steep slopes.	Features favorable	Features favorable.
High rate of potential seepage.	High erodibility; high rate of potential seepage.	Good drainage	Strong slopes	Features favorable	Features favorable.
Strata below 5 feet may leak.	Features favorable	Good drainage	Features favorable	Features favorable	Features favorable.
Strata may leak below a depth of 5 feet.	Features favorable	Good drainage	Slickspots are unstable; other features favorable.	Slickspots are unstable.	Slickspots are unstable.
Nearly level topography.	Features favorable	Good drainage	Features favorable	Nearly level topography.	Nearly level topography.
High rate of potential seepage.	High rate of seepage; high erodibility.	Good drainage but frequent flooding.	Frequent flooding	Nearly level topography; frequent flooding.	Nearly level topography; frequent flooding.
High water table	High rate of seepage in fill and foundation.	High water table	High water table	Nearly level; high water table.	Nearly level; high water table.
Features favorable	Cracks when dry; low shear strength.	Very slow internal drainage.	Very slow rate of intake; cracks when dry.	Ponded water in channels.	Features favorable.
High rate of seepage; rock at 4 feet.	Features favorable	Good drainage	Features favorable	Susceptible to slight wind erosion.	Susceptible to slight wind erosion.
Leakage below a depth of 4 feet.	Features favorable	Good drainage	Features favorable	Features favorable	Features favorable.
Features favorable	Features favorable	Good drainage	Features favorable	Features favorable	Features favorable.
Moderately steep slopes; variable rate of seepage.	Limited amount of suitable material.	Excessive drainage	Nonarable soils	Nonarable soils	Nonarable soils.
Sandstone or shale at a depth of 4 feet or less.	Limited amount of suitable material.	Good drainage	Variable rate of intake.	Features favorable	Features favorable.
Sandstone at a depth of 4 feet.	Features favorable	Good drainage	Features favorable	Features favorable	Features favorable.

TABLE 5.—*Engineering*

[Test performed by the Oklahoma Department of Highways in accordance with standard

Soil name and location	Parent material	Oklahoma report No.	Depth	Horizon	Shrinkage	
					Limit	Ratio
			Inches			
Bethany silt loam, 0 to 1 percent slopes: 50 feet E. and 1,000 feet N. of SW. corner, sec. 28, T. 11 N., R. 4 W. (Modal).	Alluvium from high terraces.	SO-7743	0-10	Ap	20	1. 72
		SO-7744	22-40	B2t	10	2. 00
		SO-7745	40-57	B3	9	2. 06
Dougherty loamy fine sand, hummocky: 400 feet W. of SE. corner, sec. 11, T. 12 N., R. 1 E. (Modal).	Alluvium from terraces.	SO-7758	4-20	A2	[4] NP	[4] NP
		SO-7759	20-40	B2t	16	1. 85
		SO-7760	40-50	B3	17	1. 80
Lela clay: NW¼SW¼ sec. 13, T. 12 N., R. 1 E. (Modal)	Alluvium.	SO-7761	0-8	Ap	11	1. 96
		SO-7762	8-48	A1	9	2. 02
Norge loam, 1 to 3 percent slopes: 2,000 feet N. of SE. corner of sec. 2, T. 14 N., R. 4 W. (Modal).	Alluvium from high terraces.	SO-7749	0-8	Ap	17	1. 80
		SO-7750	14-32	B2t	14	1. 90
		SO-7751	38-50	B3	12	1. 96
Renfrow clay loam, 1 to 3 percent slopes: 200 feet W. of NE. corner of sec. 8, T. 14 N., R. 4 W. (Modal).	Shale.	SO-7755	0-6	Ap	15	1. 89
		SO-7756	9-22	B2t	10	2. 04
		SO-7757	22-38	B3	10	2. 06
Stephenville fine sandy loam, 1 to 3 percent slopes: 400 feet N. in SW¼SE¼ sec. 25, T. 11 N., R. 1 E. (Modal).	Sandstone.	SO-7763	0-4	A1	[4] NP	[4] NP
		SO-7764	18-26	B2t	17	1. 82
		SO-7765	26-48	B3	17	1. 80
Vanoss silt loam, 0 to 1 percent slopes: 800 feet S. of NW¼SE¼ of sec. 7, T. 12 N., R. 4 W. (Modal).	Alluvium from high terraces.	SO-7746	0-8	A1	20	1. 70
		SO-7747	16-24	B21t	18	1. 77
		SO-7748	24-42	B22t	16	1. 81
A Vernon clay loam on 3 to 5 percent slopes: 500 feet N. of SW. corner of sec. 27, T. 14 N., R. 4 W. (Modal).	Shale.	SO-7752	0-6	A1	15	1. 84
		SO-7753	6-15	B2	8	2. 10
		SO-7754	15-36	R	13	1. 94

[1] Mechanical analyses according to the AASHO 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 data used in this table are not suitable for use in naming textural classes for soil.

[2] The Oklahoma Department of Highways classification procedure further subdivides the AASHO A-2-4 subgroup into the following:

Liquid limit and plastic limit indicate the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material changes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Nonfarm Uses of Soils

Table 6 was prepared mainly for rural and other landowners, city and county planners, and developers. It lists features that adversely affect use of soils in the county for septic tank filter fields, sewage lagoons, sanitary land fill, sites for low buildings, roads and streets, lawns, shrubs and trees, gardens (fig. 14), golf fairways and greens, picnic areas, intensive play areas, paths and trails, camping areas, and parks. The features listed are for soils in place.

The interpretations in table 6 do not eliminate the need for sampling and testing the soil at a proposed site. The *test data*

procedures of the American Association of State Highway Officials (AASHO) (*1*)]

Shrinkage—Con.	Mechanical analysis [1]							Liquid limit	Plasticity index	Classification	
Volume change from field moisture equivalent	Percentage passing sieve—			Percentage smaller than—						AASHO [2]	Unified [3]
	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074mm.)	0. 05 mm.	0. 02 mm.	0. 005 mm.	0. 002 mm.				
Percent											
7	----------	100	94	80	--------	19	16	27	5	A-4(8)	ML-CL
72	----------	100	97	90	--------	44	38	49	24	A-7-6(16)	CL
76	100	98	95	87	--------	46	40	53	29	A-7-6(18)	CH
[4] NP	100	98	22	13	--------	6	4	[4] NP	[4] NP	A-2-3(0)	SM
20	100	99	44	33	--------	25	24	29	10	A-4(2)	SC
12	100	98	54	37	--------	20	19	25	6	A-4(4)	ML-CL
87	----------	100	98	93	--------	57	45	57	25	A-7-5(17)	MH
129	----------	----------	100	93	--------	78	68	92	51	A-7-5(20)	MH-CH
12	100	97	82	65	--------	21	18	25	5	A-4(8)	ML-CL
40	100	98	85	76	--------	35	31	42	20	A-7-6(12)	CL
58	100	98	84	71	--------	42	39	45	20	A-7-6(13)	ML-CL
32	----------	100	94	87	--------	36	30	35	14	A-6(10)	CL
65	----------	100	97	94	--------	55	48	45	19	A-7-6(13)	ML-CL
62	[5] 99	99	96	91	--------	49	43	44	20	A-7-6(13)	CL
[4] NP	----------	100	25	14	--------	6	4	[4] NP	[4] NP	A-2-3(0)	SM
16	----------	100	46	35	--------	27	25	27	9	A-4(2)	SC
14	----------	100	50	34	--------	24	22	26	7	A-4(3)	SM-SC
5	----------	100	87	74	--------	17	14	24	3	A-4(8)	ML
21	----------	100	92	77	--------	28	23	32	7	A-4(8)	ML-CL
22	----------	100	92	76	--------	29	24	32	11	A-6(8)	CL
46	----------	100	98	89	--------	39	33	42	15	A-7-6(10)	ML-CL
79	100	99	99	95	--------	67	56	57	26	A-7-6(18)	MH-CH
39	[5] 99	97	95	91	--------	43	29	36	13	A-6(9)	ML-CL

A-2-3(0) if the plasticity index equals nonplastic (NP); A-2(0) if the plasticity index equals nonplastic to 5; and A-2-4(0) if the plasticity index is 5 to 10.

[3] The Soil Conservation Service and the Bureau of Public Roads have agreed that all soils having a plasticity index within 2 points of A-line are to be given a borderline classification. Examples of borderline classifications thus obtained are ML-CL, MH-CH, and SM-SC.

[4] NP=Nonplastic.

[5] 100 percent of the material in this layer passed the No. 4 (4.7 mm.) sieve.

interpretations should be used as a basis for planning more detailed field investigations so that the condition of the soil in place can be determined before a proposed site is put to a certain nonfarm use.

Formation and Classification of Soils

This section tells how the factors of soil formation affected the development of soils in Oklahoma County, and it names some of the processes responsible for the development of horizons. Then the current system of soil classification is explained, and each soil series in the county is placed in classes of this system. Also, the soil series are placed in the orders and great soil groups of the system adopted in 1938. More information about the soils, as well as a profile representative of each soil series, is given in the section "Descriptions of the Soils."

Formation of Soils

Soil is the product of the interaction of the five major factors of soil formation—climate, living organisms (especially vegetation), parent material, relief, and time. If, in one area, the climate, vegetation, or some other of these factors is different from that in another area, different kinds of soils will form.

TABLE 6.—*Degree and kind of*

Soil name and map symbol	Septic tank filter field	Sewage lagoons	Sanitary land fill	Sites for low buildings	Roads and streets	Lawn, shrubs, and trees
Bethany silt loam, 0 to 1 percent slopes (BeA).	Severe: Slow percolation.	Slight	Moderate: Material difficult to excavate.	Moderate: Moderate shrink-swell potential.	Moderate: Moderate shrink-swell potential.	Slight
Breaks-Alluvial land complex (Bk).	Severe: Steep slopes and narrow valleys; flooding in valleys.	Severe: Steep slopes and narrow valleys; flooding in valleys.	Severe: Steep slopes; narrow valleys.	Severe: Steep side slopes; flooding in valleys.	Severe: Steep side slopes; flooding in valleys.	Severe: Steep side slopes; shallow; flooding in valleys.
Broken alluvial land (Br).	Severe: Small area; frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding.
Canadian fine sandy loam (Ca).	Slight	Severe: Moderately rapid percolation.	Slight	Severe: Occasional flooding.	Slight	Slight
Canadian-Dale complex, undulating (CdB).	Moderate: Occasional flooding.	Severe: Moderate to moderately rapid percolation.	Slight	Severe: Occasional flooding.	Slight	Slight
Chickasha loam, 1 to 3 percent slopes (ChB).	Slight	Moderate: Moderate percolation.	Slight	Slight	Slight	Slight
Crevasse loamy fine sand (Cr).	Severe: Occasional flooding.	Severe: Occasional flooding; rapid percolation.	Severe: Occasional flooding.	Severe: Occasional flooding.	Severe: Occasional flooding.	Severe: Occasional flooding; low productivity.
Crevasse soils (Cv).	Severe: Frequent flooding.	Severe: Frequent flooding; rapid percolation.	Severe: Frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding; low productivity.
Dale silty clay loam (Dl).	Moderate: Occasional flooding.	Slight	Moderate: Occasional flooding.	Severe: Occasional flooding.	Slight	Slight
Darnell-Stephenville fine sandy loams, 3 to 12 percent slopes (DsE). (Darnell part: see Stephenville fine sandy loams for Stephenville part.)	Severe: Sandstone bedrock at 1 foot.	Severe: Sandstone bedrock at 1 foot.	Severe: Sandstone bedrock at 1 foot.	Moderate: Good foundation: sandstone at 1 foot.	Moderate: Bedrock at 1 foot.	Severe: Sandstone at 1 foot.
Darnell-Stephenville complex, 3 to 12 percent slopes, severely eroded (DtE3). (Darnell part: see Stephenville fine sandy loams for Stephenville part.)	Severe: Sandstone at or near surface.	Severe: Sandstone at or near surface.	Severe: Sandstone at or near surface.	Moderate: Fair foundation; sandstone at or near surface.	Severe: Very severe erosion susceptibility.	Severe: Sandstone at or near surface.

limitation to nonfarm uses of soils

Gardens	Golf fairways	Picnic areas	Intensive play areas	Paths and trails	Camping areas	Parks
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Severe: Steep side slopes; flooding in valleys.	Severe: Steep side slopes; flooding in valleys.	Moderate: Flooding in valleys.	Severe: Steep side slopes; flooding in valleys.	Slight	Moderate: Flooding in valleys.	Moderate: Flooding in valleys.
Severe: Small area; frequent flooding.	Severe: Small area; frequent flooding.	Severe: Small area; frequent flooding.	Severe: Small area; frequent flooding.	Slight	Severe: Frequent flooding.	Severe: Small area; frequent flooding.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Severe: Occasional flooding; low productivity.	Severe: Occasional flooding; sandy surface.	Severe: Sandy surface; occasional flooding.	Severe: Sandy surface; occasional flooding.	Moderate: Nearly level relief; occasional flooding.	Severe: Occasional flooding.	Severe: Occasional flooding.
Severe: Frequent flooding; low productivity.	Severe: Frequent flooding; sandy surface.	Severe: Frequent flooding; sandy surface.	Severe: Frequent flooding; sandy surface.	Severe: Frequent flooding.	Severe: Frequent flooding.	Severe: Frequent flooding.
Slight	Moderate: Nearly level.	Slight	Slight	Slight	Slight	Slight.
Severe: Sandstone at 1 foot.	Severe: Sandstone at 1 foot.	Slight	Severe: Strong slopes; sandstone at 1 foot.	Slight	Slight	Severe: Sandstone at about 1 foot.
Severe: Sandstone at or near surface.	Severe: Sandstone at or near surface.	Severe: Severely eroded soils.	Severe: Severely eroded soils; sandstone at or near surface.	Severe: Severely eroded soils; sandstone at or near surface.	Severe: Severely eroded soils; sandstone at or near surface.	Severe: Severely eroded soils; sandstone at or near surface.

293-288—69——4

TABLE 6.—*Degree and kind of limitation*

Soil name and map symbol	Septic tank filter field	Sewage lagoons	Sanitary land fill	Sites for low buildings	Roads and streets	Lawn, shrubs, and trees
Dougherty loamy fine sand, hummocky (DuC).	Slight	Severe: Rapid percolation in lower horizon.	Slight	Slight	Slight	Moderate: Low fertility.
Eroded clayey land (Es).	Severe: Very slow percolation.	Moderate: Sloping.	Severe: Material difficult to excavate.	Severe: High shrink-swell potential.	Severe: High shrink-swell potential.	Severe: Low productivity; droughty.
Eroded loamy land (Et).	Moderate: Severe erosion.	Moderate: Moderate percolation.	Moderate: Severe erosion.	Severe: Severe erosion.	Severe: Severe erosion susceptibility.	Severe: Low fertility; severely eroded land.
Grant silt loam, 1 to 3 percent slopes (GrB).	Slight	Moderate: Rapid percolation.	Slight	Slight	Slight	Slight
Konawa loamy fine sand, undulating (KoB).	Slight	Severe: Moderate percolation.	Slight	Slight	Slight	Moderate: Low fertility.
Lela clay (Lc).	Severe: Very slow percolation; occasional flooding.	Moderate: Occasional flooding.	Severe: Poor drainage; material difficult to excavate.	Severe: Very high shrink-swell potential; occasional flooding; poor drainage.	Severe: Very high shrink-swell potential; poor drainage.	Severe: Poor drainage; droughtiness; occasional flooding.
Miller clay (Mc). Miller-Slickspots complex (Ms).	Severe: Very slow percolation; occasional flooding.	Moderate: Occasional flooding.	Severe: Occasional flooding; material difficult to excavate; poor drainage.	Severe: Very high shrink-swell potential; occasional flooding; poor drainage.	Severe: Poor drainage; droughtiness; occasional flooding.	Severe: Poor drainage; droughtiness; material difficult to work.
Nash loam, 3 to 8 percent slopes, eroded (NaC2).	Severe: Sandstone at a depth of 2 to 3 feet.	Severe: Moderate percolation.	Severe: Sandstone at a depth of 2 to 3 feet.	Slight	Slight	Slight
Noble fine sandy loam, 3 to 8 percent slopes (NbC).	Slight	Severe: Moderately rapid percolation.	Slight	Slight	Slight	Slight
Norge loam, 1 to 3 percent slopes (NoB). Norge loam, 3 to 5 percent slopes (NoC). Norge loam, 4 to 8 percent slopes, eroded (NoC2.)	Severe: Slow percolation.	Slight	Slight	Moderate: Moderate shrink-swell potential.	Moderate: Moderate shrink-swell potential.	Slight
Norge-Slickspots complex, 0 to 3 percent slopes (NsB).	Severe: Slow percolation.	Moderate: Unstable slickspot areas.	Moderate: Unstable slickspot areas.	Severe: Moderate shrink-swell potential; slickspots; low stability.	Severe: Moderate shrink-swell potential; slickspots; high erosion susceptibility.	Severe: Unproductive slickspots.

to nonfarm uses of soils—Continued

Gardens	Golf fairways	Picnic areas	Intensive play areas	Paths and trails	Camping areas	Parks
Moderate: Low fertility.	Severe: Sandy surface; low water-holding capacity; low productivity.	Severe: Trafficability.	Severe: Sandy surface.	Moderate: Sandy surface layers.	Severe: Trafficability.	Moderate: Trafficability.
Severe: Low productivity; material difficult to work.	Severe: Low productivity; soil cracks when dry; rough relief.	Severe: Treeless, eroded land.	Severe: Clayey surface.	Severe: Severe erosion.	Severe: Clayey surface.	Severe: Clayey surface.
Severe: Low fertility; severely eroded land.	Severe: Low productivity; severe erosion.	Severe: Treeless, severely eroded land	Severe: Severely eroded land.	Severe: Severely eroded land.	Severe: Severely eroded land.	Severe: Severely eroded land.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Moderate: Low fertility.	Severe: Sandy surface; low productivity; moderate water-holding capacity.	Moderate: Trafficability.	Moderate: Sandy surface.	Moderate: Sandy surface layer.	Moderate: Sandy surface layer.	Moderate: Sandy surface layer.
Severe: Poor drainage; droughtiness; difficult to work.	Severe: Poor drainage; clay surface; soil cracks when dry.	Severe: Poor drainage; clay surface.	Severe: Poor drainage; clay surface.	Severe: Poor drainage; clay surface; nearly level relief.	Severe: Poor drainage; occasional flooding; clay surface.	Severe: Poor drainage; occasional flooding.
Severe: Poor drainage; clay surface; soil cracks when dry.	Severe: Poor drainage; clay surface.	Severe: Poor drainage; clay surface.	Severe: Poor drainage; clay surface.	Severe: Poor drainage; nearly level; clay surface.	Severe: Poor drainage; clay surface; occasional flooding.	Severe: Poor drainage; occasional flooding.
Moderate: Rock at a depth of 2 to 3 feet.	Slight	Slight	Moderate: Too sloping in places.	Slight	Slight	Slight.
Slight	Slight	Slight	Moderate: Too sloping in places.	Slight	Slight	Slight.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Severe: Unproductive slickspots.	Moderate: Unproductive slickspots.	Moderate: Slickspots have low stability.	Moderate: Slickspots unstable.	Moderate: Slickspots unstable.	Moderate: Slickspots susceptible to severe erosion.	Moderate: Slickspots susceptible to severe erosion.

TABLE 6.—*Degree and kind of limitation*

Soil name and map symbol	Septic tank filter field	Sewage lagoons	Sanitary land fill	Sites for low buildings	Roads and streets	Lawn, shrubs and trees
Port clay loam (Pc). Port loam (Po).	Severe: Occasional flooding.	Moderate: Occasional flooding.	Severe: Occasional flooding.	Severe: Occasional flooding.	Severe: Occasional flooding; low to moderate shrink-swell potential.	Moderate: Occasional flooding.
Pulaski fine sandy loam (Ps).	Severe: Occasional flooding.	Severe: Occasional flooding; high percolation.	Severe: Occasional flooding.	Severe: Occasional flooding.	Severe: Occasional flooding.	Moderate: Occasional flooding.
Pulaski soils, wet (Pw).	Severe: High water table.	Severe: High water table; occasional flooding.	Severe: High water table.	Severe: High water table.	Severe: High water table.	Severe: High water table.
Renfrow clay loam, 1 to 3 percent slopes (RfB).	Severe: Very slow percolation.	Slight	Severe: Material difficult to excavate.	Severe: High shrink-swell potential.	Severe: High shrink-swell potential.	Moderate: Droughtiness.
Renfrow-Slickspots complex, 1 to 3 percent slopes, eroded (RsB2).	Severe: Very slow percolation.	Moderate: Slickspots unstable.	Severe: Material difficult to excavate.	Severe: High shrink-swell potential.	Severe: High shrink-swell potential.	Severe: Droughtiness; clayey.
Stephenville fine sandy loam, 1 to 3 percent slopes (StB). Stephenville fine sandy loam, 3 to 5 percent slopes (StC). Stephenville fine sandy loam, 3 to 5 percent slopes, eroded (StC2).	Moderate: Sandstone at depth of about 4 feet.	Severe: Moderate percolation.	Moderate: Rock at a depth of about 4 feet.	Slight	Slight	Slight
Teller fine sandy loam, 1 to 3 percent slopes (TfB). Teller fine sandy loam, 3 to 5 percent slopes (TfC).	Slight	Moderate: Moderate percolation.	Slight	Slight	Slight	Slight
Vanoss silt loam, 0 to 1 percent slopes (VaA).	Severe: Slow percolation.	Slight	Slight	Slight	Moderate: Moderate shrink-swell potential.	Slight
Vernon-Lucien complex, 5 to 15 percent slopes (VlE).	Severe: Rock at a depth of 1 to 2 feet.	Severe: Rock at a depth of 1 to 2 feet.	Severe: Rock at a depth of 1 to 2 feet.	Severe: Moderately steep; rock or clay beds at a depth of 1 to 2 feet.	Severe: Moderately steep slopes; rock or clay beds at a depth of 1 to 2 feet.	Severe: Moderately steep slopes; rock or clay beds at a depth of 1 to 2 feet; droughtiness.
Vernon-Zaneis complex, 3 to 5 percent slopes (VzC).	Severe: Slow to very slow percolation.	Moderate: Sandstone at 4 feet on Zaneis portion.	Severe: Material difficult to excavate.	Severe: Moderate to high shrink-swell potential.	Severe: Moderate to high shrink-swell potential.	Severe: Droughtiness.
Zaneis loam, 1 to 3 percent slopes (ZaB). Zaneis loam, 3 to 5 percent slopes (ZaC).	Severe: Slow percolation.	Moderate: Sandstone at a depth of about 4 feet.	Moderate: Sandstone at a depth of about 4 feet.	Moderate: Moderate to high shrink-swell potential.	Moderate: Moderate to high shrink-swell potential.	Slight

to nonfarm uses of soils—Continued

Gardens	Golf fairways	Picnic areas	Intensive play areas	Paths and trails	Camping areas	Parks
Moderate: Occasional flooding.	Moderate: Occasional flooding; nearly level.	Moderate: Trafficability.	Moderate: Occasional flooding.	Slight	Moderate: Occasional flooding.	Moderate: Occasional flooding.
Moderate: Occasional flooding.	Moderate: Occasional flooding.	Moderate: Trafficability.	Moderate: Occasional flooding.	Slight	Moderate: Occasional flooding.	Moderate: Occasional flooding.
Severe: High water table.	Severe: High water table.	Severe: High water table.	Severe: High water table.	Moderate: High water table.	Severe: High water table.	Severe: High water table.
Moderate: Droughtiness.	Moderate: Droughtiness.	Moderate: Clayey.	Moderate: Very slow permeability.	Slight	Slight	Moderate: Very slow permeability.
Severe: Droughtiness; clayey.	Severe: Droughtiness; clayey; slickspots; low productivity.	Moderate: Slickspots; low stability.	Severe: Very slow permeability; very severe erosion susceptibility.	Moderate: Slickspots unstable.	Moderate: Slickspots unstable.	Severe: Droughtiness; slickspots; low stability.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.
Severe: Moderately steep slopes; droughtiness.	Severe: Moderately steep slopes; rock outcrop.	Severe: Moderately steep; shallow soils.	Severe: Moderately steep slopes; rock or clay beds at a depth of 1 to 2 feet.	Moderate: Moderately steep; trafficability.	Severe: Moderately steep; treeless soils.	Severe: Moderately steep; droughtiness.
Severe: Droughtiness.	Severe: Droughtiness.	Moderate: Vernon part is clayey.	Severe: Moderately sloping relief.	Moderate: Trafficability.	Severe: Trafficability.	Severe: Droughtiness.
Slight	Slight	Slight	Slight	Slight	Slight	Slight.

Figure 14.—Top, **a small garden on Teller soils.** ***Bottom,*** **golf green on Vernon-Lucien complex.**

Climate

The soils of Oklahoma County are believed to have formed under a temperate, subhumid, continental climate, or the same kind of climate that the county now has. This climate promoted rapid development of soils. Because the climate is uniform throughout the county, differences in the soils generally are not a result of climate. In local areas, however, the effect of the uniform climate has been modified by runoff and different kinds of soils have formed.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Among the changes caused by living organisms are gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity.

In this county vegetation has affected the formation of soils more than any other living organisms. This vegetation was dominantly tall grasses in the western part of the county and was of the savannah type in the central and eastern parts. In the savannah vegetation blackjack oaks and grasses were dominant and the soils that formed generally are medium to low in organic-matter content.

Parent material

Parent material is the unconsolidated mass from which soils form. It has much to do with the chemical and mineralogical composition of the soils. In Oklahoma County the parent material is weathered sandstone and shale, old alluvium, and recent alluvium.

The gently rolling soils on prairie uplands in the western part of the county formed in weathered sandstone and shale or in old alluvium. These soils are deep, dark colored, well drained, and moderately permeable to very slowly permeable. Examples are the Bethany, Renfrow, Grant, Zaneis, and Norge soils.

The hilly and rolling soils on wooded uplands in the central and eastern parts of the county also formed in weathered sandstone or shale or old alluvium. These soils are deep to shallow, light colored, well drained to excessively drained, and generally permeable. Examples are the Dougherty, Konawa, Stephenville, and Darnell soils.

In the valleys of the river and the larger creeks are silt and clay sediments that dropped from slowly moving or still water. These sediments formed wide, low benches. Lela and Miller soils formed in the clayey sediments on the back edges of the benches. These soils are very slowly permeable and somewhat poorly drained. Port, Canadian, and Pulaski soils formed in the sandy and silty sediments that were deposited on the benches. These soils are permeable and well drained.

Relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. In most of Oklahoma County the soils have slopes of more than 1 percent and are on the prairie or the wooded uplands. In some parts of the county, especially near streams, the soils have slopes of about 12 percent.

The contrast in slope has affected the soils of the county, as is shown by comparing the Stephenville and Darnell soils. These soils formed in similar sandstone material. The gently sloping Stephenville soils, however, are on the crest of the ridges where they received no runoff from surrounding areas. Stephenville soils are deep, are well drained, and have a thick, yellowish-red subsoil with weak subangular blocky structure. In contrast, the strongly sloping Darnell soils are shallow, are excessively drained, and have a thin subsoil that rests on sandstone.

Time

Time, usually a long time, is required for the formation of soils with distinct horizons. The differences in length of time that the parent material has been in place commonly is reflected in the degree of development of the soil profile.

The soils in Oklahoma County range from young to old. The young soils show very little development of horizons, but the older soils have well-expressed horizons.

Port soils are young soils that lack development. Except for a little darkening of their surface layer, Port soils retain most of the characteristics of their loamy parent material, which is recent alluvium. Norge soils are older soils in which soil horizons have developed. This parent material is alluvium similar to that of the Port soils, but the neutral clay loam subsoil that developed in the Norge soils bears little resemblance to the original parent material.

Processes of Horizon Differentiation

In Oklahoma County important processes in the formation of soil horizons are (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

In many soils organic matter has accumulated in the upper part of the profile and an A1 horizon has formed. The soils of Oklahoma County range from high to low in content of organic matter.

Leaching of carbonates and bases has occurred in almost all of the soils. The leaching of bases is generally believed to precede the translocation of silicate clay minerals. The moderate to strong leaching that has occurred in most of the soils in this county has contributed to the development of horizons.

The reduction and transfer of iron, or gleying, is evident in the somewhat poorly drained soils of the county. The gray color in the B horizon of some soils indicates that iron has been reduced and transferred. In some horizons the presence of reddish-brown mottles and concretions indicates segregation of iron.

In some soils of Oklahoma County, the translocation of clay minerals has contributed to horizon development. A massive eluviated A2 horizon has formed above the B horizon and is lower in content of clay and generally lighter in color than the B. The B horizon generally has accumulation of clay, or clay films, in pores and on the surfaces of the peds. Soils of this kind were probably leached considerably of carbonates and soluble salts before the translocation of silicate clays took place. In this county, leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation. Dougherty is an example of a soil having translocated silicate clays accumulated in the B horizon in the form of clay films.

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 to understand 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 applied in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. They 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 (*5*). 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 this system should search the latest literature available (*4*,*7*).

Table 7 shows the classification of the soil series of Oklahoma County according to the current system and according to the great soil group of the 1938 system. Some of the soils in this county do not fit in a series that has been recognized in the classification system, but recognition of a separate series would not serve a useful purpose. Such soils are named for series they strongly resemble because they differ from those series in ways too small to be of consequence in interpreting their usefulness or behavior. Soil scientists designate such soils as taxadjuncts to the series for which they are named. In this survey some of the soils named in the Miller and Renfrow series are taxadjuncts to those series.

Following are brief descriptions of each of the categories in the current system.

ORDER: Ten soil orders are recognized. 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. The two exceptions, Entisols and Histosols, occur in many different climates.

Table 7 shows the five soil orders in Oklahoma County—Entisols, Vertisols, Inceptisols, Mollisols, and Alfisols. Entisols are recent soils. They are without genetic horizons or have only the beginnings of such horizons. In Oklahoma County Entisols include many but not all of the soils previously classified as Alluvial soils or Lithosols.

Vertisols are soils in which churning or inversion of material takes place, mainly through swelling and shrinking of clays. Soils of this order were formerly called Alluvial soils.

Inceptisols generally occur on young but not recent land surfaces; hence, their name is derived from the Latin *inceptum*, for beginning. In Oklahoma County, Inceptisols include soils that were formerly called Alluvial soils and Lithosols.

Mollisols developed mainly under grasses and have well-formed genetic horizons. The Mollisols in this county were formerly called Reddish Prairie soils, Alluvial soils, or Lithosols.

Alfisols have clay-enriched B horizons that are high in base saturation. The Alfisols in this county were formerly called Red-Yellow Podzolic soils.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with 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 [1] and 1938 systems of classification*

Series	Current classification			1938 system
	Family	Subgroup	Order	Great soil group
Bethany	Fine, mixed, thermic	Typic Palustolls	Mollisols	Reddish Prairie soils.
Canadian	Coarse-loamy, mixed, thermic	Udic Haplustolls	Mollisols	Alluvial soils.
Chickasha	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Crevasse	Mixed, thermic	Typic Udipsamments	Entisols	Alluvial soils.
Dale	Fine-silty, mixed, thermic	Pachic Haplustolls	Mollisols	Alluvial soils.
Darnell	Loamy, siliceous, thermic, shallow	Udic Ustochrepts	Inceptisols	Lithosols.
Dougherty	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Grant	Fine-silty, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Konawa	Fine-loamy, mixed, thermic	Ultic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Lela	Fine, mixed, thermic	Typic Chromuderts	Vertisols	Alluvial soils.
Lucien	Loamy, mixed, thermic, shallow	Typic Haplustolls	Mollisols	Lithosols.
Miller	Fine, mixed, thermic	Vertic Haplustolls	Mollisols	Alluvial soils.
Nash	Coarse-silty, mixed, thermic	Udic Haplustolls	Mollisols	Reddish Prairie soils.
Noble	Coarse-loamy, siliceous, thermic	Udic Ustochrepts	Inceptisols	Alluvial soils.
Norge	Fine-silty, mixed, thermic	Udic Paleustolls	Mollisols	Reddish Prairie soils.
Port	Fine-silty, mixed, thermic	Cumulic Haplustolls	Mollisols	Alluvial soils.
Pulaski	Coarse-loamy, mixed, nonacid, thermic.	Typic Ustifluvents	Entisols	Alluvial soils.
Renfrow	Fine, mixed, thermic	Udertic Paleustolls	Mollisols	Reddish Prairie soils.
Stephenville	Fine-loamy, siliceous, thermic	Ultic Haplustalfs	Alfisols	Red-Yellow Podzolic soils.
Teller	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Vanoss	Fine-silty, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Vernon	Fine, mixed, thermic	Typic Ustochrepts	Inceptisols	Lithosols.
Zaneis	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.

[1] Placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

waterlogging, or soil differences resulting from the climate or vegetation.

GREAT GROUP: Soil suborders are separated into great groups on 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), and the like. The great group is not shown in table 7, because it is the last word in the name of the subgroup.

SUBGROUP: Great groups are subdivided into subgroups, one that represents the central (typic) segment of the group and others, called intergrades, that have properties of one 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. An example is a Typic Hapludolls (a typical Hapludolls).

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

Climate

The climate of Oklahoma County is fairly favorable for the growth of crops. Winters are usually short and mild, and extremely cold weather is infrequent. Heavy snowfall is rare, and the snow seldom stays on the ground for more than a few days. In summer, hot winds and droughts sometimes damage crops.

The temperature varies considerably. Extremes recorded were −17° F. in February 1899 and 113° in August 1936. The most days with a temperature of 100° or higher ever recorded in a single summer was 45° in 1934. An average year has 77 days when the temperature is freezing or lower, but in only 1 winter in 3 is the temperature zero or lower. Data on temperature and precipitaton are given in table 8. Information in this table, and in the rest of this section, is from reports published by the U.S. Weather Bureau.

The length of the average growing season is 221 days. The shortest growing season was 180 days (1952 and 1954), and the longest was 251 days (1918). The average date of the last freeze in spring is March 20. November 6 is the average date of the first freeze in fall.

Table 8 shows that the average annual precipitation is 31.93 inches. Rainfall is greatest during the growing season. On the average, about 33 percent of the annual precipitation occurs in spring, 29 percent in summer, 25 percent in fall, and 13 percent in winter. In an average year, 82 days have measurable precipitation and 9 days have 1 inch or more. From 1905 through 1962, precipita-

TABLE 8.—*Mean precipitation and temperature*

[All data from Oklahoma City for the period 1905 through 1961]

Month	Precipitation	Temperature
	Inches	*°F.*
January	1.31	37.5
February	1.22	40.8
March	2.11	49.8
April	3.30	60.1
May	5.15	68.1
June	3.98	77.1
July	2.77	81.3
August	2.72	81.3
September	3.10	74.0
October	2.85	62.7
November	1.91	49.3
December	1.51	39.9
Average annual	31.93	60.2

tion in inches for the 4 wettest years was 52.03 in 1908; 42.60 in 1920; 48.25 in 1923; and 46.46 in 1959. In the same period, precipitation in inches for the 4 driest years was 17.27 in 1910; 18.36 in 1917; 18.90 in 1936; and 17.84 in 1954.

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Glossary

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

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) 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 less than 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt. See also Texture.

Clay film. A thin coating of clay on the surface of a soil aggregate, or ped. Synonyms: clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grain, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent, soil does not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil readily deformed by moderate pressure but can be pressed into a lump; forms a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, soil adheres to other material, and tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard.—When dry, soil moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle soil; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Diversion. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect area downslope from the effects of such runoff.

Grassed waterways. A natural or constructed waterway, typically broad and shallow, that is covered by grass for protection against erosion; used to conduct surface water away from cropland.

Green-manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Horizon, soil. A layer of soil, approximately 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 it is therefore 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 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 generally underlies a C horizon but may be immediately beneath an A or B horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers of material.

Internal drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none*, *very slow*, *slow*, *medium*, *rapid*, and *very rapid*.

Leaching. The removal of soluble materials from soil or other materials by percolating water.

Legume. A member of the widely distributed *Leguminosae* family. Includes many valuable forage species, such as peas, beans, peanuts, clover, alfalfa, sweet clover, lespedeza, vetch, and kudzu. Practically all legumes are nitrogen-fixing plants, and many of the herbaceous species are used as cover and green-manure crops.

Minimum tillage. The least amount of tillage required for quick germination of seed, and a good stand.

Mottled. Irregular markings or spots of different colors that vary in number and size. Mottling in soils usually 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) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms to describe permeability and the equivalent percolation rates in inches per hour are as follows: *Very slow*—less than 0.05, 0.20 *slow*—0.05 to *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*—over 10.00.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Range. Land that, for the most part, produces native plants suitable for grazing by livestock; includes land on which there are some forest trees.

Reaction. The degree of acidity or alkalinity of a soil, expressed in pH values. The corresponding words used for ranges in pH are—

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay. See also Texture.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay. See also Texture.

Slope, soil. The amount of rise or fall in feet for each 100 feet of horizontal distance, normally expressed in percent. The slope terms and their numerical equivalents used in this survey are—

	Percent
Level and nearly level	0 to 1
Gently sloping	1 to 3
Moderately sloping	3 to 5
Sloping	5 to 8
Strongly sloping	8 to 12
Moderately steep	12 to 15

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and 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).

Stubble mulching. Stubble or other crop residues left on the soil, or partly worked into the soil, to provide protection from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil; the C or R horizon.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so that they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. Stream terraces are frequently called *second bottoms*, as contrasted to *flood plains*, and are seldom subject to overflow.

Texture. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions 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." See also Sand, Silt, and Clay.

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Water-holding capacity. The capacity of a soil to hold water. Some of this water is held by soil particles and is not available to plants.

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