SOIL SURVEY OF

Jefferson County, Oklahoma

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Oklahoma Agricultural Experiment Station

Issued 1973

Major fieldwork for this soil survey was done in the period 1961–66. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Jefferson County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. 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. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the woodland group and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the 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 from the soil descriptions and from the descriptions of the range sites and woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

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

Community planners, engineers, and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

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

Newcomers in Jefferson County might be especially interested in the "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: **Loamy prairie range site in excellent condition. The soil is Zaneis loam, 1 to 3 percent slopes.**

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Contents

SOIL SURVEY OF JEFFERSON COUNTY, OKLAHOMA

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

JEFFERSON COUNTY is in the southwestern part of Oklahoma (fig. 1). It has approximately 483,200 acres, or 755 square miles. Approximately three-fourths of the acreage is used for grazing. Although cropland is susceptible to erosion, and drought is a hazard, a substantial acreage is used for field crops, mainly wheat and melons. The number of farms is decreasing but the size is increasing.

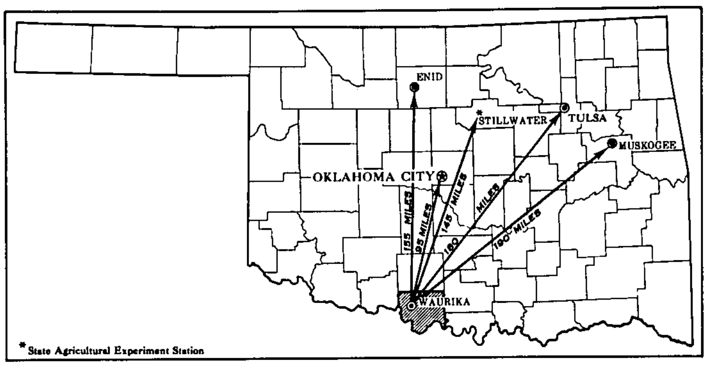

Figure 1.—**Location of Jefferson County in Oklahoma.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Jefferson County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the 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 the action of plant roots.

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. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

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. Chickasha and Minco, 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 affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects the use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Bastrop loam, 1 to 3 percent slopes, is one of several phases within the Bastrop series.

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 help in drawing boundaries accurately. The soil map in the back of this publication 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 the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. 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 phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Three such kinds of mapping units are shown on the soil map of Jefferson County: soil complexes, soil associations, and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each soil of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. An example is Port-Oscar complex.

A soil complex is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Zaneis-Lucien-Vernon association, rolling, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Port and Pulaski soils, channeled, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rough broken land is a land type in Jefferson County.

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 soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. 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 as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Jefferson 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 want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

Each of the nine soil associations in this county is described on the following pages. The terms for texture used in the title of the associations apply to the surface layer. For example, in the title for association 1, the words "loamy soils" refer to texture of the surface layer.

1. Kirkland-Renfrow Association

Deep, nearly level to gently sloping, loamy soils that have a loamy and clayey subsoil over clay and shale; on uplands

This association occupies about 19,300 acres, or 4 percent of the county. About 80 percent of this is Kirkland soils and 11 percent is Renfrow soils. The remaining 9 percent is soils of minor extent, mostly Waurika and Zaneis soils.

Kirkland soils are deep, nearly level to very gently sloping, well-drained, loamy soils that have a clayey subsoil. Renfrow soils are deep, very gently sloping to gently sloping, well-drained, loamy soils that have a clayey and loamy subsoil.

Kirkland soils are mostly cultivated. They are suited to small grain, sorghum, cotton, tame pasture, and range. Renfrow soils are used mostly for range, small grain, and grain sorghum. The principal management problems are maintaining soil structure and controlling water erosion. These soils respond favorably to good management.

2. Zaneis-Lucien-Vernon Association

Very shallow to deep, very gently sloping to rolling, loamy or clayey soils that have a loamy or clayey subsoil over clay, shale, or sandstone; on uplands

This association occupies about 140,200 acres, or 29 percent of the county. About 39 percent of this is Zaneis soils, 22 percent is Lucien soils, and 15 percent is Vernon soils. The remaining 24 percent is soils of minor extent, mostly Chickasha and Treadway soils.

Zaneis soils are deep, very gently sloping to rolling, well-drained soils that are loamy throughout. Lucien soils are very shallow and shallow, rolling, well-drained soils that are loamy throughout. Vernon soils are deep, rolling, well-drained, loamy or clayey soils that have a clayey subsoil.

Most of this association is used for range. The soils respond favorably to good range management. Small areas of Zaneis soils are used for grain sorghum, small grain, cotton, and tame pasture. The principal management problems are maintaining soil structure and controlling water erosion.

3. Zaneis-Wing Association

Deep, nearly level and very gently sloping, loamy soils that have a loamy or clayey subsoil over clay, shale, or sandstone; on uplands

This association occupies about 140,000 acres, or 29 percent of the county. About 44 percent of this is Zaneis soils and 24 percent is Wing soils. The remaining 32 percent is soils of minor extent, mostly Chickasha, Treadway, and Port soils.

Zaneis soils are deep, nearly level and very gently sloping, well-drained soils that are loamy throughout. Wing soils are deep, nearly level and very gently sloping, somewhat poorly drained to moderately well drained, loamy soils that have a loamy or clayey subsoil high in sodium content.

Most of this association is used for range. Part is used for small grain, grain sorghum, cotton, and tame pasture. The principal management problems are maintaining soil structure and fertility and controlling surface crusting and water erosion.

4. Port-Bunyan-Yahola Association

Deep, nearly level and very gently sloping soils that are loamy throughout; on flood plains

This association occupies about 67,700 acres, or 14 percent of the county. About 47 percent of this is Port soils, 17 percent is Bunyan soils, and 11 percent is Yahola soils. The remaining 25 percent is soils of minor extent, mostly Pulaski and Oscar soils.

Port soils are deep, nearly level and very gently sloping, well-drained soils that have moderately slow permeability. Bunyan soils are deep, nearly level, well-drained soils that have moderate permeability. Yahola soils are deep, nearly level, well-drained soils that have moderately rapid permeability.

Most of this association is used for small grain, grain sorghum, cotton, alfalfa, and tame pasture. The principal management problems are maintaining soil structure and protecting the soils from floods.

5. Crevasse Association

Deep, nearly level and very gently sloping soils that are sandy throughout; on flood plains

This association occupies about 19,300 acres, or 4 percent of the county. About 97 percent of this is Crevasse soils. The remaining 3 percent is soils of minor extent, mostly Yahola and Bunyan soils.

Crevasse soils are deep, nearly level, and very gently sloping soils that are sandy throughout.

Most of this association is used for range, woodland, or tame pasture. The principal management problems are maintaining fertility and protecting the soils from floods. The soils respond favorably to good management.

6. Roebuck Association

Deep, nearly level soils that are loamy or clayey throughout; on flood plains

This association occupies about 14,500 acres, or 3 percent of the county. About 89 percent of this is Roebuck soils. The remaining 11 percent is soils of minor extent, mostly Port and Oscar soils.

Roebuck soils are deep, nearly level soils that are loamy or clayey throughout.

Most of this association is used for native grass and bottom land hardwoods. The less frequently flooded soils are suitable for small grain, cotton, sorghum, alfalfa, and tame pasture. The principal management problems are protecting the soils from floods and providing surface drainage.

7. Dougherty-Tivoli Association

Deep, nearly level to rolling soils that are sandy throughout or are sandy and have a loamy subsoil over sandy or loamy sediments; on uplands

This association occupies about 9,700 acres, or 2 percent of the county. About 67 percent of this is Dougherty soils and 25 percent is Tivoli soils. The remaining 8 percent is soils of minor extent, mostly Hardeman and Teller soils.

Dougherty soils are deep, nearly level to very gently sloping and hummocky, well-drained, sandy soils that have a loamy subsoil. Tivoli soils are deep, rolling and hummocky, excessively drained soils that are sandy throughout.

Dougherty soils are mostly cultivated. They are suited to small grain, cotton, sorghum, watermelon, cantaloup, and tame pasture. Tivoli soils are used for range. Soil blowing is a problem if adequate plant cover is not maintained. These soils respond favorably to good management.

8. Minco-Bastrop-Teller Association

Deep, nearly level to sloping, loamy soils that have a loamy subsoil over loamy sediments; on uplands and terraces

This association occupies about 48,300 acres, or 10 percent of the county. About 38 percent of this is Minco soils, 31 percent is Bastrop soils, and 23 percent is Teller soils. The remaining 8 percent is soils of minor extent, mostly Hardeman and Pond Creek soils.

Minco soils are deep, nearly level to sloping, well-drained loamy soils that have a weakly developed loamy subsoil. They are on uplands. Bastrop soils are deep, nearly level to gently sloping, well-drained, loamy soils that have a well-developed loamy subsoil. They are on terraces. Teller soils are deep, nearly level to sloping, well-drained, loamy soils that have a well-developed loamy subsoil. They are on uplands.

Minco soils are used mostly for small grain, cotton, sorghum, and alfalfa. Bastrop soils are used for cutivated crops, range, and tame pasture. The main crops are small grain, cotton, and grain sorghum. Teller soils are used mostly for small grain, cotton, and sorghum. The principal management problem is maintaining soil structure and fertility. The soils respond favorably to good management.

9. Stephenville-Darnell-Windthorst Association

Very shallow to deep, very gently sloping to strongly sloping, loamy soils that have a loamy or clayey subsoil over sandstone, clay, or shale; on uplands

This association occupies about 24,200 acres, or 5 percent of the county. About 79 percent of this is Stephenville soils, 9 percent is Darnell soils, and 4 percent is Windthorst soils. The remaining 8 percent is soils of minor extent, mostly Teller and Dougherty soils.

Stephenville soils are moderately deep and deep, very gently sloping to strongly sloping, well drained, and loamy throughout. Darnell soils are very shallow and shallow, very gently sloping to strongly sloping, well drained, and also are loamy throughout. Windthorst soils are deep, very gently sloping to strongly sloping, moderately well drained, and loamy and clayey in the subsoil.

Most of this association is used for range. Part is used for tame pasture and cultivated crops. The main crops are small grain, sorghum, and cotton. The principal management problems are maintaining soil structure and fertility and controlling water erosion.

Descriptions of the Soils

This section describes the soil series and mapping units in Jefferson County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless otherwise stated, the colors given in the descriptions are those of a dry soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Rough broken land, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit, range site, and woodland group in which the mapping unit has been placed. The page for the description of each range site and woodland group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).[1]

Bastrop Series

The Bastrop series consists of deep, nearly level and gently sloping soils on terraces. These soils formed in loamy sediments under a cover of mid and tall grasses.

In a representative profile, the surface layer is reddish-brown loam about 12 inches thick. The upper part of the subsoil is reddish-brown clay loam that extends to a depth of about 30 inches. The lower part of the subsoil is red clay loam that extends to a depth of about 72 inches (fig. 2).

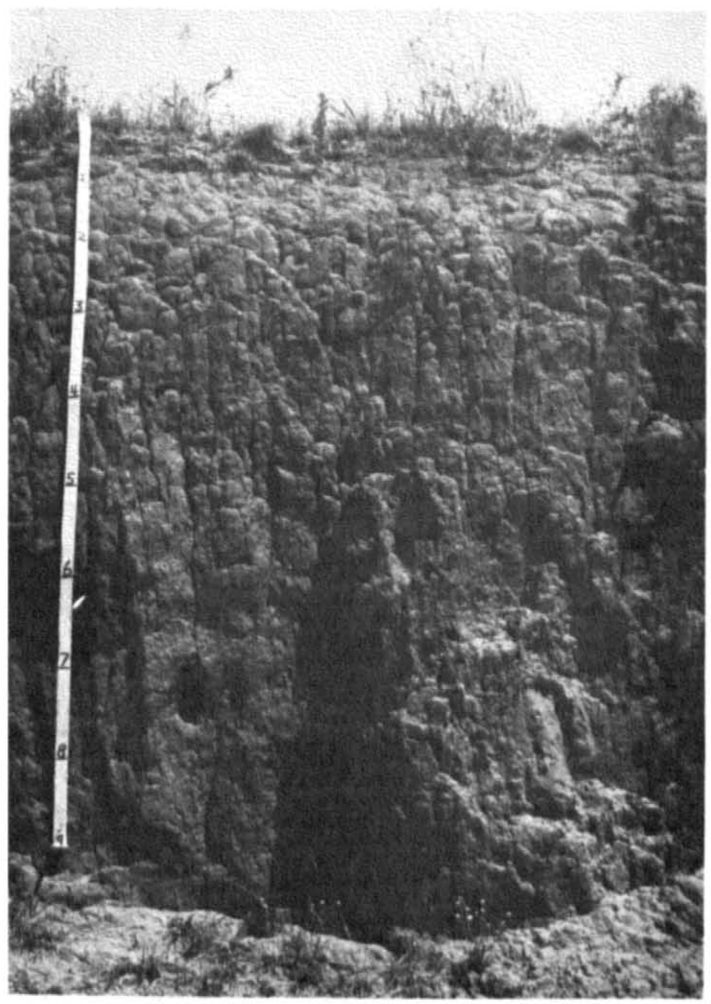

Figure 2.—**Profile of a Bastrop loam.**

[1] Italic numbers in parentheses refer to Literature Cited, p. 63.

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Bastrop loam, 0 to 1 percent slopes	550	0.1	Stephenville fine sandy loam, 1 to 3 percent slopes	7,865	1.6
Bastrop loam, 1 to 3 percent slopes	10,884	2.3	Stephenville fine sandy loam, 3 to 5 percent slopes	4,826	1.0
Bastrop loam, 3 to 5 percent slopes	4,023	.8	Stephenville fine sandy loam, 2 to 5 percent slopes, eroded	1,813	.4
Breaks-Alluvial land complex	2,966	.6	Stephenville soils, 2 to 6 percent slopes, severely eroded	1,611	.3
Bunyan loam	5,814	1.2	Stephenville-Darnell complex, 1 to 12 percent slopes	8,704	1.8
Bunyan soils, frequently flooded	5,909	1.2	Teller fine sandy loam, 0 to 1 percent slopes	1,158	.2
Chickasha fine sandy loam, 0 to 1 percent slopes	2,909	.6	Teller fine sandy loam, 1 to 3 percent slopes	2,029	.4
Chickasha fine sandy loam, 1 to 3 percent slopes	3,090	.6	Teller fine sandy loam, 3 to 5 percent slopes	1,715	.4
Crevasse soils	19,237	4.0	Teller fine sandy loam, 2 to 6 percent slopes, eroded	1,499	.3
Dougherty loamy fine sand, 0 to 3 percent slopes	5,712	1.2	Teller fine sandy loam, 5 to 8 percent slopes	1,351	.3
Dougherty loamy fine sand, hummocky	817	.2	Teller soils, 2 to 8 percent slopes, severely eroded	5,151	1.1
Hardeman fine sandy loam, 0 to 3 percent slopes	1,726	.4	Tivoli fine sand, hummocky	447	.1
Hardeman fine sandy loam, 8 to 20 percent slopes	1,039	.2	Tivoli soils, rolling	2,000	.4
Kirkland silt loam, 0 to 1 percent slopes	7,230	1.4	Treadway soils	4,529	.9
Kirkland silt loam, 1 to 3 percent slopes	9,009	1.9	Vernon soils, 3 to 5 percent slopes	1,660	.3
Minco loam, 0 to 1 percent slopes	8,920	1.8	Waurika silt loam	1,856	.4
Minco loam, 1 to 3 percent slopes	7,223	1.5	Windthorst fine sandy loam, 1 to 5 percent slopes	1,090	.2
Minco loam, 3 to 5 percent slopes	1,414	.3	Yahola fine sandy loam	7,544	1.6
Minco loam, 5 to 8 percent slopes	1,229	.3	Zaneis loam, 1 to 3 percent slopes	9,741	2.0
Pond Creek silt loam, 0 to 1 percent slopes	1,146	.2	Zaneis loam, 3 to 5 percent slopes	2,103	.4
Port silty clay loam	7,032	1.5	Zaneis loam, 2 to 5 percent slopes, eroded	2,131	.4
Port-Oscar complex	33,543	7.0	Zaneis-Lucien-Vernon association, rolling	107,277	22.2
Port and Pulaski soils, channeled	6,693	1.4	Zaneis-Wing complex, 0 to 3 percent slopes	138,355	28.6
Pulaski fine sandy loam	2,198	.5	Waurika Lake	48	.1
Renfrow silt loam, 2 to 5 percent slopes, eroded	1,015	.2			
Renfrow soils, 2 to 5 percent slopes, severely eroded	1,351	.3	Total	483,200	100.0
Roebuck clay	4,303	.9			
Roebuck soils, frequently flooded	8,932	1.8			
Rough broken land	783	.2			

Bastrop soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Bastrop loam, 1 to 3 percent slopes, 400 feet south and 100 feet west of NE. corner of sec. 6, T. 6 S., R. 8 W.:

Ap—0 to 6 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; weak, medium, granular structure; hard, friable; slightly acid; plow boundary.

A1—6 to 12 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular structure; hard, friable; neutral; clear boundary.

B21t—12 to 30 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; moderate, medium, subangular blocky structure; hard, friable; thin clay films on faces of peds; neutral; gradual boundary.

B22t—30 to 60 inches, red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) when moist; weak, medium, subangular blocky structure; hard, friable; patchy clay films on faces of peds; moderately alkaline; gradual boundary.

B3—60 to 72 inches, red (2.5YR 5/6) clay loam, red (2.5YR 4/6) when moist; weak, coarse, prismatic structure; hard, friable; calcareous; moderately alkaline.

The A horizon is brown or reddish brown. The B horizon ranges from reddish brown to yellowish red and is sandy clay loam to clay loam. Depth to calcareous material ranges from 4 to 6 feet.

Bastrop soils are associated with Hardeman, Minco, Pond Creek, and Teller soils. They are more silty than Hardeman soils and have a B2t horizon which Hardeman soils do not have. They differ from Minco soils in having a B2t horizon. They have a redder and less silty B2t horizon than Pond Creek soils. Unlike Teller soils, their clay content does not decrease within 60 inches of the surface.

Bastrop loam, 0 to 1 percent slopes (BaA).—This soil is on terraces. It has a profile similar to the one described as representative for the series except that the surface layer is slightly thicker.

Included in mapping are small areas of Minco loam and Teller fine sandy loam.

This soil is one of the best for farming in the county. It is suited to small grain, sorghum, cotton, alfalfa, melon, cantaloup, tame pasture, range, and woodland. Most of the acreage is cultivated.

Management is needed to maintain fertility and soil structure. This management consists of seeding legumes, adding fertilizer, effectively using crop residue, and avoiding excessive tillage. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Capability unit I-1; Loamy Prairie range site; woodland group 1.

Bastrop loam, 1 to 3 percent slopes (BaB).—This soil is on terraces. It has the profile described as representative for the series.

Included in mapping are small areas of Minco loam and Teller fine sandy loam.

This soil is suited to small grain, alfalfa, sorghum, cotton, cantaloup, tame pasture, range, and woodland. Most of the acreage is cultivated.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terraces, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe-1; Loamy Prairie range site; woodland group 1.

Bastrop loam, 3 to 5 percent slopes (BaC).—This soil is on terraces. Most mapped areas are small. The profile is similar to the one described as representative for the series except that the surface layer is slightly thinner. In cultivated fields, 5 to 10 percent of the acreage has been eroded to such a degree that part of the subsoil is mixed with the surface layer where the soil is plowed. In places there are a few rills where surface water accumulates.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland. Most of the acreage is in native vegetation and is used for range.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terracing, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Terracing, contour farming, and the use of crop residue are needed to control erosion, conserve moisture, and maintain soil structure. Capability unit IIIe-2; Loamy Prairie range site; woodland group 2.

Breaks-Alluvial Land

Breaks-Alluvial land complex (Bk) is about 75 to 85 percent Breaks and 15 to 25 percent Alluvial land. These land types occur in such an intricate pattern that it is impractical to map them separately.

This mapping unit has natural drainageways that drain the surrounding more uniform uplands. The areas are long; they are generally 200 to 300 feet wide but range from 75 to 500 feet in width.

Breaks consist of loamy or clayey soils on short side slopes that range from 8 to 20 percent. They are moderately deep to deep and are underlain by sandstone, shale, or clay. They range from slightly acid to moderately alkaline in reaction.

Alluvial land occurs as narrow flood plains between the side slopes. It is flooded more than once each year. Slopes range from 0 to 2 percent. It is deep and consists of stratified, loamy alluvium. It ranges from neutral to moderately alkaline in reaction.

This mapping unit is best suited to tame pasture and native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practices, and preventing fires. Capability unit VIe-4; woodland group 4; Breaks in Loamy Prairie range site; Alluvial land in Loamy Bottomland range site.

Bunyan Series

The Bunyan series consists of deep, nearly level soils on flood plains. These soils formed in loamy sediments under a cover of tall grasses. They are subject to flooding.

In a representative profile, the surface layer is reddish-brown loam about 20 inches thick. The next layer is reddish-brown loam that extends to a depth of about 30 inches. Below this are buried layers of reddish-brown loam that extend to a depth of about 72 inches.

Bunyan soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Bunyan loam, 1,320 feet north and 600 feet west of SE. corner of sec. 8, T. 4 S., R. 8 W.:

A—0 to 20 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; weak, medium, granular structure; slightly hard, friable; few worm casts; moderately alkaline; gradual boundary.

C—20 to 30 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, medium, granular structure; hard, friable; common worm casts of slightly darker material; moderately alkaline; abrupt boundary.

Ab—30 to 44 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard, friable; many worm casts; moderately alkaline; gradual boundary.

Bb—44 to 72 inches, reddish-brown (2.5YR 4/4) loam, dark reddish brown (2.5YR 3/4) when moist; weak, medium, granular structure; slightly hard, very friable; few worm casts; moderately alkaline.

The A horizon is reddish-brown or brown loam and silt loam. The C horizon ranges from brown or reddish brown to yellowish red in color and from loam to silt loam in texture. Buried horizons are at a depth of 30 to 60 inches.

The Bunyan soils in this county are redder throughout than is typical for the Bunyan series. They are enough like the Bunyan series in morphology, composition, and behavior so that a new series is not warranted.

Bunyan soils are associated with Port and Pulaski soils. They are more sandy than Port soils. They are more clayey than Pulaski soils.

Bunyan loam (Bn).—This is a nearly level soil on flood plains. It is likely to be damaged by floods once every 1 to 5 years. It has the profile described as representative for the series.

Included in mapping is a soil, similar in texture, that has a dark-brown surface layer 10 to 20 inches thick. Also included are small areas of Port silty clay loam and small areas of a soil that has a clay content of 15 to 18 percent between depths of 10 and 40 inches.

This soil is suited to all crops commonly grown in the county. Wheat and alfalfa are the principal crops. This soil also is suited to tame pasture, range, and woodland.

Management is needed to maintain soil structure and fertility and to protect the soil from damage by overflow of streams and from soil blowing. Terraces are needed for diverting water that runs off adjacent upland. Crop residue should be returned to the soil. Plant cover is needed in winter and in spring to protect the soil from soil blowing. Capability unit IIw-2; Loamy Bottomland range site; woodland group 1.

Bunyan soils, frequently flooded (Bu).—These are nearly level soils on flood plains. They are flooded more than once each year. Their profile is more stratified than the profile described as representative for the series. The strata consist of layers of fine sandy loam, loam, loamy fine sand, and clay that are generally less than 4 inches thick. The A horizon is loam or silt loam.

Included in mapping are small areas of Roebuck clay, Port silty clay loam, and Pulaski fine sandy loam.

These soils are best suited to native range and tame pasture. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit Vw-1; Loamy Bottomland range site; woodland group 2.

Chickasha Series

The Chickasha series consists of deep, nearly level to very gently sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of mid and tall grasses.

In a representative profile, the surface layer is brown fine sandy loam about 15 inches thick. The upper part of the subsoil is brown loam that extends to a depth of about 39 inches. The lower part of the subsoil is strong-brown loam that extends to a depth of about 44 inches. The underlying material is yellowish-brown and reddish-brown hard sandstone.

Chickasha soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Chickasha fine sandy loam, 1 to 3 percent slopes, 2,490 feet east and 100 feet south of NW. corner sec. 26, T. 4 S., R. 4 W.:

Ap—0 to 6 inches, brown (7.5YR 5/3) fine sandy loam, dark-brown (7.5YR 3/3) when moist; weak, fine, granular structure; slightly hard, friable; slightly acid; clear, smooth boundary.

A1—6 to 15 inches, brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; moderate, coarse, granular structure; slightly hard, friable; porous; few iron-manganese concretions; medium acid; gradual, smooth boundary.

B21t—15 to 28 inches, brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) when moist; weak, medium, subangular blocky parting to weak, medium, granular structure; hard, friable; thin clay films on faces of peds; few worm casts; medium acid; gradual, smooth boundary.

B22t—28 to 39 inches, brown (7.5YR 5/4) loam, brown (7.5YR 4/4) when moist; few, fine, distinct, reddish-brown and red mottles; weak, medium, granular structure; hard, friable; porous; few iron-manganese concretions; medium acid; gradual, smooth boundary.

B3—39 to 44 inches, strong-brown (7.5YR 5/6) loam, strong brown (7.5YR 4/6) when moist; weak, medium, granular structure; hard, friable; medium acid; gradual boundary.

R—44 inches, yellowish-brown and reddish-brown, fine-grained sandstone; hard when dry.

The A horizon is brown, dark grayish brown, dark brown, and grayish brown. It is slightly acid or medium acid. The B horizon is loam or sandy clay loam. It ranges from strong brown to dark brown in color and is slightly acid or medium acid in reaction. Depth to the R layer is 40 to 60 inches.

Chickasha soils are associated with Zaneis, Stephenville, and Minco soils. They have a less clayey and less reddish B2t horizon than the Zaneis soils. They differ from the Stephenville soils in not having an A2 horizon. They have a B2t horizon but the Minco soils do not.

Chickasha fine sandy loam, 0 to 1 percent slopes (ChA).—This soil is on uplands. The profile is similar to the one described as representative for the series except that the surface layer is slightly thicker.

Included in mapping are small areas of Zaneis loam and Kirkland silt loam which make up less than 5 percent of the mapping unit.

This soil is suited to small grain, sorghum, cotton, alfalfa, tame pasture, range, and woodland. Most of the acreage is cultivated.

Management is needed to maintain fertility and soil structure. This management consists of seeding legumes, adding fertilizer, effectively using crop residue, and avoiding excessive tillage. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Capability unit I-1; Loamy Prairie range site; woodland group 1.

Chickasha fine sandy loam, 1 to 3 percent slopes (ChB).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Bastrop loam and Zaneis loam. The soils in some areas have a yellower surface layer.

Most of the acreage is cultivated. Cotton, sorghum, and small grain are the major crops. A small acreage is used for native range, and several areas have been seeded to native grass.

Management is needed to maintain fertility and soil structure and to prevent erosion. Terraces, contour farming, stripcropping, and use of crop residue help to control erosion. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe-1; Loamy Prairie range site; woodland group 1.

Crevasse Series

The Crevasse series consists of deep, nearly level and very gently sloping soils on flood plains. These soils formed in sandy sediments under a cover of tall grasses and scattered trees. They are subject to flooding.

In a representative profile, the surface layer is light-brown fine sand about 20 inches thick. The underlying material is reddish-yellow fine sand.

Crevasse soils are somewhat excessively drained and have rapid permeability. Available water capacity is low.

Representative profile of Crevasse fine sand, SE. corner, NE 1/4 sec. 9, T. 8 S., R. 6 W.:

A—0 to 20 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; single grain; loose, very friable; thin strata with bedding planes of loamy fine sand; calcareous; moderately alkaline; gradual, smooth boundary.

C—20 to 60 inches, reddish-yellow (7.5YR 6/6) fine sand, strong brown (7.5YR 5/6) when moist; single grain; loose, very friable; calcareous; moderately alkaline.

The A horizon is mostly fine sand and loamy fine sand. It ranges from brown to reddish yellow and grayish brown to brownish yellow. The C horizon is mainly fine sand, but in some areas it is loamy fine sand that extends to a depth of about 30 inches. It is brown to reddish yellow or brownish yellow.

The Crevasse soils in this county are redder throughout than is typical for the Crevasse series. They are enough like typical soils in the Crevasse series in morphology, composition, and behavior that a new series is not warranted.

Crevasse soils are more sandy throughout the profile than the associated Yahola soils.

Crevasse soils (Cr).—These are nearly level and very gently sloping soils on flood plains. They are flooded more than once each year. The surface layer is fine sand and loamy fine sand.

Included in mapping are areas of Yahola fine sandy loam and a Tivoli fine sand that make up about 5 percent of the acreage. In about 15 percent of the acreage the Crevasse soils have thin strata of fine sandy loam to clay loam.

These soils are best suited to tame pasture and native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fire. Capability unit Vw-3; Sandy Bottomland range site; woodland group 2.

Darnell Series

The Darnell series consists of very shallow and shallow, very gently sloping to strongly sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of oak forest and an understory of tall grasses. In this county, Darnell soils are mapped only with Stephenville soils.

In a representative profile, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is yellow fine sandy loam that extends to a depth of about 17 inches. It is underlain by reddish-yellow sandstone.

Darnell soils are well drained and have moderately rapid permeability. Available water capacity is low to moderate.

Representative profile of Darnell fine sandy loam from an area of Stephenville-Darnell complex, 1 to 12 percent slopes, 1,980 feet west and 100 feet south of NE. corner of sec. 33, T. 3 S., R. 4 W.:

A—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B—5 to 17 inches, yellow (10YR 7/6) fine sandy loam, yellowish brown (10YR 5/6) when moist; weak, fine, granular structure; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

R—17 inches, reddish-yellow (7.5YR 6/6), moderately soft sandstone; noncalcareous.

The A horizon ranges from brown to grayish brown. It is slightly acid or neutral. The B horizon ranges from reddish yellow to strong brown and yellow. It is neutral to strongly acid. Depth to sandstone ranges from 4 to 20 inches.

Darnell soils are shallower than the associated Stephenville soils.

Dougherty Series

The Dougherty series consists of deep, nearly level and very gently sloping soils that are hummocky in places. These soils are on uplands. They formed in sandy and loamy sediments under a cover of oak forest and an understory of tall grasses.

In a representative profile, the surface layer is grayish-brown and brown loamy fine sand about 10 inches thick. The next layer is light-brown loamy fine sand that extends to a depth of about 28 inches. The upper part of the subsoil is yellowish-red sandy clay loam that extends to a depth of about 40 inches. The lower part of the subsoil is reddish-yellow fine sandy loam and loamy fine sand that extends to a depth of about 59 inches. The underlying material is reddish-yellow loamy fine sand.

Dougherty soils are well drained and have moderate permeability. Available water capacity is moderate.

Representative profile of Dougherty loamy fine sand, 0 to 3 percent slopes, 75 feet north and 1,000 feet east of SW. corner, SE¼ sec. 22, T. 7 S., R. 7 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft, very friable; slightly acid; abrupt, smooth boundary.

A1—6 to 10 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) when moist; weak, fine, granular structure; slightly hard, friable; medium acid; clear, smooth boundary.

A2—10 to 28 inches, light-brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) when moist; single grain; slightly hard, very friable; slightly acid; abrupt, smooth boundary.

B2t—28 to 40 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) when moist; weak, medium, subangular blocky structure; hard, friable; clay bridges between sand grains; slightly acid; gradual, smooth boundary.

B31—40 to 50 inches, reddish-yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 5/8) when moist; weak, medium, subangular blocky structure; hard, friable; medium acid; clear, smooth boundary.

B32—50 to 59 inches, reddish-yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) when moist; weak, fine, subangular blocky structure; slightly hard, very friable; medium acid; gradual, smooth boundary.

C—59 to 70 inches, reddish-yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) when moist; structureless; slightly hard, very friable; medium acid.

The A1 horizon ranges from light brown to brown and light brownish gray. The A2 horizon is pink to brown and very pale brown. The total thickness of the A horizon ranges from 20 to 40 inches. The B2t horizon ranges from reddish brown to reddish yellow. It is slightly acid to strongly acid. The C horizon is red to yellowish red and reddish yellow and is fine sandy loam to fine sand.

Dougherty soils are associated with Stephenville, Tivoli, and Teller soils. Unlike Stephenville soils, they do not have sandstone within 48 inches of the surface and their A horizon is more than 20 inches thick. Unlike Tivoli soils, they have a sandy clay loam B2t horizon. They have a thicker A horizon than Teller soils.

Dougherty loamy fine sand, 0 to 3 percent slopes (DoB).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are a few small areas of Teller fine sandy loam. Other inclusions are of a soil similar to this Dougherty soil that has a surface layer less than 20 inches thick and of another soil also similar to this Dougherty soil in which the surface layer and subsurface layer combined are more than 40 inches thick. These inclusions make up about 6 to 10 percent of the mapping unit.

This soil is suited to small grain, sorghum, cotton, alfalfa, melons, cantaloup, tame pasture, range, and woodland.

Management is needed to maintain or improve fertility and to control soil blowing. Plant cover is needed in winter and in spring to protect the soil from soil blowing. Cover crops also are needed where crops that produce little residue are grown. Stripcropping, minimum tillage, and use of residue help control erosion and improve fertility. Capability unit IIIe-4; Deep Sand Savannah range site; woodland group 1.

Dougherty loamy fine sand, hummocky (DoC).—This soil is on uplands. Slopes are dominantly 3 to 8 percent, but a few small, nearly level areas occur between sloping, elongated hummocks. The profile of this soil is similar to the one described as representative for the series except that the surface layer is slightly thicker.

Included with this soil in mapping are areas of a soil that is similar to this Dougherty soil but that has loamy fine sand or fine sand horizons more than 40 inches thick. In about 55 percent of the acreage of this included soil, the subsoil is below a depth of 40 inches and has thin bands of more clayey material; in about 30 percent the subsoil is clay loam, and in about 15 percent it is loamy fine sand.

This soil is suited to small grain, sorghum, cotton, melons, cantaloup, tame pasture, range, and woodland. It is used for both range and cultivated crops.

Management is needed to maintain or improve fertility and to control soil blowing. A cover crop in winter and in spring helps to protect the soil from soil blowing. Stripcropping, minimum tillage, and use of crop residue help to control erosion and maintain fertility. Cover crops are needed where crops that produce little residue are grown. In some areas, diversion terraces are needed to control water erosion. Capability unit IVe-2; Deep Sand Savannah range site; woodland group 3.

Hardeman Series

The Hardeman series consists of deep, nearly level to moderately steep soils on uplands. These soils formed in loamy sediments under a cover of mid and tall grasses.

In a representative profile, the surface layer is brown fine sandy loam about 11 inches thick. The subsoil is reddish-brown fine sandy loam that extends to a depth of about 24 inches. The underlying material is reddish-yellow fine sandy loam.

Hardeman soils are well drained and have moderately rapid permeability. Available water capacity is high.

Representative profile of Hardeman fine sandy loam, 0 to 3 percent slopes, 660 feet west and 200 feet north of SE. corner of sec. 18, T. 6 S., R. 8 W.:

A—0 to 11 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) when moist; weak, fine, granular structure; soft, very friable; neutral; gradual, smooth boundary.

B2—11 to 24 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard, very friable; neutral; gradual, smooth boundary.

C1—24 to 50 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; massive; slightly hard, very friable; neutral; gradual, smooth boundary.

C2—50 to 72 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The A horizon ranges from brown to dark brown. It is slightly acid or neutral. The B2 horizon ranges from reddish yellow to reddish brown. It is slightly acid to mildly alkaline. Depth to calcareous material ranges from 3 to 6 feet.

The Hardeman soils in this county are deeper, more than 24 inches, over calcareous material than is typical for the Hardeman series. They are enough like the Hardeman series in morphology, composition, and behavior that a new series is not warranted.

Hardeman soils are associated with Bastrop, Minco, and Teller soils. Unlike Bastrop soils, they have a less silty B horizon and have no B2t horizon. They have a less silty B horizon than Minco soils. They differ from Teller soils in not having a B2t horizon.

Hardeman fine sandy loam, 0 to 3 percent slopes (HaB).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Teller fine sandy loam and Minco loam.

This soil is suited to cotton, small grain, sorghum, alfalfa, melons, cantaloup, tame pasture, range, and woodland. Cotton and melons are the principal crops. Most of the acreage is cultivated.

Management is needed to maintain fertility and soil structure and to control erosion. Terraces, contour farming, stripcropping, and use of crop residue help to control erosion. A cover crop is needed in winter and in spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe-1; Sandy Prairie range site; woodland group 1.

Hardeman fine sandy loam, 8 to 20 percent slopes (HaE).—This soil is on uplands. It has a profile similar to the one described as representative for the series except that the surface layer is slightly thinner.

Included in mapping are small areas of Minco loam and Teller fine sandy loam.

This soil is best suited to tame pasture and native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fire. Capability unit VIe-3; Sandy Prairie range site; woodland group 4.

Kirkland Series

The Kirkland series consists of deep, nearly level and very gently sloping soils on uplands. These soils formed in material weathered from clays and shales under a cover of mid and tall grasses.

In a representative profile, the surface layer is brown silt loam about 12 inches thick. The upper part of the subsoil is brown clay that extends to a depth of about 47 inches. The lower part of the subsoil is reddish-brown clay that extends to a depth of about 55 inches. The underlying material is yellowish-red clay.

Kirkland soils are well drained and have very slow permeability. Available water capacity is high.

Representative profile of Kirkland silt loam, 0 to 1 percent slopes, 1,650 feet west and 150 feet south of NE. corner of sec. 32, T. 4 S., R. 5 W.:

A1—0 to 12 inches, brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; hard, friable; slightly acid; abrupt, smooth boundary.

B2t—12 to 29 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) when moist; weak, fine, blocky structure; extremely hard, extremely firm; clay films on faces of peds; neutral; gradual, smooth boundary.

B31—29 to 40 inches, brown (7.5YR 4/3) clay, dark brown (7.5YR 3/3) when moist; weak, fine, blocky structure; extremely hard, very firm; common, fine soft masses and concretions of calcium carbonate; moderately alkaline; gradual, smooth boundary.

B32ca—40 to 47 inches, brown (7.5YR 4/3) clay, dark brown (7.5YR 3/3) when moist; weak, medium, blocky structure; extremely hard, very firm; common, fine, soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B33—47 to 55 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) when moist; weak, medium, blocky structure; extremely hard, very firm; common, fine, black iron-manganese concretions; few calcium-carbonate concretions; part of soil mass noncalcareous; moderately alkaline; gradual, smooth boundary.

C—55 to 70 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; massive; extremely hard, very firm; few calcium-carbonate concretions; common fine black iron-manganese concretions; calcareous; moderately alkaline.

The A horizon ranges from brown to dark grayish brown and dark brown. It is medium acid to neutral. The B2t horizon ranges from brown to dark grayish brown and dark yellowish brown and is clay or silty clay. Depth to secondary carbonates ranges from 28 to 48 inches.

Kirkland soils are associated with Renfrow and Waurika soils. They have a less reddish B2t horizon than Renfrow soils. Unlike Waurika soils, they do not have an A2 horizon.

Kirkland silt loam, 0 to 1 percent slopes (KnA).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Waurika silt loam, Renfrow silt loam, and Wing soils. These inclusions make up about 10 percent of the mapping unit. Also included are 600 to 800 acres of a soil that has mottles in the upper part of the subsoil; this acreage is in the eastern part of the county.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland. Most of the acreage is cultivated. Some areas have been seeded to native grass or King Ranch bluestem.

Management is needed to improve soil structure and reduce surface crusting. Returning large amounts of crop residue to the soil is necessary to improve soil structure, increase water absorption, and prevent surface crusting. Capability unit IIs-1; Claypan Prairie range site; woodland group 3.

Kirkland silt loam, 1 to 3 percent slopes (KnB).—This soil is on uplands. It has a profile similar to the one described as representative for the series.

Included in mapping are small areas of Zaneis loam, Chickasha fine sandy loam, and Wing soils. About 10 percent of the acreage is Renfrow silt loam.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland. It is used mostly for small grain.

Management is needed to improve soil structure, reduce surface crusting, and control water erosion. Returning large amounts of crop residue to the soil is necessary to improve soil structure, increase water absorption, prevent surface crusting, and control erosion. Terracing and contour tillage are needed if row crops are grown. Sown crops can be grown every year if fertilizer is added and crop residue is used. Capability unit IIIe-1; Claypan Prairie range site; woodland group 3.

Lucien Series

The Lucien series consists of very shallow to shallow, rolling soils on uplands. These soils formed in material weathered from sandstone under a cover of mid and tall grasses. In this county, Lucien soils are mapped only with Vernon and Zaneis soils.

In a representative profile, the surface layer is grayish-brown fine sandy loam about 8 inches thick. The subsoil is brown fine sandy loam that extends to a depth of about 14 inches. The underlying material is very hard pale-brown sandstone (fig. 3).

Lucien soils are well drained and have moderately rapid permeability. Available water capacity is low to moderate.

Representative profile of Lucien fine sandy loam, 1,000 feet north and 200 feet west of SE. corner, SW¼ sec. 1, T. 4 S., R. 6 W.:

A1—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard, very friable; many fine pores, rootlet channels open; few worm casts; neutral; clear, smooth boundary.

B—8 to 14 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) when moist; weak, medium, granular structure; slightly hard, friable; neutral; abrupt, wavy boundary.

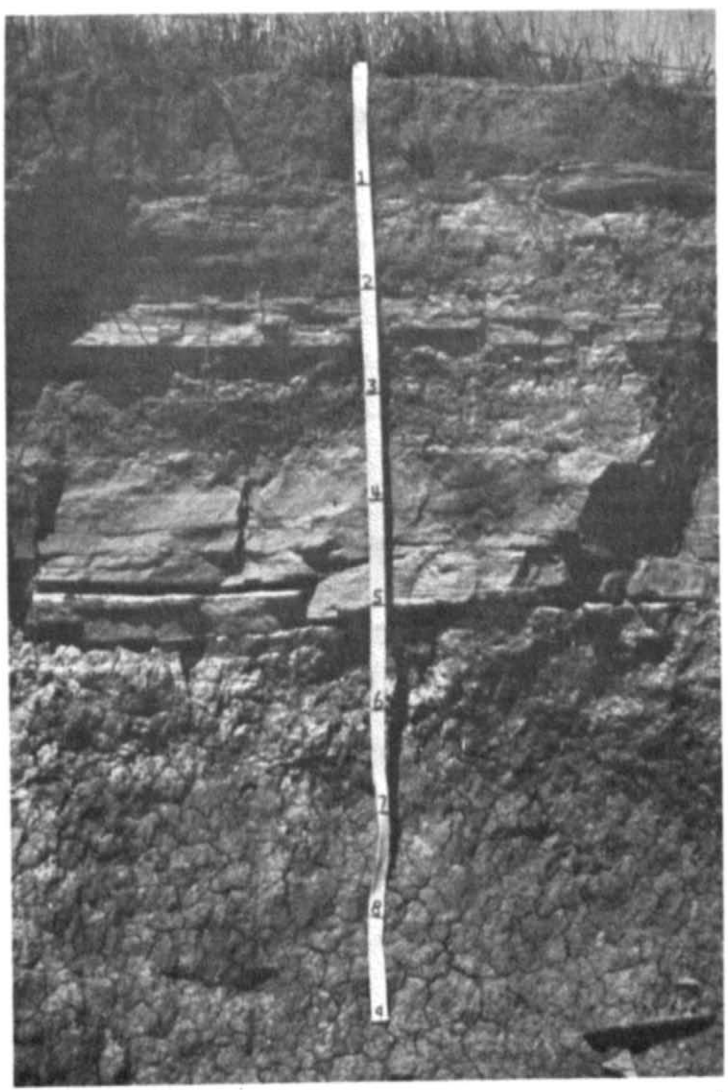

Figure 3.—Profile of a Lucien fine sandy loam from an area of Zaneis-Lucien-Vernon association, rolling. Note shallow depth to sandstone.

R—14 to 18 inches, pale-brown (10YR 6/3) consolidated, fine-grained sandstone, brown (10YR 5/3) when moist; very hard, soft to moderately hard; mildly alkaline.

The A horizon ranges from grayish brown to reddish brown and dark yellowish brown. It is neutral to medium acid. Depth to sandstone ranges from 4 to 20 inches.

Lucien soils are associated with Vernon and Zaneis soils. They are shallower and less clayey than Vernon soils. They are shallower over sandstone than Zaneis soils, and they do not have a B2t horizon.

Minco Series

The Minco series consists of deep, nearly level and sloping soils on uplands. These soils formed in loamy sediments under a cover of mid and tall grasses.

In a representative profile, the surface layer is brown loam about 19 inches thick. The subsoil is reddish-brown loam that extends to a depth of about 35 inches. The underlying material is reddish-brown loam and pale-brown silty clay loam (fig. 4).

Minco soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Minco loam, 0 to 1 percent slopes, 1,650 feet east and 200 feet south of NW. corner of sec. 20, T. 6 S., R. 8 W.:

Ap—0 to 9 inches, brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

A1—9 to 19 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; weak, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

B—19 to 35 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) when moist; weak, medium, granular structure; slightly hard, friable; neutral; gradual, smooth boundary.

C1—35 to 55 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; massive; hard, friable; moderately alkaline; gradual, smooth boundary.

IIC2—55 to 72 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) when moist; massive; hard, firm; calcareous; moderately alkaline.

The A horizon ranges from brown to dark grayish brown. It is slightly acid or neutral. The B horizon is yellowish red to reddish brown and brown. It is neutral or slightly acid. Depth to secondary carbonates is more than 36 inches. More clayey substrata are below 3 feet in places.

Minco soils are associated with Bastrop, Hardeman, and Pond Creek soils. Unlike Bastrop and Pond Creek soils, they do not have a B2t horizon. They are more silty than Hardeman soils. Unlike the Chickasha soils, they lack a B2t horizon and are not underlain by sandstone.

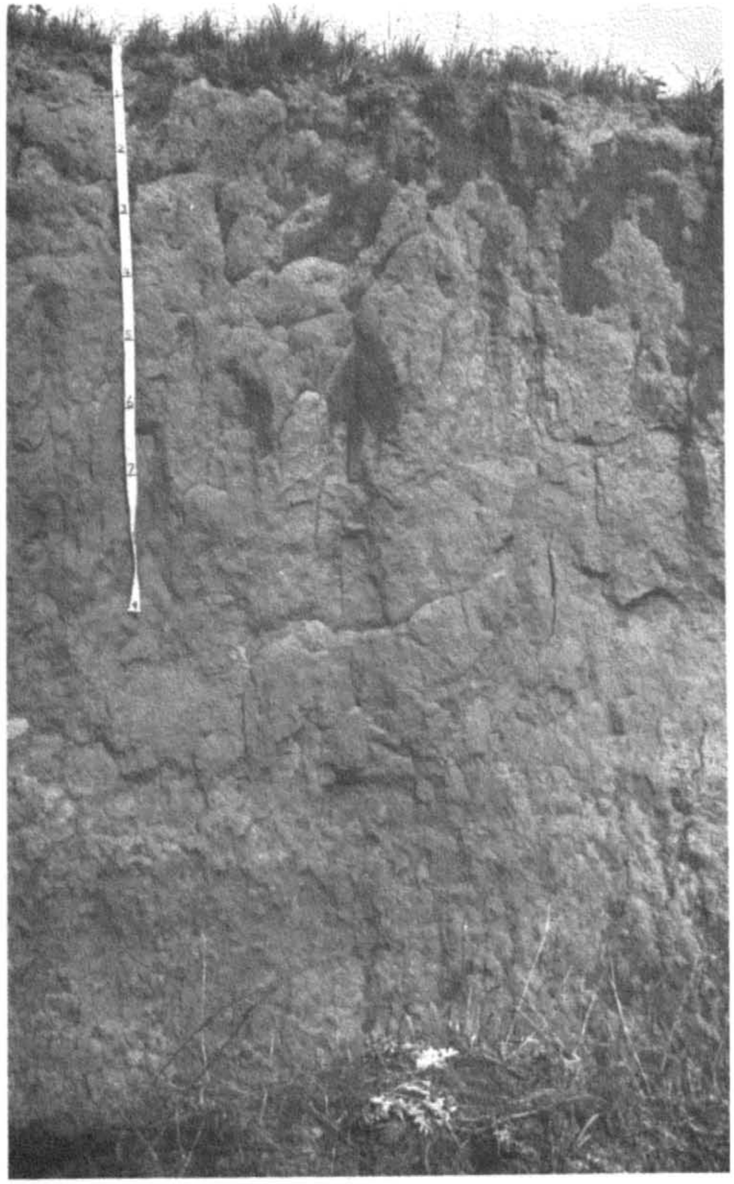

Figure 4.—Profile of a Minco loam. This soil is massive at a depth of about 3 feet.

Minco loam, 0 to 1 percent slopes (MnA).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Pond Creek silt loam, Bastrop loam, and Hardeman fine sandy loam. Also included are a few areas of a soil similar to Minco, except that it is brown and is more than 20 inches thick, and a few areas that have a silt loam surface layer.

This soil is suited to small grain, sorghum, cotton, alfalfa, melons, cantaloup, tame pasture, range, and woodland. All of the acreage is cultivated, except for a few small areas in tame pasture (fig. 5).

Management is needed to maintain fertility and soil structure. This management consists of seeding legumes, adding fertilizer, effectively using crop residue, and avoiding excessive tillage. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Capability unit I-1; Loamy Prairie range site; woodland group 1.

Minco loam, 1 to 3 percent slopes (MnB).—This soil is on uplands. It has a profile similar to the one described as representative for the series except that the two upper layers are slightly thinner.

Included with this soil in mapping are small areas of Pond Creek silt loam, Bastrop loam, and Hardeman fine sandy loam. Also included are a few areas of a soil similar to Minco, except that it is brown and is more than 20 inches thick. Substrata of sandier or more clayey material are below a depth of 36 inches in some areas. A few areas have a silt loam surface layer.

Figure 5.—Harvesting cantaloups on Minco loam, 0 to 1 percent slopes.

This soil is suited to small grain, sorghum, cotton, alfalfa, melons, cantaloup, tame pasture, range, and woodland. Cotton (fig. 6) and melons are the principal crops. All of the acreage is cultivated, except for a few small areas in tame pasture.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terraces, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe–1; Loamy Prairie range site; woodland group 1.

Minco loam, 3 to 5 percent slopes (MnC).—This soil is on uplands. It has a profile similar to the one described as representative for the series, but its surface layer is about 4 inches thinner.

Included in mapping are areas of Hardeman fine sandy loam and Bastrop loam that each make up about 5 percent of the acreage. Also included are a few areas of a soil similar to Minco, except that it is brown and is more than 20 inches thick. Substrata of sandy to clayey material are below a depth of 36 inches in some areas. A few areas have a silt loam surface layer.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terraces, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Terracing, contour farming, and use of crop residue are needed to control erosion, to conserve moisture, and to maintain soil structure. Capability unit IIIe–2; Loamy Prairie range site; woodland group 2.

Minco loam, 5 to 8 percent slopes (MnD).—This soil is on uplands. It has a profile similar to that described as representative for the series, but its surface layer is about 7 inches thinner.

Included in mapping are small areas of Hardeman fine sandy loam and Bastrop loam. In about 20 to 30 percent of the cultivated acreage, the present surface layer is a mixture of the original surface layer and material from the subsoil. A few rills and small gullies have formed where water concentrates.

This soil is suited to small grain, tame pasture, range, and woodland. Most of the acreage is used for range.

Management is needed to maintain soil fertility and soil structure, to conserve moisture, and to control erosion. Erosion can be controlled by terraces, contour farming, and stripcropping. Crop residue should be returned to the soil, and excessive tillage should be avoided to conserve moisture and to maintain soil fertility and soil structure. Capability unit IVe–1; Loamy Prairie range site; woodland group 2.

Oscar Series

The Oscar series consists of deep, nearly level and very gently sloping soils on flood plains. These soils formed in loamy sediments under a cover of mid grasses. They are subject to flooding. In this county, Oscar soils are mapped only with Port soils.

In a representative profile, the surface layer is light-brown silt loam about 5 inches thick. The subsoil is reddish-brown silty clay loam that extends to a depth of

Figure 6.—Cotton on Minco loam, 1 to 3 percent slopes.

about 24 inches. It has high sodium content. The underlying material is reddish-brown silty clay loam.

Oscar soils are moderately well drained and have slow permeability. Available water capacity is high.

Representative profile of an Oscar silt loam from an area of Port-Oscar complex, 50 feet north and 150 feet west of SE. corner of SW¼ sec. 26, T. 4 S., R. 7 W.:

A1—0 to 5 inches, light-brown (7.5YR 6/3) silt loam, dark brown (7.5YR 4/3) when moist; weak, fine, platy structure in the upper part, massive in lower part; hard, friable; numerous pores; slightly acid; abrupt, smooth boundary.

B2t—5 to 12 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; compound moderate, coarse, prismatic and weak, coarse, blocky structure; hard, firm; clay films on faces of peds; patchy, dark reddish-brown (5YR 3/2) coatings on upper part and sides on faces of peds; moderately alkaline; gradual, smooth boundary.

B3—12 to 24 inches, reddish-brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) when moist; weak, fine, blocky structure; very hard, firm; few, soft, calcium-carbonate masses; calcareous; moderately alkaline; gradual, smooth boundary.

C—24 to 60 inches, reddish-brown (2.5YR 4/4) silty clay loam, dark reddish brown (2.5YR 3/4) when moist; massive; hard, friable; strata of coarser textured material separated by bedding planes in the lower part; many, soft, calcium-carbonate masses and concretions; calcareous; moderately alkaline.

The A1 horizon ranges from pale brown to reddish brown and dark yellowish brown. The texture is loam or silt loam. It is medium acid to neutral. The B2t horizon is reddish brown to dark yellowish brown and olive brown and is clay loam or silty clay loam. It is neutral to moderately alkaline and is more than 15 percent saturated with exchangeable sodium. The B3 horizon is reddish brown to brown and dark yellowish brown and is silty clay loam, clay loam, or silt loam. It is neutral to moderately alkaline. The C horizon is reddish brown to yellowish red and dark yellowish brown and is loam, silt loam, clay loam, or silty clay loam commonly stratified with finer and coarser textured materials. It is moderately alkaline and calcareous, but the upper part ranges to mildly alkaline. These soils have soft, powdery lime at a depth of less than 60 inches.

Oscar soils are associated with Port and Wing soils. They differ from the Port soils in having a B2t horizon. They are less clayey in the B2t horizon than the Wing soils.

Pond Creek Series

The Pond Creek series consists of deep, nearly level soils on uplands. These soils formed in loamy sediments under a cover of mid and tall grasses.

In a representative profile, the surface layer is grayish-brown and dark grayish-brown silt loam about 15 inches thick. The upper part of the subsoil is dark grayish-brown silt loam that extends to a depth of about 20 inches. The lower part of the subsoil is brown silty clay loam that extends to a depth of about 51 inches. The underlying material is brown silty clay loam.

Pond Creek soils are well drained and have moderately slow permeability. Available water capacity is high.

Representative profile of Pond Creek silt loam, 0 to 1 percent slopes, 600 feet north and 150 feet west of SE. corner of sec. 14, T. 7 S., R. 4 W.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; slightly hard, friable; neutral; abrupt, smooth boundary.

A1—8 to 15 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; moderate, fine, granular structure; slightly hard, friable; neutral; gradual, smooth boundary.

B1—15 to 20 inches, dark grayish-brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; hard, friable; neutral; gradual, smooth boundary.

B2t—20 to 33 inches, brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) when moist; strong, medium, granular and weak, medium, subangular blocky structure; very hard, friable; clay films on faces of peds; neutral; gradual, smooth boundary.

B31—33 to 43 inches, brown (7.5YR 4/4) silty clay loam, dark brown (7.5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard, friable; clay films on faces of peds; mildly alkaline; gradual, smooth boundary.

B32—43 to 51 inches, brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) when moist; weak, medium, subangular blocky structure; very hard, friable; mildly alkaline; gradual, smooth boundary.

C—51 to 72 inches, brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) when moist; structureless; hard, friable; moderately alkaline.

The A horizon ranges from brown to very dark brown. It is slightly acid to neutral. The B2t horizon is brown to yellowish brown. It is loam to silty clay loam. The B3 horizon is reddish brown to brown and dark yellowish brown. It is silty clay loam to clay loam and is neutral or mildly alkaline. The C horizon is reddish brown to yellowish red and strong brown. It is loam to silty clay loam and is mildly alkaline to moderately alkaline.

The Pond Creek soils are associated with Minco and Bastrop soils. They differ from the Minco soils in having a B2t horizon. They have a less reddish and more silty B2t horizon than the Bastrop soils.

Pond Creek silt loam, 0 to 1 percent slopes (PcA).—This soil is on uplands.

Included in mapping are a few areas of Minco loam and Bastrop loam.

This soil is suited to small grain, cotton, sorghum, alfalfa, tame pasture, range, and woodland. All of the acreage is cultivated except for a few small areas in native range.

Management is needed to maintain fertility and soil structure. This management consists of seeding legumes, adding fertilizer, effectively using crop residue, and avoiding excessive tillage. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Capability unit I-1; Loamy Prairie range site; woodland group 1.

Port Series

The Port series consists of deep, nearly level to very gently sloping soils on flood plains. These soils developed in loamy sediments under a cover of hardwood trees and an understory of tall grasses. They are subject to flooding.

In a representative profile, the surface layer is brown silty clay loam about 20 inches thick. The next layer is reddish-brown silty clay loam that extends to a depth of about 30 inches. The underlying material is yellowish-red silty clay loam.

Port soils are well drained and have moderately slow permeability. Available water capacity is high.

Representative profile of Port silty clay loam, 1,320 feet west and 660 feet south of NE. corner, SW¼ sec. 2, T. 5 S., R. 8 W.:

Ap—0 to 5 inches, brown (7.5YR 4/3) silty clay loam, dark brown (7.5YR 3/3) when moist; weak, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

A11—5 to 20 inches, brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; hard, friable; mildly alkaline; gradual, smooth boundary.

A12—20 to 30 inches, reddish-brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, granular structure; hard, firm; mildly alkaline; gradual, smooth boundary.

C—30 to 70 inches, yellowish-red (5YR 4/6) silty clay loam, yellowish red (5YR 3/6) when moist; massive; hard, firm; strata of fine-textured and coarse-textured material; mildly alkaline.

The A horizon ranges from reddish brown to dark brown. It is mainly silty clay loam but is clay loam in places. The C horizon is pale red to yellowish red and strong brown. It is clay loam to silty clay loam. Generally these soils are noncalcareous to a depth of more than 60 inches. Reaction is mildly or moderately alkaline with increasing depth. In small percentage of the acreage soil is calcareous between depths of 30 and 60 inches. Darkened horizons of buried soils are common at depths of 3 to 5 feet.

The Port soils mapped in this county are outside the range defined for the Port series because they are noncalcareous to a depth of more than 60 inches. They are enough like the Port series in morphology, composition, and behavior that a new series is not warranted.

Port soils are associated with Bunyan, Oscar, Pulaski, Roebuck, and Yahola soils. They are more clayey and more silty than Bunyan soils. They differ from Oscar soils in lacking a B2t horizon. They are more clayey than Pulaski and Yahola soils. Their B horizon is less clayey than the B horizon in Roebuck soils.

Port silty clay loam (Pm).—This is a nearly level soil on flood plains. Damaging floods are likely once in 5 to 20 years. This soil has the profile described as representative for the series.

Included in mapping are a few small areas of Bunyan loam, Roebuck clay, and Pulaski fine sandy loam. Also included are a few small areas of Oscar soils that are high in sodium content.

This soil is one of the best for farming in the county. It is suited to small grain, sorghum, cotton, alfalfa, tame pasture, range, and woodland.

Management is needed to maintain soil structure and fertility and to protect the soil from damage by overflow of streams. Also needed are terraces for diverting water that runs off adjacent upland. Crop residue should be returned to the soil. Capability unit IIw-2; Loamy Bottomland range site; woodland group 1.

Port-Oscar complex (Po).—These are nearly level to very gently sloping soils on flood plains. The Port and Oscar soils occur in such an intricate pattern that it is impractical to map each separately (fig. 7). The Oscar soils are called slickspots. Damaging floods are likely once in 5 to 20 years.

About 50 to 80 percent of the acreage is Port silty clay loam, 10 to 40 percent is Oscar silt loam and Oscar loam, and 10 percent is Roebuck clay. The Oscar soil in this mapping unit has the profile described as representative for the Oscar series. The Port soil has a profile that is similar to the one described as representative for the Port series.

These soils are best suited to tame pasture and native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fire. Capability unit Vs-1; woodland group 4; Port soil in Loamy Bottomland range site; Oscar soil in Alkali Bottomland range site .

Port and Pulaski soils, channeled (Pp).—These are nearly level and very gently sloping soils on flood plains. The Port and Pulaski soils occur in such an intricate pattern that it is impractical to map each kind of soil separately. Damaging floods are likely more than once

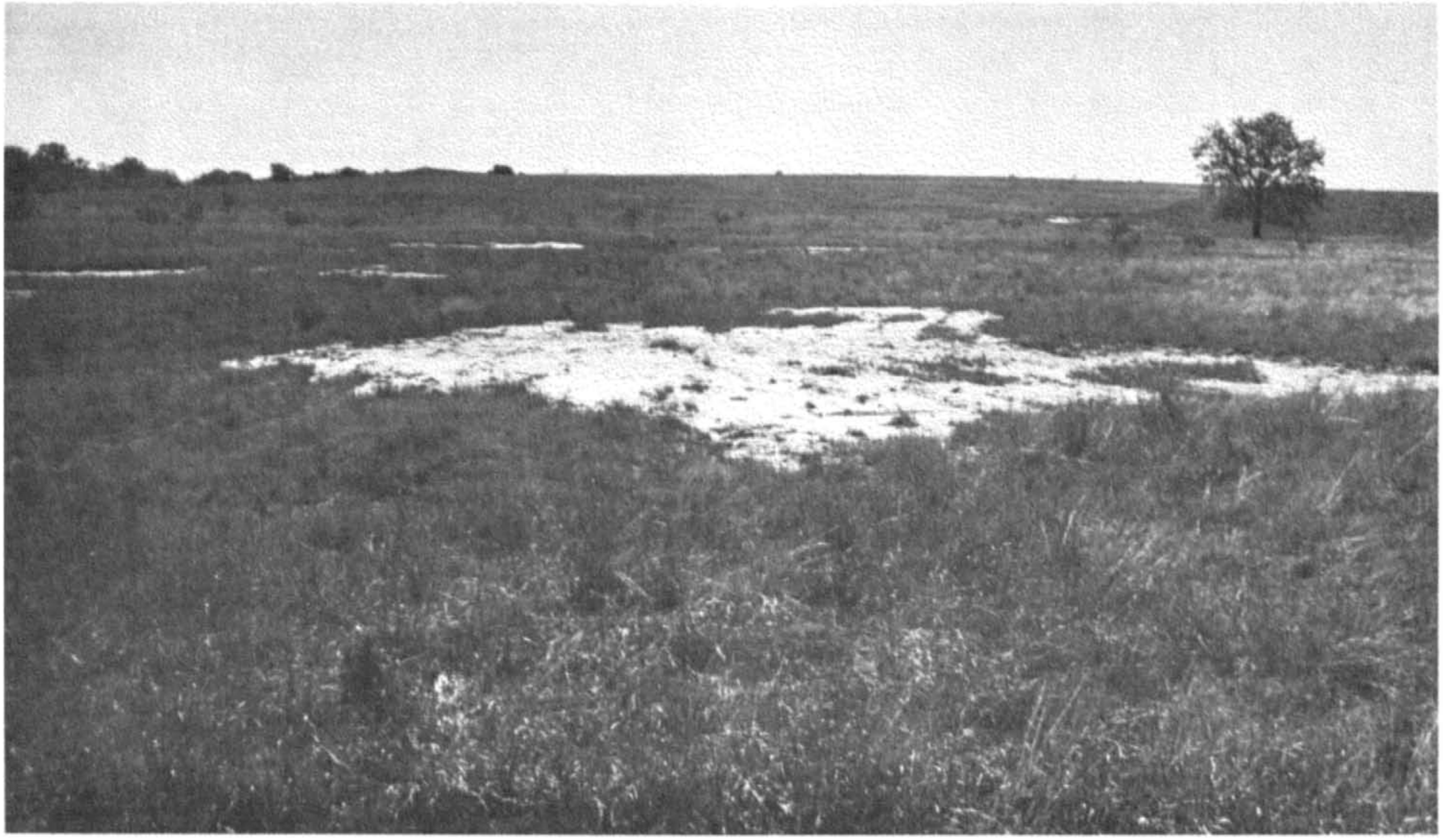

Figure 7.—Landscape of Port-Oscar complex showing light-brown Oscar silt loam intermingled with Port silty clay loam.

each year. Slopes generally range from 0 to 2 percent, but the side slopes of the narrow channels range from 8 percent to nearly vertical.

About 50 to 60 percent of the acreage is Port clay loam, 30 to 40 percent is Pulaski fine sandy loam and Pulaski loam, and 10 to 20 percent is Bunyan loam. The Port and Pulaski soils in this mapping unit are more stratified than those described as representative for their series. Most mapped areas contain both Port and Pulaski soils, but some contain only one of these soils.

These soils are best suited to tame pasture and native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit Vw–1; Loamy Bottomland range site; woodland group 3.

Pulaski Series

The Pulaski series consists of deep, nearly level and very gently sloping soils on flood plains. These soils formed in loamy sediments under a cover of hardwoods and an understory of tall grasses. They are subject to flooding.

In a representative profile, the surface layer is reddish-brown fine sandy loam about 6 inches thick. The next layer is yellowish-red fine sandy loam that extends to a depth of about 20 inches. The underlying material is yellowish-red, reddish-yellow, and reddish-brown fine sandy loam.

Pulaski soils are well drained and have moderately rapid permeability. The available water capacity is high.

Representative profile of Pulaski fine sandy loam, 160 feet north and 660 feet west of SE. corner, SW¼ sec. 27, T. 3 S., R. 4 W.:

A11—0 to 6 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

A12—6 to 20 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; weak, fine, granular structure; hard, friable; thin bands of reddish-brown loam; neutral; gradual, smooth boundary.

C1—20 to 36 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) when moist; massive; slightly hard, friable; neutral; gradual, smooth boundary.

C2—36 to 45 inches, reddish-yellow (5YR 6/8) fine sandy loam, yellowish red (5YR 5/8) when moist; massive; slightly hard, very friable; thin strata of reddish-brown fine sandy loam; neutral; clear, smooth boundary.

C3—45 to 65 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

C4—65 to 71 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; weak, fine, granular structure; slightly hard, friable; neutral.

The A horizon is light reddish brown to yellowish red and brown. It is loam or fine sandy loam. Reaction is slightly acid or neutral. The C horizon is light reddish brown to red, yellowish red, and strong brown. It is loam or fine sandy loam. In places, other textures occur below a depth of 40 inches. Reaction is slightly acid or neutral to a depth of about 40 inches, but is mildly alkaline below 40 inches in some places. Bedding planes normally are evident within 50 inches of the surface.

Pulaski soils are associated with Bunyan, Port, and Yahola soils. They are more sandy than Bunyan and Port soils. They are more acid than Yahola soils, which are calcareous throughout the profile.

Pulaski fine sandy loam (Pu).—This is a nearly level soil on flood plains. Most mapped areas are long and narrow, but in many places at the lower reaches of the creeks the areas are large and wide. This soil is likely to be damaged by floods once every 1 to 5 years.

Included with this soil in mapping are areas of Port silty clay loam that make up about 15 percent of the acreage. Also included are a few slickspots of Oscar soils.

This soil is suited to small grain, sorghum, cotton, alfalfa, tame pasture, range, and woodland. Much of it is in range and tame pasture.

Management is needed to maintain soil structure and fertility and to protect the soils from damage by the overflow of streams and from soil blowing. Terraces are needed for diverting water that runs off adjacent uplands. Crop residue should be returned to the soil. Plant cover is needed in winter and in spring to protect the soil from soil blowing. Capability unit IIw–1; Loamy Bottomland range site; woodland group 1.

Renfrow Series

The Renfrow series consists of deep, very gently sloping and gently sloping soils on uplands. These soils formed in material weathered from clay and shale under a cover of mid and tall grasses.

In a representative profile, the surface layer is brown silt loam about 4 inches thick. The next layer is reddish-brown clay loam that extends to a depth of about 12 inches. Below this is reddish-brown clay that extends to a depth of about 46 inches. The next layer is red clay and shale that extends to a depth of about 65 inches.

Renfrow soils are well drained and have very slow permeability. Available water capacity is high.

Representative profile of Renfrow silt loam, 2 to 5 percent slopes, eroded, 30 feet south and 400 feet west of NE. corner, SE¼ sec. 6, T. 5 S., R. 5 W.:

Ap—0 to 4 inches, brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) when moist; moderate, medium, granular structure; hard, friable; neutral; clear, smooth boundary.

B21t—4 to 12 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, blocky structure; very hard, firm; moderately alkaline; gradual, smooth boundary.

B22t—12 to 20 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; weak, fine, blocky structure; very hard, firm; lower part becomes calcareous; moderately alkaline; gradual, smooth boundary.

B31ca—20 to 32 inches, reddish-brown (5YR 4/4), clay, dark reddish brown (5YR 3/4) when moist; weak, fine, blocky structure; very hard, firm; many soft masses and calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B32ca—32 to 46 inches, reddish-brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) when moist; weak, medium, blocky structure; very hard, firm; many soft masses and calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B33—46 to 65 inches, red (10R 4/6) clay and shale, dark red (10R 3/6) when moist; massive; very hard, firm; calcareous; moderately alkaline.

The A horizon ranges from loam to clay loam but is dominantly silt loam. It is reddish brown to brown and is slightly acid or neutral. The B2t horizon is clay loam or clay. It is neutral to moderately alkaline and is calcareous below a depth of 24 to 30 inches.

Renfrow soils are associated with Kirkland, Vernon, and Zaneis soils. They have a redder B2t horizon than Kirkland soils. Unlike Vernon soils, they have a B2t horizon and are deeper over shale or clay. They are more clayey in the B horizon than Zaneis soils.

Renfrow silt loam, 2 to 5 percent slopes, eroded (ReC2).—This is a moderately eroded soil on uplands. It has the profile described as representative for the Renfrow series. In about 30 percent of the acreage, all of the original surface layer has been removed through erosion. In these areas the surface layer is more clayey. Erosion has caused small gullies.

Included in mapping are small areas of Kirkland silt loam.

This soil is suited to crops, range, and woodland. The principal crops are small grain and sorghum. Most of the acreage is cultivated.

Intensive management is needed to maintain soil structure and fertility, control water erosion, and increase water intake. Terracing and contour farming are needed. Crops are needed that provide large amounts of residue, which is returned to the soil to improve soil structure, fertility, and increase water intake. The quality of the native grasses can be maintained or improved by controlling brush, following suitable grazing practices, and preventing fires. Capability unit IVe–3; Claypan Prairie range site; woodland group 3.

Renfrow soils, 2 to 5 percent slopes, severely eroded (RfC3).—These soils are on uplands. Except for the surface layer, the profile is similar to the one described as representative for the series. On about 65 percent of the acreage, nearly all of the original surface layer has been removed through erosion. Texture of the surface layer ranges from silt loam in less eroded areas to clay where all of the original surface layer has been removed through erosion. Broad U-shaped gullies have formed that are 1 to 5 feet deep and 50 to 300 feet apart.

Included in mapping are areas of Kirkland silt loam that make up about 25 percent of the acreage. Also included are a few small areas of Wing soils.

This soil is so severely eroded that it is not suitable for cultivation. It should be returned to permanent vegetation. Fertilizer, shaping of gully banks, diversion of run-in water, and mulching are needed to establish tame pasture or range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practices, and preventing fires. Capability unit VIe–2; Eroded Clay range site; woodland group 4.

Roebuck Series

The Roebuck series consists of deep, nearly level soils on flood plains. These soils formed in clayey and loamy sediments under a cover of hardwood trees and an understory of tall grasses. They are subject to flooding.

In a representative profile, the surface layer is brown clay about 18 inches thick. The subsoil is reddish-brown clay that extends to a depth of about 40 inches. The underlying material is red clay loam.

Roebuck soils are somewhat poorly drained to poorly drained and have very slow permeability. Available water capacity is high.

Representative profile of Roebuck clay, 1,500 feet east and 200 feet south of NW. corner of sec. 9, T. 4 S., R. 8 W.:

A1—0 to 18 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/3) when moist; weak, fine and medium, blocky structure; very hard, firm; common, fine roots; few worm casts; moderately alkaline; gradual, smooth boundary.

B—18 to 40 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) when moist; weak, medium, blocky structure; few slickensides; very hard, firm; common fine roots through peds; few worm casts; few, fine, black concretions; moderately alkaline; gradual, smooth boundary.

C—40 to 72 inches, red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) when moist; massive; very hard, firm; few roots; few pores; few, fine, black concretions; moderately alkaline.

The A horizon is clay, silty clay, silty clay loam, or clay loam. It is reddish gray, reddish brown, brown, dark brown, and dark reddish gray. The B horizon is reddish brown. It is mainly clay, but in some areas it is clay loam. Lower horizons are mildly alkaline or moderately alkaline. In some areas the soil is calcareous, but the lime is not the result of secondary accumulation. The C horizon is reddish brown, red, or yellowish red. These soils have cracks about 20 inches deep in most years.

Roebuck soils are associated with Port and Treadway soils. They have a finer textured B horizon than the Port soils. They differ from the Treadway soils in having a brown A horizon.

Roebuck clay (Rk).—This is a nearly level soil on flood plains. Damaging floods are likely once in 5 to 10 years. This soil has the profile described as representative for the series.

Included in mapping are areas of Port silty clay loam that make up about 10 percent of the acreage. Also included are areas of two soils similar to Roebuck. One of these occupies about 20 percent of the acreage and has a lighter colored surface layer. The other occupies about 10 percent of the acreage and has a secondary accumulation of lime within 60 inches of the surface.

This soil is suited to small grain, cotton, tame pasture, alfalfa, and sorghum. Small grain is the principal crop. This soil is also suited to range and woodland.

Management is needed to control wetness, maintain soil structure, and protect the soil from damage by overflow from streams. Surface drains are generally sufficient for controlling wetness. After a heavy rain, water often remains on the surface for several days. This soil is difficult to till. Tillage should be timely and kept to a minimum. Crop residue should be returned to the soil to improve soil structure. Capability unit IIIw-1; Heavy Bottomland range site; woodland group 3.

Roebuck soils, frequently flooded (Ro).—These are nearly level soils on flood plains. Floods are likely more than once each year.

These soils have a profile and range in characteristics similar to those described as representative for the Roebuck series. Texture of the surface layer ranges from clay loam to clay.

Included in mapping are small areas of Bunyan loam, Port silty clay loam, and Oscar silt loam.

These soils are best suited to tame pasture and native range.

The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit Vw-2; Heavy Bottomland range site; woodland group 4.

Rough Broken Land

Rough broken land (Ru) consists of hilly and broken escarpments on the uplands where severe geologic erosion has cut into the red clay beds, shales, and sandstones of Permian age. Slopes range from 12 to 30 percent. The areas include some vertical cliffs. Most of the area has little soil material, and the parent material or bedrock is at the surface. Little or no soil development has taken place.

Included in mapping are small areas of Zaneis loam, Vernon clay, and Lucien fine sandy loam.

This mapping unit is not suited to cultivated crops. It supports only a sparse amount of vegetation, and it has low value for grazing. All of it is used for range and wildlife habitat.

The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIIs-1; Breaks range site; woodland group 4.

Stephenville Series

The Stephenville series consists of moderately deep and deep, very gently sloping to strongly sloping soils on uplands. These soils formed in material weathered from sandstone under a cover of oak forest that has an understory of tall grasses.

In a representative profile, the surface layer is brown fine sandy loam about 5 inches thick. The next layer is light-brown fine sandy loam that extends to a depth of about 9 inches. The upper part of the subsoil is red sandy clay loam that extends to a depth of about 25 inches. The lower part of the subsoil is red fine sandy loam that extends to a depth of about 42 inches. The underlying material is reddish-yellow sandstone (fig. 8).

Stephenville soils are well drained and have moderate permeability. Available water capacity is moderate to high.

Representative profile of Stephenville fine sandy loam, 1 to 3 percent slopes, 1,000 feet west and 75 feet south of NE. corner of sec. 34, T. 3 S., R. 4 W.:

A1—0 to 5 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, medium, granular structure; slightly hard, friable; medium acid; gradual, smooth boundary.

A2—5 to 9 inches, light-brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) when moist; slightly hard, very friable; medium acid; gradual, smooth boundary.

B2t—9 to 25 inches, red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) when moist; moderate, medium, blocky structure; very hard, firm; patchy clay films on faces of peds; strongly acid; gradual, smooth boundary.

B3—25 to 42 inches, red (2.5YR 5/8) fine sandy loam, red (2.5YR 4/8) when moist; weak, medium, blocky structure; very hard, firm; medium acid; gradual, wavy boundary.

R1—42 to 56 inches, reddish-yellow (7.5YR 7/8) soft sandstone banded or laminated with shades of red and yellow; medium acid; abrupt, irregular boundary.

R2—56 inches, reddish-yellow (7.5YR 7/8) sandstone; slightly acid.

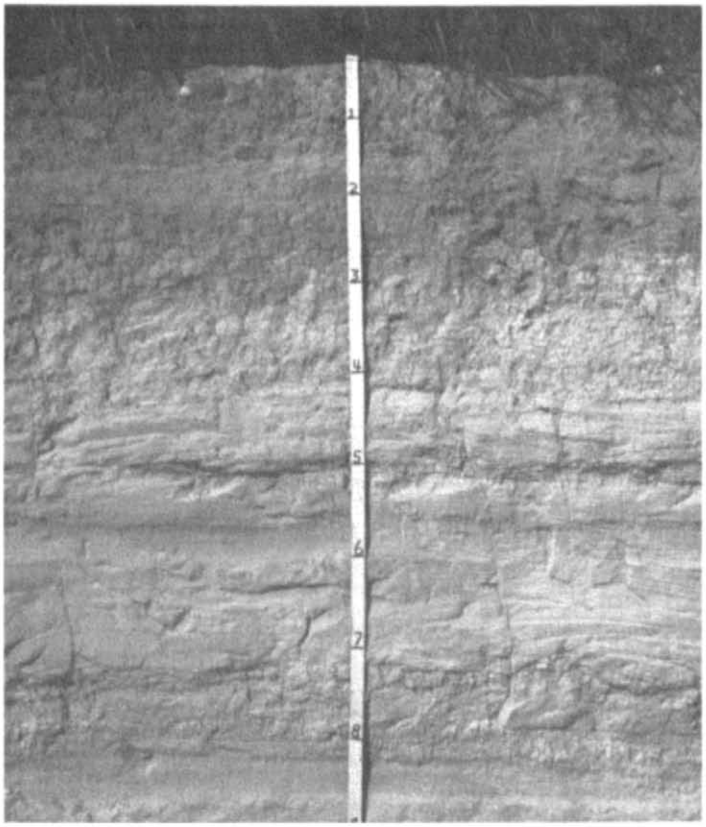

Figure 8.—**Profile of a Stephenville fine sandy loam showing the sandstone bedrock.**

The A horizon is fine sandy loam or sandy clay loam. The A1 horizon ranges from brown to dark grayish brown. The A2 horizon is pink to brown and pale brown. The A2 horizon is not present in some cultivated areas. The B2t horizon is reddish brown to red and reddish yellow. Depth to sandstone is 20 to 48 inches. Reaction in all horizons is slightly acid to strongly acid.

Stephenville soils are associated with Windthorst, Dougherty, Chickasha, and Darnell soils. They are less clayey in the B2t horizon than the Windthorst soils. They differ from the Dougherty soils in having an A horizon less than 20 inches thick and in having sandstone within 48 inches of the surface. They differ from the Chickasha soils in having an A2 horizon. They are deeper than the Darnell soils.

Stephenville fine sandy loam, 1 to 3 percent slopes (SbB).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Windthorst fine sandy loam and small areas of rock outcrops. Also included are areas of a soil similar to Stephenville that lacks sandstone within a depth of 48 inches, and a few areas that have a loamy fine sand surface layer.

This soil is suited to sorghum, cotton, melons, small grain, cantaloup, tame pasture, and woodland. A small acreage is cultivated, and some areas have been seeded to native grasses. Most of the acreage is used for native range.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terracing, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe-2; Sandy Savannah range site; woodland group 2.

Stephenville fine sandy loam, 3 to 5 percent slopes (SbC).—This soil is on uplands. It has a profile similar to the one described as representative for the series except that the surface layer is slightly thinner and the depth to sandstone is slightly less.

Included in mapping are small areas of Windthorst fine sandy loam and Darnell fine sandy loam. Also included are a few areas where the surface layer is loamy fine sand.

This soil is suited to woodland. It is used mostly for range, but part of the acreage is cultivated for cotton, sorghum, small grain, cantaloup, tame pasture, and melons.

Management is needed to maintain or improve soil structure and fertility, increase water intake, and control erosion. Terraces, contour farming, stripcropping, and use of crop residue will control erosion, increase water intake, and improve soil structure and fertility. Capability unit IIIe-3; Sandy Savannah range site; woodland group 2.

Stephenville fine sandy loam, 2 to 5 percent slopes, eroded (SbC2).—This soil is on uplands. In most of the acreage part of the original surface layer has been removed through erosion. The present surface layer is a mixture of the original surface layer and subsoil material, mainly as a result of tillage. Otherwise, the profile is similar to the one described as representative for the series. Small rills and a few small gullies have formed. Tillage operations tend to eliminate these rills and gullies.

Included in mapping are small areas of severely eroded Stephenville soils, areas of Windthorst fine sandy loam, and a few small areas of rock outcrops.

This soil is well suited to grasses. The principal crops grown are tame pasture grasses, sorghum, and small grain. Many areas have been seeded to native grass. Nearly all of the acreage is or has been cultivated.

In managing this soil, protection of cultivated areas from severe erosion is needed. Intensive management through use of terraces, contour farming, crop residue, and fertilizer is needed to improve the suitability of this soil for cultivation and to improve the growth of crops. Capability unit IIIe-5; Sandy Savannah range site; woodland group 3.

Stephenville soils, 2 to 6 percent slopes, severely eroded (ScC3).—These soils are on uplands. The mapped areas are small. In most of the acreage most of the original surface layer has been removed through erosion. The present surface layer is a mixture of the original surface layer and subsoil material, mainly as a result of tillage. Otherwise, the profile is similar to the one described as representative for the series.

Texture of the present surface layer ranges from fine sandy loam to sandy clay loam. In most areas gullies, 1 to more than 6 feet deep, have formed that are too wide to be crossed by farm equipment.

Included in mapping are areas of severely eroded Windthorst fine sandy loam that make up about 35 percent of the acreage, severely eroded Dougherty loamy fine sand that make up about 10 percent, and rock outcrops that make up about 5 percent of the area.

These soils are so severely eroded that they are not suitable for cultivation.

These soils should be returned to permanent vegetation. Addition of fertilizer, smoothing of gully banks, diversion of run-in water, and mulching are needed to establish tame pasture or range grasses. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIe-5; Eroded Sandy Savannah range site; woodland group 4.

Stephenville-Darnell complex, 1 to 12 percent slopes (SdE).—These soils are on uplands. They occur in such an intricate pattern that it is impractical to map each kind of soil separately. The Darnell soil in this mapping unit has the profile described as representative for the Darnell series. The Stephenville soil in this unit is similar to the one described as representative of the Stephenville series except that it is slightly shallower over sandstone.

About 60 percent of the acreage is Stephenville fine sandy loam, 25 percent is Darnell fine sandy loam, 5 percent is rock outcrops, and 5 percent is Windthorst fine sandy loam. The rest is a soil similar to Stephenville that lacks an A2 horizon and is less than 20 inches deep over sandstone.

These soils are best suited to tame pasture and native range.

The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIe-7; Stephenville soil in Sandy Savannah range site; Darnell soil in Shallow Savannah range site; woodland group 4.

Teller Series

The Teller series consists of deep, nearly level and sloping soils on uplands. These soils formed in loamy sediments under a cover of mid and tall grasses.

In a representative profile, the surface layer is brown fine sandy loam about 12 inches deep. The upper part of the subsoil is reddish-brown clay loam that extends to a depth of about 24 inches. The lower part of the subsoil is yellowish-red fine sandy loam that extends to a depth of about 45 inches. The underlying material is reddish-yellow fine sandy loam.

Teller soils are well drained and have moderate permeability. Available water capacity is high.

Representative profile of Teller fine sandy loam, 1 to 3 percent slopes, 190 feet east and 1,000 feet south of NW. corner of sec. 22, T. 4 S., R. 8 W.:

A1—0 to 12 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, medium, granular structure; slightly hard, very friable; neutral; gradual, smooth boundary.

B2t—12 to 24 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, granular and weak, coarse, prismatic structure; hard, friable; patchy clay films on faces of peds; slightly acid; gradual, smooth boundary.

B3—24 to 45 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; weak, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

C—45 to 72 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; massive; slightly hard, very friable; slightly acid.

The A horizon is dark reddish gray, reddish brown, brown, and reddish gray. It is dominantly fine sandy loam but is loam in places. It is slightly acid to neutral. The B2t horizon is reddish brown, red, yellowish red, strong brown, brown, and dark brown. It ranges from loam to clay loam. The C horizon is red, light red, reddish yellow, or yellowish red. It is fine sandy loam to clay loam.

Teller soils are associated with Bastrop, Dougherty, Hardeman, and Minco soils. Unlike Bastrop soils, their clay content decreases within 60 inches of the surface. They differ from Dougherty soils in having an A horizon less than 20 inches thick. Unlike Hardeman and Minco soils, they have a B2t horizon.

Teller fine sandy loam, 0 to 1 percent slopes (TfA).—This soil is on uplands. It has a profile similar to the one described as representative for the series except that the surface layer is slightly thicker.

Included in mapping are small areas of Bastrop loam and Pond Creek silt loam. In about 10 percent of the area the surface layer is yellower.

This soil is one of the more desirable for farming in the county. It is suited to small grain, sorghum, cotton, alfalfa, melons, cantaloup, tame pasture, range, and woodland. Most of the acreage is cultivated.

Management is needed to maintain fertility and soil structure. This management consists of seeding legumes, adding fertilizer, effectively using crop residue, and avoiding excessive tillage. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Capability unit I-1; Loamy Prairie range site; woodland group 1.

Teller fine sandy loam, 1 to 3 percent slopes (TfB).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Bastrop loam and Stephenville fine sandy loam. In about 15 percent of the acreage the surface layer is thinner and eroded or is more yellow than typical.

This soil is suited to small grain, cotton, sorghum, alfalfa, melons, cantaloup, tame pasture, and woodland. Many areas that were cultivated have been seeded to native grasses. Most of the acreage is used for native range.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terraces, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown. Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe-1; Loamy Prairie range site; woodland group 1.

Teller fine sandy loam, 3 to 5 percent slopes (TfC).—This soil is on uplands. It has a profile similar to the one described as representative for the series except that the lower part of the subsoil contains slightly more clay. Mapped areas are small.

Included in mapping are areas of Bastrop loam that make up about 5 percent of the acreage and areas of Stephenville fine sandy loam that make up about 5 percent. The surface layer has been thinned through erosion or is more yellow than typical in about 20 percent of the acreage.

This soil is suited to crops, range, and woodland. It is used mostly for native range. Small areas are cultivated to small grain, cotton, sorghum, and tame pasture.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terraces, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Terracing, contour farming, and use of crop residue are needed to control erosion, conserve moisture, and maintain soil structure. Capability unit IIIe-2; Loamy Prairie range site; woodland group 2.

Teller fine sandy loam, 2 to 6 percent slopes, eroded (TfC2).—This soil is on uplands. It has a profile similar to the one described as representative for the series, but its surface layer is about 2 inches thinner. In most areas part of the original surface layer has been removed through erosion. In some areas the present surface layer is a mixture of the original surface layer and subsoil material, mainly as a result of tillage. Erosion has caused small rills.

Included in mapping are small areas of Bastrop loam, Stephenville fine sandy loam, and Minco loam. In about 30 percent of the acreage the surface layer has been thinned through erosion or is more yellow than typical.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland. Most of the acreage has been cultivated. A large area has been seeded to native grass and is now used for range.

In managing this soil, protection of cultivated areas from severe erosion is needed. Intensive management through use of terraces, contour farming, crop residue, and fertilizer is needed to improve the suitability of this soil for cultivation and to improve the growth of crops. Capability unit IIIe-5; Loamy Prairie range site; woodland group 3.

Teller fine sandy loam, 5 to 8 percent slopes (TfD).—This soil is on uplands. It has a profile similar to the one described as representative for the series. Most mapped areas are small and occupy the stronger slopes in the landscape.

Included in mapping are small areas of Bastrop loam, Zaneis loam, and Minco loam. In about 25 percent of the acreage the surface layer has been thinned through erosion or is more yellow than typical.

This soil is suited to small grain, tame pasture, range, and woodland. Because of the slope, most of the acreage is used for native range.

Management is needed to maintain soil fertility and soil structure, to conserve moisture, and to control erosion. Erosion can be controlled by terracing, contour farming, and stripcropping. Crop residue should be returned to the soil. Excessive tillage should be avoided to conserve moisture and to maintain fertility and soil structure. Capability unit IVe-1; Loamy Prairie range site; woodland group 2.

Teller soils, 2 to 8 percent slopes, severely eroded (TlD3).—These soils are on uplands. In most of the acreage, part of the original surface layer has been removed through erosion. In some places, erosion has removed all of the original surface layer. In these areas the present surface layer is loam or fine sandy loam. Otherwise, the profile is similar to the one described as representative for the series. Gullies have formed that are 1 to 5 feet deep and 50 to 100 feet apart. These gullies are not crossable by farm equipment.

Included in mapping are small areas of Minco loam. Severely eroded Zaneis loam and Chickasha fine sandy loam make up about 25 percent of the acreage. In about 20 percent of the acreage the surface layer has been thinned through erosion or is more yellow than typical.

The soils are so eroded that they are not suitable for cultivation. They should be returned to permanent vegetation. Addition of fertilizer, smoothing of gully banks, diversion of run-in water, and mulching are needed to establish tame pasture or range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIe-1; Loamy Prairie range site; woodland group 4.

Tivoli Series

The Tivoli series consists of deep, hummocky and rolling soils on uplands. These soils formed in sandy sediments under a cover of tall grasses. In some areas the vegetation is oak forest that has an understory of tall grasses.

In a representative profile, the surface layer is brown loamy fine sand about 5 inches thick. The underlying material is reddish-yellow fine sand.

Tivoli soils are excessively drained and have rapid permeability. Available water capacity is low.

Representative profile of a Tivoli loamy fine sand from an area of Tivoli soils, rolling, 100 feet south and 1,320 feet west of NE. corner of sec. 9, T. 8 S., R. 7 W.:

A—0 to 5 inches, brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/4) when moist; single grain; loose, very friable; mildly alkaline; gradual, smooth boundary.

C—5 to 70 inches, reddish-yellow (7.5YR 6/6) fine sand, strong brown (7.5YR 5/6) when moist; single grain; loose, very friable; moderately alkaline.

The A horizon is loamy fine sand or fine sand. It ranges from pink to brown and yellowish brown. It is mildly alkaline. The C horizon is pink to reddish brown, yellowish red, brown, and yellowish brown. It is mildly alkaline or moderately alkaline and is calcareous below a depth of 40 inches in some areas.

Tivoli soils differ from the associated Dougherty soils in lacking a sandy clay loam B2t horizon.

Tivoli fine sand, hummocky (ToC).—This soil is on uplands. It has a profile similar to the one described as representative for the series except that the surface layer is fine sand. The vegetation is oak forest that has an understory of tall grasses.

This soil is best suited to tame pasture and native range.

The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIe-8; Deep Sand Savannah range site; woodland group 3.

Tivoli soils, rolling (TrD).—These soils are on uplands. They have the profile described as representative for the series. The vegetation is tall grasses.

The surface layer ranges from loamy fine sand to fine sand in texture. Soils on the higher ridges commonly have a fine sand surface layer. Those in the lower swales between the ridges commonly have a loamy fine sand surface layer.

Included in mapping are soils that have a loamy fine sand subsoil.

These Tivoli soils are best suited to native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIIe–1; Deep Sand range site; woodland group 4.

Treadway Series

The Treadway series consists of deep, nearly level and very gently sloping soils on flood plains or alluvial fans. These soils formed in clayey sediments under a cover of short and mid grasses. They are subject to flooding.

In a representative profile, the surface layer is reddish-brown clay loam about 8 inches deep. The subsoil is red clay that extends to a depth of about 20 inches. The underlying material is red clay.

Treadway soils are well drained and have very slow permeability. Available water capacity is high.

Representative profile of Treadway clay loam from an area of Treadway soils, 100 feet south and 1,250 feet east of NW. corner of sec. 29, T. 4 S., R. 8 W.:

A—0 to 8 inches, reddish-brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) when moist; thin platy structure in upper 2 or 3 inches and weak, medium, blocky structure below; very hard, firm; few small calcium-carbonate concretions; moderately alkaline; gradual, smooth boundary.

B—8 to 20 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; weak, fine, blocky structure; very hard, very firm; calcareous; moderately alkaline; gradual, smooth boundary.

C—20 to 60 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; massive; very hard, very firm; weak bedding planes; calcareous; moderately alkaline.

The A horizon ranges from clay loam to clay. The B horizon is reddish brown, red, or yellowish red. The C horizon is reddish brown, red, or yellowish red. It is clay that has thin bedding planes. These soils have cracks about 20 inches deep in most years.

Treadway soils differ from the associated Roebuck soils in having a reddish-brown A horizon.

Treadway soils (Ts).—These are nearly level and very gently sloping soils on alluvial fans or flood plains. Damaging floods are likely once in 1 to 5 years. The surface layer is clay loam and clay.

Included in mapping are small areas of Roebuck clay, Vernon soils, and Port silty clay loam. Some areas have a thin mantle 3 to 15 inches thick. In many areas the mantle has been thinned and dissected through erosion, the underlying clay is exposed, and the surface is irregular and uneven. Inclusions make up about 12 percent of this mapping unit.

These soils are best suited to native range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIs–1; Red Clay Flats range site; woodland group 4.

Vernon Series

The Vernon series consists of deep, gently sloping and rolling soils on uplands. These soils formed in material weathered from shale or clay under a cover of short and mid grasses.

In a representative profile, the surface layer is reddish-brown clay about 8 inches deep. The subsoil is red clay that extends to a depth of about 24 inches. The underlying material is red clay (fig. 9).

Vernon soils are well drained and have very slow permeability. Available water capacity is moderate to high.

Representative profile of a Vernon clay from an area of Vernon soils, 3 to 5 percent slopes, 1,650 feet south and 100 feet east of NW. corner of sec. 28, T. 3 S., R. 8 W.:

A—0 to 8 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) when moist; weak, fine, granular structure; hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

B—8 to 24 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) when moist; weak, fine, blocky structure; extremely hard, very firm; calcareous; moderately alkaline; gradual, smooth boundary.

C—24 to 70 inches, red (2.5YR 5/6) clay, red (2.5YR 4/6) when moist; massive; extremely hard, very firm; few pockets of shaly clay; calcareous; moderately alkaline.

The A horizon ranges from clay loam to clay. It is red, reddish brown, or yellowish red. The B horizon is red, reddish brown, or yellowish red. All horizons are moderately alkaline and calcareous. Depth to the C horizon is 20 to 36 inches. Depth to massive clay beds or shale is 20 to 36 inches.

Vernon soils lack the B2t horizon of the associated Renfrow soils and are deeper and more clayey than the associated Lucien soils.

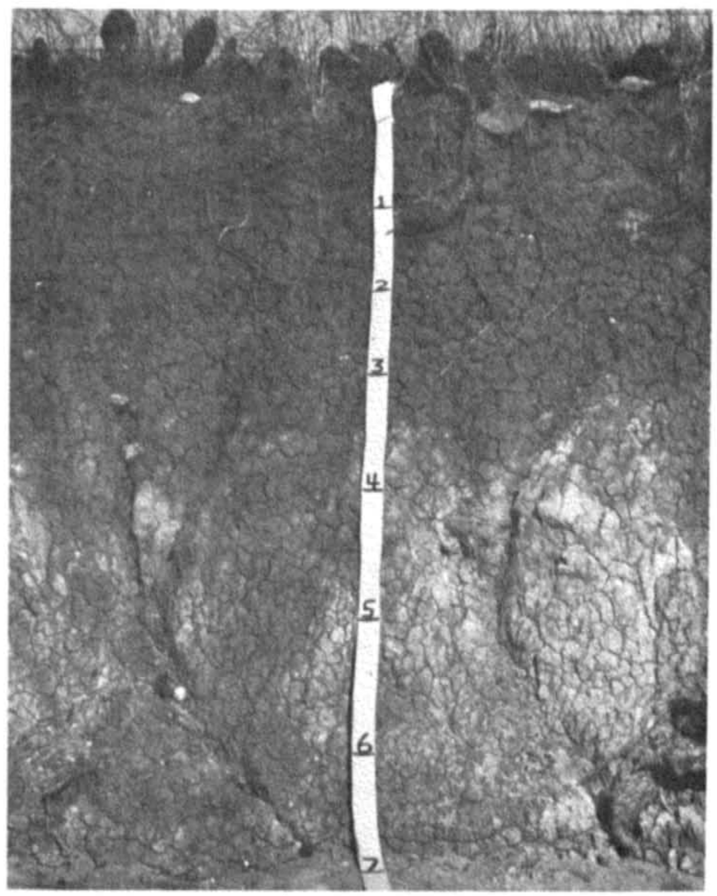

Figure 9.—Profile of Vernon soils showing the underlying Permian clay.

Vernon soils, 3 to 5 percent slopes (VsC).—These are gently sloping soils on uplands. They have the profile described as representative for the series. The texture of the surface layer is clay loam or clay.

Included in mapping are small areas of Renfrow silt loam and areas where the depth to the C horizon is less than 20 inches. Also included are some small loamy areas that have been eroded.

These soils are used for cultivated crops and for range. Cultivated areas are used for small grain, mainly wheat and forage sorghum.

Management is needed to improve or maintain soil structure and fertility, reduce crusting, increase water intake, and control erosion. The soil is difficult to till because of the clayey materials. The cropping system should include crops that produce large amounts of residue, which can be returned to the soil to maintain soil structure and fertility, increase water intake, and prevent surface crusting. Tillage should be timely and kept to a minimum. Terraces and contour farming are needed. Capability unit IVe-4; Red Clay Prairie range site; woodland group 4.

Waurika Series

The Waurika series consists of deep, nearly level soils on uplands. These soils formed in loamy and clayey sediments under a cover of short and mid grasses.

In a representative profile, the surface layer is grayish-brown and light grayish-brown silt loam about 13 inches deep. The upper part of the subsoil is dark grayish-brown clay that extends to a depth of about 25 inches. The lower part of the subsoil is grayish-brown silty clay loam and clay loam that extends to a depth of about 45 inches. The underlying material is grayish-brown and light-gray clay loam.

Waurika soils are somewhat poorly drained and have very slow permeability. Available water capacity is high.

Representative profile of Waurika silt loam, 1,250 feet east and 660 feet north of SW. corner, NW¼ sec. 33, T. 4 S., R. 7 W.:

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, plowed boundary.

A1—6 to 10 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, friable; neutral; gradual, smooth boundary.

A2—10 to 13 inches, light grayish-brown (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; few, fine, faint, gray mottles and few, fine, distinct, yellowish-red mottles; weak, fine, granular structure; slightly hard, friable; neutral; abrupt, wavy boundary.

B2t—13 to 25 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; few, fine, distinct, reddish-brown mottles and few, fine, faint, gray mottles; moderate, medium, blocky structure; very hard, very firm; clay films on faces of peds; mildly alkaline; gradual, smooth boundary.

B31ca—25 to 40 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; few, fine, faint, gray mottles; weak, medium, blocky structure; very hard, firm; few calcium-carbonate concretions 3 to 4 mm. in diameter; calcareous; moderately alkaline; gradual, smooth boundary.

B32ca—40 to 45 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; common, medium, faint, light-gray (10YR 6/1) mottles that are spots of soft lime; weak, coarse, blocky structure; very hard, firm; common calcium-carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C1—45 to 57 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; common, coarse, distinct, light-gray (10YR 6/1) mottles, brownish yellow (10YR 6/6) when moist; massive; very hard, firm; few calcium-carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

C2—57 to 72 inches, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) when moist; few, fine, distinct, brownish-yellow mottles, dark gray when moist; massive; very hard, firm; calcareous in most of mass; moderately alkaline.

The A horizon is slightly acid or neutral. The A1 horizon is brown or dark brown and very dark gray to grayish brown. The A2 horizon is light gray or light brownish gray. The B2t horizon is brown or dark brown and very dark gray to grayish brown. Reaction is neutral or mildly alkaline. Depth to secondary carbonates is 24 to 48 inches.

Waurika soils differ from the associated Kirkland soils in having a distinct A2 horizon.

Waurika silt loam (Wa).—This is a nearly level soil on uplands. Included in mapping are small areas of Kirkland silt loam and a few small areas of soils that have a surface crust.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland. Much of the acreage is used for range. In cultivated areas the chief crop is small grain.

Management is needed to improve soil structure and reduce surface crusting. The cropping system should include crops that produce large amounts of residue, which can be returned to the soil to improve soil structure, increase water intake, and prevent surface crusting. Capability unit IIs-1; Claypan Prairie range site; woodland group 3.

Windthorst Series

The Windthorst series consists of deep, very gently sloping to gently sloping soils on uplands. These soils formed in material weathered from sandstone and clay under a cover of oak forest and tall grasses.

In a representative profile, the surface layer is brown fine sandy loam about 4 inches deep. The subsurface layer is very pale brown fine sandy loam that extends to a depth of about 8 inches. The upper part of the subsoil is red sandy clay that extends to a depth of about 39 inches. The lower part of the subsoil is yellowish-red clay that extends to a depth of about 48 inches. The underlying material is reddish-brown shaly clay.

Windthorst soils are moderately well drained and have moderately slow permeability. Available water capacity is high.

Representative profile of Windthorst fine sandy loam, 1 to 5 percent slopes, 500 feet north and 350 feet west of SE. corner, NE¼ sec. 32, T. 5 S., R. 4 W.:

A1—0 to 4 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, wavy boundary.

A2—4 to 8 inches, very pale brown (10YR 7/4) fine sandy loam, yellowish brown (10YR 5/4) when moist; weak, fine, granular structure; slightly hard, friable; slightly acid; abrupt, smooth boundary.

B21t—8 to 19 inches, red (2.5YR 4/6) sandy clay, dark red (2.5YR 3/6) when moist; weak, medium, blocky structure; very hard, firm; clay films on faces of peds; medium acid; gradual, smooth boundary.

B22t—19 to 39 inches, red (2.5YR 4/6) sandy clay, dark red (2.5YR 3/6) when moist; weak, medium, blocky structure; very hard, firm; clay films on faces of peds; slightly acid; gradual, smooth boundary.

B3—39 to 48 inches, yellowish-red (5YR 5/6) clay, yellowish red (5YR 4/6) when moist; weak, medium, blocky structure; very hard, firm; slightly acid; clear, smooth boundary.

C—48 to 66 inches, reddish-brown (5YR 5/4) shaly clay, reddish brown (5YR 4/4) when moist; distinct mottles in shades of red and gray; massive; very hard, very firm; calcareous; moderately alkaline.

The A horizon is slightly acid or neutral. The A1 horizon ranges from dark grayish brown to yellowish brown. The A2 horizon ranges from brown to yellow. Where cultivated, the A2 horizon generally is mixed with the plow layer. The B horizon is slightly acid or medium acid. The B2t horizon is reddish brown, dark reddish brown, red, yellowish red, or dark red. It is sandy clay loam to sandy clay and clay. The C horizon is massive clay, sandy clay loam, or shaly clay. It is neutral to moderately alkaline and calcareous. Depth to bedrock of sandstone and clay is 40 to more than 60 inches.

Windthorst soils are associated with Stephenville and Dougherty soils. They have a more clayey B2t horizon than those soils.

Windthorst fine sandy loam, 1 to 5 percent slopes (WhC).—This soil is on uplands.

Included in mapping are small areas of Stephenville fine sandy loam.

This soil is suited to small grain, sorghum, cotton, tame pasture, range, and woodland. Most of the acreage is used for range. A few small areas are cultivated.

Management is needed to maintain or improve soil structure and fertility, increase water intake rate, and control erosion. Terracing, contour farming, stripcropping, and use of crop residue control erosion, increase water intake, and improve soil structure and fertility. Capability unit IIIe-3; Sandy Savannah range site; woodland group 3.

Wing Series

The Wing series consists of deep, nearly level to very gently sloping soils on uplands. These soils formed in material weathered from clay, shale, or sandstone under a cover of short and mid grasses. In this county, Wing soils are mapped only with Zaneis soils.

In a representative profile, the surface layer is brown and grayish-brown loam about 8 inches thick. The subsoil is pale-brown clay loam that extends to a depth of about 31 inches (fig. 10). It has high sodium content. The underlying material is pale-brown and light yellowish-brown clay loam.

Wing soils are somewhat poorly drained to moderately well drained and have very slow permeability. Available water capacity is high.

Representative profile of a Wing loam from an area of Zaneis-Wing complex, 0 to 3 percent slopes, 534 feet north and 27 feet east of SW. corner of sec. 8, T. 4 S., R. 6 W.:

Ap—0 to 4 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; weak, medium, granular structure; slightly hard, friable; slightly acid; abrupt, plowed boundary.

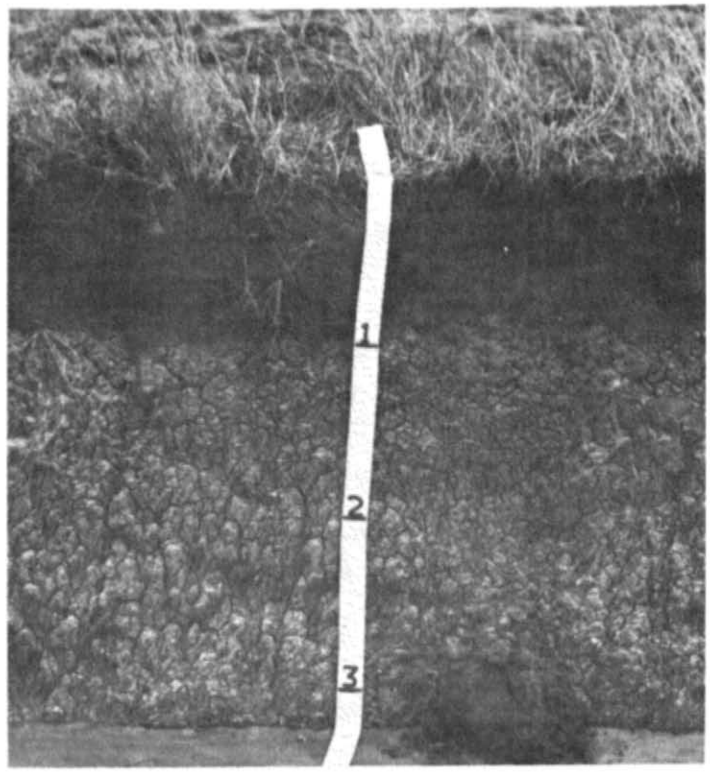

Figure 10.—Profile of a Wing loam showing the blocky structure of the subsoil and ground cover of three-awn.

A1—4 to 8 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; moderate, medium, granular structure; hard, friable; slightly acid; abrupt, smooth boundary.

B21t—8 to 15 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; common, fine, distinct, yellowish-brown mottles and common, medium, distinct, gray (10YR 5/1) mottles; compound weak, coarse, prismatic structure and moderate, medium, blocky structure; extremely hard, very firm; bleached silt grains on top of prisms and a few patchy spots on sides of prisms; nearly continuous clay films on faces of peds; patchy very dark brown organic matter on peds and in root channels; numerous iron-manganese concretions 2 to 5 millimeters in size; moderately alkaline; gradual, smooth boundary.

B22t—15 to 19 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; common, fine, distinct, gray mottles and common, medium, distinct, olive-yellow (2.5Y 6/6) mottles; moderate, medium, blocky structure; extremely hard, very firm; nearly continuous clay films on faces of peds; grayish-brown (2.5Y 5/2) ped coatings; moderately alkaline; gradual, smooth boundary.

B3—19 to 31 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; common, fine, distinct, gray mottles and common, medium, distinct, olive-yellow (2.5Y 6/6) mottles; weak, medium, blocky structure; extremely hard, very firm; patchy clay films on faces of peds; few fine iron-manganese concretions; moderately alkaline; gradual, smooth boundary.

C1—31 to 52 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) when moist; common, fine, faint, yellowish-brown mottles and common, medium, faint, grayish-brown (10YR 5/2) mottles; massive; extremely hard, very firm; many soft calcium-carbonate masses and few calcium-carbonate concretions; few iron-manganese concretions; moderately alkaline; gradual, smooth boundary.

C2—52 to 68 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) when moist; many coarse, distinct, light-gray (10YR 7/1) mottles and common, medium and coarse, prominent, red (2.5YR 4/6) mottles; massive; extremely hard, very firm; few iron-manganese concretions; few soft calcium-carbonate masses; calcareous; moderately alkaline.

The A horizon ranges from brown to grayish brown and light brownish gray. It is very fine sandy loam, silt loam, or loam. The surface crust, where present, is ⅛ to 2 inches thick and is glazed and whitish when dry. The B2t horizon is yellowish brown to pale brown, strong brown, and brown. It is clay loam to clay and is moderately alkaline. It is calcareous in some profiles.

Wing soils are associated with Oscar and Zaneis soils. They differ from the similar Oscar soils in having a more clayey B2t horizon and in having mottles when wet. They differ from the Zaneis soils in having a more silty B2t horizon.

Yahola Series

The Yahola series consists of deep, nearly level soils on flood plains. These soils formed in loamy sediments under a cover of hardwood trees and tall grasses. They are subject to flooding.

In a representative profile, the surface layer is reddish-brown fine sandy loam about 11 inches thick. The underlying material is reddish-yellow, reddish-brown, and yellowish-red fine sandy loam and loam and has thin strata of loamy fine sand to clay loam.

Yahola soils are well drained and have moderately rapid permeability. Available water capacity is high.

Representative profile of Yahola fine sandy loam 2,000 feet north and 200 feet east of SW. corner of sec. 18, T. 6 S., R. 8 W.:

A1—0 to 11 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; soft, very friable; the upper 6 inches is a plowed horizon and does not differ noticeably from the lower part of the horizon; calcareous; moderately alkaline; gradual, smooth boundary.

C1—11 to 40 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; massive; slightly hard, very friable; thin strata of loamy fine sand and silt loam in the lower part; calcareous; moderately alkaline; gradual, smooth boundary.

C2—40 to 56 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

C3—56 to 72 inches, yellowish-red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) when moist; massive; slightly hard, very friable; thin strata of loamy fine sand to clay loam; calcareous; moderately alkaline.

The A horizon ranges from dark reddish gray or dark brown to reddish yellow. The C horizon generally is stratified with coarse and fine soil material. Degree of stratification varies widely. The C1 horizon is brown or reddish brown to reddish yellow.

Yahola soils are associated with Bunyan, Crevasse, Roebuck, Port, and Pulaski soils. They are sandier than Roebuck, Port, and Bunyan soils and are calcareous throughout. They are less sandy than Crevasse soils. They are more alkaline than Pulaski soils.

Yahola fine sandy loam (Ya).—This is a nearly level soil on flood plains. It is likely to be damaged by floods once in 1 to 5 years.

Included in mapping are small areas of Crevasse soils and of soils similar to Yahola but having a surface layer of silt loam or loamy fine sand.

This soil is well suited to small grain, sorghum, cotton, alfalfa, melons, cantaloup, tame pasture, range, and woodland.

Management is needed to maintain soil structure and fertility, to protect the soil from damage by overflow of streams, and to control soil blowing. Also needed are terraces for diverting water that runs off adjacent upland. Crop residue should be returned to the soil. Plant cover is needed in winter and in spring to protect the soil from soil blowing. Capability unit IIw–1; Loamy Bottom land range site; woodland group 1.

Zaneis Series

The Zaneis series consists of deep, very gently sloping to rolling soils on uplands. These soils formed in material weathered from sandstone or sandy shale under a cover of mid and tall grasses.

In a representative profile, the surface layer is reddish-brown loam about 10 inches thick. The upper part of the subsoil is reddish-brown clay loam that extends to a depth of about 53 inches. The lower part of the subsoil is red sandy clay loam that has thin bands of soft sandstone (fig. 11). It extends to a depth of about 72 inches.

Zaneis soils are well drained and have moderately slow permeability. Available water capacity is high.

Representative profile of Zaneis loam, 1 to 3 percent

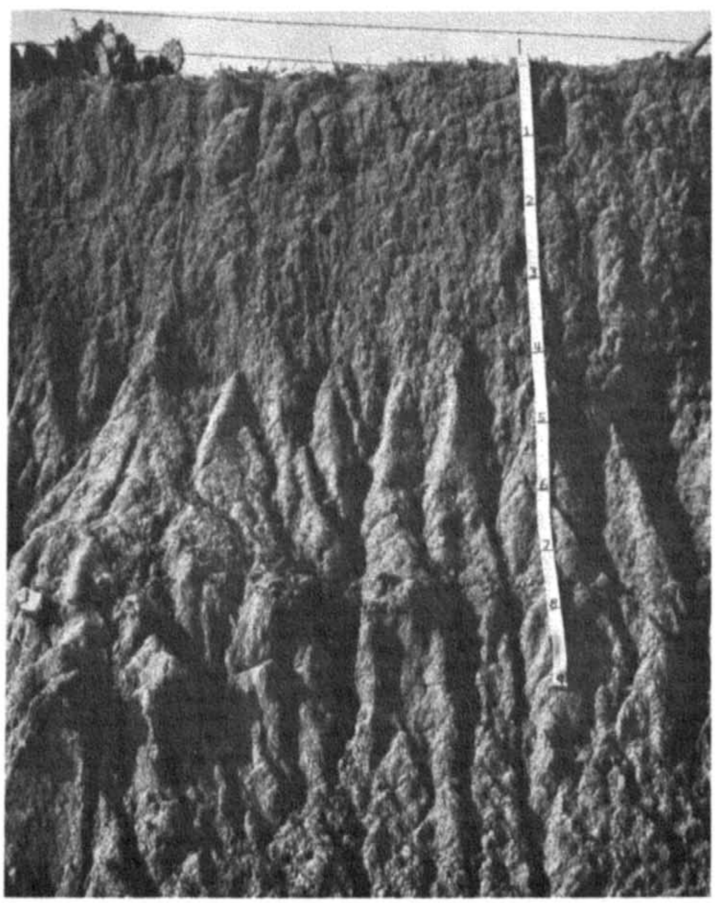

Figure 11.—Profile of a Zaneis loam showing the thin bands of soft sandstone.

slopes, 150 feet east and 1,450 feet south of NW. corner of sec. 10, T. 4 S., R. 8 W.:

Ap—0 to 7 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; weak, medium, granular structure; hard, friable; slightly acid; clear, smooth boundary.

A1—7 to 10 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

B21t—10 to 20 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, medium, granular structure; hard, friable; numerous worm casts; clay films on faces of peds; slightly acid; gradual, smooth boundary.

B22t—20 to 38 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard, friable; thin clay films on faces of peds; few iron-manganese concretions; neutral; gradual, smooth boundary.

B31—38 to 53 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) when moist; weak, medium, subangular blocky structure; hard, friable; patchy clay films on faces of peds; few iron-manganese concretions; mildly alkaline; gradual, smooth boundary.

B32&C—53 to 72 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; weak, medium, subangular blocky structure; hard, friable; patchy clay films on face of peds; many iron-manganese concretions; thin bands of soft sandstone; mildly alkaline.

The solum is 40 to 72 inches thick. The A horizon ranges from reddish brown to brown. It is slightly acid to medium acid. The B2t horizon is reddish brown, red, or yellowish red and is slightly acid to mildly alkaline. The B3 horizon is similar to the B2t horizon in color.

Zaneis soils are associated with Chickasha, Lucien, Renfrow, and Wing soils. Their B2t horizon is more clayey and redder than in Chickasha soils and is less clayey and less compact than in Renfrow soils. Unlike Lucien soils, they have a B2t horizon and are deeper over sandstone. They have a less silty B2t horizon than Wing soils. They differ from Bastrop soils in having a more clayey B2t horizon and in being shallower to red bed material.

Zaneis loam, 1 to 3 percent slopes (ZaB).—This soil is on uplands. It has the profile described as representative for the series.

Included in mapping are small areas of Chickasha fine sandy loam, Kirkland silt loam, Renfrow silt loam, and Waurika silt loam. Some areas have a lighter colored surface layer.

This soil is suited to small grain, cotton, sorghum, alfalfa, tame pasture, range, and woodland. Half or more of the acreage is used for range. Many formerly cultivated areas have been seeded to native grasses.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terracing, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Terracing and contour farming are needed if row crops are grown (fig. 12). Crop residue should be returned to the soil, and excessive tillage should be avoided. Capability unit IIe–1; Loamy Prairie range site; woodland group 1.

Zaneis loam, 3 to 5 percent slopes (ZaC).—This soil is on uplands. It has a profile similar to the one described as representative for the series, but its surface layer is about 4 inches thinner.

Included in mapping are small areas of Chickasha fine sandy loam, Lucien fine sandy loam, and Renfrow silt loam. Also included are small areas of rock outcrops and areas of Wing soils. Some areas have a light colored surface layer.

Most of the acreage is used for range, but a few areas are used for small grain, cotton, sorghum, and tame pasture.

Management is needed to maintain fertility and soil structure and to control erosion. Erosion can be controlled by terracing, contour farming, stripcropping, and use of crop residue. Plant cover is needed in winter and in spring to protect the soil from soil blowing and water erosion. Terracing, contour farming, and the use of crop residue are needed to control erosion, conserve moisture, and maintain soil structure. Capability unit IIIe–2; Loamy Prairie range site; woodland group 2.

Zaneis loam, 2 to 5 percent slopes, eroded (ZaC2).—This is a moderately eroded soil on uplands. Part of the original surface layer has been removed through erosion in most of the acreage. In about 20 to 35 percent of the acreage the present surface layer is a mixture of the original surface layer and subsoil material, mainly as a result of tillage. Rills about 500 feet or less apart have formed in many places. This soil has a profile similar to the one described as representative for the series, but its surface layer is about 6 to 9 inches thinner.

Included in mapping are small areas of Chickasha fine sandy loam and Lucien fine sandy loam. Also included are a few small areas of rock outcrops and areas of Wing soils. Some areas have a lighter colored surface layer.

This soil is suited to small grain, forage, sorghum, and tame pasture. Some areas have been seeded to native grasses. Most of the acreage is cultivated.

Management is needed to protect cultivated areas from severe erosion. Intensive management by means of terracing, contour farming, use of crop residue, and addition of fertilizer is needed to improve the suitability of this soil for cultivation and to improve the growth of crops. Capability unit IIIe–5; Loamy Prairie range site; woodland group 3.

Zaneis-Lucien-Vernon association, rolling (ZvD).—These soils are on uplands. Most areas are along streams and drainageways that have dissected the smooth uplands. Slopes are mainly 5 to 12 percent but range up to 20 percent.

About 45 percent of the acreage is Zaneis loam, 30 percent is Lucien fine sandy loam, and 20 percent is Vernon clay. Included in mapping are Chickasha fine sandy loam, a soil similar to Zaneis loam except that depth to sandstone is less than 40 inches, and an alluvial soil. These inclusions make up about 5 percent of the acreage.

The composition of this unit is more variable than that of other mapping units in the county, but has been controlled well enough to interpret for the expected uses of the soils.

The Zaneis soil in this unit is similar to the one described as representative for the series except that the surface layer is about 6 inches thinner. The Lucien soil in this unit has a profile similar to the one described as representative for the Lucien series. The Vernon soil in this unit is similar to the one described as representative for the Vernon series.

Figure **12.—Contour tillage and terraces on Zaneis loam, 1 to 3 percent slopes.**

This association is best suited to tame pasture and range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practice, and preventing fires. Capability unit VIe–6; Zaneis soil in Loamy Prairie range site; Lucien soil in Shallow Prairie range site; Vernon soil in Red Clay Prairie range site; woodland group 4.

Zaneis-Wing complex, 0 to 3 percent slopes (ZwB).—These soils are on uplands. They occur in such an intricate pattern that it is impractical to map each separately.

About 40 percent of the acreage is Zaneis loam. About 25 percent is Wing loam, Wing silt loam, and Wing very fine sandy loam. About 20 percent is a soil that is intermediate in characteristics between Zaneis loam and Wing loam. Also included in mapping are Chickasha fine sandy loam, Kirkland silt loam, Renfrow silt loam, Vernon soils, and rock outcrops, which make up about 15 percent of the acreage.

The Wing soil in this mapping unit has the profile described as representative for the Wing series. The soil that is intermediate between Zaneis loam and Wing loam has a surface layer about 10 to 18 inches thick that is loam or clay loam and has a subsoil that is clay loam or clay. The Zaneis soil in this mapping unit has a profile similar to the one described as representative for the series except that the surface layer is about 6 inches thinner.

Small areas of this complex are used for cultivated crops, mainly small grain, sorghum, tame pasture, and cotton. Most of the acreage is used for range. Many cultivated areas have been abandoned or seeded to native grasses.

Management is needed to maintain soil structure, reduce crusting, and increase water intake. Large amounts of crop residue should be returned to the soil to improve soil structure, increase water intake, and prevent surface crusting. Tillage should be timely and kept to a minimum. Applications of gypsum may be needed. The treated areas should not be tilled for a minimum of two growing seasons. Capability unit IVs–1; Zaneis soil in Loamy Prairie range site; Wing soil in Slickspot range site; woodland group 4.

Use and Management of the Soils

This section explains the system of capability classification used by the Soil Conservation Service, lists the capability units in Jefferson County, and gives estimated yields of the principal crops grown in the county under two levels of management. The capability classification of each soil mapped in the county is given in the "Guide to Mapping Units." Information about suitable use and management for each soil is given in the section "Descriptions of the Soils." This section also groups the soils according to their suitability for range and for woodland, discusses the use of the soils for wildlife, and gives information about soil properties significant in engineering.

Capability Grouping

The soils of Jefferson County have been grouped according to their suitability for most kinds of field crops. The capability group designation of each soil is shown at the end of the description of each mapping unit in the section "Descriptions of the Soils" and in the "Guide to Mapping Units" at the back of this survey.

Capability groups are made according to the limitation of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, subclass, and unit. The capability classes in Jefferson County are described in the following paragraphs.

Capability classes are the broadest groups and are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use.

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 that 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, 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 the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict 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–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following outline the capability units in Jefferson County are described. Suggestions for the use and management of the soils are given in the descriptions of the soil management groups.

Class I. Soils that have few limitations that restrict their use. (No subclass)
- Unit I–1.—Deep, nearly level, well-drained soils that are loamy throughout; on prairie uplands and terraces.

Class II. Soils that have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Subclass IIe.—Soils subject to moderate erosion if not protected.
  - Unit IIe–1.—Deep, nearly level and very gently sloping, well-drained soils that are loamy throughout; on prairie uplands and terraces.
  - Unit IIe–2.—Moderately deep and deep, very gently sloping, well-drained soils that are loamy throughout; on forested uplands.
- Subclass IIs.—Soils that have moderate limitations because of very slow permeability.
  - Unit IIs–1.—Deep, nearly level, well-drained, loamy soils that have a clayey subsoil; on prairie uplands.
- Subclass IIw.—Soils that have moderate limitations because of seasonal overflow.
  - Unit IIw–1.—Deep, nearly level, well-drained soils that are loamy throughout and have moderately rapid permeability; on flood plains.
  - Unit IIw–2.—Deep, nearly level, well-drained soils that are loamy throughout and have moderate and moderately slow permeability; on flood plains.

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

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

Unit IIIe-1.—Deep, very gently sloping, well-drained, loamy soils that have a clayey subsoil; on prairie uplands.

Unit IIIe-2.—Deep, gently sloping, well-drained soils that are loamy throughout; on prairie uplands and terraces.

Unit IIIe-3.—Moderately deep and deep, very gently sloping and gently sloping, well drained and moderately well drained, loamy soils that have a loamy and clayey subsoil; on forested uplands.

Unit IIIe-4.—Deep, nearly level and very gently sloping, well-drained, sandy soils that have a loamy subsoil; on forested uplands.

Unit IIIe-5.—Moderately deep and deep, very gently sloping, gently sloping, and sloping, well-drained, eroded soils that are loamy throughout; on forested and prairie uplands.

Subclass IIIw.—Soils that have severe limitations because of excess water.

Unit IIIw-1.—Deep, nearly level, somewhat poorly drained and poorly drained, clayey soils; on flood plains.

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

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

Unit IVe-1.—Deep, sloping, well-drained soils that are loamy throughout; on prairie uplands.

Unit IVe-2.—Deep, gently sloping and sloping, well-drained sandy soils that have a loamy subsoil; on forested uplands.

Unit IVe-3.—Deep, very gently sloping and sloping, well-drained, eroded loamy soils that have a loamy and clayey subsoil; on prairie uplands.

Unit IVe-4.—Deep, gently sloping, well-drained, loamy and clayey soils that have a clayey subsoil; on prairie uplands.

Subclass IVs.—Soils that have very severe limitations because of toxic salts and tilth.

Unit IVs-1.—Deep, nearly level and very gently sloping, somewhat poorly drained to well-drained, loamy soils that have a loamy and clayey subsoil; on prairie uplands.

Class V. Soils that are not likely to erode, but that have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Subclass Vw.—Soils that are subject to frequent flooding.

Unit Vw-1.—Deep, loamy soils that are either flooded frequently or strongly dissected by stream channels, or both; on flood plains.

Unit Vw-2.—Deep, loamy and clayey soils that have a clayey subsoil and are flooded frequently; on flood plains.

Unit Vw-3.—Deep, sandy soils that are flooded frequently; on flood plains.

Subclass Vs.—Soils that have toxic salts.

Unit Vs-1.—Deep, loamy soils that have toxic salts and are subject to flooding.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, range, woodland, or wildlife habitat.

Subclass VIe.—Soils that have severe limitations, chiefly because of risk of erosion, if protective cover is not maintained.

Unit VIe-1.—Deep, very gently sloping to sloping, well-drained, severely eroded soils that are loamy throughout; on prairie uplands.

Unit VIe-2.—Deep, very gently sloping and gently sloping, well-drained, severely eroded, loamy soils that have a loamy and clayey subsoil; on prairie uplands.

Unit VIe-3.—Deep, strongly sloping and moderately steep, well-drained soils that are loamy throughout; on prairie uplands.

Unit VIe-4.—Shallow to deep, nearly level to moderately steep, loamy and clayey soils; on prairie uplands and flood plains.

Unit VIe-5.—Moderately deep, very gently sloping to sloping, well-drained, severely eroded soils that are loamy throughout; on forested uplands.

Unit VIe-6.—Very shallow to deep, rolling, well-drained loamy and clayey soils that have a loamy and clayey subsoil; on prairie uplands.

Unit VIe-7.—Very shallow to moderately deep, very gently sloping to strongly sloping, well-drained soils that are loamy throughout; on forested uplands.

Unit VIe-8.—Deep, hummocky, excessively drained soils that are sandy throughout; on prairie or forested uplands.

Subclass VIs.—Soils that are generally unsuitable for cultivation and are limited for other uses because of permeability and tilth.

Unit VIs-1.—Deep, nearly level and very gently sloping, well-drained, loamy and clayey soils that have a clayey subsoil; on flood plains.

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

Subclass VIIe.—Soils that have very severe limitations, chiefly because of risk of erosion, if protective cover is not maintained.

Unit VIIe-1.—Deep, rolling, excessively drained soils that are sandy throughout; on prairie uplands.

Subclass VIIs.—Soils that are very severely limited by moisture capacity, stones, or other soil features.

Unit VIIs-1.—Very shallow to deep, hilly, rocky and stony, loamy and clayey soils; on prairie uplands.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to purposes for improving the landscape esthetically. (None in Jefferson County.)

Management of Crops and Pasture [2]

Major concerns in management and use of the soils in Jefferson County are protection against soil blowing, control of water erosion, conservation of moisture, and production and management of crop residue. High sodium content is a limitation in the Wing and Oscar soils. Improvement and maintenance of good soil tilth is also a concern. Crop yields that can be obtained under different levels of management are provided in this section as a guide in the planning and use of a conservation cropping system. Cultivated soils require a combination of locally adapted conservation practices. These practices consist of a conservation cropping system, production and management of crop residue, minimum tillage, terracing and contour farming, stabilization of waterways, use of fertilizer, and use of a winter cover crop. If cantaloup and other special crops that require irrigation are grown on large areas of Dougherty loamy fine sand, Teller fine sandy loam, and Hardeman fine sandy loam, a winter cover crop is required for protection during the season of soil blowing.

Tame pasture is an important source of forage for Jefferson County's expanding livestock industry. Tame pasture grasses are being planted in a large acreage to provide year-round grazing in combination with native range and supplemental pastures.

Bermudagrass is best suited to deep soils on bottom land, such as Yahola and Pulaski fine sandy loams and Port and Bunyan silty clay loams and loams. King Ranch bluestem is well suited to loam and silt loam soils. Zaneis loam and Kirkland silt loam support an increasing acreage of this recently introduced tame pasture grass. Weeping lovegrass is widely suited and provides good yields of forage and seed on moderately coarse textured upland soils, such as Stephenville, Hardeman, and Teller fine sandy loams.

Tame pasture requires proper management to control erosion and furnish a dependable and economical source of forage. Systematic application of fertilizer, based on soil and plant needs, is needed to achieve desired levels of production. When production is lowered by deterioration of the stand, the old pasture should be renovated and restored to satisfactory production.

Estimated Yields

Estimated yields of the main crops grown in Jefferson County under two levels of management are shown in table 2. The estimates are averages for a period long enough to include both dry and wet years. Yields are considerably higher than those averages in years when the moisture supply is ample, and lower in years when the moisture supply is inadequate.

The estimates are based partly on records of soil fertility, crop variety tests, and rotation and tillage trials made by the Oklahoma Agricultural Experiment Station, and partly on information obtained during the course of the soil survey by observation and by personal communication with farmers. If the information about a given soil was insufficient, estimates were based on comparison with a similar soil about which adequate information had been obtained. No estimates are given for soils not normally considered suited to crops.

Columns A in table 2 show the yields that can be expected under common management, which is followed by a substantial number of farmers in the county. This management includes proper seeding rates and dates of planting and efficient harvesting methods; control of weeds, insects, and plant diseases sufficient to insure normal plant growth; terracing and contour farming, if appropriate; deep plowing, if appropriate; fertilizer in relatively small amounts applied to cash crops; and widespread use of one-way and moldboard plows.

Columns B in table 2 show the yields that can be expected under improved management. It includes the first four practices mentioned under common management plus application of the kinds and amounts of fertilizer indicated by soil analysis; the use of adapted, improved crop varieties; growing cover crops or stripcropping on sandy soils subject to blowing; and residue management and tillage by methods designed to control erosion, preserve soil structure, increase water intake, and favor seed germination.

Recommendations for use of fertilizer and selection of crop varieties can be obtained from local agricultural technicians.

Range [3]

Approximately 67 percent of Jefferson County, or 325,780 acres, is range. Range is land on which the natural potential plant community is composed principally of native grasses, forbs, and shrubs valuable for grazing and in sufficient quantity to justify use for grazing.

Much of the land presently used for range is in small livestock farms, but more than 30 ranch units are 1,000 acres to 20,000 acres in size. The major livestock enterprises raise beef cattle, including cow calf and feeder steers. There are two feedlots in the county. Range is commonly grazed all year and supplemented with feed high in protein and with hay. Many operators grow King Ranch bluestem, bermudagrass, and other introduced grasses for supplemental pasture.

Range sites and condition classes

For successful management of range, operators need to know the capability of different kinds of range in terms of the kind and quantity of herbage that can be produced. A range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants. Operators should be able to judge the present condition of their rangeland and understand its possibilities for improvement.

[2] Prepared by M. D. GAMBLE, conservation agronomist, Soil Conservation Service.

[3] Prepared by CHARLES I. GRIMES, range conservationist, Soil Conservation Service.

TABLE 2.—*Estimated average acre yields of principal crops*

[Figures in columns A are for yields obtained under normal management; those in columns B are for improved management. Absence of yield indicates crop is seldom grown, or that the soil is not suited to the crop. Mapping units ToC and TrD in the Tivoli series and unit Ts in the Treadway series are not shown in this table because they are not used for the crops listed]

Soil	Wheat		Barley		Grain sorghum		Forage sorghum		Cotton		Alfalfa		Watermelon		Cantaloup		Common bermudagrass	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	Tons	*Tons*	*Lb.*	*Lb.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*A.U.M.*[1]	*A.U.M.*[1]
Bastrop loam, 0 to 1 percent slopes	16	27	24	36	25	38	2.3	3.5	250	360	1.5	2.5	2.5	4.0	200	250	5.0	6.0
Bastrop loam, 1 to 3 percent slopes	14	22	22	32	21	32	2.0	3.1	240	340	1.3	2.4	---	---	200	250	4.0	5.5
Bastrop loam, 3 to 5 percent slopes	12	20	20	30	17	28	1.8	2.8	180	250	---	---	---	---	---	---	3.5	5.3
Bunyan loam	22	33	34	40	35	50	3.0	4.0	340	450	2.8	3.8	---	---	---	---	5.5	7.5
Chickasha fine sandy loam, 0 to 1 percent slopes	15	20	24	35	23	36	2.0	3.0	230	310	1.4	2.3	---	---	---	---	4.0	6.0
Chickasha fine sandy loam, 1 to 3 percent slopes	14	19	23	31	22	35	1.8	2.8	220	290	1.2	2.0	---	---	---	---	4.0	6.0
Crevasse soils	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.5	5.0
Dougherty loamy fine sand, 0 to 3 percent slopes	10	18	16	25	20	30	1.8	2.8	150	275	1.0	2.0	3.5	5.5	250	300	2.5	5.0
Dougherty loamy fine sand, hummocky	9	15	13	20	14	23	1.2	2.2	100	200	---	---	3.0	4.5	200	250	2.0	4.5
Hardeman fine sandy loam, 0 to 3 percent slopes	14	20	23	31	20	36	1.8	3.0	230	400	1.3	2.2	3.5	5.5	250	300	4.5	6.0
Kirkland silt loam, 0 to 1 percent slopes	16	24	22	38	20	30	1.6	2.4	200	275	---	---	---	---	---	---	2.5	3.5
Kirkland silt loam, 1 to 3 percent slopes	14	19	20	32	17	25	1.2	2.0	150	225	---	---	---	---	---	---	2.5	3.5
Minco loam, 0 to 1 percent slopes	22	30	28	36	30	42	2.7	3.5	280	460	2.0	3.0	3.0	5.0	250	300	4.5	6.5
Minco loam, 1 to 3 percent slopes	18	25	24	32	23	38	2.3	3.1	240	380	2.0	2.5	2.5	4.0	200	250	4.0	6.0
Minco loam, 3 to 5 percent slopes	14	22	22	30	21	35	2.0	3.0	190	275	---	---	---	---	---	---	3.5	5.2
Minco loam, 5 to 8 percent slopes	13	20	18	25	---	---	---	---	---	---	---	---	---	---	---	---	3.0	5.0
Pond Creek silt loam, 0 to 1 percent slopes	22	30	32	42	30	42	2.7	3.5	275	450	2.0	3.0	---	---	---	---	5.0	6.5
Port silty clay loam	22	35	34	45	35	50	3.0	4.0	340	475	2.8	3.8	---	---	---	---	5.5	7.5
Port-Oscar complex	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.0	3.0
Port and Pulaski soils, channeled	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3.5	6.0
Pulaski fine sandy loam	14	25	24	34	30	40	2.8	3.8	320	400	2.4	3.3	---	---	---	---	4.5	6.5
Renfrow silt loam, 2 to 5 percent slopes, eroded	9	14	13	18	11	16	1.3	2.0	---	---	---	---	---	---	---	---	---	---
Roebuck clay	18	24	24	32	28	36	2.9	3.7	250	380	1.0	2.5	---	---	---	---	4.0	5.5
Roebuck soils, frequently flooded	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.0	4.0
Stephenville fine sandy loam, 1 to 3 percent slopes	10	17	14	21	13	20	1.5	2.5	110	180	---	---	2.5	3.0	125	150	2.5	5.5
Stephenville fine sandy loam, 3 to 5 percent slopes	9	16	13	20	10	17	1.1	1.8	100	170	---	---	2.0	2.5	75	125	2.0	5.0
Stephenville fine sandy loam, 2 to 5 percent slopes, eroded	8	14	12	19	9	15	1.0	1.5	---	---	---	---	---	---	---	---	1.8	3.5
Stephenville-Darnell complex, 1 to 12 percent slopes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.5	2.5
Teller fine sandy loam, 0 to 1 percent slopes	16	25	24	35	25	38	2.0	3.0	240	350	1.4	2.3	2.5	4.0	200	250	4.5	6.0
Teller fine sandy loam, 1 to 3 percent slopes	15	22	23	34	24	36	1.8	2.8	230	330	1.2	2.1	2.0	3.5	170	225	4.5	6.0
Teller fine sandy loam, 3 to 5 percent slopes	13	20	20	31	21	33	1.2	2.0	160	260	---	---	---	---	---	---	3.5	5.5
Teller fine sandy loam, 2 to 6 percent slopes, eroded	9	18	17	27	18	31	1.0	1.8	125	200	---	---	---	---	---	---	3.0	5.0
Teller fine sandy loam, 5 to 8 percent slopes	9	18	17	27	---	---	---	---	---	---	---	---	---	---	---	---	3.0	5.0
Vernon soils, 3 to 5 percent slopes	7	10	7	15	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Waurika silt loam	14	22	21	32	18	26	1.5	2.4	200	275	---	---	---	---	---	---	2.5	3.5
Windthorst fine sandy loam, 1 to 5 percent slopes	8	18	11	25	10	16	1.0	1.5	100	170	---	---	---	---	---	---	2.0	5.0
Yahola fine sandy loam	20	30	25	35	30	40	2.8	3.8	340	475	2.4	3.4	4.0	5.0	300	350	4.5	7.5
Zaneis loam, 1 to 3 percent slopes	14	22	20	32	22	32	2.0	2.8	235	340	1.2	2.0	---	---	---	---	4.0	5.5
Zaneis loam, 3 to 5 percent slopes	12	20	18	30	17	28	1.5	2.2	165	240	---	---	---	---	---	---	3.0	5.0
Zaneis loam, 2 to 5 percent slopes, eroded	10	15	16	24	---	---	1.4	2.0	---	---	---	---	---	---	---	---	2.0	4.0
Zaneis-Lucien-Vernon association, rolling	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.5	3.0
Zaneis-Wing complex, 0 to 3 percent slopes	9	15	16	24	13	18	1.2	1.8	110	175	---	---	---	---	---	---	1.8	2.5

[1] A.U.M. stands for animal unit month. The figures represent the number of months that 1 acre will provide grazing for 1 animal unit (1,000 pounds live weight).

Range condition is the present state of the vegetation in relation to the potential plant community for that site. Range condition is relative. When a particular range is said to be in "good condition" or "poor condition," the description is always relative to a standard that has been established for that range site (fig. 13). This standard is the kind and amount of native vegetation the site is capable of producing.

The kind and amount of vegetation presently growing on the site generally reflect the extent of grazing use. The plants on each range site are grouped according to how they will respond to grazing. The plants are called *decreasers*, *increasers*, and *invaders*.

Decreasers are plants present in the potential plant community that gradually disappear under continuous heavy grazing. They generally are the most palatable and most productive perennial plants.

Increasers are plants present in the potential plant community that normally increase as the decreaser plants are grazed out. These are generally the less palatable or less productive plants in the potential plant community. Under prolonged heavy grazing of the decreasers, these less desirable plants dominate the site.

Invaders are plants that are not members of the potential plant community for the site. They invade the site from an adjoining site or from a great distance. They are generally woody or herbaceous annuals or perennials. Following prolonged abuse or disturbance of the site, these invaders may replace the increaser plants.

Range condition classes express the degree to which the present vegetation on a site is similar to that of the natural potential plant community.

A range site is in excellent condition if 76 to 100 percent of the present vegetation is of the same kind as the

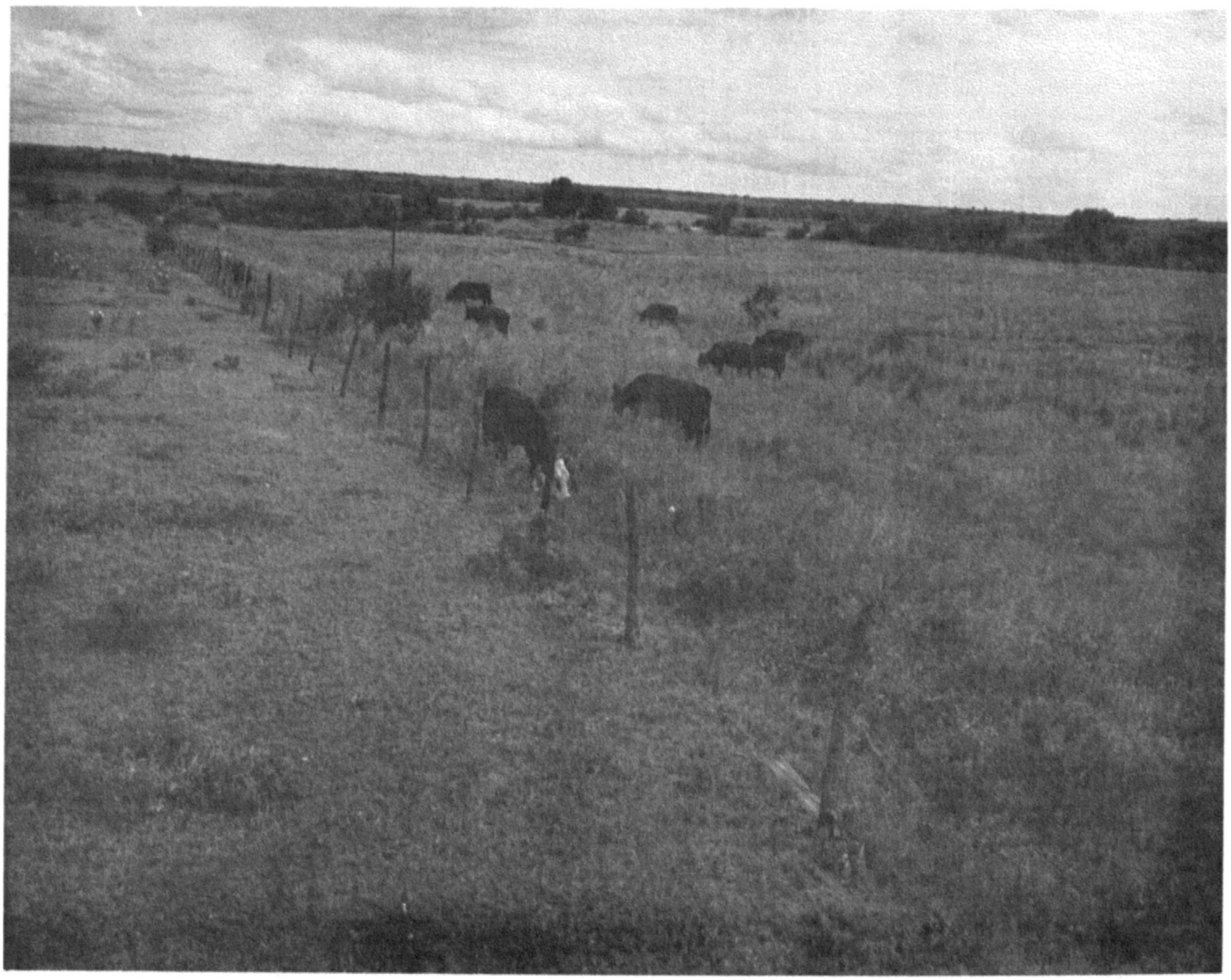

Figure 13.—Deep Sand range site on Tivoli soils, rolling, showing poor condition on the left and excellent condition on the right.

potential plant community for the site. It is in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is 25 or less.

Present composition can be determined by identifying the living plants, whether grazed or not and whether dormant or not, and comparing the amount of existing plants with the amount of plants in the potential plant community for the site. Range condition class guides are available at the local office of the Soil Conservation Service.

Range management

Potential forage production depends upon the range site. Current forage production depends upon the range condition and the available moisture.

Conservation treatment of range requires management practices that conserve plants, accelerate range improvement, and control livestock. Such range practices as proper use for grazing, deferred grazing, and rotation-deferred grazing conserve range vegetation. Range seeding, brush control, and other practices specifically designed to improve range cover faster than is possible through grazing management alone accelerate range improvement. Livestock-control practices facilitate handling livestock and include fencing and placing stock watering facilities to obtain better distribution of livestock.

Grazing should be scheduled so that enough cover is left to protect the soil and maintain the quantity and quality of desirable plants. Repeated or prolonged overgrazing reduces the ability of the plants to produce the deep roots, seeds, and new shoots necessary for reproduction and maintenance of the stand.

Operators who are familiar with their range sites and the main grasses generally understand signs of improvement or decline in range condition and adjust management to fit the condition.

One of the main objectives of good range management is to keep the range in excellent condition or at least in good condition. When this is done, moisture is conserved, yields are maintained or improved, and the soils are protected from deterioration. A major problem is being able to recognize important changes in the kind of cover on a range site. The changes are so gradual that they are often overlooked or misunderstood. Lush growth, encouraged by heavy rainfall, might lead to the conclusion that the range is in good condition and improving. Actually this type of cover is often weedy and the long-term trend is toward poorer condition and lower production.

On the other hand, range in excellent condition that is being closely grazed, but for only a short time, and is under the supervision of a careful manager, might have a degraded appearance that conceals its good quality.

Specific information about the stocking of each range site is not included in this survey. Technical personnel of the local agricultural agencies can help ranchers to classify range sites and to estimate the condition of the range and the number of animals to stock.

Range condition classifies the present vegetation of a range site, but it does not indicate whether the range is improving or deteriorating. Some factors that indicate trend are vigor, number of seedling, plant composition, plant residue, and soil crusting.

Plant vigor is reflected primarily by the size of the plant in relation to its age and the environment in which it is growing. Evidence of increased vigor of decreaser plants indicates that the range is improving.

Abundance of seedlings of the species that are the most palatable to livestock is evidence of improvement. Few seedlings are able to establish themselves, however, on range in excellent condition.

A change in composition of the plants on a range indicates a trend. Weakening or dying out of some of the decreaser plants indicates a decline in condition. Likewise, an increase in the number of decreaser plants usually indicates an improvement in condition. Generally, the invasion of plants not native to the site indicates that a decline has already taken place.

An accumulation of plant residue is an indication of improving range condition. Plant residue reduces erosion caused by rain and makes the surface of the soil more favorable for seedlings and for the intake and conservation of moisture.

The condition of the soil surface affects the trend in condition and rate of recovery. An increase in bare ground, soil crusting, compaction from trampling, and erosion indicates a declining trend in range condition.

Descriptions of the range sites

The 18 range sites in Jefferson County are described in the following paragraphs. The most important plants of the potential plant community and the principal invaders are named. Estimated yields are given for each site. The estimates and annual herbage yields are based on clippings made near the end of the growing season on sites in excellent condition. The weights given are for air-dry herbage clipped at ground level. Data on herbage yields for these range sites are limited. The estimates given can be useful in comparing potential productivity of sites. Shrub and tree yields are not included in the estimates.

ALKALI BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level to very gently sloping soils on flood plains. These soils are loamy throughout. The subsoil is high in content of exchangeable sodium (fig. 14). The concentration of salts and the compacted subsoil limit the vegetation to drought-resistant and salt-tolerant plants.

The kind of vegetation varies with the depth of the surface layer and the concentration of salts. The main plants are alkali sacaton, switchgrass, whorled dropseed, buffalograss, inland saltgrass, white tridens, side-oats grama, and rhombopod.

Where this site is in excellent condition, the estimated annual yield per acre is about 3,200 pounds in favorable years and about 1,800 pounds in unfavorable years. This site makes up about 2 percent of the rangeland in the county.

BREAKS RANGE SITE

This range site consists of areas of hilly and broken escarpments on uplands having severe geologic erosion. Most areas are adjacent to the Red River (fig. 15). Soil depth is variable. Areas of exposed bedrock are common.

The potential plant community consists of sand bluestem, little bluestem, side-oats grama, and blue grama. Some of the invader plants common to this site are silver bluestem, windmillgrass, hairy tridens, and tumblegrass.

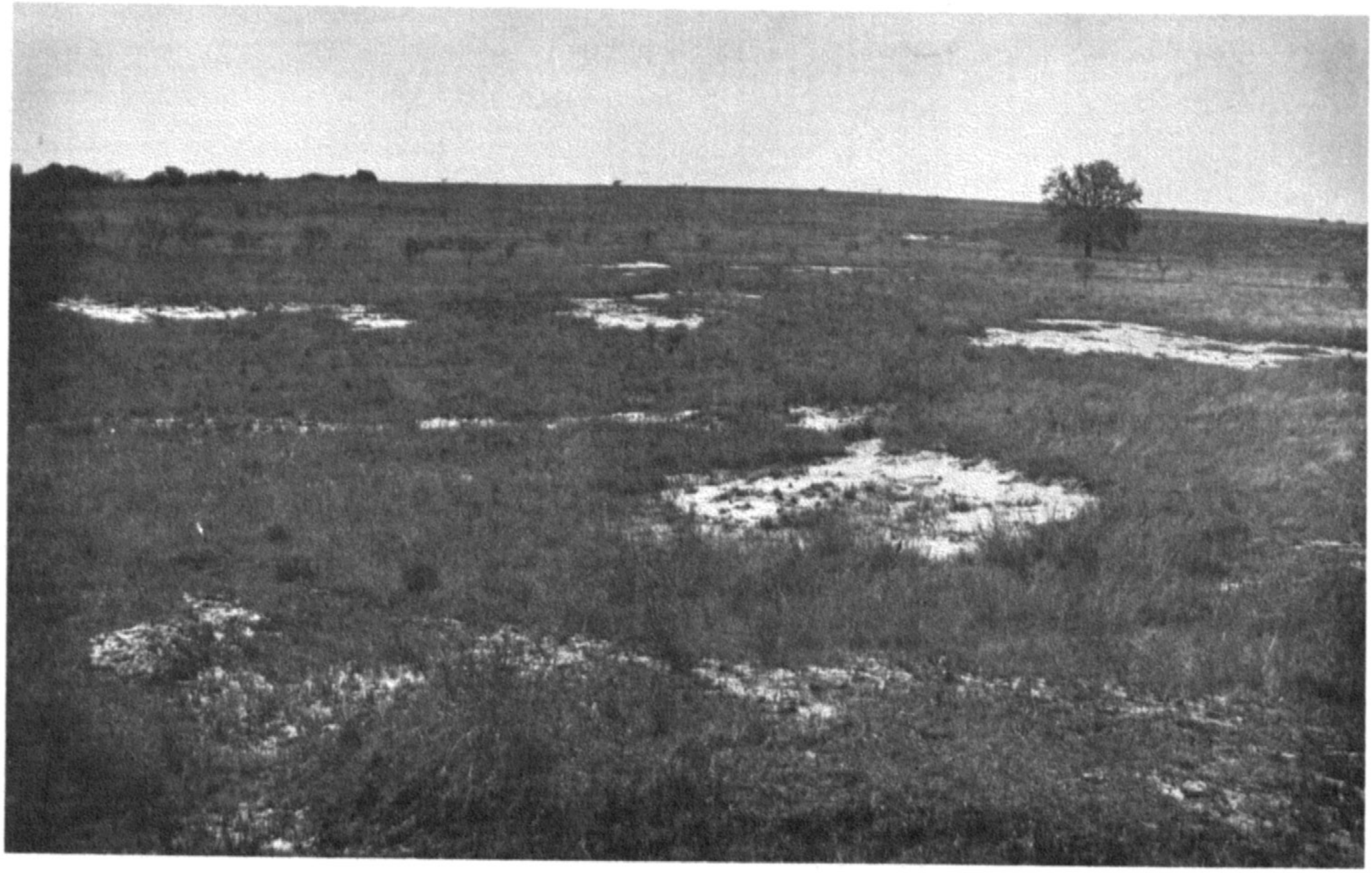

Figure 14.—**Alkali Bottomland range site in poor condition on the Oscar part of Port-Oscar complex. Note bare areas and mesquite invasion.**

Because the slopes are steep, livestock do not graze this site as readily as they do the smoother adjacent sites. The escarpments also act as barriers for livestock moving from one site to another, thus causing heavy grazing on the site below and light grazing on the site above, or vice versa. Proper placement of fences, salt, and watering facilities provides a better overall distribution of grazing.

Where this site is in excellent condition, the estimated annual yield per acre is about 2,000 pounds in favorable years and about 1,000 pounds in unfavorable years. This site makes up less than 1 percent of the rangeland in the county.

CLAYPAN PRAIRIE RANGE SITE

This range site consists of deep, nearly level to gently sloping soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil. The clayey subsoil restricts the penetration of water and roots.

The potential plant community consists of little bluestem, side-oats grama, blue grama, and switchgrass. The most common invader plants are annual broomweed, three-awn, and mesquite.

Where this site is in excellent condition, the estimated annual yield per acre is about 3,500 pounds in favorable years and about 1,500 pounds in unfavorable years. This site makes up about 4 percent of the rangeland in the county.

DEEP SAND RANGE SITE

This range site consists of deep, rolling soils on uplands. These soils are sandy throughout.

The taller grasses can be managed to dominate the site, but their yield varies sharply with the characteristically wide fluctuation in rainfall.

The potential plant community consists of sand bluestem, indiangrass, switchgrass, and little bluestem. Some of the invader plants common to this site are mat sandbur, fall witchgrass, annual wild buckwheat, and sand dropseed. Sand sagebrush is the main woody plant and where seen is an indication of this site.

Where this site is in excellent condition, the estimated annual yield per acre is about 3,800 pounds in favorable years and about 1,900 pounds in unfavorable years. This site makes up less than 1 percent of the rangeland in the county.

DEEP SAND SAVANNAH RANGE SITE

This range site consists of deep, nearly level to very gently sloping soils that are hummocky in places. These soils are on uplands. They have a sandy surface layer and loamy subsoil or are sandy throughout (fig. 16).

The potential plant community consists of sand bluestem, little bluestem, switchgrass, indiangrass, post oak, and blackjack oak. Common invader species are mat sandbur, annual wild buckwheat, fall witchgrass, and snakecotton.

Figure 15.—**Breaks range site on Rough broken land in excellent condition along the Red River.**

Where this site is in excellent condition, the estimated annual yield per acre is about 3,800 pounds in favorable years and about 1,900 pounds in unfavorable years. This site makes up 1 percent of the rangeland in the county.

ERODED CLAY RANGE SITE

This range site consists of deep, very gently sloping to gently sloping, severely eroded soils on uplands. These soils are loamy or clayey throughout. They were formerly cultivated. Erosion has removed much of the surface layer, and the clayey subsoil is exposed in many areas. Revegetation is difficult. Native grasses are suited to these soils.

Old abandoned fields are low producers. The common plants are silver bluestem, windmillgrass, three-awn, and Japanese brome. If revegetated this site produces big bluestem, little bluestem, indiangrass, switchgrass, sideoats grama, and blue grama. Range seeding improves the forage potential for this site.

Where this site is in excellent condition, the estimated annual yield per acre is about 2,000 pounds in favorable years and about 1,000 pounds in unfavorable years. This site makes up less than 1 percent of the rangeland in the county.

ERODED SANDY SAVANNAH RANGE SITE

This range site consists of moderately deep and deep, very gently sloping to sloping, severely eroded soils on uplands. These soils are loamy throughout. They were formerly cultivated.

This site generally requires range seeding to establish the desired native grasses. The potential plant community consists mainly of sand bluestem, little bluestem, indiangrass, and switchgrass. Much of the site has been cultivated, and the vegetation now is less desirable plants, such as annual three-awn, silver bluestem, splitbeard bluestem, windmillgrass, and fall witchgrass.

Where this site is in excellent condition, the estimated annual yield per acre is about 2,500 pounds in favorable years and about 1,700 pounds in unfavorable years. This site makes up less than 1 percent of the rangeland in the county.

HEAVY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level soils that are loamy or clayey throughout. These soils are on flood plains and are subject to flooding.

The potential plant community consists of wildrye, western wheatgrass, switchgrass, knotroot bristlegrass, buffalograss, vine-mesquite, and other cool-season and warm-season grasses. Some sedges, mostly cool season,

Figure 16.—**Deep Sand Savannah range site on Dougherty loamy fine sand, hummocky, in poor condition and severely overgrazed.**

also are important. The grasses and sedges make this site well suited to use in winter. Invader plants include silver bluestem, sumpweed, windmillgrass, cactus, and mesquite.

This site frequently is infested with mesquite, and control measures generally are needed.

Where this site is in excellent condition, the estimated annual yield per acre is about 4,500 pounds in favorable years and about 2,500 pounds in unfavorable years. This site makes up about 3 percent of the rangeland in the county.

LOAMY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level and very gently sloping soils on flood plains. These soils are loamy throughout. The extra moisture from occasional flooding has made this range site the most productive in the county.

This range site is capable of supporting cool-season and warm-season grasses, including Canada wildrye, western wheatgrass, switchgrass, indiangrass, and Florida paspalum. Common invader plants are silver bluestem, buffalograss, ironweed, cactus, and mesquite.

Where this site is in excellent condition, the estimated annual yield per acre is about 8,500 pounds in favorable years and 4,500 pounds in unfavorable years. This site makes up about 11 percent of the rangeland in the county.

LOAMY PRAIRIE RANGE SITE

This range site consists of moderately deep to deep, nearly level to moderately steep soils on uplands. These soils are loamy or clayey throughout (fig. 17).

The potential plant community consists of sand bluestem, big bluestem, little bluestem, switchgrass, and

Figure 17.—Loamy Prairie range site on Zaneis loam, 1 to 3 percent slopes, in excellent condition.

indiangrass. Typical invader plants on this site are buffalograss, three-awn, western ragweed, silver bluestem, and mesquite. Many thousands of acres of this site now in range or pasture were formerly cultivated. In most areas the vegetation is of very poor quality.

Reseeding these areas to desirable grasses has proven profitable and is an important practice on this site (fig. 18).

Where this site is in excellent condition, the estimated annual yield per acre is about 6,000 pounds in favorable years and about 3,000 pounds in unfavorable years. This site makes up about 42 percent of the rangeland in the county.

RED CLAY FLATS RANGE SITE

This range site consists of deep, nearly level to very gently sloping loamy or clayey soils on flood plains or alluvial fans. These soils have a clayey subsoil (fig. 19).

The plant community normally consists of side-oats grama, blue grama, vine-mesquite, and alkali sacaton. Common invader and increaser plants are cactus, mesquite, buffalograss, three-awn, and western ragweed.

The encroachment of mesquite decreases grass production; therefore, the control of this brush is of prime importance on this site (fig. 20).

Where this site is in excellent condition, the estimated annual yield per acre is about 1,000 pounds in favorable years and about 500 pounds in unfavorable years. This site makes up about 1 percent of the rangeland in the county.

RED CLAY PRAIRIE RANGE SITE

This range site consists of moderately deep, gently sloping to rolling soils on uplands (fig. 21). These soils have a loamy or clayey surface layer and a clayey subsoil.

The potential plant community is side-oats grama, little bluestem, and tall dropseed. Common invaders are three-awn, Texas grama, puffsheath dropseed, and cactus.

Where this site is in excellent condition, the estimated annual yield per acre is about 3,000 pounds in favorable years and about 1,500 pounds in unfavorable years. This site makes up about 5 percent of the rangeland in the county.

SANDY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level to very gently sloping soils on flood plains (fig. 22). These soils are sandy throughout. Small areas are subirrigated. Production is limited in some areas because of sediments deposited during overflows and soil blowing.

The potential plant community consists of sand bluestem, switchgrass, indiangrass, and wildrye. Woody invaders and increasers present in varying amounts are tamarisk, cottonwood, and willow. Common invader plants are mat sandbur, sand dropseed, annual wild buckwheat, and snakecotton. Bermudagrass is commonly carried in by floodwater and has become established in many areas.

Where this site is in excellent condition, the estimated annual yield per acre is about 4,500 pounds in favorable years and 3,000 pounds in unfavorable years. This site makes up about 4 percent of the rangeland in the county.

SANDY PRAIRIE RANGE SITE

This range site consists of deep, nearly level to moderately steep soils on uplands (fig. 23). These soils are

Figure 18.—Loamy Prairie range site on Minco loam, 3 to 5 percent slopes, in excellent condition. This formerly cultivated field was reseeded to a mixture of native grasses.

loamy throughout. They are capable of supporting sand bluestem, big bluestem, switchgrass, indiangrass, little bluestem, and Canada wildrye. Common invader plants are fall witchgrass, sand dropseed, annual wild buckwheat, gummy lovegrass, and silver bluestem. Skunkbrush and other woody plants often invade this site.

Where this site is in excellent condition, the estimated annual yield per acre is about 5,000 pounds in favorable years and about 2,500 pounds in unfavorable years. This site makes up less than 1 percent of the rangeland in the county.

SANDY SAVANNAH RANGE SITE

This range site consists of deep and moderately deep, very gently sloping to strongly sloping soils on uplands. They have a loamy surface layer and a loamy or clayey subsoil.

This site developed under savannah conditions that often changed from an open canopy of blackjack oak and post oak over a dense stand of tall grass to a closed canopy of trees and brush over a thin stand of grass. These changes have generally resulted from continuous heavy grazing and from fires.

The potential plant community consists of little bluestem, switchgrass, indiangrass, big bluestem, and tick clover. The increaser woody plants are mostly post oak and blackjack oak. Common invader plants are annual three-awn, sand dropseed, and silver bluestem.

Measures should be taken to control the undesirable woody species. Good management is essential to maintain high forage production.

Where this site is in excellent condition, the estimated annual yield per acre is about 4,500 pounds in favorable years and about 2,500 pounds in unfavorable years. This site makes up 4 percent of the rangeland in the county.

SHALLOW PRAIRIE RANGE SITE

This range site consists of very shallow to shallow, rolling soils on uplands. These soils are loamy throughout. They are shallow over sandstone. Consequently the penetration of plant roots and moisture is restricted, and the available water capacity is low to moderate.

Where this site is in excellent condition, decreaser plants are little bluestem, big bluestem, indiangrass, wildrye, tall dropseed, catslaw sensitivebrier, and perennial sunflowers. Increasers make up about 30 percent of the climax vegetation where the range is in excellent condition. Important increasers are side-oats grama, meadow dropseed, hairy grama, silver bluestem, jointtail, heath aster, coralberry, hawthorn, and sumac. Common invaders are annual brome, three-awn, splitbeard bluestem, broomsedge bluestem, ragweed, and common broomweed.

Where this site is in excellent condition, the estimated annual yield per acre of air-dry herbage is 3,000 pounds in favorable years and 1,500 pounds per acre in unfavorable years. This site makes up about 10 percent of the rangeland in the county.

SHALLOW SAVANNAH RANGE SITE

This range site consists of very shallow and shallow, very gently sloping to strongly sloping soils on uplands. These soils are loamy throughout. They occur in irregular patterns in association with the Sandy Savannah range site. The shallowness of this loamy soil, and the rocks that have horizontal bedding planes near or on the

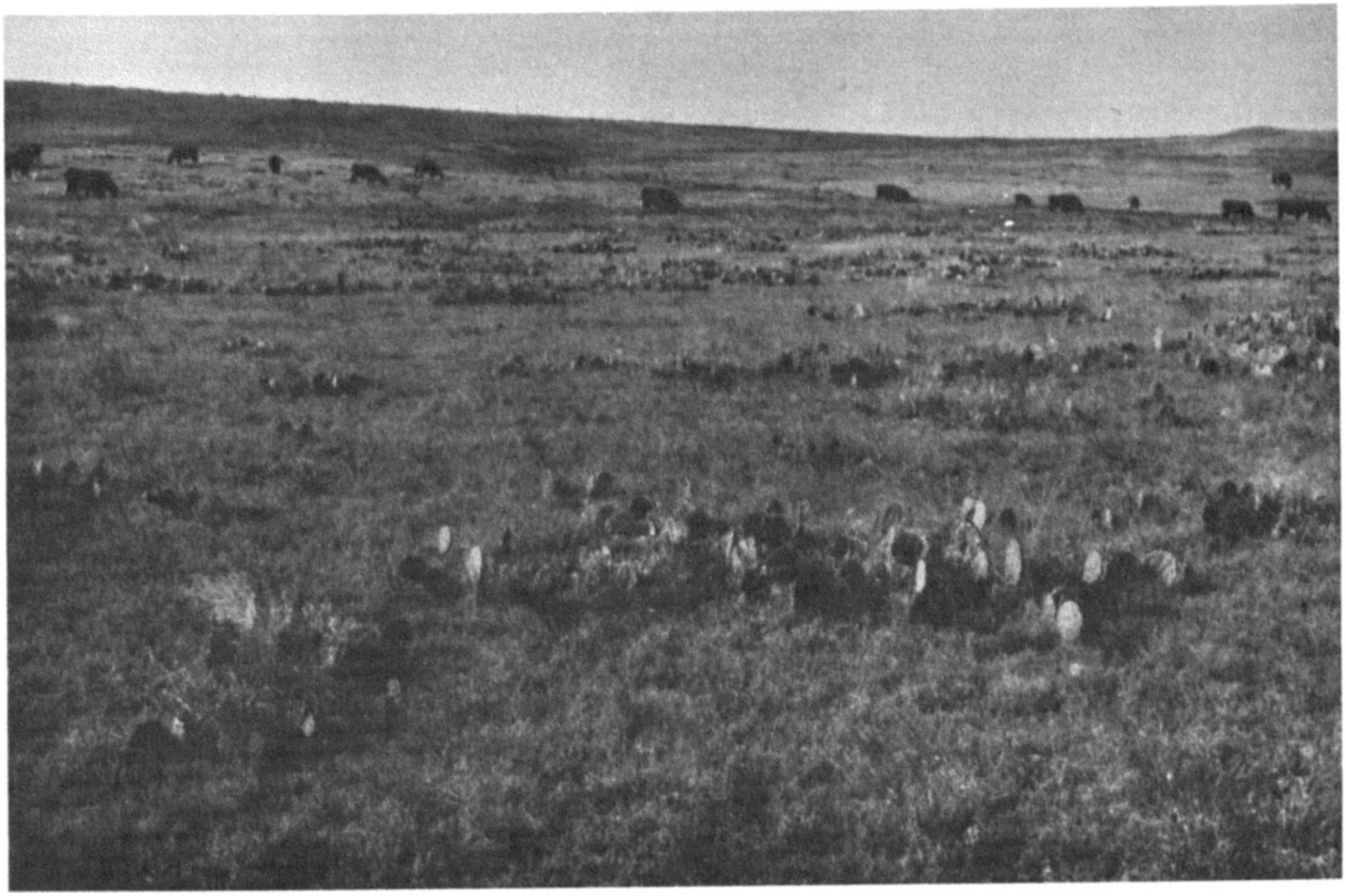

Figure 19.—**Red Clay range site on Treadway soils in fair condition. Note cactus invasion.**

surface, restrict plant root penetration except through rock cracks and deeper soil pockets. As a result the herbage production is lower than on the associated Sandy Savannah site.

The potential plant community consists of little bluestem, big bluestem, indiangrass, switchgrass, perennial lespedeza, and many desirable forbs. Increaser plants are post oak, blackjack oak, and Scribner's panicum. Common invader species are three-awn and windmillgrass.

Where the condition of the site declines to poor, the grasses generally are thinned out by overgrazing. They are replaced by woody sprouts and weeds. Brush control is generally essential to management on this site.

Where this site is in excellent condition, the estimated annual yield per acre is about 3,200 pounds in favorable years and about 1,600 pounds in unfavorable years. This site makes up less than 1 percent of the rangeland in the county.

SLICKSPOT RANGE SITE

This range site consists of deep, nearly level and very gently sloping soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil (fig. 24). Vegetation on this site varies because of differences in salt content and the compact clay loam subsoil.

Where this site is in excellent condition, the vegetation includes side-oats grama, blue grama, meadow dropseed, alkali sacaton, buffalograss, whorled dropseed, and dotted gayfeather. Common invader plants are three-awn, six-weeks fescue, and Japanese brome.

Where this site is in excellent condition, the estimated annual yield per acre is about 2,200 pounds in favorable years and about 1,200 pounds in unfavorable years. This site makes up about 7 percent of the rangeland in the county.

Woodland [4]

Native woodland in Jefferson County was mainly along the Red River and the lower part of major tributary streams, such as Beaver and Mud Creeks. Some trees grew on loamy to sandy uplands. Early settlers in the county used the trees on flood plains for building materials, fenceposts, and firewood.

The trees on flood plains are cottonwood, willow, sycamore, hackberry, elm, pecan, and black walnut. Black walnut logs are marketed outside the county. The trees on uplands are mostly blackjack oak and post oak. Trees

[4] Prepared by CHARLES P. BURKE, forester, Soil Conservation Service.

and shrubs also are planted for windbreaks on farmsteads throughout the county.

Woodland groups

The soils of Jefferson County have been placed in four woodland groups. The woodland group for each soil is shown in the "Guide to Mapping Units." The soils in groups 1, 2, and 3 are suited to trees and shrubs planted for windbreaks, but the soils in group 4 are not, mainly because they are severely eroded, are high in content of sodium, or are shallow.

WOODLAND GROUP 1

This group consists of deep and moderately deep, nearly level to very gently sloping soils. These soils are well drained and have moderate to high available water capacity.

The soils in this group are very well suited to farmstead windbreaks. Trees suitable for planting in the tall row include Siberian elm, honeylocust, cottonwood, and sycamore. These trees normally reach a height of 55 to 65 feet in 20 years.

Suitable evergreens are shortleaf pine, Austrian pine, ponderosa pine, eastern redcedar, and Arizona cypress. Suitable shrubs or shrublike trees include white mulberry, low-growing varieties of arborvitae, common lilac, and Russian-olive. In 20 years the evergreens normally reach a height of 20 to 30 feet, and the shrubs, 6 to 9 feet.

WOODLAND GROUP 2

This group consists of deep and moderately deep, nearly level to sloping soils. These soils are well drained to somewhat excessively drained. They have low to high available water capacity. The nearly level soils are frequently flooded or have low available water capacity.

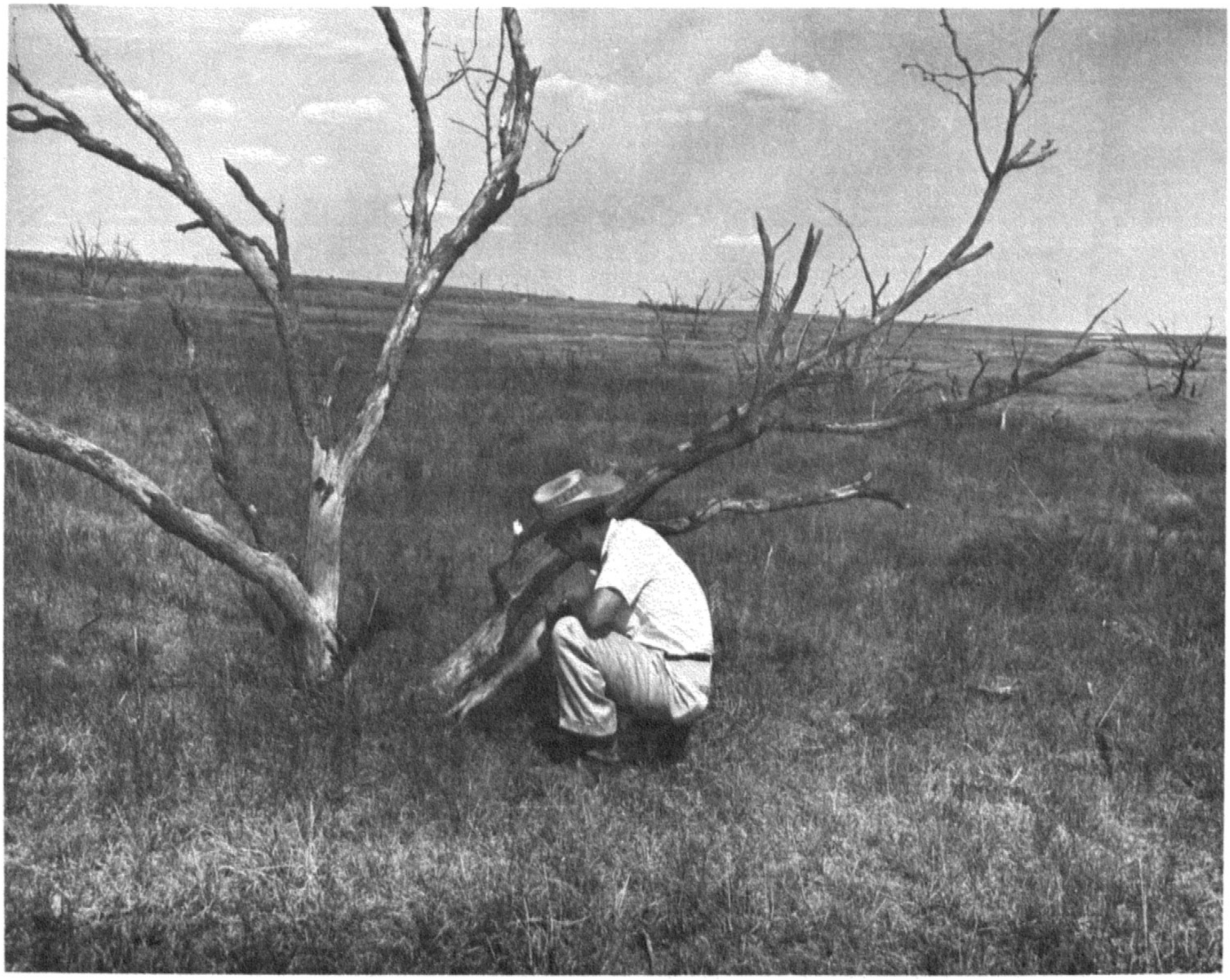

***Figure 20.*—Red Clay Flats range site on Treadway soils. The mesquite trees have been killed by treating the base with kerosene.**

Figure 21.—In the background is Red Clay Prairie range site in good condition on Vernon part of Zaneis-Lucien-Vernon association, rolling. In the foreground is a formerly cultivated field of Loamy Prairie range site on Minco loam, 1 to 3 percent slopes. Note mesquite invasion.

The soils in this group are well suited to farmstead windbreaks. Trees suitable for planting in the tall row include Siberian elm, honeylocust, cottonwood, and sycamore. Suitable evergreens are Austrian pine, ponderosa pine, eastern redcedar, and Arizona cypress. Suitable shrubs or shrublike trees include white mulberry, low-growing arborvitae, common lilac, and Russian-olive. Average seedling survival on these soils is about 70 percent. Average tree height in 20 years is 45 to 55 feet. Tree vigor shows some signs of decline in 20 years.

WOODLAND GROUP 3

This group consists of deep and moderately deep, nearly level to sloping soils that are hummocky in places. These soils are poorly drained to excessively drained and have a low to high available water capacity. The nearly level to sloping soils are eroded and channeled. They are poorly drained to moderately well drained or have very slow permeability.

The soils are fairly well suited to farmstead windbreaks, but care in planting and management is needed. Suitable trees are Siberian elm and honeylocust. The only suitable evergreens are eastern redcedar and ponderosa pine. Suitable shrubs include white mulberry, Russian-olive, and low-growing varieties of arborvitae. Tree height in 20 years is 30 feet in only a few places. The evergreens can reach a height of 20 to 25 feet. Tree vigor shows a definite decline in 20 years.

WOODLAND GROUP 4

This group consists of very shallow to deep, nearly level to rolling soils. These soils have one or more characteristics which are unfavorable for trees. These characteristics are severe erosion, frequent flooding, shallowness, high sodium content, slow permeability, excessive drainage, and poor drainage.

The soils in this group are not suited to growing trees for windbreaks.

Wildlife [5]

The wildlife population of any area depends upon the availability of food, cover, and water in a suitable combination. Habitats are established, improved, or maintained by planting or farming desirable vegetation and developing water supplies in suitable places.

The suitability of the soils in Jefferson County for elements of wildlife habitat and kinds of wildlife is rated in table 3. The ratings refer only to the suitability of the soils and do not take into account the climate, the present use of the soils, or the distribution of wildlife and human populations. The suitability of individual sites has to be determined by onsite inspection.

The ratings used in table 3 are well suited, suited, poorly suited, and unsuited. *Well suited* means that habi-

[5] Prepared by JEROME SYKORA, biologist, Soil Conservation Service.

tat generally is easily established, improved, or maintained; that the soil has few or no limitations that affect management; and that satisfactory results can be expected. *Suited* means that habitat can be established, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that moderately intensive management and fairly frequent attention may be required for satisfactory results. *Poorly suited* indicates that habitat can be established, improved, or maintained in most places; that the soil has rather severe limitations; that management is difficult and expensive and must be intensive; and that results are not

***Figure 22.*—Sandy Bottomland range site in excellent condition on Crevasse soils.**

Figure 23.—**Sandy Prairie range site in excellent condition on Hardeman fine sandy loam, 0 to 3 percent slopes.**

always satisfactory. *Unsuited* indicates that it is impractical or impossible to establish, improve, or maintain habitat.

Grain and seed crops refers to grain-producing or seed-producing annual plants, such as corn, sorghum, millet, and soybeans.

Grasses and legumes refers to domestic grasses that are established by planting and that furnish food and cover for wildlife. The grasses include weeping lovegrass, johnsongrass, bahiagrass, ryegrass, and panicgrasses. Legumes include clovers, annual lespedezas, and bush lespedezas.

Wild herbaceous upland plants refers to native or introduced perennial grasses, forbs, and weeds that provide food and cover for wildlife on uplands. Examples are beggarweed, perennial lespedezas, wild beans, pokeberry, and cheat.

Hardwood plants refers to nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, or foliage (browse) used extensively as food by wildlife. These plants commonly become established through natural processes, but may be planted. They include oak, cherry, dogwood, viburnum, black locust, sand plum, sumac, Osage-orange, grape, honeysuckle, greenbrier, eleagnus, mulberry, hackberry, grape, fescue, and hickory.

Coniferous plants are cone-bearing trees and shrubs that are used mainly as cover but may furnish food in the form of browse, seeds, or fruitlike cones. They become established through natural processes or may be planted. Included are pines, cedars, and ornamentals.

Wetland food and cover plants are annual and perenial wild herbaceous plants that grow on moist to wet sites, excluding submersed or floating aquatics. These plants furnish food or cover mostly for wetland wildlife. Examples are smartweed, wild millet, spikerush and other rushes, sedges, and bur reed.

Waterfowl impoundments are established by means of low dikes and water-control structures to impound shallow water for habitat suited mainly to waterfowl. They may be designed so that they can be drained, planted, and flooded or they may be used as permanent impoundments to grow submersed aquatics. Both fresh water and brackish water impoundments are considered in the ratings.

Fishponds are sites where water of suitable quality can be impounded primarily for fish production.

Openland wildlife includes cottontail rabbits, fox, quail, doves, meadowlarks, field sparrows, and other

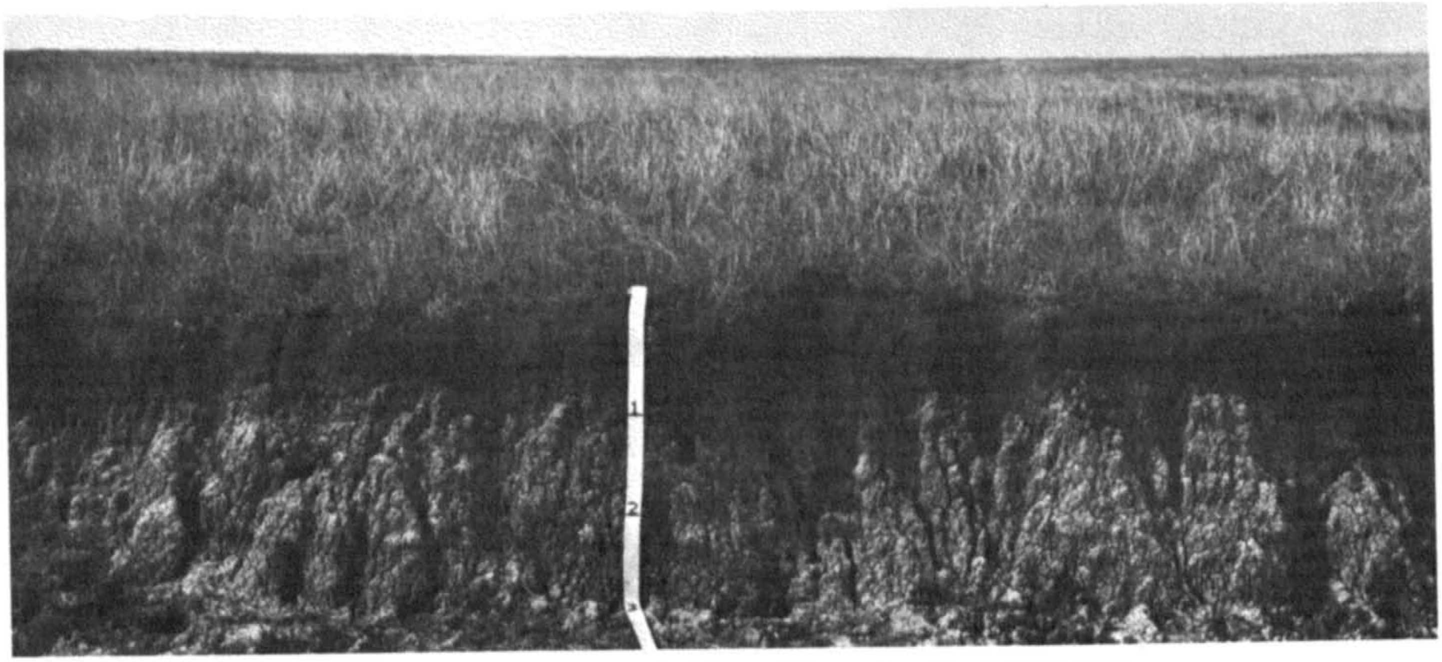

Figure 24.—Slickspot range site in fair condition and profile of Wing loam.

birds and mammals that normally live on cropland, pasture, meadow, lawn, and in other openland areas where grasses, herbs, and shrubby plants grow.

Woodland wildlife includes squirrel, deer, raccoon, wild turkey, woodcock, thrush, vireo, and other birds and mammals that normally live in wooded areas where hardwood trees and shrubs and coniferous trees grow.

Wetland wildlife includes ducks, geese, rail, heron, shore birds, mink, muskrat, and other birds and mammals that normally live in wet areas, marshes, and swamps.

Engineering Uses of the Soils [6]

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

Much of the information in this section is presented in tables 4, 5, and 6. The information in these tables can be used to—

1. Make studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Develop information that can be used in planning drainage systems, farm ponds, irrigation systems, field terraces, and diversion terraces.
3. Make preliminary evaluations that will aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations of the soils at the selected locations.
4. Locate probable sources of gravel and other construction material.
5. Correlate performance of engineering structures with soil mapping units to develop information that can be useful in designing and maintaining such structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from published maps, 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 pertinent to a particular area.

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

The data in table 4 are from actual laboratory tests. The estimates in table 5 and the interpretations in table 6 are based on comparisons of soils with those tested. At many construction sites, major variations in soil characteristics occur within the depth of the proposed excavation, and several kinds of soil occur within short distances. Specific laboratory data on engineering properties of the soil at the site should be obtained before planning detailed engineering work.

[6] Prepared by HARRY A. ELAM, agricultural engineer, and BOB G. DAY, civil engineer, Soil Conservation Service.

TABLE 3.—*Suitability*

Soil series and map symbol	Elements of wildlife habitat			
	Grain and seed crops	Grass and legumes	Wild herbaceous upland plants	Hardwood plants
Bastrop: BaA, BaB, BaC	Well suited	Well suited	Well suited	Well suited
Breaks-Alluvial land complex: Bk	Poorly suited	Suited	Suited	Suited
Bunyan:				
Bn	Well suited	Well suited	Well suited	Well suited
Bu	Poorly suited	Suited	Well suited	Well suited
Chickasha: ChA, ChB	Well suited	Well suited	Well suited	Well suited
Crevasse: Cr	Poorly suited	Poorly suited	Suited	Well suited
Darnell	Poorly suited	Poorly suited	Suited	Suited
Mapped only with Stephenville soils.				
Dougherty: DoB, DoC	Suited	Suited	Well suited	Well suited
Hardeman:				
HaB	Well suited	Well suited	Well suited	Well suited
HaE	Poorly suited	Suited	Suited	Suited
Kirkland:				
KnA	Well suited	Well suited	Suited	Suited
KnB	Well suited	Well suited	Suited	Suited
Lucien	Poorly suited	Poorly suited	Suited	Poorly suited
Mapped only with Zaneis and Vernon soils.				
Minco: MnA, MnB, MnC, MnD	Well suited	Well suited	Well suited	Well suited
Oscar	Poorly suited	Poorly suited	Poorly suited	Poorly suited
Mapped only with Port soils.				
Pond Creek: PcA	Well suited	Well suited	Well suited	Well suited
Port:				
Pm, Po	Well suited	Well suited	Well suited	Well suited
Pp	Poorly suited	Suited	Suited	Well suited
Pulaski: Pu	Well suited	Well suited	Well suited	Well suited
Renfrow:				
ReC2	Suited	Suited	Suited	Suited
RfC3	Poorly suited	Suited	Poorly suited	Poorly suited
Roebuck: Rk, Ro	Poorly suited	Poorly suited	Suited	Suited
Rough broken land: Ru	Unsuited	Poorly suited	Poorly suited	Unsuited
Stephenville:				
SbB, SbC	Well suited	Well suited	Well suited	Well suited
SbC2	Suited	Suited	Suited	Suited
ScC3, SdE	Unsuited	Suited	Suited	Poorly suited
For Darnell part of SdE refer to Darnell series.				
Teller:				
TfA, TfB, TfC, TfD	Well suited	Well suited	Well suited	Well suited
TfC2	Suited	Suited	Suited	Suited
TlD3	Poorly suited	Suited	Suited	Suited
Tivoli: ToC, TrD	Unsuited	Poorly suited	Poorly suited	Poorly suited
Treadway: Ts	Poorly suited	Poorly suited	Poorly suited	Unsuited
Vernon: VsC	Suited	Suited	Suited	Poorly suited
Vernon part of ZvD	Poorly suited	Suited	Suited	Unsuited
Waurika: Wa	Well suited	Well suited	Well suited	Poorly suited
Windthorst: WhC	Suited	Well suited	Well suited	Well suited
Wing	Poorly suited	Suited	Suited	Unsuited
Mapped only with Zaneis soils.				
Yahola: Ya	Well suited	Well suited	Well suited	Well suited
Zaneis:				
ZaB, ZaC, ZvD, ZwB	Well suited	Well suited	Well suited	Well suited
For Lucien and Vernon parts of ZvD refer to Lucien and Vernon series; for Wing part of ZwB refer to Wing series.				
ZaC2	Suited	Suited	Suited	Suited

of the soils for wildlife

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous plants	Wetland food and cover plants	Waterfowl impoundments	Fish-ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Well suited	Unsuited	Poorly suited	Suited	Well suited	Well suited	Unsuited.
Suited	Poorly suited	Poorly suited	Suited	Suited	Suited	Poorly suited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Unsuited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Unsuited	Unsuited	Suited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Unsuited	Suited	Poorly suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Poorly suited	Suited	Unsuited.
Well suited	Unsuited	Unsuited	Poorly suited	Suited	Well suited	Unsuited.
Well suited	Unsuited	Unsuited	Poorly suited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Suited	Suited	Unsuited.
Suited	Unsuited	Poorly suited	Poorly suited	Well suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Suited	Well suited	Suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Unsuited	Suited	Suited	Unsuited.
Well suited	Unsuited	Unsuited	Suited	Well suited	Well suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Well suited	Unsuited	Unsuited	Suited	Well suited	Well suited	Unsuited.
Well suited	Unsuited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Poorly suited	Porrly suited	Poorly suited	Suited	Suited	Poorly suited.
Well suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Suited	Unsuited	Unsuited	Suited	Suited	Suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Poorly suited	Unsuited.
Unsuited	Suited	Suited	Poorly suited	Poorly suited	Suited	Suited.
Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Well suited	Unsuited	Unsuited	Suited	Suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Suited	Suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Well suited	Unsuited	Unsuited	Suited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Unsuited	Suited	Suited	Unsuited.
Unsuited	Unsuited	Unsuited	Poorly suited	Poorly suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Suited	Suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Suited	Suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Poorly suited	Poorly suited	Well suited	Poorly suited	Poorly suited.
Well suited	Unsuited	Unsuited	Suited	Suited	Well suited	Unsuited.
Unsuited	Unsuited	Unsuited	Poorly suited	Suited	Poorly suited	Unsuited.
Well suited	Unsuited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Unsuited	Unsuited	Suited	Well suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Suited	Suited	Unsuited.

Some of the terms used in this publication have a special meaning to soil scientists and a different meaning to engineers. The Glossary defines many such terms as they are used in soil science.

Engineering classification systems

Two systems of classifying soils for engineering purposes are in general use. Classification of the soils of Jefferson County according to both of these systems is given in this survey.

The system used by the American Association of State Highway Officials (AASHO) (*1*) is based on field performance of soils in highways. In this system, soil materials are classified into seven principal groups, designated A–1 through A–7. The best materials for use in highway subgrades (gravelly soils of high bearing capacity) are classified as A–1, the poorest (clayey soils having low strength when wet) are classified A–7. The relative engineering value of the soils within each group is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest.

The Unified system of soil classification was developed by the Waterways Experiment Station, Corps of Engineers (*7*). In this system, soil materials are identified as coarse grained (G or S), fine grained (M or C), and highly organic (O), and symbols are used to identify each group. For example, soils that consist primarily of fine-grained material, either plastic or nonplastic, are identified by the symbols ML or CL if the liquid limit is low and by MH or CH if the liquid limit is high.

The U. S. Department of Agriculture system of classifying soils according to texture is primarily for agricultural use, but the textural classification is useful in engineering also. In this system, soils are classified according to the proportional amounts of different sizes of mineral particles. A soil that is 40 percent clay particles, for example, is called clay. Beginning with the largest, the particle sizes are designated as cobblestones, gravel, sand, silt, and clay. Rarely does a soil consist of particles of only one size, but in many places particles of one size are dominant. Soil texture is a characteristic closely associated with workability, fertility, permeability, erodibility, and other important soil characteristics.

TABLE 4.—*Engineering*

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

Soil name and location	Parent material	Oklahoma Report No.	Depth	Shrinkage		Volume change
				Limit	Ratio	
			In.			
Bastrop loam, 1 to 3 percent slopes: 400 feet W. and 1,850 feet N. of SE. corner, SW ¼ sec. 4, T. 6 S., R. 8 W.	Loamy sediment.	8748	2–8	[4] NP	-------	-------
		8749	12–30	NP	1. 91	33
		8750	38–56	NP	1. 91	37
Kirkland silt loam, 0 to 1 percent slopes: 1,320 feet E. and 1,320 feet S. of NW. corner of sec. 16, T. 5 S., R. 8 W.	Clay and shale.	8753	1–10	16	1. 76	15
		8754	14–26	9	2. 02	67
Minco loam, 0 to 1 percent slopes: 450 feet N. and 800 feet E. of SW. corner NW ¼, sec. 16, T. 7 S., R. 7 W.	Loamy sediment.	8751	6–15	19	1. 71	7
		8752	25–55	18	1. 72	7
Port silty clay loam: 200 feet E. and 550 feet S. of NW. corner of sec. 32, T. 5 S., R. 7. W.	Loamy sediment.	8759	0–14	12	1. 94	47
		8760	14–40	12	1. 94	36
		8761	40–64	14	1. 87	22
Roebuck clay: 400 feet W. and 1,400 feet S. of NE. corner of sec. 27, T. 4 S., R. 8 W.	Clayey and loamy sediment.	8762	1–8	11	2. 00	55
		8763	36–58	10	2. 05	37
Treadway soils: 1,100 feet E. and 200 feet S. of NW. corner of sec. 29, T. 4 S., R. 8 W.	Clayey sediment.	8746	2–8	9	2. 08	41
		8747	12–36	10	2. 07	40
Zaneis loam, 1 to 3 percent slopes: 1,000 feet S. and 300 feet E. of NW. corner of sec. 30, T. 3 S., R. 8 W.	Sandy shale and sandstone.	8764	1–8	15	1. 79	12
		8765	16–40	13	1. 89	44
		8766	44–66	14	1. 84	34

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

Engineering test data

Table 4 gives test data for samples from 7 soil series in the county. Selected layers of the soils were sampled, and the samples were tested by the Oklahoma Department of Highways according to standard procedures. The samples tested were taken from profiles considered modal for the series. They do not represent all of the soils of Jefferson County, or even the maximum range of characteristics of each series sampled.

Volume change is the volume change, expressed as a percentage of the dry volume of the soil mass when the moisture content is reduced from the moisture equivalent to the shrinkage limit. The field moisture equivalent is the minimum moisture content at which a smooth soil surface will absorb no more water within 30 seconds when the water is added in individual drops. This is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soils.

Shrinkage limit is the moisture content, expressed as percent, at which a soil ceases to decrease in volume, even though additional moisture is removed.

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.

Mechanical analyses show the percentages of soil particles that pass through sieves of specified sizes. Sand and other coarser materials do not pass through the No. 200 sieve, but silt and clay do. Silt is material larger than 0.002 millimeter in diameter that passes through the No. 200 sieve, and clay is material smaller than 0.002 millimeter in diameter. The clay fraction was determined by the hydrometer method, rather than the pipette method.

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

test data

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

Mechanical analysis [1]						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—					AASHO [2]	Unified [3]
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.				
						Pct.			
100	91	60	41	12	10	[4] NP	[4] NP	A-4(5)	ML
100	92	66	57	28	27	31	13	A-6(7)	CL
100	92	63	52	29	27	30	13	A-6(7)	CL
100	100	90	79	23	19	28	6	A-4(8)	ML-CL
100	100	93	84	45	41	54	32	A-7-6(19)	CH
100	100	90	78	17	15	24	3	A-4(8)	ML
100	100	91	71	17	15	25	4	A-4(8)	ML
100	100	97	90	50	41	48	24	A-7-6(15)	CL
100	100	90	79	38	32	37	17	A-6(11)	CL
100	100	86	56	15	10	29	11	A-6(8)	CL
100	100	97	91	64	53	54	22	A-7-5(16)	MH
100	99	93	88	50	37	37	20	A-6(12)	CL
100	99	90	84	52	42	36	17	A-6(11)	CL
100	100	98	98	72	53	42	20	A-7-6(12)	CL
100	100	93	43	20	16	25	6	A-4(8)	ML
100	100	71	60	34	32	37	18	A-6(10)	CL
100	100	70	55	27	25	31	14	A-6(9)	CL

[2] Based on AASHO Designation M 145-49. Oklahoma Department of Highways Classification procedure further subdivides the AASHO A-2.4 subgroup according to the plasticity index: A-2-3(0) if nonplastic; A-2(0) if nonplastic to 5; and A-2-4(0) if plasticity is 5 to 10.

[3] Soil Conservation Service and Federal Highway Administration have agreed to consider that all soils having plasticity indexes within 2 points from A-line are to be given a borderline classification. Example: ML-CL.

[4] Nonplastic.

TABLE 5.—*Estimates of soil*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in the first column

Soil series and map symbols	Depth to: Bedrock	Depth to: Seasonal high water table	Depth from surface of typical profile	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches	*Feet*	*Inches*			
Bastrop: BaA, BaB, BaC	>72	>6	0–12	Loam	ML or CL	A–4
			12–72	Clay loam	CL	A–6
Breaks-Alluvial land complex: Bk. No reliable estimates can be made.						
Bunyan: Bn, Bu	>72	>6	0–72	Loam	ML or ML–CL	A–4
Chickasha: ChA, ChB	40–60	>6	0–15	Fine sandy loam	ML or SM	A–4
			15–44	Loam	ML	A–4
			44	Sandstone	Bedrock.	
Crevasse: Cr	>72	>6	0–60	Fine sand	SP–SM or SM	A–3 or A–2
Darnell. Mapped only with Stephenville soils.	4–20	>6	0–17	Fine sandy loam	SM or ML	A–4
			17	Sandstone.		
Dougherty: DoB, DoC	>72	>6	0–28	Loamy fine sand	SM	A–2
			28–40	Sandy clay loam	SC or ML–CL	A–4
			40–50	Fine sandy loam	SM or ML	A–4 or A–2
			50–70	Loamy fine sand	SM	A–2
Hardeman: HaB, HaE	>72	>6	0–72	Fine sandy loam	SM or ML	A–4 or A–2
Kirkland: KnA, KnB	>72	>6	0–12	Silt loam	ML–CL or ML	A–4
			12–70	Clay	CH or CL	A–7
Lucien. Mapped only with Vernon and Zaneis soils.	4–20	>6	0–14	Fine sandy loam	SM, ML, or ML–CL	A–4 or A–2
			14	Sandstone.		
Minco: MnA, MnB, MnC, MnD	>72	>6	0–55	Loam	ML or CL	A–4
			55–72	Silty clay loam	CL	A–4 or A–6
Oscar. Mapped only with Port soils.	>72	>6	0–5	Silt loam	ML or ML–CL	A–4
			5–60	Silty clay loam	CL or ML–CL	A–6
Pond Creek: PcA	>72	>6	0–20	Silt loam	ML or ML–CL	A–4
			20–72	Silty clay loam	ML–CL or CL	A–6
*Port: Pm, Po, Pp. For Oscar part of Po, see Oscar series. For Pulaski part of Pp, see Pulaski series.	>72	>6	0–70	Silty clay loam	CL	A–6 or A–7
Pulaski: Pu	>72	>6	0–71	Fine sandy loam	SM, ML, or ML–CL	A–4 or A–2
Renfrow: ReC2, RfC3	>72	>6	0–4	Silt loam	CL or ML	A–4 or A–6
			4–12	Clay loam	CL or ML–CL	A–6 or A–7
			12–65	Clay	CL or CH	A–7
Roebuck: Rk, Ro	>72	>6	0–40	Clay	CL or MH or CH	A–7 or A–6
			40–72	Clay loam	CL or ML–CL	A–6 or A–7
Rough broken land: Ru. No reliable estimates can be made.						

See footnote at end of table.

properties significant in engineering

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for of this table. Symbol > means greater than; symbol < means less than]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Corrosivity		Shrink-swell potential	Hydrologic soil group
No. 10	No. 40	No. 200				Uncoated steel	Concrete		
			Inches/hour	*Inches/inch of soil*	*pH*				
100	90–100	55–85	0. 63–2. 00	0. 12–0. 16	6. 1–7. 3	Low	Low	Low	B
100	90–100	60–80	0. 63–2. 00	0. 15–0. 19	6. 6–8. 4	Low	Low	Moderate	
100	90–100	55–85	0. 63–2. 00	0. 12–0. 16	7. 9–8. 4	Low	Low	Low	B
100	70–85	40–55	2. 0–6. 30	0. 09–0. 13	5. 6–6. 5	Low	Low to moderate	Low	B
100	85–95	60–75	0. 63–2. 00	0. 12–0. 16	5. 6–6. 5	Low	Low to moderate	Low	
100	85–95	9–30	6. 30–20. 0	0. 04–0. 06	7. 9–8. 4	Very low	Low	Very low	A
100	85–98	40–50	2. 00–6. 30	0. 09–0. 13	5. 1–7. 3	Low	Moderate	Low	C
100	90–98	15–30	6. 3–20. 0	0. 06–0. 09	5. 6–6. 5	Very low	Low to moderate	Low	A
100	96–100	40–60	0. 63–2. 00	0. 12–0. 16	5. 1–6. 5	Low	Low to moderate	Low	
100	85–98	30–60	2. 0–6. 3	0. 09–0. 13	5. 6–6. 0	Low	Low to moderate	Low	
100	90–98	15–30	6. 3–20. 0	0. 06–0. 09	5. 6–6. 0	Very low	Low to moderate	Low	
100	85–98	30–60	2. 00–6. 30	0. 09–0. 13	6. 1–8. 4	Low	Low	Low	B
100	96–100	75–90	0. 63–2. 0	0. 14–0. 18	5. 6–7. 3	Low	Low to moderate	Low	D
100	95–100	90–98	<0. 06	0. 14–0. 18	6. 6–8. 4	High	Low	High	
100	85–98	30–85	2. 0–6. 3	0. 09–0. 13	5. 6–7. 3	Low	Low	Low	C
100	90–100	70–90	0. 63–2. 0	0. 12–0. 16	6. 1–8. 4	Low	Low	Low	B
100	95–100	80–95	0. 63–2. 0	0. 15–0. 19	7. 9–8. 4	Moderate	Low	Moderate	
100	90–100	55–90	0. 63–2. 0	0. 14–0. 18	5. 6–7. 3	High	Low	Low	D
100	97–100	85–95	0. 06–0. 20	0. 15–0. 19	6. 6–8. 4	High	Low	Moderate	
100	96–100	75–90	0. 63–2. 0	0. 14–0. 18	6. 1–7. 3	Low	Low	Low	B
100	95–100	85–95	0. 20–0. 63	0. 15–0. 19	6. 6–8. 4	Moderate	Low	Moderate	
100	97–100	75–98	0. 20–0. 63	0. 15–0. 19	6. 1–8. 4	Moderate	Low	Moderate	B
100	85–100	30–85	2. 00–6. 30	0. 09–0. 13	6. 1–7. 8	Low	Low	Low	B
100	90–100	55–90	0. 63–2. 0	0. 14–0. 18	6. 1–7. 3	Low	Low	Low	D
100	97–100	75–95	0. 20–0. 63	0. 15–0. 19	6. 6–8. 4	Moderate	Low	Moderate	
100	94–100	90–98	<0. 06	0. 14–0. 18	6. 6–8. 4	High	Low	High	
100	94–100	75–98	<0. 06	0. 14–0. 18	7. 4–8. 4	High	Low	High	D
100	95–100	75–95	0. 20–0. 63	0. 15–0. 19	7. 4–8. 4	High	Low	Moderate	

TABLE 5.—*Estimates of soil properties*

Soil series and map symbols	Depth to: Bedrock	Depth to: Seasonal high water table	Depth from surface of typical profile	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches	*Feet*	*Inches*			
*Stephenville: SbB, SbC, SbC2, ScC3, SdE. For Darnell part of SdE, see Darnell series.	20–48	>6	0–9	Fine sandy loam	SM or ML	A–4 or A–2
			9–25	Sandy clay loam	SC or ML–CL	A–4
			25–42	Fine sandy loam	SM or ML	A–4 or A–2
			42–56	Soft to hard sandstone.		
Teller: TfA, TfB, TfC, TfC2, TfD, TlD3	>72	>6	0–12	Fine sandy loam	ML–CL, SM, or ML	A–4 or A–2
			12–24	Clay loam	CL or ML–CL	A–6
			24–72	Fine sandy loam	SM or ML	A–4 or A–2
Tivoli: ToC, TrD	>72	>6	0–5	Loamy fine sand	SM or SP–SM	A–2 or A–3
			5–70	Fine sand	SP–SM or SM	A–3 or A–2
Treadway: Ts	>72	>6	0–8	Clay loam	CL, CH, or ML–CL	A–6 or A–7
			8–60	Clay	CL or CH	A–7
Vernon: VsC	>72	>6	0–70	Clay	CH or CL	A–7 or A–6
Waurika: Wa	>72	0–1	0–13	Silt loam	ML or ML–CL	A–4
			13–25	Clay	CH	A–7
			25–45	Silty clay loam	CL or ML–CL	A–6
			45–72	Clay loam	CL or ML–CL	A–6 or A–7
Windthorst: WhC	40–>60	4–5	0–8	Fine sandy loam	SM or ML	A–4 or A–2
			8–39	Sandy clay	CH or CL or SC	A–6 or A–7
			39–66	Clay	CL or CH	A–6 or A–7
Wing. Mapped only with Zaneis soils.	>72	0–1	0–8	Loam	CL or ML	A–4
			8–68	Clay loam	CL or ML–CL	A–6 or A–7
Yahola: Ya	>72	>6	0–72	Fine sandy loam and loam.	SM or ML	A–2 or A–4
*Zaneis: ZaB, ZaC, ZaC2, ZvD, ZwB. For Lucien part of ZvD, see Lucien series. For Vernon part of ZvD, see Vernon series. For Wing part of ZwB, see Wing series.	40–72	>6	0–10	Loam	ML or CL	A–4
			10–53	Clay loam	CL	A–6

[1] In some areas of this soil, the upper 0 to 9 inches have been removed through erosion.

significant in engineering—Continued

Percentage passing sieve— No. 10	Percentage passing sieve— No. 40	Percentage passing sieve— No. 200	Permeability	Available water capacity	Reaction	Corrosivity: Uncoated steel	Corrosivity: Concrete	Shrink-swell potential	Hydrologic soil group
			Inches/hour	*Inches/inch of soil*	*pH*				
100	85–98	30–60	2. 0–0. 63	0. 09–0. 13	5. 1–6. 5	Low	Moderate	Low	B
100	96–100	40–60	0. 63–2. 0	0. 12–0. 16	5. 1–6. 5	Moderate	Moderate	Low	
100	85–98	30–60	2. 0–6. 3	0. 09–0. 13	5. 1–6. 5	Low	Moderate	Low	
100	85–98	30–85	2. 0–6. 3	0. 09–0. 13	6. 1–7. 3	Low	Low	Low	B
100	97–100	75–95	0. 63–2. 0	0. 15–0. 19	6. 1–7. 3	Low	Low	Low to moderate	
100	85–98	30–60	2. 0–6. 3	0. 09–0. 13	6. 1–7. 3	Low	Low	Low	
100	85–98	9–30	6. 30–20. 0	0. 06–0. 09	7. 4–7. 8	Very low	Low	Low	A
100	85–95	9–20	6. 30–20. 0	0. 04–0. 06	7. 4–8. 4	Very low	Low	Low	
100	95–100	75–98	0. 20–0. 63	0. 15–0. 19	7. 9–8. 4	High	Low	High	D
100	94–100	90–98	<0. 06	0. 14–0. 18	7. 9–8. 4	High	Low	High	
100	95–100	75–98	<0. 06	0. 14–0. 18	7. 9–8. 4	High	Low	High	D
100	96–100	75–90	0. 63–2. 0	0. 14–0. 18	6. 1–7. 3	Low	Low	Low	D
100	94–100	90–98	<0. 06	0. 14–0. 18	6. 6–7. 8	High	Low	High	
100	95–100	85–95	0. 20–0. 63	0. 15–0. 19	7. 9–8. 4	Moderate	Low	High	
100	95–100	75–95	0. 20–0. 63	0. 15–0. 19	7. 9–8. 4	Moderate	Low	Moderate to high	
100	85–98	30–60	0. 20–0. 63	0. 09–0. 13	6. 1–7. 3	Low	Low	Low	C
100	50–70	40–60	0. 20–0. 63	0. 14–0. 18	5. 6–6. 5	Moderate	Low to Moderate	Moderate to high	
100	94–100	90–98	0. 20–0. 63	0. 14–0. 18	5. 6–8. 4	High	Low	Moderate to high	
100	90–100	60–85	0. 63–2. 0	0. 12–0. 16	6. 1–6. 5	Moderate	Low	Low	D
100	97–100	75–95	<0. 06	0. 15–0. 19	7. 9–8. 4	High	Low	Moderate	
100	85–98	30–60	2. 00–6. 30	0. 09–0. 13	7. 9–8. 4	Low	Low	Low	B
100	95–100	80–95	0. 63–2. 0	0. 12–0. 16	5. 6–6. 5	Low	Low to moderate	Low	B
100	95–100	70–95	0. 20–0. 63	0. 15–0. 19	6. 1–7. 8	Moderate	Low	Moderate	

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in

Soil series and map symbol	Suitability as source of—		Features affecting—		
	Topsoil	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Bastrop: BaA, BaB, BaC.	Fair: limited quantity of suitable material.	Fair: moderate traffic-supporting capacity.	Moderate shrink-swell potential; moderate traffic-supporting capacity.	Moderate permeability.	Features generally favorable.
Breaks-Alluvial land complex: Bk.	Variable	Variable	Steep slopes; flooding; rock outcrops.	Variable	Shallow borrow material on abutments.
Bunyan: Bn, Bu	Good	Fair: moderate traffic-supporting capacity.	Subject to flooding.	Moderate permeability; nearly level slopes.	Features favorable.
Chickasha: ChA, ChB.	Good	Fair: limited quantity suitable material; moderate traffic-supporting capacity.	Features favorable.	Depth to bedrock 40 to 60 inches.	Depth to bedrock 40 to 60 inches.
Crevasse: Cr	Poor: high sand content.	Good	Subject to flooding.	Rapid permeability.	Pervious when compacted; poor slope stability.
Darnell Mapped only with Stephenville soils.	Fair: limited quantity of suitable material.	Poor: limited quantity of suitable material.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.
Dougherty: DoB, DoC	Poor: High sand content.	Good	Features favorable	Moderately rapid permeability at depth of 50 inches.	Poor resistance to piping and erosion.
Hardeman: HaB, HaE	Good	Fair to good: moderate traffic-supporting capacity.	Features favorable	Moderately rapid permeability.	Poor resistance to piping and erosion; fair slope stability.
Kirkland: KnA, KnB	Fair: limited quantity of suitable material.	Poor: low traffic-supporting capacity; high shrink-swell potential.	Low traffic-supporting capacity; high shrink-swell potential.	Features favorable.	Fair slope stability.
Lucien Mapped only with Vernon and Zaneis soils.	Fair: limited quantity of suitable material.	Poor: limited quantity of suitable material.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.
Minco: MnA, MnB, MnC, MnD.	Good	Good	Features favorable	Moderate permeability.	Features favorable.

interpretations

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for the first column of this table]

Features affecting—Continued				Limitations for—	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Features generally favorable.	Features generally favorable.	Features generally favorable.	Features generally favorable.	Moderate: moderate permeability.	Slight to moderate: slope; moderate permeability.
Steep slopes; rock outcrops; very narrow alluvial land.	Steep slopes; rock outcrops.	Steep slopes; rock outcrops.	Steep slopes; rock outcrops; alluvial land is flooded.	Severe: slopes of more than 10 percent.	Severe: slope.
Features favorable except flooding.	Nearly level flood plain.	Nearly level flood plain.	Subject to flooding.	Moderate to severe: subject to flooding.	Moderate to severe: subject to flooding.
Features favorable	Features favorable	Features favorable	Features favorable	Moderate: moderate permeability.	Moderate: slope; moderate permeability.
Available water capacity is low; subject to flooding; rapid permeability.	Nearly level to very gently sloping flood plain; rapid permeability.	Nearly level to very gently sloping flood plain; available water capacity is low.	Subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; rapid permeability.
Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Severe: Depth to bedrock 4 to 20 inches.	Severe: Depth to bedrock 4 to 20 inches.
Available water capacity is moderate; moderate permeability.	Susceptible to soil blowing.	Easily eroded	Features favorable	Slight	Severe: moderate permeability.
Slopes to 20 percent; moderately rapid permeability.	Susceptible to soil blowing.	Easily eroded; some slopes to 20 percent.	Features favorable	Slight on mapping unit HaB; severe on mapping unit HaE; slopes of more than 10 percent.	Severe: moderately rapid permeability.
Very slow permeability.	Very slow permeability.	Very slow permeability; droughty; clay at depth of 12 inches.	High shrink-swell potential.	Severe: very slow permeability.	Slight.
Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Depth to bedrock 4 to 20 inches.	Severe: depth to bedrock 4 to 20 inches.	Severe: depth to bedrock 4 to 20 inches.
Features favorable	Features favorable	Features favorable	Features favorable	Slight	Moderate: moderate permeability.

TABLE 6.—*Engineering*

Soil series and map symbol	Suitability as source of—		Features affecting—		
	Topsoil	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Oscar. Mapped only with Port soils.	Fair: limited quantity of suitable material.	Poor: low traffic-supporting capacity; moderate shrink-swell potential.	Subject to flooding; low traffic-supporting capacity.	Subject to flooding; nearly level.	High sodium content; unstable.
Pond Creek: PcA	Good	Fair: moderate traffic-supporting capacity; moderate shrink-swell potential.	Moderate traffic-supporting capacity; moderate shrink-swell potential.	Features favorable.	Features favorable.
*Port: Pm, Po, Pp. For Oscar part of Po, see Oscar series. For Pulaski part of Pp, see Pulaski series.	Fair: high clay content.	Fair: moderate traffic-supporting capacity; moderate shrink-swell potential.	Subject to flooding	Subject to flooding; nearly level.	Features favorable.
Pulaski: Pu	Good	Good	Subject to flooding	Moderately rapid permeability.	Fair slope stability; poor resistance to piping and erosion.
Renfrow: ReC2, RfC3	Fair: limited quantity suitable material.	Poor: high shrink-swell potential; low traffic-supporting capacity.	Low traffic-supporting capacity; high shrink-swell potential.	Features favorable.	Fair slope stability; high compressibility.
Roebuck: Rk, Ro	Poor: high clay content.	Poor: high shrink-swell potential; low traffic-supporting capacity; wetness.	Subject to flooding; high shrink-swell potential; poorly drained.	Subject to flooding; nearly level.	Fair slope stability; high compressibility.
Rough broken land: Ru	Poor: limited quantity of suitable material.	Poor: limited quantity of suitable material.	Slopes of 12 to 30 percent.	Steep slopes; bedrock near surface.	Limited and stony borrow material.
* Stephenville: SbB, SbC, SbC2, ScC3, SdE. For Darnell part of SdE, see Darnell series.	Fair: limited quantity of suitable material.	Fair: moderate traffic-supporting capacity.	Depth to bedrock 20 to 48 inches.	Depth to bedrock 20 to 48 inches.	Borrow material limited to 20 to 48 inches; poor resistance to piping and erosion.
Teller: TfA, TfB, TfC, TfC2, TfD, TlD3.	Fair: limited quantity of suitable material.	Fair: moderate traffic-supporting capacity.	Features favorable	Moderate permeability.	Poor resistance to piping and erosion.
Tivoli: ToC, TrD	Poor: high sand content.	Good	Features favorable	Rapid permeability.	Pervious when compacted; poor slope stability.
Treadway: Ts	Fair: limited quantity of suitable material.	Poor: high shrink-swell potential; low traffic-supporting capacity.	Flooding; low traffic-supporting capacity; high shrink-swell potential.	Subject to flooding; nearly level.	Fair slope stability.

interpretations—Continued

Features affecting—Continued				Limitations for—	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
High sodium content.	Nearly level flood plain; high sodium content.	Nearly level flood plain; high sodium content; droughty.	Subject to flooding.	Severe: slow permeability; subject to flooding.	Severe: subject to flooding; slight if protected from flooding.
Features favorable	Features favorable	Features favorable	Features favorable	Moderate: moderately slow permeability.	Slight.
Features favorable except subject to flooding.	Nearly level flood plain.	Nearly level flood plain.	Subject to flooding	Severe: moderately slow permeability; subject to flooding.	Severe: subject to flooding.
Subject to flooding; moderately rapid permeability.	Nearly level flood plain.	Nearly level flood plain.	Subject to flooding	Severe: subject to flooding.	Severe: moderately rapid permeability; subject to flooding.
Very slow permeability.	Very slow permeability.	Clay at depth of 12 inches; droughty.	High shrink-swell potential.	Severe: very slow permeability.	Moderate: slope.
Subject to flooding; very slow permeability; poorly drained.	Nearly level flood plain; poorly drained.	Nearly level flood plain; very slow permeability.	High shrink-swell potential; subject to flooding; poorly drained.	Severe: very slow permeability; subject to flooding.	Severe: subject to flooding.
Steep slopes; rock outcrop.	Steep slopes; rock outcrop.	Steep slopes; rock outcrop.	Steep slopes; rock outcrop.	Severe: slopes of more than 10 percent.	Severe: slope.
Depth to bedrock 20 to 48 inches.	Features favorable	Features favorable	Features favorable	Moderate to severe: depth to bedrock 20 to 48 inches.	Moderate to severe: depth to bedrock 20 to 48 inches; moderate permeability.
Features favorable	Features favorable	Features favorable	Features favorable	Slight	Moderate to severe: moderate permeability; slope.
Rapid permeability; low available water capacity.	Rapid permeability; hummocky; subject to soil blowing.	Low available water capacity; hummocky.	Low shear strength; poor stability unless confined.	Slight	Severe: rapid permeability.
Very slow permeability; flooding.	Nearly level flood plain; very slow permeability.	Nearly level flood plain; clay at a depth of 8 inches; droughty.	High shrink-swell potential; subject to flooding.	Severe: very slow permeability.	Severe: subject to flooding.

TABLE 6.—*Engineering*

Soil series and map symbol	Suitability as source of—		Features affecting—		
	Topsoil	Road fill	Highway location	Farm ponds	
				Reservoir area	Embankment
Vernon: VsC	Poor: high clay content; low traffic-supporting capacity.	Poor: high shrink-swell potential; low traffic-supporting capacity.	High shrink-swell potential; low traffic-supporting capacity.	Features favorable.	High shrink-swell potential.
Waurika: Wa	Fair: limited quantity of suitable material.	Poor: high shrink-swell potential; wetness; low traffic-supporting capacity.	Low traffic-supporting capacity; high shrink-swell potential.	Nearly level	High shrink-swell potential; fair slope stability.
Windthorst: WhC	Fair: limited quantity of suitable material.	Poor: moderate traffic-supporting capacity; moderate to high shrink-swell potential.	Moderate traffic-supporting capacity; moderate to high shrink-swell potential.	Depth to bedrock 40 to more than 60 inches.	Moderate to high shrink-swell potential; fair slope stability.
Wing. Mapped only with Zaneis soils.	Poor: high sodium content.	Fair: moderate traffic-supporting capacity; moderate shrink-swell potential.	Moderate shrink-swell potential; moderate traffic-supporting capacity.	Features favorable.	High sodium content; poor slope stability.
Yahola: Ya	Good	Good	Subject to flooding	Moderately rapid permeability; subject to flooding.	Pervious when compacted; low resistance to piping and erosion.
*Zaneis: ZaB, ZaC, ZaC2, ZvD, ZwB. For Lucien part of ZvD, see Lucien series. For Vernon part of ZvD, see Vernon series. For Wing part of ZwB, see Wing series.	Fair: limited quantity of suitable material.	Fair: moderate traffic-supporting capacity; moderate shrink-swell potential.	Moderate shrink-swell potential; moderate traffic-supporting capacity.	Depth to bedrock 40 to 72 inches.	Features favorable.

interpretations—Continued

Features affecting—Continued				Limitations for—	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Very slow permeability.	Very slow permeability.	Clay soils; droughty.	High shrink-swell potential.	Severe: very slow permeability.	Moderate to severe: slope.
Very slow permeability; somewhat poorly drained.	Very slow permeability.	Nearly level; somewhat poorly drained.	High shrink-swell potential.	Severe: very slow permeability.	Slight.
Features favorable	Features favorable	Features favorable	Moderate to high shrink-swell potential.	Severe: moderately slow permeability.	Moderate: slope.
High sodium content; very slow permeability.	High sodium content; very slow permeability.	High sodium content; unstable; droughty.	Moderate shrink-swell potential; seasonal water table at depth of 1 foot.	Severe: very slow permeability.	Severe: poor embankment stability.
Moderately rapid permeability; flooding.	Nearly level flood plain.	Nearly level flood plain.	Subject to flooding.	Severe: subject to flooding.	Severe: moderately rapid permeability.
Slopes to 12 percent.	Features favorable	Features favorable	Moderate shrink-swell potential.	Moderate: moderately slow permeability; depth to bedrock 40 to 72 inches.	Slight to severe: slope.

Estimated properties

In table 5, soil properties significant in engineering are estimated. The estimates are based on a modal profile, or a profile typical for the soil series. For the soils in the county that were tested, estimates in table 5 are based on the test data listed in table 4. For the other soils, estimates are based on test data obtained from similar soils in the county and in other counties, and on past experience in engineering. Because the estimates are for typical profiles, variations from the estimates may be considerable.

Permeability, as used in the table, refers only to the downward movement of water through undisturbed soil material. The estimates are based on structure and porosity of the soil as it occurs in place. Such features as plowpans and surface crust were not considered.

Available water capacity, given in terms of inches per inch of soil, is the approximate amount of capillary water in the soil when it is wet to field capacity. When the amount of moisture in the soil is at the wilting point of plants, the amount of water shown in the table will wet the soil material to a depth of 1 inch without further 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. A pH of 7 indicates the soil is neutral in reaction.

Corrosivity is a measure of the corrosive effect of the soil on uncoated steel pipe or concrete buried in the soil, as a result of the electrochemical process of converting iron into its ions. Soil moisture forms solutions with soluble salts in the soil. These solutions become electrolytes. Deterioration of concrete is caused by a chemical reaction between the base (the concrete) and a weak acid (the soil solution). Soil texture, salt content, and moisture content are properties that influence corrosivity.

The shrink-swell potential indicates the change in volume to be expected when the moisture content changes. It is estimated primarily on the basis of the amount and kind of clay in a soil.

For the hydrologic soil group, the entire thickness of the soil profile shown in the table is considered. The soils are classified in four hydrologic groups (A, B, C, and D). The basis of the grouping is intake of water at the end of a long-duration storm after prior wetting and opportunity for swelling, without consideration of the protective effect of vegetation. Group A consists mostly of sandy soils that have the lowest runoff potential. In group B are soils that have moderately low runoff potential, and in group C are soils that have moderately high runoff potential. Group D consists mostly of clays that have the highest runoff potential.

Engineering interpretations

Table 6 gives engineering interpretations of the soils and estimates of their suitability for engineering uses. The data apply to the soil considered representative of the series. A detailed profile typical of each series is described in the section "Descriptions of the Soils." Some soil features are favorable for certain kinds of engineering work but unfavorable for others. Among the soil features for which suitability ratings are given are the following:

Topsoil is the soil material used to cover or resurface an area where vegetation is to be established and maintained. Properties considered are those that affect the productivity and workability of the soil material and the amount of suitable material available.

Road fill or subgrade is the soil material on which a subbase is laid and the pavement is built. Suitability ratings are based on the performance of the soil material as subgrade when excavated and compacted or compacted and used in place.

Highway location refers to trafficways made up of the subgrade of underlying soil material; the base material of gravel; the subbase of crushed rock or soil cement-stabilized soil; and the actual road surface or pavement, either flexible or rigid.

Pond reservoirs are areas behind a dam or embankment where water is collected and stored for use. The floor of the reservoir area is normally undisturbed except where soil material may be borrowed for embankment construction.

Pond embankments are raised structures of soil material constructed across drainageways in order to impound water. These embankments are generally less than 20 feet high, are constructed of more or less homogeneous soil material, and are compacted to medium density.

Irrigation is the application of water to cropland by a sprinkler system or by overland flow.

Terraces are low ridges or channels constructed on the approximate contour to divert runoff water to a safe disposal area.

Waterways are constructed or natural drainageways, on which suitable vegetation is established, that are used to convey excess water.

Foundations for low buildings are footings and shallow piers for houses and other low buildings no higher than three stories.

Septic tank filter fields are the subsurface tile systems that distribute effluent from a septic tank into the natural soil. The properties that affect absorption are permeability, depth to water table or rock, and flooding.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet for the time required for the bacterial decomposition of solids. The lagoon consists of a nearly level floor and an embankment or dike that forms the sides of the pond.

Formation and Classification of the Soils

In this section the five major factors of soil formation are discussed, some of the common processes in horizon development are described, and the soils are classified according to the higher categories of the current system.

Factors of Soil Formation

Soil is the product of five major factors of soil formation: parent material, climate, plant and animal life, relief, and time.

Parent material

Parent material is the unconsolidated material from which soil is formed. It influences the rate of soil formation, the chemical, physical, and mineralogical composition, and the color of the soil.

Some soils on the uplands of Jefferson County formed from material weathered from sandstone, shales, and clays laid down during the Permian geologic period. Kirkland, Renfrow, and Vernon soils are examples of soils that formed from material weathered from shales and clays. Chickasha, Darnell, and Stephenville soils are examples of soils that formed from material weathered from sandstone.

Some soils on the terraces of Jefferson County formed from material weathered from sandy or loamy sediments laid down during the Quaternary geologic period. Bastrop, Minco, and Teller soils are examples of soils that formed from material weathered from loamy sediments.

Alluvial sediments are extensive along the streams and rivers of the county. The kinds of sediments deposited and the kinds of soils that formed in them largely depend on the source of sediments and the velocity of the floodwaters. Port soils formed from the loamy sediments deposited near the streambed when the streams overflowed. Roebuck soils formed from clayey and loamy sediments that were deposited by slow-moving water at the outer edges of the flood plain.

Climate

Jefferson County has a temperate, continental climate of the dry, subhumid type. Rainfall is heaviest in spring. Summers are hot and generally dry, and winters are mild, although severe cold spells sometimes occur. The rainfall is often of high intensity. Strong winds and high temperature make the rate of evaporation high. Consequently, little water moves through the soils, except for the more permeable sandy soils, and the basic elements are not depleted by leaching. The presence of a lime zone in many soils indicates the average depth to which water moves.

Climate is directly or indirectly the cause of many variations in plant and animal life; thus it affects the changes in soils that are brought about by plant and animal life.

Plant and animal life

Plants, burrowing animals, insects, and soil microorganisms have a direct influence on the formation of soils. The native grasses and the trees in the county have had different effects on the losses and gains of organic matter and plant nutrients and on soil structure and porosity. Soils that formed under prairie vegetation, such as those of the Pond Creek series, have a grayish-brown and dark grayish-brown surface layer and a moderately high content of organic matter. Soils that formed under trees, such as those of the Dougherty series, have a grayish-brown and brown surface layer and a light-brown subsurface layer and are low to moderate in content of organic matter.

Relief

Relief has influenced the formation of the soils mainly through its effect on the movement of water, on erosion, on soil temperature, and on the kind of plant cover. In Jefferson County relief is determined largely by the resistance of underlying formations to weathering and geological erosion.

Chickasha and Lucien soils formed in material weathered from similar sandstone, but their development has been controlled to an extent by relief. Chickasha soils, which are deep, are less sloping than Lucien soils, which are very shallow to shallow.

Time

The length of time needed for the development of genetic horizons depends on the intensity and the interactions of the soil-forming factors in promoting the losses, gains, transfers, or transformations of soil constitutents that are necessary for forming soil horizons. Soils that have no distinct genetic horizons are young or immature. Mature or older soils tend to have well-defined horizons.

The soils of Jefferson County range from young to old. Some of the old, mature soils are Kirkland, Renfrow, and Windthorst soils on the uplands. Chickasha and Stephenville soils are younger, but they have well-defined soil horizons.

Darnell, Lucien, and Vernon soils are young soils. They have had sufficient time to form well-defined soil horizons, but because they are sloping, geological erosion has removed soil material as fast, or almost as fast, as it has formed. Pulaski and Yahola soils are on flood plains and have been developing for such a short time that they show little horizon development.

Processes of Horizon Development

Several processes were involved in the formation of the soils of this county. These processes are the accumulation of organic matter, the leaching of calcium carbonates and bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. The results of these processes are not evident to the same degree in all the soils of the county.

Most of the older soils in the county have three major horizons. Some of the properties in which the major horizons differ are color, texture, structure, consistence, reaction, organic-matter content, and thickness. Subdivisions within the major horizons are based on minor differences.

The A horizon is the surface layer. The A1 horizon is a part of the surface layer in which there is an accumulation of organic matter. The A2 horizon is a part that is lighter colored and strongly leached of bases. Some of the soils of this county, such as those of the Dougherty series, have both A1 and A2 horizons.

The B horizon is the mineral horizon below the A horizon, generally called the subsoil. In the older soils of the county, such as those of the Kirkland series, this is the horizon of maximum accumulation of silicate clay. The younger soils of the county, such as those of the Yahola series, do not have a B horizon.

The C horizon is the weathered rock material. It has been little affected by soil-forming processes but may have been modified by reduction of iron or accumulation of calcium carbonates.

The R layer is the consolidated bedrock.

Classification of Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*4*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*3*) and adopted in 1965 (*6*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 7 shows the classification of each soil series of Jefferson County by family, subgroup, and order, according to 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 groups. The two exceptions, Entisols and Histosols, are in many different climates.

Table 7 lists the five soil orders represented in Jefferson County. These are the Entisols, Inceptisols, Aridisols, Mollisols, and Alfisols.

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 suborder narrows the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging, or soil differences resulting from the climate or vegetation.

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or

TABLE 7.—*Classification of soil series in Jefferson County, Okla.*

Series	Family	Subgroup	Order
Bastrop	Fine-loamy, mixed, thermic	Udic Paleustalfs	Alfisols.
Bunyan [1]	Fine-loamy, mixed, nonacid, thermic	Typic Udifluvents	Entisols.
Chickasha	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollislos.
Crevasse [2]	Mixed, thermic	Typic Udipsamments	Entisols.
Darnell	Loamy, siliceous, thermic, shallow	Udic Ustochrepts	Inceptisols.
Dougherty	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Hardeman [3]	Coarse-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Kirkland	Fine, mixed, thermic	Abruptic Pachic Paleustolls	Mollisols.
Lucien	Loamy, mixed, thermic, shallow	Udic Haplustolls	Mollisols.
Minco	Coarse-silty, mixed, thermic	Udic Haplustolls	Mollisols.
Oscar	Fine-silty, mixed, thermic	Typic Natrustalfs	Alfisols.
Pond Creek	Fine-silty, mixed, thermic	Pachic Argiustolls	Mollisols.
Port [4]	Fine-silty, mixed, thermic	Cumulic Haplustolls	Mollisols.
Pulaski	Coarse-loamy, mixed, nonacid, thermic	Typic Ustifluvents	Entisols.
Renfrow	Fine, mixed, thermic	Udertic Paleustolls	Mollisols.
Roebuck	Fine, montmorillonitic, thermic	Vertic Hapludolls	Mollisols.
Stephenville	Fine-loamy, siliceous, thermic	Ultic Haplustalfs	Alfisols.
Teller	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.
Treadway	Fine, mixed, thermic	Ustertic Camborthids	Aridisols.
Vernon	Fine, mixed, thermic	Typic Ustochrepts	Inceptisols.
Waurika	Fine, montmorillonitic, thermic	Aeric Argialbolls	Mollisols.
Windthorst	Fine, mixed, thermic	Ultic Paleustalfs	Alfisols.
Wing	Fine, mixed, thermic	Aquic Natrustalfs	Alfisols.
Yahola	Coarse-loamy, mixed, calcareous, thermic	Typic Ustifluvents	Entisols
Zaneis	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols.

[1] These soils are redder throughout than is typical for the Bunyan series. They are enough like the Bunyan series in morphology, composition, and behavior so that a new series is not warranted.

[2] These soils are redder throughout than is typical for the Crevasse series. They are enough like the Crevasse series in morphology, composition, and behavior so that a new series is not warranted.

[3] These soils are taxadjuncts to the Hardeman series. They differ in being deeper, more than 24 inches, to calcareous material than is typical for the Hardeman series. They are enough like the Hardeman series in morphology, composition, and behavior so that a new series is not warranted.

[4] These soils are taxadjuncts to the Port series. They differ in being noncalcareous to a depth of more than 60 inches. They are enough like the Port series in morphology, composition, and behavior so that a new series is not warranted.

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 clay, 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 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 Typic Udifluvents (typical Udifluvents).

FAMILY: Families are established within the 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.

SERIES: The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

General Nature of the County

This section describes the geology, drainage and water supply, and climate of Jefferson County.

Geology [7]

Jefferson County lies within the Central Redbeds Plains, characterized by red shale and sandstone. In about 60 square miles near the Red River is terrace sand and gravel and narrow areas of river alluvium.

All bedrock exposed in the county is Permian in age. The lowest is the Wichita Formation of Early Permian age. It is red-bed shale that has lenses of sandstone in places. Above this is cross-bedded bituminous lenticular sandstone, which is radioactive in places.

The higher red beds are Garber Sandstone. This is sandstone that has tongues of red shale.

Near the Red River are terrace deposits of Nebraskan, Kansan, and Wisconsin age. Later deposits are dune sand and river alluvium.

Drainage and Water Supply

Jefferson County is an eroded plain, a large part of which is dissected by drainageways. There are two nearly level to sloping terraces along the Red River in the southwestern and south-central parts of the county. Narrow ridges occupy the divides between the drainageways and flood plains. They are adjacent to the larger streams of the county. Drainage generally is south toward the Red River. The area is drained from the west to the east by laterals to Red River, Beaver Creek, Cow Creek, and Mud Creek and their several tributaries. There is an area of nearly level to rolling sandy upland soils generally east of Terral. There are small areas of broken land throughout the county. Some small timbered areas are south of Waurika and east of Terral. A large rolling area of timberland is in the Ringling area on the eastern boundary of the county. There are some steep escarpments along the Red River.

Supplies of water for domestic use are generally good throughout the county. Most wells produce suitable drinking water. There are some areas where water is difficult to locate, and some small areas produce salt water.

Water for livestock is obtained from wells, streams, and ponds. The major source of water is ponds.

Irrigation is limited to small areas along the Red River. The water is obtained from wells that are usually of good quality but limited in productivity.

Climate [8]

Jefferson County has a temperate, continental climate of the dry, subhumid type. Weather patterns influencing this area are substained by the alternate movement of warm, moist air masses from the Gulf of Mexico and cool, modified marine air masses from the west or the cold, dry air masses from the north. Changes in air mass often occur quite rapidly and are characterized by distinct fluctuations of temperature, humidity, cloudiness, wind, and precipitation.

Changes between seasons are generally gradual, and distinct seasonal characteristics vary in severity from year to year. Winters are mild. Cold spells normally last only 2 to 5 days before the return of sunny skies and warm, southerly winds. Spring, the most variable season, has both the heaviest rainfall and the greatest number of severe local storms and tornadoes. Summers are long and quite warm, and rain falls generally in heavy localized storms or as light ineffective showers towards the end of summer. The discomforting effects of hot spells are quite often eased by the prevalence of a good southerly breeze and low humidity, which on the other hand, tend to accelerate the loss of valuable soil moisture. An increase in general rainfall early in fall is timely for the establishment of fall grains and pastures, and the many pleasant, sunny days and cool nights are favorable for completing the fall harvest.

Jefferson County has a mean annual temperature of about 64° F., as indicated by 55 years of record. Mean monthly temperature ranges from about 43° in January to 84° in August. Extreme temperatures at Waurika have varied from 116° on August 6, 1964, to −10° on January 4, 1947. Freezing temperatures occur on an average of 73 days between October and April. Daily highs are below freezing on only three of these days. Minimum temperatures of 0° or below occur about once in 7 years. Data from Waurika indicate an average annual total of

[7] Prepared by CARL C. BRANSON, Director, Oklahoma Geological Survey.

[8] Prepared by S. HOLBROOK, State climatologist for Oklahoma, National Weather Service, U.S. Department of Commerce.

2,823 degree-days with monthly figures varying from none for June through September to a maximum of 704 during January. Table 8 shows December and January as the cold months and July and August as the warm months. Temperatures of 90° or more occur on an average of 123 days between March and October. Temperatures of 100° or more can be expected on an average of 43 days from May through October; the number of days has varied from none in 1950 to 69 days in 1963. In the summer of 1964, temperatures of 100° or more occurred on 65 days, 25 of them consecutive.

Annual precipitation in Jefferson County averages about 30 inches. Records during the 1910 to 1964 period indicate a normal of 30.76 inches at Waurika. Monthly precipitation shown in table 8 indicates a seasonal distribution favorable for crop growth and maturity. About 31 percent of the total occurs in spring, 28 percent in summer, 26 percent in fall, and 15 percent in winter. The effectiveness of this distribution is determined largely by the annual variations in precipitation. Based on 55 years of record at Waurika, annual precipitation ranged from 16.69 inches in 1924 to 52.73 inches in 1941. Other dry years when precipitation was less than 20 inches are 1910 and 1952. More than 40 inches of precipitation fell in 1915, 1920, 1926, 1940, 1941, and 1957.

Normally more than 15 percent of the annual precipitation occurs in May, the wettest month. Precipitation in May has varied from 0.41 inch in 1927 to 12.97 inches in 1957. The greatest monthly total of 15.45 inches fell in October 1941. January, having only 4.5 percent of the normal precipitation, is the driest month, even though Waurika received about 4.54 inches in January 1949. Since 1910, there have been only 5 months when no measurable precipitation was recorded in Waurika. Heavy 24-hour rains of 2 inches and more have occurred in all months, while 24-hour rains of 3 to 4 inches have occurred in all months except January and March. A record of 7.57 inches of rain fell at Waurika within a 24-hour period in September 1925. Such heavy rains cause farmers loss of time, seed, and crops, as well as damage resulting from the erosion and siltation of susceptible land. The worth of proper land management and water conservation practices is well proven during these years of excessive or subnormal rainfall.

Seasonal snowfall averages 4.2 inches at Waurika as indicated by the 54 winters since 1910. While snow is not a major source of moisture in winter, snow falls several times each season. The greatest seasonal snowfall was 14 inches in the winter of 1920–21, and the greatest monthly snowfall was 8 inches in January 1921 and February 1956. Snow remains on the ground no more than a few days, so that it is more of a nuisance than a hazard.

Windspeeds across Jefferson County during the year average about 12 miles per hour and range from an average of 14 miles per hour during March and April to an average of 10 miles per hour during August and September. The prevailing wind direction during the year is southerly, except during January and February when winds are northerly. Strong winds of 30 to 50 miles per hour are fairly common and are associated with the passage of violent squalls. Stronger local winds gusting up to 80 miles per hour occur occasionally during severe thunderstorms, which are most common from April through June. Tornadoes have occurred in most parts of the county. Since 1875 there have been 10 tornadoes in months from March through August, and 4 occurred in the month of June. Most of the tornadoes damaged property and caused 5 deaths and 13 injuries.

TABLE 8.—*Temperature and precipitation data*

[All data from Waurika; period of record 1910–64]

Month	Temperature				Precipitation				
	Average daily maximum [1]	Average daily minimum [1]	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	° F.	° F.	° F.	° F.	Inches	Inches	Inches		Inches
January	54	30	73	11	1.39	0.2	3.2	2	1.8
February	59	34	76	19	1.52	.2	3.6	2	1.2
March	68	41	84	23	1.87	.3	3.9	(2)	.7
April	76	50	91	36	2.91	1.0	7.0	(2)	.1
May	83	59	96	47	4.66	1.5	9.0	0	----------
June	91	68	101	59	3.53	.6	7.3	0	----------
July	96	71	106	65	2.72	.4	5.7	0	----------
August	97	70	109	61	2.46	.1	6.4	0	----------
September	90	63	102	50	2.90	.2	6.0	0	----------
October	79	52	93	37	3.04	.1	7.5	0	----------
November	66	40	82	24	1.94	.2	4.4	(2)	.2
December	55	32	73	18	1.82	.2	4.5	1	.6
Year	76	51	[3] 107	[4] 7	30.76	21.0	42.2	5	.8

[1] Based on 42 years of record through 1952.
[2] Less than half a day.
[3] Average annual highest temperature.
[4] Average annual lowest temperature.

Since 1923, 22 hailstorms have been recorded in some part of the county. About 37 percent of these storms produced hailstones that averaged between 1½ and 2½ inches in diameter. The largest stones of 3¾ inches in diameter fell at Waurika on April 28, 1956. Nearly 60 percent of these storms damaged crops and property. Each year about 85 percent of these hailstorms occur by the end of June and can cause total loss of such crops as small grain. Cotton, sorghum, and other crops can be replanted in June and still mature under normal growing conditions.

Occasionally summer drought and parching winds also damage crops. Hot, dry winds and high temperatures evaporate moisture needed in summer. Average annual lake evaporation is 61 inches, and 69 percent of this evaporates during the growing season from May to October. The smaller amounts of moisture received during July and August are often removed by high temperatures and hot, dry winds, which may damage some summer-growing crops beyond recovery.

The occurrence of freezing temperatures late in spring and early in fall should be considered in farm and commercial planning, but this usually is not a serious problem. The dates of freezing temperatures shown in table 9 indicate an average freeze-free period of 218 days for Jefferson County. The growing season is generally adequate to permit crop maturity, unless heavy rain or hailstorms require late replantings. The latest date in spring when a temperature of 32° or less was recorded at Waurika was April 15 in 1910; the earliest date in fall was October 8 in 1924 and again in 1952.

The climate of Jefferson County is generally favorable for farm operations. Unfavorable variations of temperature, precipitation, and wind may be offset by good soil and water conservation management and recommended agricultural practices, except in the case of prolonged severe drought.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

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

Association, soil. A group of soils geographically associated in a characteristic repeating pattern.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Chiseling. Tillage of soil with an implement having one or more soil penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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

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

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

[All data from Waurika; period of record, 1921–50]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10 later than	March 1	March 12	March 24	April 6	April 15
2 years in 10 later than	February 21	March 4	March 17	March 31	April 11
5 years in 10 later than	February 4	February 17	March 3	March 19	April 1
Fall:					
1 year in 10 earlier than	November 30	November 19	November 15	November 1	October 21
2 years in 10 earlier than	December 7	November 28	November 21	November 7	October 26
5 years in 10 earlier than	December 20	December 14	December 5	November 18	November 9

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizons above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

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

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Concretions. Grains, 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 when dry or moist; does not hold together in a mass.

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

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

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

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

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

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

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

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately benath the solum. They have uniform color in the A horizon and in the upper part of the B horizon and have mottling in the lower part of the B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age or landform.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

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 therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

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

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

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

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Mottling, soil. Irregular marking with 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.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

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

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH Value. A numerical means for designating relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value acidity.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	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

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 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.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Slickspots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

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

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging in size between specified limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter; *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into mass of unaggregated primary soil particles. The principal compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal 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 clay pans and hardpans).

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

Substratum. Technically the part of the soil below the solum.

Surface soil. 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 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, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

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

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

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