SOIL SURVEY OF

# Pontotoc County, Oklahoma

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

Issued April 1973

**Major fieldwork for this soil survey was done in the period 1960–1966. 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 Pontotoc 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 Pontotoc 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 range site and woodland group 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 discussions of the range sites and woodland groups.

*Foresters and others* can refer to the section "Use of the Soils for 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 "Use of the Soils for Wildlife Habitat."

*Ranchers and others* can find under "Use of the Soils for 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.

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

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

**Cover: Improved varieties of bermudagrass yield more forage than common varieties on Konawa fine sandy loam.**

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Issued April 1973

# SOIL SURVEY OF PONTOTOC COUNTY, OKLAHOMA

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

PONTOTOC COUNTY, in the south-central part of Oklahoma (fig. 1), has an area of 460,160 acres. The Canadian River forms the northern boundary. The county seat is Ada, which has a population of about 15,000.

The county is largely rural, and raising beef cattle is the chief enterprise. Oil and gas production, as well as manufacturing, contribute much to the economy.

The soils of Pontotoc County are about equally divided between those formed under woodland and those formed under grasses. About one-third of the total acreage is sloping to steep soils on uplands. These soils have a shallow to moderately deep rooting zone. They are mostly well drained, deep, and fertile. A sizable acreage is severely eroded. Large fields suitable for crop production are mostly along the creeks and rivers.

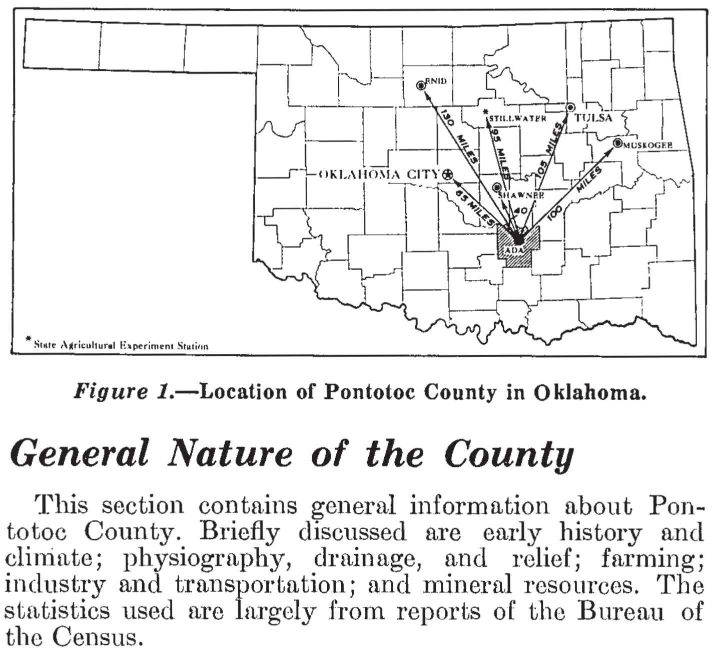


***Figure 1.*—Location of Pontotoc County in Oklahoma.**

## *General Nature of the County*

This section contains general information about Pontotoc County. Briefly discussed are early history and climate; physiography, drainage, and relief; farming; industry and transportation; and mineral resources. The statistics used are largely from reports of the Bureau of the Census.

Pontotoc County was formed out of the Chickasaw Nation of Indian Territory. Early settlers, other than the Indian tribes, migrated into the county in the latter part of the 19th century. Most of the first settlers came from across the Red River in Texas and established small subsistence-type farms.

In 1960 Pontotoc County had a population of 39,792. Ada, the county seat, is the only city. Other towns are Stonewall, Allen, Fittstown, Roff, and Francis. In the early 1960's the Robert S. Kerr Water Research Center was established south of Ada and designed as a regional laboratory serving several states in connection with water pollution problems.

### Climate [1]

The temperate, continental climate of Pontotoc County is characteristic of conditions prevailing in the southern part of the Sandstone Hills region in south-central Oklahoma. The gradual transitions between seasons are occasionally marked by rapid changes in the weather. Spring has the most changeable conditions and provides the greatest number of severe local storms and the heaviest rains. Long, hot summers are eased by occasional rains and moderate winds; the cooling trend in fall is accompanied by heavy September rains and an increasing number of sunny days. Generally short, mild winters provide brief periods of low temperature and snow cover. Table 1 summarizes the records of temperature and precipitation at Ada.

January, the coldest month, has average temperatures below freezing only 1 year in 30. The record low temperature of −10° F. occurred on January 18, 1930. The mildest winter on record was in 1931, when the lowest recorded temperature was 20°. Summer temperatures reach 90° and above on 84 days per year, but only 17 days per year average 100° and above. In 1 out of 10 years the temperature fails to reach 100° in summer.

Table 2 gives probabilities, by specified dates, for the last freezing temperature in spring and the first freezing temperature in fall. The rolling terrain provides many cold air drainage areas and frost pockets where first freezes in fall can occur a few days earlier and the last freezes in spring can occur a few days later. First fall freezes have varied from October 7 in 1952 to November 27 in 1965; the dates of the last spring freezes have varied from March 1 in 1907 to April 25 in 1910. The freeze-free season averages 210 days at the higher elevations of the southwestern part of the county and ranges to about 222 days in the northeastern part.

Precipitation data recorded at Ada shows 17 percent of the moisture received in winter, 33 percent in spring, 27 percent in summer, and 23 percent in fall. Annual precipitation has ranged from as little as 23.51 inches in 1963 to as much as 66.03 inches in 1908. The greatest monthly totals range from 6.82 inches in March 1945 to 16.42 inches in June 1908. Daily totals of 0.5 inch or more occur on an average of 27 days a year, and totals of 1 inch or more occur on 14 days a year. Wet days that have 3 to

[1] By STANLEY G. HOLBROOK, State climatologist.

TABLE 1.—*Temperature and precipitation data*

[All data from Ada. Period of record 1931 to 1960]

| Month | Temperature: Average daily maximum | Temperature: Average daily minimum | Two years in 10 will have at least 4 days with—: Maximum temperature equal to or higher than— | Two years in 10 will have at least 4 days with—: Minimum temperature equal to or lower than— | Precipitation: Average total | One year in 10 will have—: Less than— | One year in 10 will have—: More than— | Days that have snow cover 1 inch or more | Average depth of snow on days that have snow cover |
|---|---|---|---|---|---|---|---|---|---|
| | °F. | °F. | °F. | °F. | *Inches* | *Inches* | *Inches* | *Number* | *Inches* |
| January | 52 | 31 | 70 | 13 | 1.9 | 0.1 | 4.0 | 2 | 2 |
| February | 57 | 35 | 72 | 19 | 2.6 | .3 | 4.9 | 1 | 2 |
| March | 64 | 41 | 81 | 24 | 2.8 | .6 | 5.1 | (1) | 2 |
| April | 74 | 51 | 87 | 36 | 3.8 | 1.2 | 7.9 | 0 | 0 |
| May | 80 | 59 | 90 | 46 | 6.4 | 2.8 | 10.6 | 0 | 0 |
| June | 89 | 68 | 99 | 57 | 4.5 | .8 | 8.3 | 0 | 0 |
| July | 94 | 72 | 103 | 65 | 3.1 | .2 | 7.7 | 0 | 0 |
| August | 95 | 71 | 105 | 62 | 3.1 | .4 | 7.0 | 0 | 0 |
| September | 88 | 63 | 100 | 49 | 3.4 | .2 | 7.7 | 0 | 0 |
| October | 77 | 53 | 91 | 39 | 3.5 | .4 | 7.5 | 0 | 0 |
| November | 63 | 40 | 79 | 24 | 2.4 | .1 | 5.4 | 0 | 0 |
| December | 54 | 34 | 70 | 20 | 2.4 | .5 | 4.2 | 1 | 2 |
| Year | 74 | 52 | (2) 105 | (3) 6 | 39.9 | 25.8 | 49.7 | 4 | 2 |

[1] Less than half a day. [2] Average annual highest maximum. [3] Average annual lowest minimum.

5 inches of rain occur in 6 years out of 10, and four such days occurred in 1957. The wettest day was September 29, 1926, which had 7.80 inches.

Snowfall accounts for only 6 percent of the winter moisture and occurs in four to six storms between November and April. Snow usually melts in a day or so but has stayed on the ground up to 10 days on several occasions. Snowfall averages 5.4 inches per year; the greatest monthly total was 21.2 inches in January 1949. The greatest daily snowfall was 12 inches on January 8, 1944.

The percentage of possible sunshine received ranges from 58 percent in January to 77 percent in August. An average year has 142 clear days, 93 partly cloudy days, and 130 cloudy days. The annual lake evaporation averages 55 inches, and 70 percent of this total occurs from May to October.

Thunderstorms average 52 per year, and some of these produce damaging surface winds of 60 to 80 m.p.h. Severe hailstorms strike the county in about 1 year out of 3 and cause damage of more than $50,000 in half of these storms. Only 16 tornadoes have been observed in the county in 11 different years during the past 93 years of record. Only four of the tornadoes have resulted in deaths, injuries, and property damage of more than $40,000.

## Physiography, Drainage, and Relief

Pontotoc County is about equally divided between prairie and woodland soils. On the prairie soils were mostly tall grasses of big bluestem, little bluestem, indiangrass, and switchgrass and a scattering of forbs. On the wooded

TABLE 2.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data from Ada. Period of record 1921 to 1950]

| Probability | 16° F. | 20° F. | 24° F. | 28° F. | 32° F. |
|---|---|---|---|---|---|
| Spring: | | | | | |
| 1 year in 10 later than | March 5 | March 14 | March 26 | April 8 | April 14 |
| 2 years in 10 later than | February 24 | March 6 | March 20 | April 2 | April 9 |
| 5 years in 10 later than | February 7 | February 19 | March 9 | March 21 | March 31 |
| Fall: | | | | | |
| 1 year in 10 earlier than | December 1 | November 11 | November 11 | October 27 | October 21 |
| 2 years in 10 earlier than | December 7 | December 1 | November 17 | November 3 | October 26 |
| 5 years in 10 earlier than | December 20 | December 13 | November 30 | November 17 | November 6 |

soils were blackjack oak, post oak, and a scattering of elm trees. In most places these woodlands had an understory of scattered tall native grasses.

Four major land resource areas (*2*)[2] are represented in this county. The Grand Prairie extends into the county from the south, the Cherokee Prairies from the east, the Cross Timbers from the north, and the Central Rolling Red Prairies from the west.

The northwestern part of Pontotoc County drains into the Canadian River, and the southeastern part drains principally into the Blue River, Clear Boggy Creek, and Muddy Boggy Creek. These streams eventually flow into the Red River, south of Pontotoc County. Ada, the county seat, is at an elevation of 1,050 feet.

The southwestern corner of the county is a very gently sloping to sloping limestone plateau that has numerous outcrops of limestone. Northeast of this plateau, an escarpment, 1 to 3 miles wide, extends from the southeastern corner of the county nearly to the town of Lawrence. The rest of the county is characterized by sandstone and conglomerate ridges that have moderately narrow summits and deep drainageways alternating with broad, nearly level to strongly sloping valleys. Many narrow streams traverse both the sandstone ridges and the shale valleys. The valley areas support mostly tall grasses, and the ridges are largely covered with trees and a patchy understory of grass.

Most of the bottom lands are along the major streams. These are nearly level, and for the most part are well drained. They range from 200 yards to nearly half a mile in width. The very narrow bottom-land areas are frequently flooded by meandering streams. The first bottoms along the Canadian River are as much as half a mile in width. In many places the river channel is adjacent to the uplands.

There are no low or intermediate terraces, but some old alluvial terrace remnants are still present, mostly between Spring Brook Creek and the Canadian River. Erosion has removed some of the old alluvial material from the side slopes so that the soil is much thinner than on the ridgetops where the slope is less. These old alluvial soils are very gently to strongly sloping. Gully erosion has been severe on the stronger slopes of this mantle.

## Farming

Farming in Pontotoc County began with a few early settlers in the latter part of the 19th century. From the beginning there have been a few large ranchers in the county, but until about 1935 small farms made up most of the county. During this time cotton was the major cash crop, and there were just enough other crops to provide feed for the milk cows, a few hogs, and the work stock.

After about 1935, the trend toward larger and fewer farms began. The lay of the land and the kinds of soil did not favor large-scale cropping systems; thus, livestock and livestock products became the logical answer to expansion of operations. This came about as small, uneconomical farms were bought up and placed under a larger livestock operation. During the period 1939 to 1964, crop acreage has decreased to about one-fourth of the 1939 acreage. Although the value of crops sold more than doubled, the value of livestock products sold has increased more than fivefold.

Statistics from the Bureau of the Census indicate a trend toward an increase in cattle production. General farm trends from 1939 to 1964 are shown in the following list.

| | *1939* | *1949* | *1964* |
|---|---|---|---|
| Number of farms | 2, 580 | 1, 863 | 1, 359 |
| Average size of farm (acres) | 131 | 191 | 303 |
| Cropland harvested (acres) | 98, 875 | 45, 599 | 24, 076 |

## Industry and Transportation

Three of the largest industries in Pontotoc County use raw products obtained largely within the county. The industries are a large cement manufacturing company, two meat packing companies, and a brick plant. These are in the city of Ada. A large glass manufacturing company operates in Ada, but its raw materials are shipped in.

Other manufacturers in the county produce finished products. These include a pickup camper plant at Allen, a clothing manufacturer, a small furniture manufacturer, a pre-stressed concrete products manufacturer, and a large feed processor.

These products are transported to wholesalers and retailers by trucks and freight cars over six State highways and four railroads. The county is also served by a network of all-weather feeder roads that are maintained by the county.

## Mineral Resources

Oil and gas production has been largely from the Allen, Fittstown, and Oil Center fields. Oil was first discovered in 1913 west of Allen, and the oil industry reached its peak activity between 1930 and 1940. Present production is somewhat lower but still significant to the economy of the county.

High-grade limestone is abundant in the southern part of the county. It is quarried chiefly for production of cement but is also used for building stone. It has high potential for agricultural lime.

High-quality sand is produced in large quantities near the town of Roff and shipped out for production of glass. Mixtures of sand and gravel are taken from other pits and used in road construction.

Clear water from springs and wells is supplied in abundance by the limestone formations in the area around Fittstown. There are presently about 60 small watershed lakes within the county, and several more are to be built in the near future.

# *How This Survey Was Made*

Soil scientists made this survey to learn what kinds of soil are in Pontotoc 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

[2] Italic numbers in parentheses refer to Literature Cited, page 67.

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 (*6*).

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. Steedman and Fitzhugh, 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 layer and in slope, stoniness, or some other characteristic that affects 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, Konawa fine sandy loam, 0 to 1 percent slopes, is one of several phases within the Konawa 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 at the back of this publication was prepared from 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. Two such kinds of mapping units are shown on the soil map of Pontotoc County: soil complexes 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 area 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. Lula-Talpa complex, 2 to 6 percent slopes, 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 names of the dominant soils, joined by "and." Port and Cleora soils, channeled, is an example.

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

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of 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.

The soil associations in Pontotoc County are discussed in the following pages. The terms for texture used in the descriptive heading for several of the associations apply to the surface layer. For example, in the heading for association 1, the words "sandy and loamy" refer to texture of the surface layer.

### 1. Konawa-Galey-Dougherty association

*Deep, nearly level to sloping, well-drained, sandy and loamy soils that have a loamy subsoil*

This association consists of about 36,800 acres, or 8 percent of the county. Konawa soils make up 56 percent of the association; Galey soils, 19 percent; Dougherty soils, 10 percent; and minor soils the rest. The minor soils are of the Eufaula, Vanoss, Port, and Cleora series.

Konawa soils are deep, sandy and loamy, and well drained. They are nearly level to sloping. Galey soils are deep, sandy, and well drained. They are very gently sloping. Dougherty soils are deep, sandy, and well drained. They are very gently sloping to moderately steep.

This association is used mostly for tame pasture, cultivated crops, range, and woodland. The main crops are peanuts, cotton, grain sorghum, and corn.

These soils can be improved mainly by maintaining soil structure and fertility, and controlling soil blowing and water erosion.

Sizable areas within this association are severely eroded, and numerous gullies cut deep into the subsoil.

### 2. *Port-Verdigris-Cleora association*

*Deep, nearly level to very gently sloping, well drained to moderately well drained, loamy soils*

This association consists of about 59,820 acres, or 13 percent of the county. Most areas are flooded once in 10 years, but some areas are flooded more than once every year. Port soils make up 55 percent of the association; Verdigris soils, 17 percent; Cleora soils, 16 percent; and minor soils make up the rest. Of the minor soils, Arkabutla soils are the most extensive.

Port soils are deep, loamy, and well drained. Verdigris soils are deep, loamy, and moderately well drained. Cleora soils are deep, loamy, and well drained.

Most of this association is cultivated. The main crops are alfalfa, small grains, grain sorghum, cotton, corn, and peanuts. Some areas are used for tame pasture, native range, wildlife, and woodland.

These soils can be improved by maintaining soil structure and fertility, protecting from flood damage, and providing surface drainage.

### 3. *Yahola-Lincoln association*

*Deep, nearly level to very gently sloping, well-drained to somewhat excessively drained, loamy and sandy soils*

This association consists of about 9,240 acres, or 2 percent of the county. The soils of this association are subject to flooding. Yahola soils make up about 37 percent of the association; Lincoln soils, about 30 percent; and minor soils make up the rest. The minor soils are of the Cleora and Port series.

Yahola soils are deep, loamy, and well drained. Lincoln soils are deep, sandy and loamy, and are somewhat excessively drained.

Most areas of Yahola soils are used for cultivated crops and tame pasture. The main crops are alfalfa, grain sorghum, cotton, and corn. The Lincoln soils are used mostly for tame pasture, range, and woodland.

These soils can be improved mainly by maintaining soil structure and fertility and protecting from flood damage.

### 4. *Dennis-Bates-Steedman association*

*Deep and moderately deep, very gently sloping to sloping, loamy soils underlain by shale, sandstone, and clay*

This association (fig. 2) consists of about 50,600 acres, or 11 percent of the county. Dennis soils make up 24

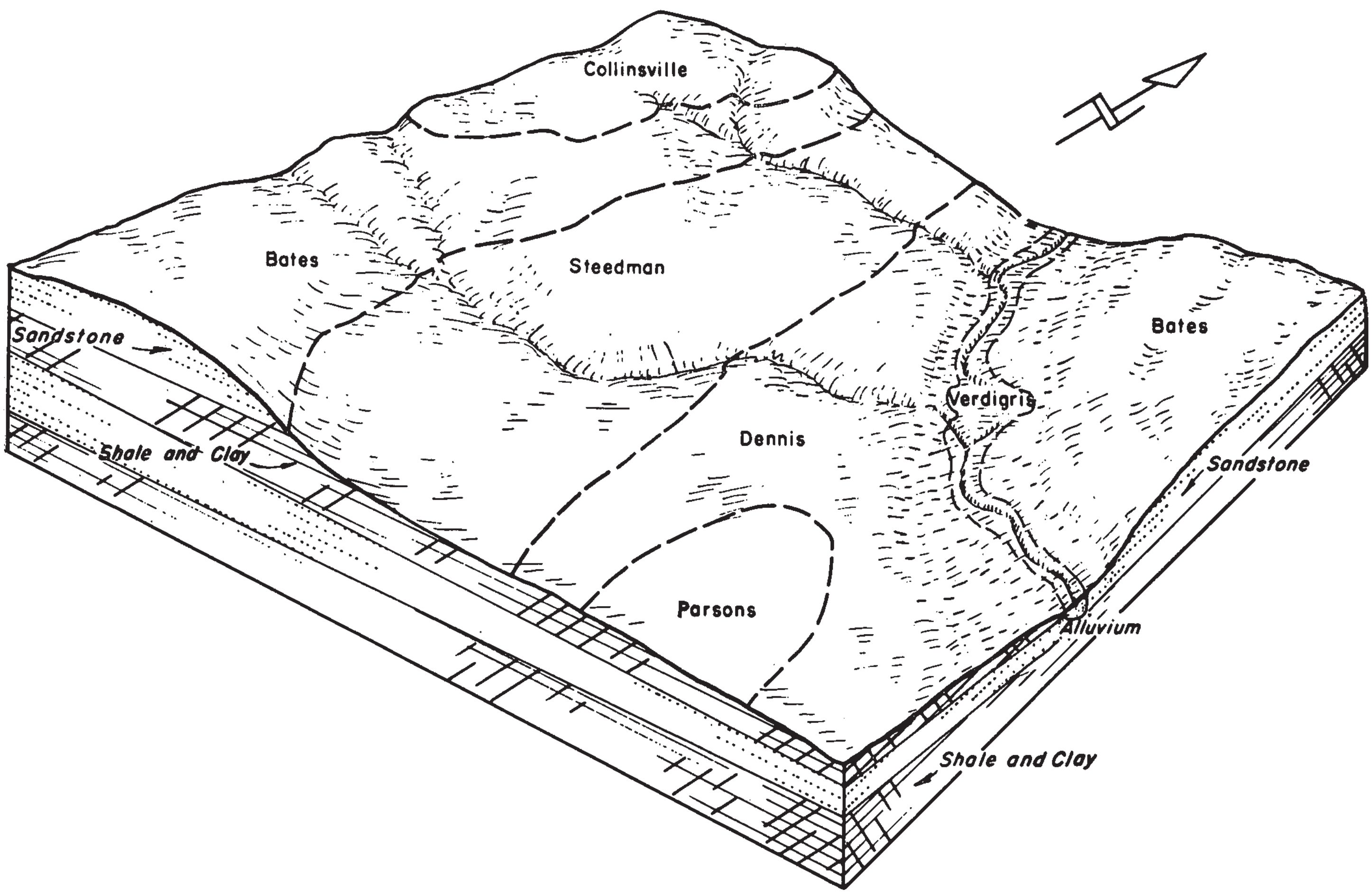


*Figure 2.*—**Pattern of soils in the Dennis-Bates-Steedman association.**

percent of the association; Bates soils, 21 percent; Steedman soils, 20 percent; and minor soils make up the rest. The minor soils are of the Parsons, Dwight, Durant, Verdigris, Woodson, and Collinsville series.

Dennis soils are deep, loamy, and moderately well drained. Bates and Steedman soils are moderately deep, loamy, and well drained.

Most areas of Dennis and Bates soils are used for small grains, grain sorghum, cotton, and peanuts. The Steedman soils are used mostly for range and tame pasture.

These soils can be improved mainly by controlling water erosion and maintaining soil structure and fertility. Diversified farming is practical in this association.

### 5. *Fitzhugh-Bates association*

*Deep and moderately deep, very gently sloping and gently sloping, well-drained, loamy soils underlain by sandstone*

This association consists of about 18,400 acres, or 4 percent of the county. Fitzhugh soils make up 31 percent of the association, Bates soils make up 24 percent, and minor soils make up the rest. The minor soils are of the Durant, Woodson, and Lula series.

Fitzhugh soils are deep, loamy, and well drained. They are very gently sloping to gently sloping. Bates soils are moderately deep, loamy, and well drained. They are very gently sloping to gently sloping.

This association is suitable for most of the common crops, such as grain sorghum, cotton, corn, peanuts, alfalfa, and small grains. Some areas are used for tame pasture and range.

These soils can be improved mainly by maintenance of soil structure and fertility and protection from erosion.

### 6. *Lula-Talpa-Scullin association*

*Deep to very shallow, very gently sloping to sloping, loamy soils underlain by limestone and chert*

This association (fig. 3) consists of about 69,020 acres, or 15 percent of the county.

Lula soils make up 32 percent of the acreage; Talpa soils, 20 percent; Scullin soils, 10 percent; and minor soils make up the rest. The minor soils are of the Claremore, Durant, Port, and Pickens series. Areas of Rock outcrop are also part of this association.

Lula soils are deep, loamy, and well drained. They are very gently sloping to sloping. Talpa soils are very shallow, loamy, and well drained. They are very gently sloping. Scullin soils are moderately deep, loamy, and well drained. They are very gently sloping to sloping.

Most areas of Lula soils are used for cotton, corn, small grains, grain sorghum, peanuts, and alfalfa. Some soils are used for tame pasture and range. The Scullin and Talpa soils are used mostly for native range.

These soils can be improved mainly by maintaining soil structure and fertility and by proper management of the range. Development of stock watering places is difficult in some places because the underlying limestone,

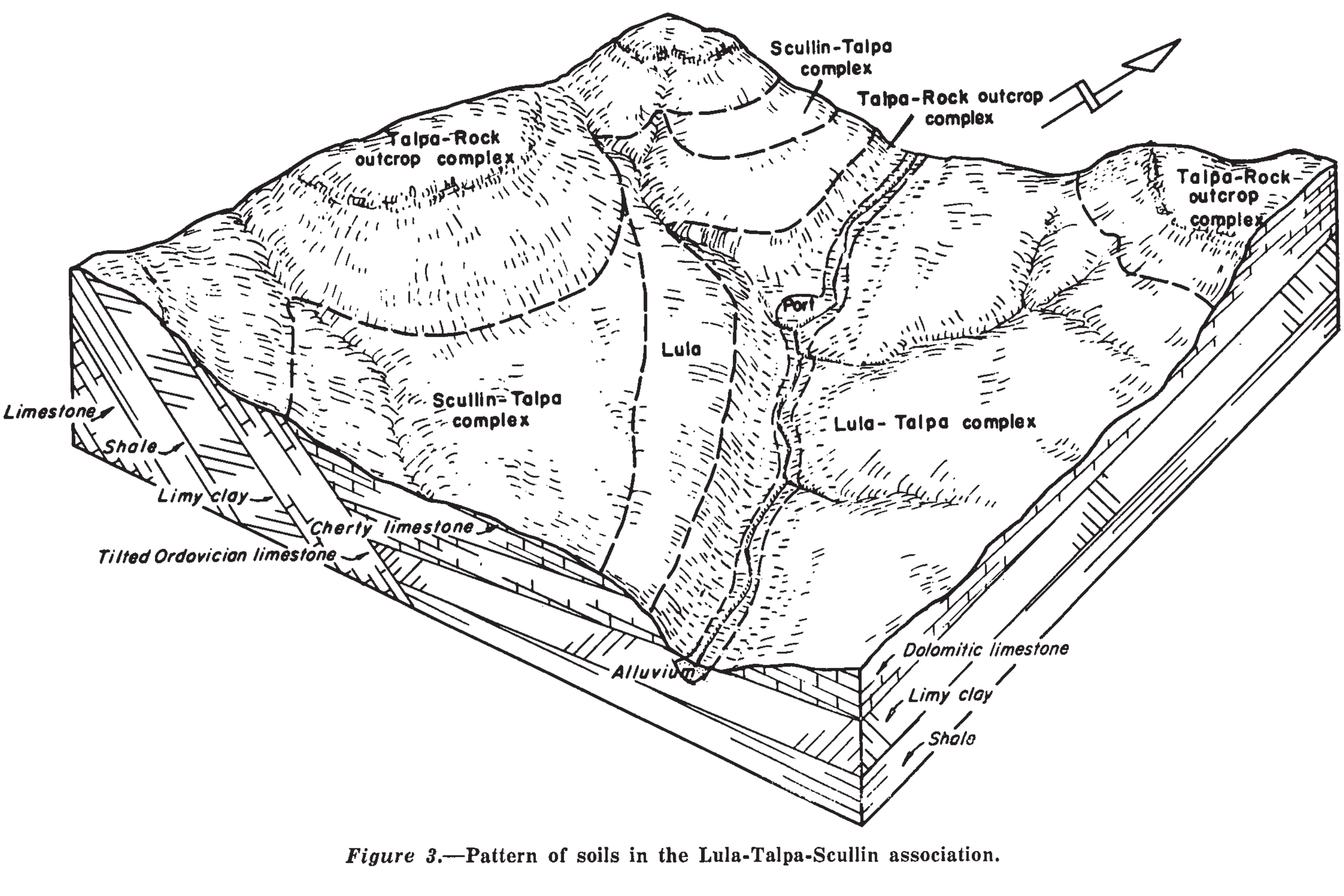


*Figure 3.*—**Pattern of soils in the Lula-Talpa-Scullin association.**

which is normally fractured and near the surface, allows water to escape underground.

### 7. Talpa-Rock outcrop association

*Very shallow, sloping to steep soils that have outcrops of limestone*

This association consists of about 27,610 acres, or 6 percent of the county. Talpa soils make up about 75 percent of the association, and Rock outcrop makes up the rest. Talpa soils are very shallow, loamy, and well drained. They are sloping to steep.

This association is used for native range. These soils can be improved mainly by controlling brush and weeds, which invade if the range is not well managed.

In most places development of stock watering places is difficult because the underlying limestone is near the surface and fractures allow water to escape underground.

### 8. Stephenville-Darnell-Windthorst association

*Deep to shallow, very gently sloping to moderately steep, moderately well drained to somewhat excessively drained, loamy soils that are underlain by sandstone and clay*

This association (fig. 4) consists of about 96,000 acres, or 21 percent of the county. Stephenville soils make up 31 percent of the association; Darnell soils, 22 percent; Windthorst soils, 18 percent; and minor soils make up the rest. These minor soils are of the Verdigris, Port, Cleora, Dennis, Bates, and Steedman series.

Stephenville soils are moderately deep, loamy, and well drained. They are very gently sloping to moderately steep. Darnell soils are shallow, loamy, and well drained to somewhat excessively drained. They are sloping to moderately steep. Windthorst soils are deep, loamy, and moderately well drained. They are very gently sloping to sloping.

The very gently sloping and gently sloping areas of Stephenville and Windthorst soils are suitable for most common crops, such as peanuts, cotton, grain sorghum, and corn. Production of beef cattle is the main enterprise. Stock water is provided by farm ponds and creeks.

These soils can be improved mainly by maintaining soil structure and fertility and controlling erosion.

### 9. Chigley-Windthorst association

*Deep, very gently sloping to strongly sloping, loamy soils that are underlain by conglomerate rock, clay, or sandstone*

This association (fig. 5) consists of about 41,460 acres, or 9 percent of the county.

Chigley soils make up 71 percent of the association, Windthorst soils make up 15 percent, and minor soils

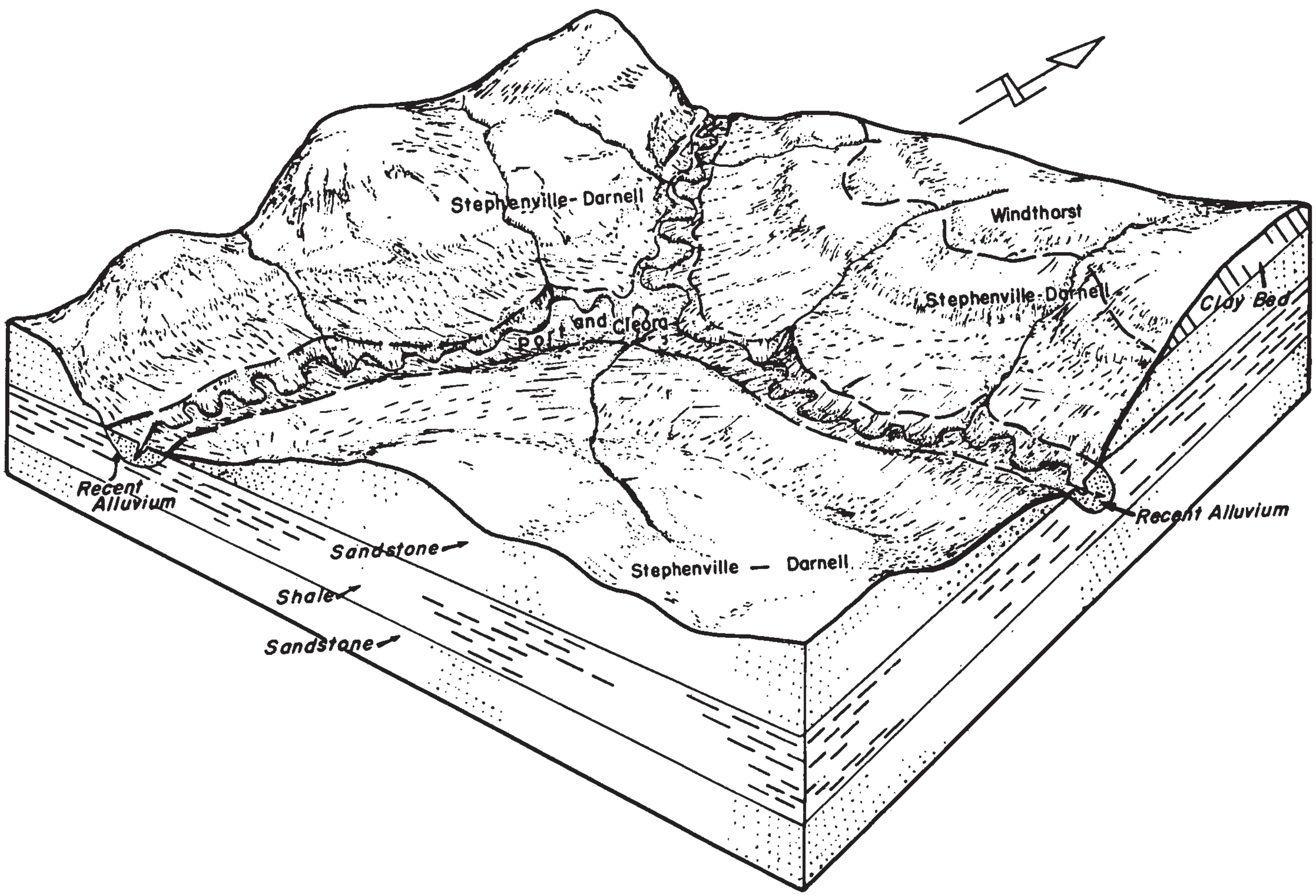


*Figure 4.*—**Pattern of soils in the Stephenville-Darnell-Windthorst association.**

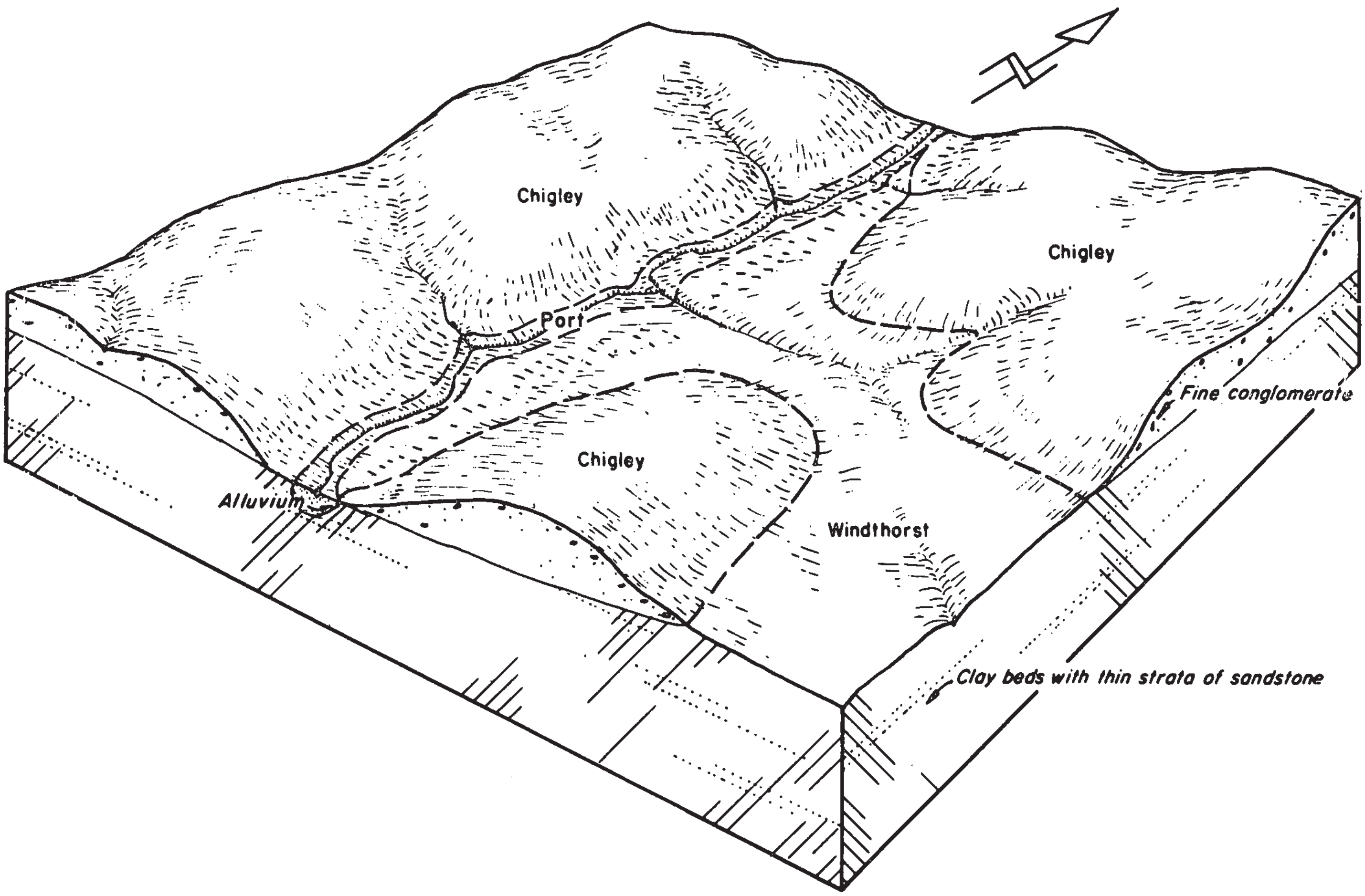


*Figure 5.*—Pattern of soils in the Chigley-Windthorst association.

make up the rest. The minor soils are of the Stephenville, Darnell, and Port series.

Chigley soils are deep gravelly sandy loams and are moderately well drained. They are very gently sloping to strongly sloping. Windthorst soils are deep, loamy, and moderately well drained. They are very gently sloping to sloping.

This association is mainly used for range and tame pasture. Some soils are cultivated; the main crops are peanuts, grain sorghum, and cotton.

These soils can be improved by controlling erosion, maintaining or increasing fertility, and controlling regrowth of brush on pasture and rangeland. Stock watering places can be provided by farm ponds and creeks.

### *10. Durant-Vernon-Clarita association*

*Deep and moderately deep, very gently sloping to strongly sloping, loamy or clayey soils underlain by calcareous clay and shale*

This association consists of about 27,610 acres, or 6 percent of the county. Durant soils make up about 45 percent of the association; Vernon soils, 25 percent; Clarita soils, 18 percent; and minor soils make up the rest. The minor soils are of the Chigley and Port series.

Durant soils are deep, loamy, very slowly permeable, and moderately well drained. They are very gently sloping to sloping. Vernon soils are moderately deep, clayey, slowly permeable, and well drained. They are gently sloping to strongly sloping. Clarita soils are deep, clayey, very slowly permeable, and moderately well drained. They are very gently sloping to gently sloping.

This association is suited to cotton, grain sorghum, and small grains. Some areas are used for tame pasture and range.

These soils can be improved mainly by controlling water erosion, increasing water intake, and maintaining soil structure and fertility. Range and pasture management is needed in most places.

### *11. Heiden-Burleson association*

*Deep, very gently sloping to strongly sloping, clayey soils underlain by calcareous clay and shale*

This association consists of about 23,000 acres, or 5 percent of the county. Heiden soils make up 32 percent of the association, Burleson soils make up 18 percent, and minor soils make up the rest. The minor soils are of the Durant, Woodson, Okemah, and Lula series.

Heiden soils are deep, clayey, very slowly permeable, and well drained. They are gently sloping to strongly sloping. Burleson soils are deep, clayey, very slowly permeable, and moderately well drained. They are very gently sloping.

Except for the steeper areas of Heiden soils, this association is suitable for small grains, grain sorghum, cotton, tame pasture, range, and wild hay. It is used principally for production of beef cattle and wild hay. Farm ponds and creeks supply stock water.

These soils can be improved mainly by controlling water erosion, increasing water intake, and maintaining soil structure. Tillage is difficult.

# Descriptions of the Soils

This section describes the soil series and mapping units in Pontotoc County. The procedure is first to describe each soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which it belongs.

An important part of each series description is the representative profile. This profile is first described briefly in terms familiar to the layman, and then in detail in terms suitable for scientists, engineers, and others who need to make thorough and precise studies of soils. In both descriptions, colors are for a dry soil, unless otherwise indicated.

Mapping units are described in much less detail than soil series because the need is to emphasize mainly how each mapping unit differs from the series, not to repeat the many ways in which it is similar.

As mentioned in "How This Survey Was Made," not all mapping units are members of a soil series. Rock outcrop, for example, does not belong to a series; nevertheless, it is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses, which identifies it on the detailed soil map. Listed at the end of the description of each mapping unit are the capability unit, range site, and woodland suitability group in which the mapping unit has been placed. The page on which the range sites and woodland suitability groups are described 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 3. Many of the terms used in describing soils can be found in the Glossary.

A given soil series in this county may be identified by a different name in a recently published soil survey of an adjacent county. Such differences in name result from refinement in the current system of soil classification. The characteristics of the soil series described in this county are considered to be within the range defined for that series. In those instances where a soil series has one or more features outside the defined range, the differences are explained.

TABLE 3.—*Approximate acreage and proportionate extent of the soils*

| Soil | Acreage | Percent | Soil | Acreage | Percent |
|---|---|---|---|---|---|
| Arkabutla silty clay loam | 2, 041 | 0. 4 | Heiden clay, 3 to 5 percent slopes | 3, 461 | . 8 |
| Bates fine sandy loam, 1 to 3 percent slopes | 5, 161 | 1. 1 | Heiden clay, 5 to 12 percent slopes | 4, 016 | . 9 |
| Bates fine sandy loam, 3 to 5 percent slopes | 5, 185 | 1. 1 | Hilgrave gravelly sandy loam, moderately shallow variant, 1 to 5 percent slopes | 929 | . 2 |
| Bates fine sandy loam, 2 to 5 percent slopes, eroded | 2, 407 | . 5 | Konawa fine sandy loam, 0 to 1 percent slopes | 709 | . 2 |
| Burleson clay, 1 to 3 percent slopes | 4, 195 | . 9 | Konawa fine sandy loam, 1 to 3 percent slopes | 1, 909 | . 4 |
| Chigley gravelly sandy loam, 1 to 5 percent slopes | 8, 314 | 1. 8 | Konawa fine sandy loam, 3 to 5 percent slopes | 909 | . 2 |
| Chigley gravelly sandy loam, 5 to 12 percent slopes | 14, 572 | 3. 2 | Konawa loamy fine sand, 3 to 8 percent slopes | 6, 552 | 1. 4 |
| Chigley soils, 2 to 8 percent slopes, severely eroded | 8, 784 | 1. 9 | Konawa loamy fine sand, 3 to 8 percent slopes, eroded | 6, 120 | 1. 3 |
| Claremore loam, 2 to 5 percent slopes | 4, 862 | 1. 1 | Konawa soils, 3 to 8 percent slopes, severely eroded | 10, 452 | 2. 3 |
| Clarita clay, 2 to 5 percent slopes | 5, 298 | 1. 2 | Lincoln soils | 2, 789 | . 6 |
| Collinsville fine sandy loam, 2 to 5 percent slopes | 1, 636 | . 4 | Lula loam, 1 to 3 percent slopes | 4, 265 | . 9 |
| Darnell-Stephenville fine sandy loams, 5 to 20 percent slopes | 41, 612 | 9. 0 | Lula loam, 3 to 5 percent slopes | 7, 317 | 1. 6 |
| Dennis loam, 1 to 3 percent slopes | 5, 397 | 1. 2 | Lula loam, 2 to 5 percent slopes, eroded | 2, 100 | . 5 |
| Dennis loam, 3 to 5 percent slopes | 2, 844 | . 6 | Lula-Talpa complex, 2 to 6 percent slopes | 19, 505 | 4. 2 |
| Dennis loam, 2 to 5 percent slopes, eroded | 4, 408 | 1. 0 | Okemah silty clay loam, 1 to 3 percent slopes | 1, 862 | . 4 |
| Dougherty loamy fine sand, 1 to 3 percent slopes | 1, 477 | . 3 | Parsons silt loam, 0 to 1 percent slopes | 2, 226 | . 5 |
| Dougherty loamy fine sand, 3 to 8 percent slopes | 1, 798 | . 4 | Parsons silt loam, 1 to 3 percent slopes | 4, 816 | 1. 0 |
| Dougherty-Eufaula loamy fine sands, 8 to 20 percent slopes | 2, 506 | . 5 | Pickens shaly loam, 3 to 15 percent slopes | 2, 165 | . 5 |
| Durant loam, 1 to 3 percent slopes | 11, 347 | 2. 5 | Port silty clay loam | 24, 823 | 5. 4 |
| Durant loam, 3 to 5 percent slopes | 2, 466 | . 5 | Port and Cleora soils, channeled | 25, 907 | 5. 6 |
| Durant loam, 2 to 5 percent slopes, eroded | 5, 376 | 1. 2 | Port and Cleora soils, frequently flooded | 3, 916 | . 9 |
| Durant and Bates soils, 2 to 6 percent slopes, severely eroded | 14, 017 | 3. 0 | Scullin-Talpa complex, 2 to 6 percent slopes | 10, 379 | 2. 3 |
| Dwight silt loam, 0 to 1 percent slopes | 3, 153 | . 7 | Steedman silty clay loam, 3 to 8 percent slopes | 10, 232 | 2. 2 |
| Eufaula loamy fine sand, 0 to 3 percent slopes | 2, 122 | . 5 | Stephenville fine sandy loam, 1 to 3 percent slopes | 1, 355 | . 3 |
| Fitzhugh fine sandy loam, 1 to 3 percent slopes | 1, 502 | . 3 | Stephenville fine sandy loam, 3 to 5 percent slopes | 5, 924 | 1. 3 |
| Fitzhugh fine sandy loam, 3 to 5 percent slopes | 1, 339 | . 3 | Stephenville fine sandy loam, 2 to 5 percent slopes, eroded | 1, 682 | . 4 |
| Fitzhugh fine sandy loam, 3 to 5 percent slopes eroded | 2, 963 | . 6 | Stephenville-Darnell fine sandy loams, 3 to 8 percent slopes | 16, 506 | 3. 6 |
| Galey loamy fine sand, 1 to 3 percent slopes | 7, 035 | 1. 5 | Talpa-Rock outcrop complex, 5 to 30 percent slopes | 38, 532 | 8. 4 |
| | | | Vanoss silt loam, 0 to 1 percent slopes | 1, 051 | . 2 |
| | | | Vanoss silt loam, 1 to 3 percent slopes | 1, 361 | . 3 |
| | | | Verdigris silt loam | 11, 034 | 2. 4 |

TABLE 3.—*Approximate acreage and proportionate extent of the soils*—Continued

| Soil | Acreage | Percent | Soil | Acreage | Percent |
|---|---|---|---|---|---|
| Vernon clay, 3 to 5 percent slopes | 1, 577 | . 3 | Woodson silt loam, 0 to 1 percent slopes | 2, 720 | . 6 |
| Vernon clay, 5 to 12 percent slopes | 6, 827 | 1. 5 | Yahola clay loam | 850 | . 2 |
| Vernon clay, 3 to 8 percent slopes, severely eroded | 2, 527 | . 5 | Yahola fine sandy loam | 2, 593 | . 6 |
| Windthorst fine sandy loam, 2 to 5 percent slopes | 19, 593 | 4. 2 | Land areas | 456, 062 | 99. 1 |
| Windthorst-Stephenville complex, 2 to 6 percent slopes, severely eroded | 10, 754 | 2. 3 | River channel | 3, 600 | . 8 |
| | | | Quarries | 498 | . 1 |
| | | | Total | 460, 160 | 100. 0 |

## Arkabutla Series

The Arkabutla series consists of deep, nearly level, somewhat poorly drained soils on flood plains. These soils formed in loamy alluvium. They are subject to flooding.

In a representative profile the surface layer, to a depth of 12 inches, is light brownish-gray silty clay loam. The upper part of the subsoil, to a depth of 24 inches, is grayish-brown silty clay loam. The lower part, to a depth of 36 inches, is gray silty clay loam that has yellowish-brown mottles. The underlying material is gray silty clay loam that has yellowish-brown mottles.

Arkabutla soils are moderately permeable. The available water capacity is high.

Representative profile of Arkabutla silty clay loam, 2,950 feet east and 1,400 feet north of the southwest corner of sec. 23, T. 4 N., R. 8 E.

Ap—0 to 12 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak, medium, granular structure; very hard, firm; medium acid; clear, wavy boundary.

B21—12 to 24 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; common, medium, faint mottles of dark yellowish brown (10YR 4/4); weak, medium, subangular blocky structure; very hard, very firm; silt coatings are on upper vertical faces; medium acid; gradual, smooth boundary.

B22—24 to 36 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; common, fine, faint mottles of yellowish brown; weak, medium, subangular blocky structure; very hard, very firm; medium acid; gradual, smooth boundary.

C—36 to 72 inches, gray (10YR 5/1) silty clay loam, dark gray (10YR 4/1) moist; many, medium, faint mottles of yellowish brown (10YR 5/4); massive; extremely hard, very firm; slightly acid.

The reaction of these soils is slightly higher than that defined as the range for the series, but this difference does not alter the usefulness and behavior of the soils.

The color of the A horizon ranges from light brownish gray to grayish brown. Reaction of the A horizon is medium acid or slightly acid. When the soil is dry, the color of the B21 horizon is grayish brown or dark grayish brown. Reaction of the B2 horizon ranges from slightly acid to strongly acid. The C horizon is similar to the B22 horizon in color, texture, and reaction.

Arkabutla soils are more poorly drained than the associated Verdigris and Port soils.

**Arkabutla silty clay loam** (Ar).—This soil occurs on flood plains. It is damaged by flooding about once each year and is wet during some period in the spring. Included in mapping were some areas where the surface layer is silt loam or clay loam and some areas where the subsoil is clay. Also included were areas of Verdigris silt loam, which make up about 10 percent of the acreage.

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

Management is needed to control wetness, maintain soil structure, and protect the soil from damaging floods. Surface drains are generally sufficient for controlling wetness. After heavy rains, water often stands on the surface for several days. This soil can be tilled only within a narrow range of moisture content. Crop residue should be returned to the soil to improve soil structure. (Capability unit IIIw-1; Heavy Bottomland range site; woodland suitability group 3)

## Bates Series

The Bates series consists of moderately deep, very gently sloping to sloping, well-drained 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 grayish-brown fine sandy loam about 12 inches thick. The upper part of the subsoil, to a depth of 18 inches, is brown loam. The lower part, to a depth of 36 inches, is yellowish-brown to brownish-yellow loam that has a few strong-brown mottles and iron concretions. The underlying material is sandstone.

Bates soils are moderately permeable. The available water capacity is moderate to high.

Representative profile of Bates fine sandy loam, 1 to 3 percent slopes, in a pasture, 1,975 feet east and 40 feet north of the southwest corner of sec. 30, T. 4 N., R. 8 E.

A1—0 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate to strong, fine, granular structure; slightly hard, friable; medium acid; gradual, smooth boundary.

B1—12 to 18 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate, coarse, granular structure; slightly hard, friable; strongly acid; clear, wavy boundary.

B2t—18 to 32 inches, yellowish-brown (10YR 5/6) loam, dark yellowish brown (10YR 4/6) moist; few, medium, distinct mottles of strong brown (7.5YR 5/8); moderate, medium, subangular blocky structure; hard, firm; clay films on ped faces; strongly acid; gradual, smooth boundary.

B3—32 to 36 inches, brownish-yellow (10YR 6/6) loam, yellowish brown (10YR 5/6) moist; weak, medium and coarse, subangular blocky structure; hard, friable; few iron concretions; medium acid; abrupt, wavy boundary.

R—36 inches +, yellow and brownish-yellow sandstone; hard when dry.

The color of the A horizon is grayish brown to dark brown. Reaction is slightly acid or medium acid. The texture of the B2t horizon is loam, clay loam, and sandy clay loam. The color ranges from light yellowish brown to dark yellowish brown. The reaction is slightly acid to strongly acid. The depth to sandstone is 20 to 40 inches.

Bates soils are not so deep nor so red as the similar Fitzhugh soils. They are not so deep as the similar Vanoss soils, and they have less clay in the B2t horizon than the associated Dennis soils.

**Bates fine sandy loam, 1 to 3 percent slopes** (BaB).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were Dennis loam, which makes up about 10 percent of the acreage; Fitzhugh fine sandy loam, which makes up 5 percent; and a few areas where the surface layer is loam.

This soil is suited to tame pasture, cotton, peanuts, grain sorghum, alfalfa, corn, range, and woodland.

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. Erosion can be controlled by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Sown crops can be grown continuously if fertilizer is applied and other good management practices are followed. Terracing and contour farming are needed if row crops are grown. Excessive tillage should be avoided. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group 3)

**Bates fine sandy loam, 3 to 5 percent slopes** (BaC).—This soil occurs on uplands. Included in mapping were areas of Dennis loam, which make up 10 percent of the acreage; areas of Fitzhugh fine sandy loam, which make up 5 percent; and minor areas of Collinsville fine sandy loam. Also included were small eroded areas and areas where the surface layer is loam.

This soil is suited to corn, peanuts, cotton, soybeans, grain sorghum, tame pasture, range, and woodland. Tame pasture occupies most of the acreage.

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Terracing, contour farming, and the use of crop residue are needed in controlling erosion, in conserving moisture, and in maintaining soil structure. (Capability unit IIIe-1; Loamy Prairie range site; woodland suitability group 3)

**Bates fine sandy loam, 2 to 5 percent slopes, eroded** (BaC2).—This soil is very gently sloping to gently sloping. It is eroded and occurs on uplands. In about 75 percent of the area, part of the original surface layer has been removed through erosion. In about 35 percent of the area, tillage has mixed material from the subsoil with the surface layer. In some of these more eroded areas, crossable gullies are numerous. There are a few gullies in all the eroded areas. Included in mapping were minor areas of Dennis loam and a few areas of Bates soils where the surface layer is loam.

This soil is used largely for tame pasture, but it could be used for peanuts, grain sorghum, cotton, range, and woodland.

Protection of cultivated areas from severe rill and gully erosion is needed. Intensive management, through use of terraces, contour farming, crop residue, and fertilizer, is needed to improve suitability of this soil for cultivation and to encourage growth of crops. Close-growing crops are better suited than row crops. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 3)

## Burleson Series

The Burleson series consists of deep, very gently sloping, moderately well drained soils on uplands. These soils formed in material weathered from calcareous clay and shale under a cover of tall grasses.

In a representative profile the surface layer is very dark gray clay about 14 inches thick. The next layer is dark-gray clay that extends to a depth of 30 inches. Between depths of 30 and 50 inches is grayish-brown clay that contains old cracks filled with dark material similar to the overlying layers. Material at a depth below 50 inches is light olive-brown calcareous clay that has many yellowish-brown mottles.

Permeability is very slow, and the available water capacity is high.

Representative profile of Burleson clay, 1 to 3 percent slopes, 1,470 feet north and 1,470 feet west of the southeast corner of sec. 11, T. 2 N., R. 6 E.

A11—0 to 14 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate, fine and medium, granular structure; hard, firm; medium acid; gradual, smooth boundary.

A12—14 to 30 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, fine and medium, blocky structure; pronounced slickensides in the lower part; extremely hard, very firm; few, fine, iron concretions; moderately alkaline; gradual, wavy boundary.

AC—30 to 50 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak to moderate, medium, blocky structure; common wedge-shape slickensides and parallelepipeds that have the long axis tilted 10 to 60 degrees from horizontal; extremely hard, very firm; few iron-manganese concretions 3 millimeters in size; old cracks are filled with dark-colored material like that of the A1 horizon; few pockets of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

C—50 to 72 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; many, medium and coarse, distinct, yellowish-brown (10YR 5/6) mottles; massive; pronounced slickensides in the upper part of the layer; extremely hard, very firm; few medium-size chert fragments; few small pockets of calcium carbonate; calcareous; moderately alkaline.

The color of the A horizon is very dark gray to gray. Reaction ranges from medium acid to moderately alkaline. The color of the AC horizon ranges from light brownish gray to olive brown. Reaction is mildly alkaline or moderately alkaline, and the horizon ranges from noncalcareous to calcareous. The depth to calcareous clay ranges from 30 to more than 60 inches.

The color of these soils at a depth below 30 inches is outside the defined range for the series, but this difference does not alter the usefulness and behavior of the soils.

Burleson soils are gray to a greater depth than are the associated Heiden and Clarita soils. Burleson soils have a more clayey A horizon than the associated Durant and Woodson soils.

**Burleson clay, 1 to 3 percent slopes** (BuB).—This soil is on uplands. Included in mapping were areas of Woodson silt loam, which make up 10 percent of the acreage, and of Durant loam, which make up 5 percent. Also included were minor areas where the surface layer is silty clay or silty clay loam.

This soil is suitable for cotton, small grains, grain sorghum, alfalfa, tame pasture, range, and woodland.

Management is needed to improve soil structure, reduce crusting, increase water intake, and control water erosion. A cropping system is needed that includes crops that produce large amounts of residue. Return of crop residue to the soil improves soil structure, increases water intake, and limits surface crusting. Tillage is difficult because of the clayey material. It should be timely and kept to a minimum. Large cracks occur at the surface when these soils are dry. Terraces and contour tillage are needed if row crops are grown. Sown crops can be grown continuously if fertilizer is added and other good management practices are followed. (Capability group IIe-2; Black Clay Prairie range site; woodland suitability group 3)

## Chigley Series

The Chigley series consists of deep, very gently sloping to strongly sloping, moderately well drained soils on uplands. These soils formed in material weathered from conglomerate rock. The native vegetation was forest and an understory of grasses.

In a representative profile the surface layer is grayish-brown gravelly sandy loam about 5 inches thick. The subsurface layer, to a depth of 10 inches, is pale-brown gravelly sandy loam. The upper part of the subsoil, to a depth of 24 inches, is red gravelly sandy clay that has many brown mottles. The lower part of the subsoil, to a depth of 60 inches, is red sandy clay loam. Conglomerate rock begins at a depth of 60 inches.

Permeability is slow, and the available water capacity is high.

Representative profile of Chigley gravelly sandy loam, 1 to 5 percent slopes, in a woodland 2,375 feet east and 50 feet north of the southwest corner of sec. 22, T. 3 N., R. 4 E.

A1—0 to 5 inches, grayish-brown (10YR 5/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

A2—5 to 10 inches, pale-brown (10YR 6/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; slightly acid; abrupt, wavy boundary.

B2t—10 to 24 inches, red (2.5YR 4/6) sandy clay (contains fine chert fragments), dark red (2.5YR 3/6) moist; many, medium, distinct, brown (7.5YR 4/4) mottles; moderate, medium and coarse, subangular blocky structure; very hard, very firm; clay films on ped faces and lining root channels; medium acid; diffuse, smooth boundary.

B3—24 to 60 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; many, medium, distinct, pale-brown (10YR 6/3) mottles; weak, coarse, subangular blocky structure; very hard, very firm; medium acid; abrupt, wavy boundary.

R—60 inches +, conglomerate rock.

The A horizon is principally gravelly sandy loam, but it is gravelly loam, sandy loam, and loam in some areas. The reaction of the A horizon is slightly acid or medium acid. The gravel content ranges from 5 to 25 percent. The colors of the B horizon are red, reddish brown, or yellowish red. Reaction of the B horizon is medium acid to neutral. The depth to conglomerate rock ranges from 40 to 72 inches.

Chigley soils have more gravel in the A horizon than the associated Windthorst soils, and they have a more clayey B2t horizon than the associated Stephenville soils.

**Chigley gravelly sandy loam, 1 to 5 percent slopes** (CgC).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were eroded areas and small areas of Windthorst fine sandy loam, which make up about 15 percent of the acreage.

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

Management is needed to maintain soil fertility, increase water intake, and control erosion. The erosion hazard can be reduced by terracing, contour farming, and stripcropping. Crop residue needs to be returned to the soil to improve fertility and increase water intake. (Capability unit IVe-1; Sandy Savannah range site; woodland suitability group 3)

**Chigley gravelly sandy loam, 5 to 12 percent slopes** (CgD).—This soil occurs on uplands. Included in mapping were small areas of Windthorst fine sandy loam, small eroded areas, and a few areas of rock outcrop.

This soil is suited to tame pasture and native range. The quality of the grasses can be maintained or improved by controlling brush, using suitable grazing practices, and protecting the soil from fire. (Capability unit VIe-1; Sandy Savannah range site; woodland suitability group 3)

**Chigley soils, 2 to 8 percent slopes, severely eroded** (ChD3).—These soils are on uplands. Part of the original surface layer has been removed by erosion, and the present surface layer is gravelly loam or gravelly sandy loam. Gullies, 18 to 60 inches deep and 50 to 200 feet apart, are common. Included in mapping were areas of Windthorst fine sandy loam.

These soils are so severely eroded that they are not suitable for cultivation. They should be returned to permanent vegetation. Additions of fertilizer, sloping of gully banks, diverting water from higher lying soils, and mulching are needed for successful establishment of tame pasture or range. The quality of the grasses can be maintained and improved by controlling brush, using suitable grazing practices, and protecting the soil from fire. (Capability unit VIe-2; Eroded Sandy Savannah range site; woodland suitability group 4)

## Claremore Series

The Claremore series consists of shallow, very gently sloping to gently sloping, well-drained soils on uplands. These soils formed in material weathered from limestone. The natural vegetation was grass.

In a representative profile the surface layer is dark grayish-brown loam about 10 inches thick. The subsoil is brown clay loam. Limestone begins at a depth of 16 inches.

Permeability is moderate, and the available water capacity is low to moderate.

Representative profile of Claremore loam, 2 to 5 percent slopes, 2,700 feet east and 60 feet north of the southwest corner of sec. 23, T. 3 N., R. 5 E.

A1—0 to 10 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; slightly hard, firm; slightly acid; clear, smooth boundary.

B2t—10 to 16 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure; hard, firm; patchy clay films on ped faces; slightly acid; clear, wavy boundary.

R—16 inches +, limestone.

The A horizon is grayish brown to dark grayish brown. The texture of the B2t horizon ranges from loam to silty clay loam, and the color from brown to reddish brown. The depth to limestone ranges from 10 to 20 inches.

Claremore soils are not so deep to limestone as the associated Lula soils and are deeper than the associated Talpa soils. They have a B2t horizon, which the similar Collinsville soils lack.

**Claremore loam, 2 to 5 percent slopes** (ClC).—This soil occurs on uplands. Included in mapping were small areas of Talpa soils and minor areas of a similar soil that is 20 to 40 inches deep to limestone. Also included were a few areas where the surface layer is loam.

This soil has limited farming use. It is used mostly for range but is suited to small grains, grain sorghum, tame pasture, and woodland.

Management is needed to maintain fertility and soil structure, reduce the hazard of water erosion, and conserve moisture. Terracing, contour farming, and using crop residue are needed. Excessive tillage should be avoided, and other good management practices should be followed. (Capability unit IVe–2; Loamy Prairie range site; woodland suitability group 3)

## Clarita Series

The Clarita series consists of deep, very gently sloping to gently sloping, moderately well drained soils on uplands. These soils formed under a native vegetation consisting of grasses, in material weathered from calcareous clay and shale.

In a representative profile the surface layer is very dark gray and dark-gray clay to a depth of 22 inches. The next layer, between depths of 22 and 50 inches, is reddish-brown clay. This layer has shiny faces on the peds and vertical cracks 3 to 4 inches wide and 30 inches or more deep. At a depth below 50 inches, the underlying material is dark reddish-brown and gray, calcareous, clayey shale.

Permeability is very slow, and the available water capacity is high.

Representative profile of Clarita clay, 2 to 5 percent slopes, 800 feet west and 50 feet south of the northeast corner of sec. 29, T. 4 N., R. 4 E.

A11—0 to 10 inches, very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; strong, medium and fine, subangular blocky structure that parts to coarse and medium, granular; hard, very firm; moderately alkaline; gradual, wavy boundary.

A12—10 to 22 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure; very hard, very firm; some pressure faces; few wedge-shaped slickensides in lower part of horizon; many fine calcium carbonate concretions; moderately alkaline; gradual, wavy boundary.

AC—22 to 50 inches, reddish-brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; common intersecting slickensides and a few parallelepipeds that are tilted 10 to 60 degrees from the horizontal; vertical cracks 3 to 4 inches wide extend to a depth of 30 inches or more; extremely hard, extremely firm; dark-colored soil (10YR 3/1, moist) occurs in old crevices; many soft and a few cemented calcium carbonate concretions; calcareous; moderately alkaline; gradual, wavy boundary.

C—50 to 72 inches, dark reddish-brown (2.5YR 3/4) and gray (N 5/0) clayey shale of the Permian red beds; many calcium carbonate concretions; calcareous; moderately alkaline.

The color of the A horizon is mostly very dark gray but ranges to dark gray. The A horizon is cyclic and ranges from 12 inches to 40 inches in thickness at linear intervals of 5 to 15 feet. The depth to hard shale is more than 60 inches.

Clarita soils are redder in the AC horizon than the associated Burleson and Heiden soils and have a thicker A horizon than the associated Vernon soils.

**Clarita clay, 2 to 5 percent slopes** (CnC).—This soil occurs on uplands. Included in mapping were areas of a similar soil that has olive-colored layers in the lower part of the profile. These areas make up 25 percent of the acreage. Also included were minor areas of Vernon clay and a few areas where the surface layer is silty clay loam.

This soil is suited to cotton, small grains, grain sorghum, tame pasture, range, and woodland. It is primarily used for range, but some small grains and forage crops are grown.

Management is needed to improve soil structure, reduce crusting, increase water intake, and control water erosion. Tillage is difficult because of the clayey material. A cropping system is needed to provide crops that produce large amounts of residue, which is returned to the soil to improve soil structure, increase water intake, and limit crusting. Large cracks occur at the surface when the soil is dry. Tillage should be timely and kept to a minimum. Terraces and contour tillage are needed. (Capability unit IIIe–3; Black Clay Prairie range site; woodland suitability group 3)

## Cleora Series

The Cleora series consists of deep, nearly level, well-drained soils on flood plains. These soils formed in loamy alluvium. They are subject to flooding. In this county Cleora soils are mapped only with Port soils.

In a representative profile the surface layer is grayish-brown fine sandy loam about 14 inches thick. The next layer is brown fine sandy loam to a depth of 40 inches. Below a depth of 40 inches is brown fine sandy loam that is stratified with thin layers of pale-brown loamy fine sand.

Permeability is moderately rapid, and the available water capacity is high.

Representative profile of Cleora fine sandy loam from an area of Port and Cleora soils, channeled, 2,160 feet west and 75 feet south of the northeast corner of sec. 8, T. 3 N., R. 8 E.

A1—0 to 14 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; slightly hard, friable; slightly acid; gradual, smooth boundary.

AC—14 to 40 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; few thin strata of pale-brown loamy fine sand; massive; slightly hard, friable; medium acid; diffuse, smooth boundary.

C—40 to 60 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; many thin strata of pale-brown loamy fine sand; massive; slightly hard, very friable; medium acid.

The texture of the A horizon is principally fine sandy loam, but in a few areas it is loam and silt loam. The A horizon ranges from grayish brown to dark brown. Reaction in all horizons is slightly acid or medium acid. The texture of the AC and C horizons is variable, but between depths of 10 and 40 inches it averages fine sandy loam to loam. The AC horizon ranges from dark brown to yellowish brown in color.

Cleora soils have a sandier profile than the associated Port soils. They are better drained and have a sandier profile than the associated Arkabutla soils. Cleora soils have a thinner A horizon and a sandier AC horizon than the associated Verdigris soils.

## Collinsville Series

The Collinsville series consists of shallow, very gently sloping to gently sloping, well-drained to somewhat excessively drained soils on uplands. These soils formed under tall and mid grasses in material weathered from sandstone.

In a representative profile the surface layer is grayish-brown fine sandy loam about 10 inches thick. The next layer, to a depth of 15 inches, is a mixture of brown fine sandy loam and sandstone fragments in about equal proportions. The underlying material is sandstone.

Permeability is moderately rapid, and the available water capacity is low to moderate.

Representative profile of Collinsville fine sandy loam, 2 to 5 percent slopes, 1,280 feet west and 1,280 feet north of the southeast corner of sec. 21, T. 3 N., R. 7 E.

A1—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable; medium acid; gradual, irregular boundary.

B&C—10 to 15 inches, mixture of brown (10YR 5/3) fine sandy loam and sandstone fragments in equal proportions; weak, fine, granular structure; medium acid; abrupt, irregular boundary.

R—15 inches +, brown sandstone.

The A horizon is grayish brown to dark brown. Reaction ranges from slightly acid to strongly acid. In most places the texture of the B horizon is fine sandy loam, but it ranges to light loam. Reaction in this horizon is medium acid or slightly acid. The depth to sandstone is 8 to 20 inches.

Collinsville soils lack a B2t horizon that the similar Claremore soils have; they are not so deep as the associated Bates soils. They are less clayey than the associated Steedman soils.

**Collinsville fine sandy loam, 2 to 5 percent slopes** (CoC).—This soil occurs on uplands. Included in mapping were areas of Bates fine sandy loam, which make up 15 percent of the acreage, and minor areas of Steedman silty clay loam. A few small areas where the surface layer is loamy fine sand or loam were also included.

This soil is 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 protecting the soil from fire. (Capability unit VIe–3; Shallow Prairie range site; woodland suitability group 3)

## Darnell Series

The Darnell series consists of shallow, gently sloping to moderately steep, well-drained to somewhat excessively drained soils on uplands. These soils formed under a natural vegetation of trees, in material weathered from sandstone.

In a representative profile the surface layer is grayish-brown fine sandy loam about 7 inches thick. The next layer, to a depth of 15 inches, is very pale brown fine sandy loam. The underlying material is sandstone.

Permeability is moderately rapid, and the available water capacity is low to moderate.

Representative profile of Darnell fine sandy loam, from an area of Darnell-Stephenville fine sandy loams, 5 to 20 percent slopes, 350 feet south and 2,070 feet east of the northwest corner of sec. 12, T. 4 N., R. 8 E.

A1—0 to 7 inches, grayish-brown (10YR 5/2) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; medium acid; gradual, smooth boundary.

B—7 to 15 inches, very pale brown (10YR 7/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak, fine, granular structure; soft, very friable; strongly acid; gradual, smooth boundary.

R—15 inches +, sandstone; very hard when dry and hard when moist.

The color of the A horizon ranges from grayish brown to pale brown. Reaction ranges from slightly acid to strongly acid. The texture of the B horizon ranges from fine sandy loam to loam, and reaction ranges from medium acid to strongly acid. The depth to sandstone ranges from 8 to 20 inches.

Darnell soils lack a B2t horizon and are not so deep to sandstone as the associated Stephenville soils. The A horizon is lighter colored than that of the similar Collinsville soils, which developed under grass.

**Darnell-Stephenville fine sandy loams, 5 to 20 percent slopes** (DaE).—This complex occurs on uplands. The soils have the profile described as representative of their respective series (fig. 6), except that in the Stephenville soil the depth to sandstone is 24 inches instead of 35 inches. Darnell fine sandy loam makes up about 25 to 45 percent of the acreage, and Stephenville fine sandy loam makes up 15 to 35 percent. Included in mapping were areas of Windthorst fine sandy loam, which make up 10 to 20 percent, and areas of Rock outcrop, which make up 3 to 17 percent. Also included were small areas where the solum is less than 20 inches thick and the subsoil is clay, as well as a few small areas where the surface layer is loamy fine sand.

This complex is suited to native range. The quality of the native grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit VIIs–1; woodland suitability group 4; Darnell soil in Shallow Savannah range site; Stephenville soil in Sandy Savannah range site)

## Dennis Series

The Dennis series consists of deep, very gently sloping to gently sloping, moderately well drained soils on uplands. These soils formed under tall and mid grasses in material weathered from clay and shale.

In a representative profile the surface layer is dark grayish-brown loam about 12 inches thick. The subsoil is 58 inches thick. The uppermost 5 inches of the subsoil is brown clay loam that has grayish-brown mottles. The lower part is yellowish-brown clay that has mottles in shades of brown or gray.

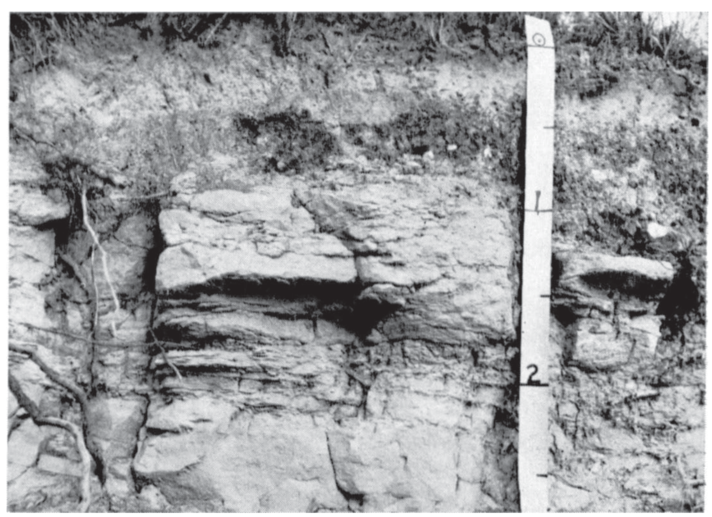


*Figure 6.*—**Profile of Darnell fine sandy loam, from an area of Darnell-Stephenville fine sandy loams, 5 to 20 percent slopes. Note the tree roots in the cracks of the sandstone.**

Permeability is slow, and the available water capacity is high.

Representative profile of Dennis loam, 1 to 3 percent slopes, in a pasture, 840 feet north and 75 feet west of the southeast corner of sec. 29, R. 8 E., T. 3 N.

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; soft, very friable; medium acid; gradual, smooth boundary.

B1—12 to 17 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; few, fine, faint, grayish-brown mottles; strong, fine, subangular blocky structure; hard, friable; clean silt and sand grains; medium acid; gradual, wavy boundary.

B21t—17 to 35 inches, yellowish-brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; few, medium and fine, faint mottles of dark brown (10YR 3/3); strong, medium, blocky structure; very hard, very firm; clay films coat ped surfaces; medium acid; gradual, smooth boundary.

B22t—35 to 50 inches, yellowish-brown (10YR 5/4) clay; dark yellowish brown (10YR 4/4) moist; common, fine, distinct, yellowish-brown mottles; weak, coarse, blocky structure; extremely hard, very firm; clay films on ped surfaces; few iron concretions; medium acid; gradual, smooth boundary.

B3—50 to 70 inches, yellowish-brown (10YR 5/8) clay; common, course, faint, gray (10YR 6/1) mottles; weak, coarse, blocky structure; extremely hard, extremely firm; few iron concretions; slightly acid.

The color of the A horizon ranges from grayish brown to dark brown and dark grayish brown. The B2t horizon is clay or silty clay in texture and pale brown to yellowish brown in color. The uppermost part of the B horizon is strongly acid to medium acid, and the lower part is medium acid to slightly acid. The depth to unweathered clay or shale is more than 60 inches.

Dennis soils are less clayey in the uppermost part of the B2t horizon than the associated Parsons soils. They do not have free lime at a depth above 60 inches, as do the associated Durant soils. They are more clayey throughout the B2t horizon than the associated Bates soils. The depth to shale is greater in Dennis soils than in the associated Steedman soils.

**Dennis loam, 1 to 3 percent slopes** (DeB).—This soil occurs on uplands. It has the profile described as representative for the series. Included in mapping were areas of Parsons silt loam, which make up 5 percent of the acreage; areas of Bates fine sandy loam, which make up about 10 percent; and small areas of Steedman silty clay loam.

This soil is suited to tame pasture, range, small grains, grain sorghum, cotton, corn, peanuts, alfalfa, and woodland. Most of the acreage is used for tame pasture and range.

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. Terracing, contour farming, and using of crop residue are needed in controlling water erosion, in conserving moisture, and in maintaining structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. Terracing and contour farming are needed if row crops are grown. Sown crops can be grown continuously if fertilizer is added and other good management practices are followed. (Capability unit IIe-3; Loamy Prairie range site; woodland suitability group 2)

**Dennis loam, 3 to 5 percent slopes** (DeC).—This soil occurs on uplands. Included in mapping were areas of Bates fine sandy loam, which make up about 10 percent of the acreage, and small areas of Steedman silty clay loam.

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

Management is needed to maintain fertility and soil structure and to protect the soil from water erosion. Terracing, contour farming, and using crop residue are needed in controlling water erosion, in conserving moisture, and in maintaining structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. (Capability unit IIIe-4; Loamy Prairie range site; woodland suitability group 2)

**Dennis loam, 2 to 5 percent slopes, eroded** (DeC2).—This soil occurs on uplands.

In about 80 percent of the acreage, erosion has removed part of the original surface layer. In about 30 percent of the eroded acreage, tillage has mixed the surface layer with material from the subsoil, and in about 10 percent, plowing has exposed the subsoil. There are a few crossable gullies. Included in mapping were minor areas of Bates fine sandy loam and Steedman silty clay loam.

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

Cultivated areas need protection from severe rill and gully erosion. Intensive management is needed to improve suitability of this soil for cultivated crops. Suitable practices are terracing, contour farming, returning crop residue, and adding fertilizer. Close-growing crops are better suited than row crops. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 3)

## Dougherty Series

The Dougherty series consists of deep, very gently sloping to moderately steep, well-drained soils on uplands. These soils formed in sandy or loamy sediments under forest that has an understory of tall grasses.

In a representative profile the surface layer is light brownish-gray loamy fine sand about 6 inches thick. The subsurface layer, to a depth of 26 inches, is very pale brown loamy fine sand. The upper part of the subsoil, to a depth of 45 inches, is yellowish-red sandy clay loam. The lower part of the subsoil, to a depth of 60 inches, is yellowish-red fine sandy loam. The underlying material, to a depth of 72 inches, is reddish-yellow fine sandy loam.

Permeability is moderate, and the available water capacity is moderate or high.

Representative profile of Dougherty loamy fine sand, 3 to 8 percent slopes, 1,440 feet west and 90 feet north of the southeast corner of sec. 30, T. 5 N., R. 4 E.

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

A2—6 to 26 inches, very pale brown (10YR 8/3) loamy fine sand, very pale brown (10YR 7/3) moist; massive; loose; slightly acid; clear, smooth boundary.

B2t—26 to 45 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, coarse, prismatic structure; hard, firm; clay films on ped faces; strongly acid; diffuse, smooth boundary.

B3—45 to 60 inches, yellowish-red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) moist; weak, coarse, subangular blocky structure; slightly hard, firm; bands, ⅛ to ½ inch wide, that have a color value of 1 or less; strongly acid; diffuse, smooth boundary.

C—60 to 72 inches, reddish-yellow (7.5YR 6/6) fine sandy loam, strong brown (7.5YR 5/6) moist; massive; soft, friable; strongly acid.

The Ap horizon ranges from light brownish gray to dark brown in color, and the A2 horizon ranges from very pale brown to brown. The thickness of the A horizon is more than 20 inches. Reaction in the A horizon is slightly acid or medium acid. In the B2t horizon, reaction is medium acid or strongly acid. The B and C horizons are yellowish red, red, or reddish yellow. The texture of the C horizon is fine sandy loam or loamy fine sand.

Dougherty soils differ from the associated Konawa and Galey soils in having an A horizon that is more than 20 inches thick. The B2t horizon is more clayey than that of the associated Eufaula soils.

**Dougherty loamy fine sand, 1 to 3 percent slopes** (DoB).—This soil occurs on uplands. Included in mapping were areas, which make up 10 percent of the acreage, where the subsoil is yellowish brown; areas, which make up another 10 percent of the acreage, where the subsoil is more clayey; and a few areas where the surface layer is fine sand. Also included were areas of Eufaula loamy fine sand, which make up 15 percent of the acreage, and a few areas where the surface layer is fine sand.

This soil is suited to tame pasture, range, woodland, peanuts, and cotton. Much of the acreage is still used for trees. Some has been farmed in the past but is presently used for range. Other areas have been cleared and planted to tame pasture.

Management is needed to maintain or improve fertility and control soil blowing. A cropping system is needed to provide plant cover in winter and spring to protect the soil from blowing. Cover crops or crops that produce a large amount of residue are needed. Stripcropping, minimum tillage, and other good management practices control erosion and improve fertility. (Capability unit IIIe-5; Deep Sand Savannah range site; woodland suitability group 2)

**Dougherty loamy fine sand, 3 to 8 percent slopes** (DoD).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were areas, which make up 10 percent of the acreage, where the subsoil is more clayey. Also included were minor areas where the subsoil is yellowish brown, as well as small areas of Konawa loamy fine sand and Eufaula loamy fine sand. In addition, there are a few areas where the surface layer is fine sand.

This soil is used mainly for range and tame pasture. It is suited to peanuts, cotton, tame pasture, range, and woodland.

Management is needed to maintain or improve fertility and to control erosion. A cropping system is needed to provide plant cover in winter and spring to protect the soil from blowing. Stripcropping, minimum tillage, and use of crop residue will control erosion and maintain fertility. Cover crops or crops that produce large amounts of residue are needed. Diversion terraces are needed in some areas. (Capability unit IVe-3; Deep Sand Savannah range site; woodland suitability group 2)

**Dougherty-Eufaula loamy fine sands, 8 to 20 percent slopes** (DrE).—This complex occurs on uplands. Dougherty loamy fine sand makes up about 60 percent of the acreage, Eufaula loamy fine sand makes up 30 percent, and Konawa loamy fine sand makes up 10 percent.

This complex is 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 protecting the soil from fire. (Capability unit VIe-4; Deep Sand Savannah range site; woodland suitability group 3)

## Durant Series

The Durant series consists of deep, very gently sloping to sloping, moderately well drained soils on uplands. These soils formed under tall and mid grasses in material weathered from clay and shale. When dry, they shrink and crack.

In a representative profile the surface layer is dark grayish-brown to very dark grayish-brown loam about 12 inches thick. The upper part of the subsoil, to a depth of 30 inches, is mainly grayish-brown clay that has mottles in shades of brown or red. The lower part of the subsoil, to a depth of 55 inches, is light olive-brown and yellowish-brown clay that has a few lime concretions. The underlying material is calcareous shale and clay.

Permeability is very slow, and the available water capacity is high.

Representative profile of Durant loam, 1 to 3 percent slopes, 660 feet west and 270 feet south of the northeast corner of sec. 16, T. 4 N., R. 4 E.

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

A1—6 to 12 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate, fine, subangular blocky structure; hard, friable; slightly acid; clear, wavy boundary.

B21t—12 to 15 inches, grayish-brown (10 YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; common, fine, distinct, dark-brown mottles; strong, medium, subangular blocky structure; very hard, firm; patchy clay films on ped faces; medium acid; clear, smooth boundary.

B22t—15 to 30 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; common, fine, prominent, dark-red mottles; strong, medium, subangular blocky structure; extremely hard, very firm; clay films on ped faces; slightly acid; diffuse, smooth boundary.

B23t—30 to 40 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; few, fine, distinct, yellowish-brown mottles; moderate, coarse and medium, subangular blocky structure; extremely hard, extremely firm; clay films on ped faces; few iron concretions; mildly alkaline; diffuse, smooth boundary.

B3—40 to 55 inches, yellowish-brown (10YR 5/4) clay, yellowish brown (10YR 5/4) moist; weak, coarse, blocky structure; extremely hard, extremely firm; many iron concretions; few lime concretions; mildly alkaline; gradual, smooth boundary.

R—55 to 70 inches +, calcareous clay and shale.

The color of the A horizon is grayish brown to very dark grayish brown. Reaction is slightly acid to medium acid. The texture of the B2t horizon is clay loam, clay, or silty clay, and reaction is medium acid to mildly alkaline. The depth to free lime is less than 60 inches, and in most places it begins at a depth of 40 inches. The depth to shale or clay ranges from 50 to more than 60 inches.

Durant soils differ from the associated Dennis soils by having free lime at a depth of less than 60 inches. They have a less grayish B2t horizon than the associated Woodson soils.

**Durant loam, 1 to 3 percent slopes** (DuB).—This soil occurs on uplands. It has the profile described as representative of the series (fig. 7). Included in mapping were


*Figure 7*.—**Profile of Durant loam. In this soil the subsoil is subject to cracking.**

areas of Burleson clay, which make up about 5 percent of the acreage, and of Clarita clay, which make up 5 percent. Also included were areas where the surface layer is fine sandy loam, which make up 5 percent of the acreage, and a few areas where the surface layer is silt loam and silty clay loam.

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

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. Terracing, contour farming, and use of crop residue are needed in controlling erosion, in conserving moisture, and in maintaining structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. Terracing and contour farming are needed if row crops are grown. Sown crops can be grown continuously if fertilizer is applied and other good management practices are followed. (Capability unit IIe-3; Loamy Prairie range site; woodland suitability group 3)

**Durant loam, 3 to 5 percent slopes** (DuC).—This soil occurs on uplands. Included in mapping were a few eroded areas and small areas of Burleson clay and Heiden clay.

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

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. Terracing, contour farming, and using crop residue are needed in controlling water erosion, in conserving moisture, and in maintaining structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. (Capability unit IIIe-4; Loamy Prairie range site; woodland suitability group 3)

**Durant loam, 2 to 5 percent slopes, eroded** (DuC2).—This soil occurs on uplands. In about 80 percent of the acreage, erosion has removed part of the original surface layer. In about 40 percent of the acreage, tillage has mixed material from the subsoil with that of the surface layer. In about 10 percent of the acreage, plowing has exposed the subsoil. Shallow gullies occur in a few of the more eroded places. In about 15 percent of the acreage, there is shale or clay at a depth of 30 to 50 inches.

This soil is used for native range, tame pasture, and a few cultivated crops. Suitable crops are peanuts, grain sorghum, and cotton.

Intensive management is needed to maintain soil structure and fertility, control erosion, and increase water intake. Terracing and contour farming are needed. Crops are needed that provide large amounts of residue, which should be returned to the soil to improve soil structure and fertility, and to increase water intake. Close-growing crops are better suited than row crops. The quality of the native grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit IVe-4; Loamy Prairie range site; woodland suitability group 3)

**Durant and Bates soils, 2 to 6 percent slopes, severely eroded** (DvC3).—These soils occur on uplands. Durant loam makes up 45 percent of the acreage; Bates fine sandy loam, 25 percent; and the rest is inclusions. In any given area, this undifferentiated group may consist of either Durant or Bates soils or a combination of the two. Gullies and areas where nearly all of the original surface layer has been lost make up about 55 percent of the acreage. The gullies are commonly 2 to 5 feet deep, 5 to 30 feet wide, and 50 to 150 feet apart (fig. 8). In many places the surface layer of the soil between the gullies is as thick as that in uneroded soils.

Included in mapping were areas of Dennis loam, which make up about 15 percent of the acreage; of Fitzhugh fine sandy loam, which make up about 7 percent; and of Lula loam, which make up about 7 percent.

These soils are so severely eroded that they are not suitable for cultivation. They are used mainly for range, and all areas should be returned to permanent vegetation. Additions of fertilizer, sloping of gully banks, diversion of water from higher lying areas, and mulching are needed for successful establishment of tame pasture or range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soils from fire. (Capability unit VIe-5; Eroded Prairie range site; woodland suitability group 4)

*Figure 8.*—**A landscape showing gully erosion on Durant and Bates soils, 2 to 6 percent slopes, severely eroded.**

## Dwight Series

The Dwight series consists of deep, nearly level, moderately well drained soils on uplands. These soils formed in material weathered from alkaline clay and shale under a native vegetation of tall grasses.

In a representative profile the surface layer is grayish-brown silt loam about 6 inches thick, which abruptly overlies the subsoil. The upper part of the subsoil, to a depth of 36 inches, is dark-gray clay that is high in sodium. The lower part of the subsoil, to a depth of 56 inches, is yellowish-brown clay. The underlying material is brownish-yellow clay that has gray mottles.

Permeability is very slow, and the available water capacity is high.

Representative profile of Dwight silt loam, 0 to 1 percent slopes, in a pasture, 350 feet south and 50 feet west of the northeast corner of the SW¼ sec. 19, T. 3 N., R. 7 E.

Ap—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, friable; neutral; abrupt, smooth boundary.

B2t—6 to 36 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; weak, coarse, prismatic structure becoming weak, coarse, blocky at a depth below 20 inches; extremely hard, very firm; clay films or pressure faces are nearly continuous on ped faces; mildly alkaline; gradual, smooth boundary.

B3—36 to 56 inches, yellowish-brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; weak, medium, blocky structure; extremely hard, very firm; clay films or pressure faces are weak; moderately alkaline; diffuse, smooth boundary.

C—56 to 72 inches, brownish-yellow (10YR 6/8) clay, yellowish brown (10YR 5/8) moist; few, medium, faint, gray mottles; weak, medium, blocky structure; extremely hard, very firm; gray mottles increase in size and number with depth; moderately alkaline.

When the soil is dry, the color of the A horizon ranges from gray to grayish brown. Reaction in the A horizon is slightly acid to neutral. The texture of the B2t horizon ranges from silty clay to clay. Reaction in the B horizon is slightly acid to moderately alkaline. The depth to shale is more than 60 inches.

The mean annual temperature of these soils at a depth of 20 inches is more than 59° F., which is outside the defined range for the series. This difference, however, does not alter the usefulness and behavior of these soils.

Dwight soils have a thinner A horizon than the associated Dennis, Parsons, and Woodson soils. They lack mottles in the B2t horizon, which Dennis soils have. They are deeper than the associated Steedman soils.

**Dwight silt loam, 0 to 1 percent slopes** (DwA).—This soil (fig. 9) occurs on uplands. Included in mapping were areas of Woodson silt loam, which make up about 5 percent of the acreage; areas of Dennis loam, which make up 5 percent; areas of Parsons silt loam; and a few areas where the surface layer is loam.

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

Management is needed to maintain soil structure, reduce crusting, and increase water intake. A cropping system is needed to provide crops that produce large amounts of residue. Tillage should be timely and kept to a minimum. Applications of gypsum may be helpful. The treated areas should not be tilled for a minimum of two growing seasons. (Capability unit IVs–1; Shallow Claypan range site; woodland suitability group 4)

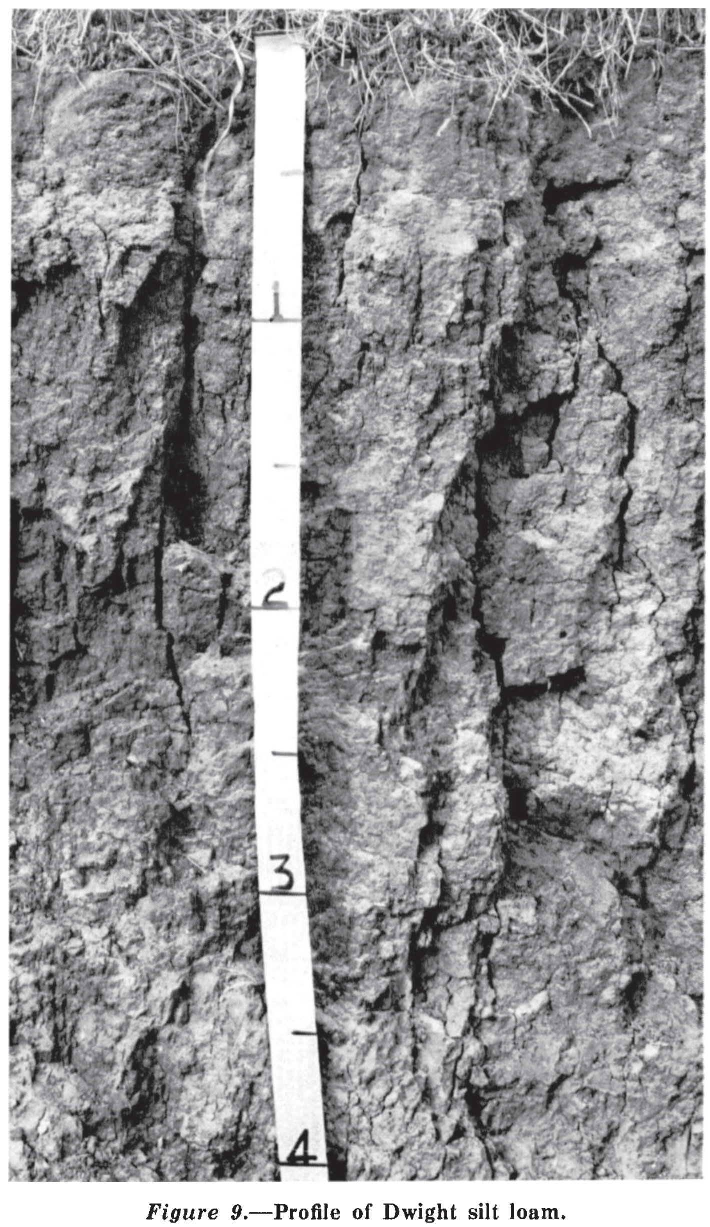


*Figure 9.*—**Profile of Dwight silt loam.**

## Eufaula Series

The Eufaula series consists of deep, nearly level to moderately steep, somewhat excessively drained soils on uplands. These soils formed in sandy material under native vegetation of oak forest and an understory of tall grasses.

In a representative profile the surface layer is pale-brown loamy fine sand about 6 inches thick. The subsurface layer is pink fine sand to a depth of 45 inches. The next layer is pink fine sand that contains lamellas of loamy fine sand that are ⅛ to 1 inch thick and 2 to 4 inches apart. This layer extends to a depth of 80 inches or more.

Permeability is rapid, and the available water capacity is low.

Representative profile of Eufaula loamy fine sand, 0 to 3 percent slopes, in a pasture, 2,990 feet north and 1,280 feet west of the southeast corner of sec. 9, T. 5 N., R. 6 E.

Ap—0 to 6 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; massive; loose; slightly acid; clear, smooth boundary.

A21—6 to 45 inches, pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; massive; loose; slightly acid; gradual, wavy boundary.

A22&B2t—45 to 80 inches, pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; lamellas of reddish-brown (5YR 5/4) loamy fine sand, ⅛ to 1 inch thick and 2 to 4 inches apart; the lamellas are wavy, discontinuous, and massive; slightly hard, friable; the lamellas have clay bridges between the sand grains; slightly acid.

The color of the A1 horizon is light gray to brown. Reaction in the A horizon is medium or slightly acid. The color of the A21 horizon ranges from light brownish gray and pale brown to light brown and pink. The lamellas of the A22 and B2t horizon are ⅛ to 1 inch thick and 2 to 6 inches apart. Reaction of the A22 and B2t horizons is medium acid or slightly acid.

Eufaula soils have a less clayey B2t horizon than the associated Dougherty and Konawa soils.

**Eufaula loamy fine sand, 0 to 3 percent slopes** (EuB).—This soil occurs on uplands. Included in mapping were areas of Dougherty loamy fine sand, which make up about 5 percent of the acreage; areas that lack the red lamellas, which make up 15 percent; and a few areas where the surface layer is fine sand.

Small acreages of this soil are used for peanuts, and some are used for tame pasture. Range and woodland are also suitable uses.

Management is needed to maintain and improve fertility and to control soil blowing. A cropping system is needed to provide plant cover during the winter and spring to protect the soil from blowing. Cover crops or crops that produce large amounts of residue are needed. Stripcropping, minimum tillage, and return of crop residue help to control erosion and improve fertility. (Capability unit IVs-2; Deep Sand Savannah range site; woodland suitability group 2)

## Fitzhugh Series

The Fitzhugh series consists of deep, very gently sloping to gently sloping, well-drained soils on uplands. These soils formed in material weathered from sandstone under vegetation that consisted of tall and mid grasses.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 12 inches thick. The next layer is dark-brown loam to a depth of 20 inches. The subsoil, to a depth of 60 inches, is yellowish-red clay loam. Below this is sandstone.

Permeability is moderate, and the available water capacity is high.

Representative profile of Fitzhugh fine sandy loam, 3 to 5 percent slopes, 2,490 feet east and 50 feet north of the southwest corner of sec. 35, T. 2 N., R. 4 E., near the Murray County line.

A1—0 to 12 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; slightly hard, very friable; slightly acid; gradual, smooth boundary.

A3—12 to 20 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, medium, subangular blocky structure; hard, firm; strongly acid; gradual, smooth boundary.

B21t—20 to 36 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, firm; clay films on ped faces; medium acid; gradual, smooth boundary.

B22t—36 to 45 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/8) moist; common, medium, distinct, red (2.5YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; hard, firm; patchy clay films; common to many iron concretions; medium acid; diffuse, smooth boundary.

B3—45 to 60 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak, coarse, subangular blocky structure; hard, firm; few iron concretions, 2 to 5 millimeters in size; strongly acid; clear, wavy boundary.

R—60 to 72 inches, reddish-brown sandstone that is hard when dry but easily crushed with the hand when moist.

The color of the A horizon is grayish brown to dark grayish brown and dark brown. Reaction is slightly acid to strongly acid. The texture of the B2t and B3 horizons ranges from sandy clay loam to clay loam. The color of the B horizon is yellowish red, reddish yellow, or reddish brown. Reaction in the B2t and B3 horizons ranges from slightly acid to strongly acid. The depth to sandstone is more than 50 inches.

Fitzhugh soils are deeper than the similar Bates soils.

**Fitzhugh fine sandy loam, 1 to 3 percent slopes** (FhB).—This soil occurs on uplands. Included in mapping were areas of Bates fine sandy loam, which make up 10 percent of the acreage; small areas where the surface layer is less than 10 inches thick; and a few areas where the surface layer is loam.

This soil is suited to corn, peanuts, alfalfa, cotton, grain sorghum, tame pasture, range, and woodland. The primary use is for range and tame pasture.

Management is needed to maintain fertility and soil structure, and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from 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. Excessive tillage should be avoided. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group 2)

**Fitzhugh fine sandy loam, 3 to 5 percent slopes** (FhC).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were areas of Bates fine sandy loam, which make up about 5 percent of the acreage; areas of Dennis loam, which make up 5 percent; and a few areas where the surface layer is loam. Also included were small areas of Lula loam.

*Figure 10.*—**Peanuts on Fitzhugh fine sandy loam, 3 to 5 percent slopes. Terracing and contour farming are practices that help to control erosion.**

This soil is suited to corn, peanuts (fig. 10), cotton, grain sorghum, tame pasture, range, and woodland. The primary use is for range and tame pasture.

Management is needed to maintain fertility and soil structure, and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Terracing, contour farming, and using crop residue are needed to conserve moisture and to maintain soil structure. (Capability unit IIIe-1; Loamy Prairie range site; woodland suitability group 2)

**Fitzhugh fine sandy loam, 3 to 5 percent slopes, eroded** (FhC2).—This soil occurs on uplands. In about 75 percent of the area, part of the original surface layer has been removed through erosion. In about 35 percent of the area, the present surface layer consists of a mixture, by tillage, of the original surface layer and material from the upper part of the subsoil. In a few places there are crossable gullies. Included in mapping were small areas of Bates fine sandy loam and of Lula loam, and a few areas where the surface layer is loam or clay loam.

This soil is used largely for tame pasture and range, but it is suited to peanuts, grain sorghum, cotton, and woodland.

Protection of cultivated areas from severe rill and gully erosion is needed. Intensive management is needed to improve suitability of this soil for cultivated crops. Suitable practices are terracing, contour farming, returning crop residue, and adding fertilizer. Close-growing crops are better suited than row crops. (Capability unit IIIe-2; Loamy Prairie range site; woodland suitability group 3)

## Galey Series

The Galey series consists of deep, very gently sloping, well-drained soils on uplands. These soils formed in loamy and sandy material under a native vegetation of oak forest and an understory of tall grasses.

In a representative profile the surface layer is brown loamy fine sand about 6 inches thick. The subsurface layer is very pale brown loamy fine sand about 8 inches thick. The upper part of the subsoil, to a depth of 52 inches, is brownish-yellow sandy clay loam. The lower part of the subsoil, to a depth of 72 inches, is yellow sandy clay loam that has mottles in shades of gray, brown, and red.

Permeability is moderate, and the available water capacity is high.

Representative profile of Galey loamy fine sand, 1 to 3 percent slopes, 2,300 feet south and 100 feet east of the northwest corner of sec. 26, T. 5 N., R. 4 E.

Ap—0 to 6 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

A2—6 to 14 inches, very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; massive; soft, very friable; slightly acid; clear, smooth boundary.

B21t—14 to 34 inches, brownish-yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; moderate, coarse, prismatic structure breaking to weak, medium, subangular blocky; very hard, friable; clay films on ped faces, in pores, and bridging sand grains; medium acid; diffuse, smooth boundary.

B22t—34 to 52 inches, brownish-yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; common, coarse, distinct, yellowish-red (5YR 5/6) and gray (10YR 6/1) mottles; moderate, coarse, prismatic structure breaking to weak, medium, subangular blocky;

very hard, friable; clay films on ped faces, in pores, and bridging sand grains; medium acid; diffuse, smooth boundary.

B3—52 to 72 inches, yellow (10YR 7/6) sandy clay loam, brownish yellow (10YR 6/6) moist; common, coarse, distinct, gray (10YR 5/1), pale-brown, (10YR 6/3), and yellowish-red (5YR 5/6) mottles; weak, coarse, prismatic structure; hard, friable; patchy clay films on ped faces and bridging sand grains; clean sand grains; medium acid.

The color of the Ap horizon ranges from light brownish gray to dark brown, and the color of the A2 horizon ranges from very pale brown to brown. Reaction in the A horizon is slightly acid or medium acid. The texture of the B2t horizon is mainly sandy clay loam but ranges to clay loam. The color of the B2t and B3 horizons ranges from reddish yellow and strong brown to yellowish brown, brownish yellow, and yellow. Reaction is medium acid or strongly acid. The texture of the B3 horizon is fine sandy loam or sandy clay loam.

Galey soils have a less reddish B2t horizon than the associated Konawa and Dougherty soils. They also have a thinner A horizon than Dougherty soils. They are deeper than the similar Stephenville soils.

**Galey loamy fine sand, 1 to 3 percent slopes** (GaB).—This soil occurs on uplands. Included in mapping were areas that have a redder subsoil, which make up about 10 percent of the acreage; areas where the subsoil is redder and the surface layer is thicker, which make up about 5 percent; and a few areas where the surface layer is fine sandy loam.

This soil is suited to cotton, peanuts, tame pasture (fig. 11), grain sorghum, corn, range, and woodland. The most common use is for tame pasture.

Management is needed to maintain or improve fertility, and control soil blowing. A cropping system is needed to provide plant cover during winter and spring to protect the soil from blowing. Cover crops or crops that produce large amounts of residue are needed. Stripcropping, minimum tillage, and return of crop residue help to control erosion and improve fertility. (Capability unit IIIe-5; Deep Sand Savannah range site; woodland suitability group 2)

## Heiden Series

The Heiden series consists of deep, gently sloping to strongly sloping, well-drained soils on uplands. These soils formed in material weathered from clay and shale under native grass vegetation.

In a representative profile the surface layer is dark-gray clay about 8 inches thick. The next layer, to a depth of 22 inches, is olive-colored clay. This layer has shiny faces on peds. During prolonged dry seasons, cracks up to 4 inches wide form, and in places they extend to a depth of 22 inches. The next layer, to a depth of 60 inches, is olive-colored clay. The underlying material is a light olive-gray calcareous claybed.

Permeability is very slow, and the available water capacity is high.

Representative profile of Heiden clay, 5 to 12 percent slopes, 1,720 feet east and 150 feet south of the northwest corner of sec. 31, T. 2 N., R. 7 E.

A11—0 to 8 inches, dark-gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; strong, fine and very fine, blocky structure; extremely hard, very firm; moderately alkaline; gradual, smooth boundary.

A12—8 to 22 inches, olive (5Y 4/3) clay, dark olive (5Y 3/3) when moist; strong, fine and very fine, blocky structure; slickensides apparent when soil is moist and a few parallelepipeds in lower part; extremely hard, very firm; few fine chert fragments; many lime concretions; calcareous; moderately alkaline; gradual, wavy boundary.

*Figure 11.*—Bermudagrass on Galey loamy fine sand, 1 to 3 percent slopes.

AC—22 to 60 inches, olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak, medium, blocky structure; many slickensides apparent and a few parallelepipeds; extremely hard, extremely firm; few lime concretions; calcareous; moderately alkaline; gradual, wavy boundary.

C—60 to 72 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; massive; extremely hard; calcareous; moderately alkaline.

The color of the A11 horizon ranges from dark gray to very dark gray. The A12 horizon ranges from olive gray to olive. The depth to unweathered clay or shale ranges from 40 to 60 inches.

Heiden soils are less reddish in the AC horizon than are the associated Clarita soils.

**Heiden clay, 3 to 5 percent slopes** (HeC).—This soil occurs on uplands. Included in mapping were eroded areas, which make up 15 percent of the acreage; areas of Durant loam, which make up 5 percent; and a few areas where the surface layer is silty clay loam.

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

Management is needed to improve soil structure, reduce crusting, increase water intake, and control water erosion. A cropping system is needed to provide crops that produce large amounts of residue, which is returned to the soil to improve soil structure, increase water intake, and limit surface crusting. Tillage is difficult because of the clayey material. It should be timely and kept to a minimum. Large cracks occur at the surface when the soil is dry. Terraces and contour tillage are needed. (Capability unit IIIe-3; Black Clay Prairie range site; woodland suitability group 3)

**Heiden clay, 5 to 12 percent slopes** (HeD).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were eroded areas, which make up 15 percent of the acreage, and a few areas where the surface layer is silty clay loam. Also included were minor areas of Talpa stony silty clay loam.

This soil is 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 protecting the soil from fire. (Capability unit VIe-6; Black Clay Prairie range site; woodland suitability group 4)

## Hilgrave Series, Moderately Shallow Variant

No soils typical of the Hilgrave series were mapped in Pontotoc County, but one variant was mapped. Hilgrave gravelly sandy loam, moderately shallow variant, 1 to 5 percent slopes, is a moderately deep, well-drained soil on ridgetops in the uplands. This soil formed in loamy material under forest vegetation and an understory of mid and tall grasses.

In a representative profile the surface layer is brown gravelly sandy loam about 6 inches thick. The subsurface layer is very pale brown gravelly sandy loam to a depth of 11 inches. The subsoil is reddish-yellow gravelly clay loam that is about 60 percent gravel and coarse sand to a depth of 24 inches. The underlying material is a very gravelly conglomerate.

Permeability is moderately rapid, and the available water capacity is moderate.

Representative profile of Hilgrave gravelly sandy loam, moderately shallow variant, 1 to 5 percent slopes, 1,860 feet west and 525 feet south of the northeast corner of sec. 3. T. 4 N., R. 6 E.

Ap—0 to 6 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak, medium, granular structure; slightly hard, friable; 35 percent gravel and coarse sand, by volume; slightly acid; gradual, smooth boundary.

A2—6 to 11 inches, very pale brown (10YR 7/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak, medium and coarse, granular structure; slightly hard, friable; gravel and coarse sand make up 40 percent of horizon, by volume; neutral; clear, wavy boundary.

B2t—11 to 24 inches, reddish-yellow (5YR 6/6) gravelly clay loam, yellowish red (5YR 4/6) moist; moderate, very fine, subangular blocky structure; hard, firm; clay films bridge and coat sand grains; 60 percent, by volume, of this horizon is coarse sand and gravel up to ¾ inch in diameter; neutral; gradual, wavy boundary.

R—24 to 30 inches, very gravelly conglomerate.

The color of the Ap horizon ranges from light brownish gray to brown, and the color of the A2 horizon ranges from very pale brown to brown. The color of the B2t horizon ranges from light yellowish brown to yellowish red. Reaction ranges from medium acid to neutral. The depth to gravelly conglomerate ranges from 20 to about 36 inches.

Hilgrave soils are less clayey in the B2t horizon than the similar Chigley and Scullin soils.

**Hilgrave gravelly sandy loam, moderately shallow variant, 1 to 5 percent slopes** (HgC).—This soil occurs on narrow ridgetops in the uplands. Included in mapping were areas, which make up 10 percent of the acreage, where the subsoil contains less gravel than is typical of the series. Also included were areas where the depth to cemented conglomerate is less than 20 inches; these areas make up 15 percent of the acreage.

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

Management is needed to maintain soil fertility, increase water intake, and control erosion. The hazard of erosion can be reduced by terracing, contour farming, and stripcropping. Crop residue needs to be returned to the soil to improve fertility and increase water intake. (Capability unit IVe-1; Sandy Savannah range site; woodland suitability group 4)

## Konawa Series

The Konawa series consists of deep, nearly level to sloping, well-drained soils on uplands. These soils formed in loamy and sandy material under forest vegetation and an understory of tall and mid grasses.

In a representative profile the surface layer is grayish-brown loamy fine sand about 6 inches thick. The subsurface layer, to a depth of 14 inches, is very pale brown loamy fine sand. The subsoil is yellowish-red sandy clay loam to a depth of about 62 inches. The underlying material is reddish-yellow loamy fine sand.

Permeability is moderate, and the available water capacity is high.

Representative profile of Konawa loamy fine sand, 3 to 8 percent slopes, 475 feet east and 120 feet north of the southwest corner of SE¼ sec. 5, T. 4 N., R. 5 E.

A1—0 to 6 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

A2—6 to 14 inches, very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; massive; loose, very friable; medium acid; abrupt, smooth boundary.

B2t—14 to 35 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, medium and coarse, subangular blocky structure;

hard, firm; clay films on ped faces; strongly acid; diffuse, smooth boundary.

B3—35 to 62 inches, yellowish-red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; few, medium, distinct, pale-brown (10YR 6/3) mottles; weak, coarse, subangular blocky structure; hard, friable; strongly acid; diffuse, smooth boundary.

C—62 to 75 inches, reddish-yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; massive; loose; medium acid.

The texture of the A horizon is loamy fine sand and fine sandy loam. The color of the Ap horizon ranges from light gray to dark brown, and that of the A2 horizon ranges from very pale brown to brown. The B2t and B3 horizons are reddish brown, red, and yellowish red. Reaction in the B horizon is medium acid or strongly acid. The texture of the B3 horizon is fine sandy loam or sandy clay loam. The texture of the C horizon ranges from fine sand to fine sandy loam. Reaction is medium acid or strongly acid.

Konawa soils have a redder subsoil that is less clayey in the lower part than the associated Galey soils. They differ from the associated Dougherty soils in having a surface layer that is less than 20 inches thick. Konawa soils are deeper than the similar Stephenville soils.

**Konawa fine sandy loam, 0 to 1 percent slopes** (KoA).—This soil occurs on uplands. It has a profile similar to that described as representative of the series, except that the surface layer is fine sandy loam. Included in mapping were areas where the surface layer is dark grayish brown in color and more than 8 inches in thickness; these areas make up about 10 percent of the acreage. Also included were small areas of Galey loamy fine sand and Vanoss silt loam.

This soil is suited to alfalfa, corn, grain sorghum, peanuts, cotton, tame pasture, range, and woodland.

Management is needed to maintain fertility and soil structure. Suitable practices are seeding legumes, adding fertilizer, effectively using crop residue, and avoiding excessive tillage. Sown crops can be grown continuously if fertilizer is added and other good management practices are followed. (Capability unit I–1; Sandy Savannah range site; woodland suitability group 2)

**Konawa fine sandy loam, 1 to 3 percent slopes** (KoB).—This soil occurs on uplands. It has a profile similar to that described as representative of the series, except that the surface layer is fine sandy loam. Included in mapping were areas, which make up about 10 percent of the acreage, where the surface layer is dark grayish brown in color and more than 8 inches in thickness. Also included were minor areas of Galey loamy fine sand and Vanoss silt loam.

This soil is suited to alfalfa, corn, grain sorghum, peanuts, cotton, tame pasture, range, and woodland.

Management is needed to maintain fertility and soil structure, and to control erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from 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 Savannah range site; woodland suitability group 2)

**Konawa fine sandy loam, 3 to 5 percent slopes** (KoC).—This soil occurs on uplands. It has a profile similar to that described as representative of the series, except that the surface layer is fine sandy loam. Included in mapping were small areas of Dougherty loamy fine sand and Galey loamy fine sand.

This soil is suitable for corn, grain sorghum, peanuts, cotton, tame pasture, range, and woodland. It is used primarily for tame pasture.

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Terracing, contour farming, and using crop residue are needed to control erosion, conserve moisture, and maintain soil structure. (Capability unit IIIe–1; Sandy Savannah range site; woodland suitability group 2)

**Konawa loamy fine sand, 3 to 8 percent slopes** (KsD).—This soil occurs on uplands. It has the profile described as representative of the series (fig. 12). Included in


*Figure 12.*—**Profile of Konawa loamy fine sand.**

mapping were areas of Galey loamy fine sand, which make up 15 percent of the acreage, and minor areas of Dougherty loamy fine sand.

This soil is suitable for peanuts, cotton, grain sorghum, tame pasture, range, and woodland.

Management is needed that maintains or improves fertility and controls erosion. A cropping system is needed to provide plant cover during winter and spring to protect the soil from blowing. Stripcropping, minimum tillage, and use of crop residue will control erosion and maintain fertility. Cover crops or crops that produce large amounts of residue are needed. Diversion terraces are needed in some areas. (Capability unit IVe-3; Deep Sand Savannah range site; woodland suitability group 2)

**Konawa loamy fine sand, 3 to 8 percent slopes, eroded** (KsD ).—This soil occurs on uplands. Erosion has removed most of the original surface layer, and in about 15 to 25 percent of the acreage the reddish sandy clay loam subsoil is exposed. A few shallow gullies occur in some places. The present surface layer consists of a mixture, by tillage, of the original surface layer and material from the upper part of the subsoil. Included in mapping were small areas of Galey loamy fine sand and Dougherty loamy fine sand.

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

Management is needed that maintains or improves fertility and controls erosion. The hazard of rill and gully erosion is severe. Crops are needed that provide large amounts of residue, which can be returned to the soil to improve fertility and control erosion. Cover crops that provide large amounts of residue are needed. A cropping system that provides plant cover during winter and spring is needed to protect the soil from erosion. Diversion terraces are needed in some areas. (Capability unit IVe-5; Deep Sand Savannah range site; woodland suitability group 3)

**Konawa soils, 3 to 8 percent slopes, severely eroded** (KtD3).—These soils occur on uplands. The texture of the surface layer is fine sandy loam to loamy fine sand. In about 50 percent of the acreage, tillage has brought part of the subsoil into the surface layer. There are many uncrossable gullies (fig. 13). These gullies are 2 to 8 feet deep, 5 to 40 feet wide, and occur at 25- to 150-foot intervals. Included in mapping were minor areas of Dougherty loamy fine sand, Konawa loamy fine sand, and small severely eroded areas.

*Figure 13.*—A landscape of Konawa soils, 3 to 8 percent slopes, severely eroded. Gullies limit the use of this soil.

These soils are so severely eroded that they are not suitable for cultivation. They should be returned to permanent vegetation. Additions of fertilizer, sloping of gully banks, diversion of overhead water, and mulching are needed for successful establishment of tame pasture or range. The quality of the grasses can be maintained and improved by controlling brush, using suitable grazing practices, and protecting the area from fire. (Capability unit VIe-2; Eroded Sandy Savannah range site; woodland suitability group 4)

## Lincoln Series

The Lincoln series consists of deep, nearly level to very gently sloping, somewhat excessively drained soils on flood plains. These soils are subject to flooding. They formed in sandy alluvium.

In a representative profile the surface layer, to a depth of 9 inches, is light yellowish-brown loamy fine sand. The underlying material, to a depth of 72 inches, is very pale brown fine sand stratified with thin layers of brown fine sandy loam in the upper part.

Permeability is rapid, and the available water capacity is low. These soils have a water table within reach of deep-rooted plants.

Representative profile of Lincoln loamy fine sand from an area of Lincoln soils, 1,200 feet west and 420 feet north of the southeast corner of sec. 18, T. 5 N., R. 8 E.

A1—0 to 9 inches, light yellowish-brown (10YR 6/4) loamy fine sand, yellowish-brown (10YR 5/4) moist; weak, fine, granular structure; soft, very friable; calcareous; moderately alkaline; gradual, smooth boundary.

C1—9 to 40 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grain; soft, very friable; thin strata of brown fine sandy loam that decrease in thickness and number as depth increases; bedding planes are visible; calcareous; moderately alkaline; diffuse, smooth boundary.

C2—40 to 72 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; structureless; loose; calcareous; moderately alkaline.

The texture of the A1 horizon ranges from fine sand to loamy fine sand, but in small areas it is fine sandy loam. The color of the A1 horizon is light yellowish brown to brown. The texture of the C horizon ranges from sand to loamy sand that has thin strata of finer textured material. This layer extends to a depth of many feet.

Lincoln soils have more sand in the profile than the associated Yahola soils.

**Lincoln soils** (Ln).—These soils occur as long, narrow bands on flood plains. They are subject to damaging floods once each year. They have the profile described as representative of the Lincoln series, but the surface layer ranges from fine sand to loamy fine sand. Included in mapping were a few areas where the surface layer is clay loam. Also included were areas that are not calcareous, which make up 20 percent of the acreage, and areas of Yahola fine sandy loam, which make up 10 percent of the acreage.

These soils are suited to tame pasture and native range. The quality of the native grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit Vw-1; Sandy Bottomland range site; woodland suitability group 1)

## Lula Series

The Lula series consists of deep, very gently sloping to sloping, well-drained soils on uplands. These soils formed in material weathered from limestone under a natural vegetation of tall and mid grasses.

In a representative profile, the surface layer is dark-brown loam about 12 inches thick. The upper part of the subsoil, to a depth of 22 inches, is reddish-brown clay loam. The lower part of the subsoil, to a depth of 48 inches, is red silty clay loam. Below this is limestone.

Permeability is moderate, and the available water capacity is high.

Representative profile of Lula loam, 1 to 3 percent slopes, 900 feet east and 60 feet north of the southwest corner of sec. 18, T. 1 N., R. 6 E.

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

B1—12 to 22 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, coarse and medium, granular structure; slightly hard; friable; slightly acid; gradual, smooth boundary.

B21t—22 to 40 inches, red (2.5YR 4/6) silty clay loam, dark red (2.5YR 3/6) moist; moderate, medium, subangular blocky structure; very hard, very firm; distinct, nearly continuous clay films on ped faces; strongly acid; gradual, smooth boundary.

B22t—40 to 48 inches, red (2.5YR 4/6) silty clay loam, dark red (2.5YR 3/6) moist; weak, medium, subangular blocky structure; very hard, very firm; strongly acid; abrupt, wavy boundary.

R—48 inches+, dolomitic limestone.

The color of the A horizon ranges from brown to grayish brown or dark brown. Reaction is slightly acid or medium acid. The texture of the B2t horizon is silt loam or silty clay loam. The color of the B2t horizon ranges from yellowish red and red to dark reddish brown. Reaction in the B2t horizon ranges from slightly acid to strongly acid. The depth to limestone ranges from 40 to 60 inches.

Lula soils are deeper and redder than the similar Bates soils. They are less gravelly than the associated Scullin soils and have less sand and more silt throughout the profile than the associated Fitzhugh soils.

**Lula loam, 1 to 3 percent slopes** (LuB).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were areas where clay is in the lower part of the subsoil, which make up 15 percent of the acreage; eroded areas, which make up 15 percent; and minor areas of Claremore loam. Also included were minor areas where the surface layer is silt loam.

This soil is suitable for grain sorghum, small grains, peanuts, corn, cotton, alfalfa, tame pasture, range, and woodland. The present use is mostly for range because of the size of the areas and their association with other soils that are suitable only for range.

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Sown crops can be grown continuously if fertilizer is added and crop residue is returned to the soil. Terracing and contour farming are needed if row crops are grown. Excessive tillage should be avoided. (Capability unit IIe-1; Loamy Prairie range site; woodland suitability group 2)

**Lula loam, 3 to 5 percent slopes** (LuC).—This soil occurs on uplands. Included in mapping were areas, which make up about 10 percent of the acreage, where the subsoil is silty clay at a depth of about 24 inches; eroded areas, which make up 20 percent; and areas where limestone occurs at a depth of less than 40 inches, which make up about 10 percent. Also included were minor areas of Fitzhugh fine sandy loam and a few areas where the surface layer is silt loam.

This soil is suitable for grain sorghum, small grains, peanuts, corn, cotton, tame pasture, range, and woodland. The present use is primarily for range because of the size of the areas and their association with other soils suited primarily to range.

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Terracing and contour farming and using crop residue are needed to control erosion, conserve moisture, and maintain soil structure. (Capability unit IIIe–1; Loamy Prairie range site; woodland suitability group 2)

**Lula loam, 2 to 5 percent slopes, eroded** (LuC2).—This soil occurs on uplands. Part of the original surface layer has been removed by erosion. Tillage has brought material from the subsoil into the surface layer. There are crossable rills or gullies. Included in mapping were minor areas of Fitzhugh fine sandy loam and a few areas where the surface layer is silt loam or silty clay loam.

The major use is for range and tame pasture. This soil is suitable for peanuts, grain sorghum, cotton, tame pasture, range, and woodland.

In managing this soil, protection of cultivated areas from severe rill and gully erosion is needed. Intensive management is needed to improve suitability of this soil for cultivation. Suitable practices are terracing, contour farming, returning crop residue, and adding fertilizer. Close-growing crops are better suited than row crops. (Capability unit IIIe–2; Loamy Prairie range site; woodland suitability group 3)

**Lula-Talpa complex, 2 to 6 percent slopes** (LxC).—This complex occurs on uplands. About 45 percent of the acreage is Lula loam, and 30 percent is Talpa stony silty clay loam. Claremore loam makes up about 15 percent, and limestone outcrops make up about 10 percent.

This complex is used primarily for range, although small areas of the Lula soil are used for tame pasture. It is suited to tame pasture and native range. King Ranch bluestem is a better suited pasture plant than other grasses. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit VIs–1; woodland suitability group 4; Lula soil in Loamy Prairie range site; Talpa soil in Very Shallow range site)

## Okemah Series

The Okemah series consists of deep, moderately well drained, very gently sloping soils on uplands. These soils formed in material weathered from calcareous shale under tall and mid grasses.

In a representative profile the surface layer is very dark gray silty clay loam about 12 inches thick. The upper part of the subsoil, to a depth of 20 inches, is dark grayish-brown silty clay loam that has yellowish-brown mottles. The lower part of the subsoil, to a depth of 44 inches, is light olive-brown clay that has grayish-brown and olive-yellow mottles. The underlying material is gray, calcareous clay that has yellowish-brown and olive-brown mottles.

Permeability is slow, and the available water capacity is high.

Representative profile of Okemah silty clay loam, 1 to 3 percent slopes, 1,375 feet south and 1,350 feet west of the northeast corner of sec. 21, T. 3 N., R. 6 E.

A1—0 to 12 inches, very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate, fine and medium, granular structure; slightly hard, friable; neutral; gradual, smooth boundary.

B1—12 to 20 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; few, fine, faint, yellowish-brown mottles; moderate, medium and coarse, granular structure; very hard, firm; slightly acid; gradual, smooth boundary.

B2t—20 to 44 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; common, medium, faint mottles of grayish brown (2.5Y 5/2) and olive yellow (2.5Y 6/6); moderate, fine, blocky structure; extremely hard, very firm; nearly continuous clay films on ped faces; slightly acid; gradual, smooth boundary.

C—44 to 72 inches +, gray (N 5/0) clay, dark gray (N 4/0) moist; many, coarse, distinct, yellowish-brown (10YR 5/6) and olive-brown (2.5Y 4/4) mottles; massive; extremely hard, extremely firm; few lime concretions; calcareous; moderately alkaline.

The color of the A horizon is dark gray to very dark gray, and the color of the B horizon ranges from dark grayish brown to light olive brown. The depth to shale is more than 72 inches.

Unlike the associated Durant soils, Okemah soils do not shrink and crack when dry. They are deeper than the associated Steedman soils.

**Okemah silty clay loam, 1 to 3 percent slopes** (OkB).—This soil occurs on uplands. Included in mapping were areas of Durant loam, which make up 10 percent of the acreage, and of Burleson clay, which make up 5 percent. Also included were a small acreage of Dennis loam and a few areas where the surface layer is silt loam.

This soil is suited to grain sorghum, cotton, alfalfa, tame pasture, range, and woodland. The primary use is for alfalfa and tame pasture.

Management is needed to maintain fertility and soil structure and to protect the soil from water erosion. Terracing, contour farming, and using crop residue are needed to control water erosion, conserve moisture, and maintain structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. Terracing and contour farming are needed if row crops are grown. Sown crops can be grown continuously if fertilizer is added and crop residue is returned. (Capability unit IIe–3; Loamy Prairie range site; woodland suitability group 2)

## Parsons Series

The Parsons series consists of deep, nearly level to very gently sloping, somewhat poorly drained to moderately well drained soils on uplands. These soils formed in material weathered from clay and shale under grass vegetation.

In a representative profile the surface layer is grayish-brown silt loam to a depth of 8 inches. The subsurface layer, to a depth of 12 inches, is light brownish-gray silt loam. The upper part of the subsoil, to a depth of 20 inches, is grayish-brown clay that has some dark reddish-brown mottles. The lower part of the subsoil, to a depth of 72 inches, is gray clay that has yellowish-brown mottles. The underlying material is weathered shale that has thin seams of sandy clay.

Permeability is very slow, and the available water capacity is high.

Representative profile of Parsons silt loam, 1 to 3 percent slopes, 1,980 feet west and 90 feet south of the northeast corner of sec. 1, T. 2 N., R. 7 E.

A1—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; hard, friable; strongly acid; clear, smooth boundary.

A2—8 to 12 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, medium, granular structure; slightly hard, friable; medium acid; abrupt, wavy boundary.

B21t—12 to 20 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; many, fine, distinct, dark reddish-brown mottles; weak, medium, blocky structure; extremely hard, extremely firm; clay films or pressure faces occur on the horizontal and vertical ped faces; medium acid; diffuse, smooth boundary.

B22t—20 to 42 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; common, fine, distinct, yellowish-brown mottles; weak, coarse, blocky structure; extremely hard, extremely firm; clay films or pressure faces on vertical and horizontal ped faces; neutral; diffuse, smooth boundary.

B3—42 to 72 inches, gray (10YR 6/1) clay, gray (10YR 5/1) moist; common, coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, blocky structure; extremely hard, extremely firm; mildly alkaline; gradual, smooth boundary.

C—72 inches, weathered shale that has thin seams of sandy clay.

The color of the A1 horizon ranges from grayish brown to dark grayish brown, but the color value of the A2 horizon is one or two points higher. The color of the B2t horizon ranges from gray to dark grayish brown. Reaction in this horizon generally is medium acid, but it ranges to neutral in the lower part. The depth to shale or unweathered clay is more than 60 inches.

Parsons soils are more clayey in the upper part of the B horizon than the associated Dennis or Durant soils. Durant soils also have free lime at a depth above 60 inches. Parsons soils have an A2 horizon, unlike the associated Woodson soils. They have a thicker A horizon than the associated Dwight soils.

**Parsons silt loam, 0 to 1 percent slopes** (PaA).—This soil occurs on uplands. Included in mapping were areas of Woodson silt loam, which make up about 10 percent of the acreage, and of Dennis loam, which make up 5 percent. Also included were small areas of Dwight silt loam and a few areas where the surface layer is loam.

This unit is suited to grain sorghum, tame pasture, corn, small grains, peanuts, cotton, range, and woodland.

Management is needed to improve soil structure and reduce surface crusting. A cropping system is needed to provide crops that produce large amounts of residue, which can be returned to the soil to improve soil structure, increase water intake, and limit surface crusting. (Capability unit IIs–1; Claypan Prairie range site; woodland suitability group 3)

**Parsons silt loam, 1 to 3 percent slopes** (PaB).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were areas of Dennis loam, which make up about 10 percent of the acreage, and of Dwight silt loam, which make up 5 percent. Also included were eroded areas, which make up 10 percent, and a few areas where the surface layer is loam.

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

Management is needed to improve soil structure, reduce surface crusting, and control water erosion. A cropping system is needed to provide crops that produce large amounts of residue, which can be returned to the soil to improve soil structure, increase water intake, limit crusting of the surface, and control erosion. Terracing and contour tillage are needed if row crops are grown. Sown crops can be grown year after year if fertilizer is added and crop residue is returned. (Capability unit IIIe–6; Claypan Prairie range site; woodland suitability group 3)

## Pickens Series

The Pickens series consists of shallow, gently sloping to moderately steep, somewhat excessively drained soils on uplands. These soils formed in material weathered from sandy shale under forest and an understory of grasses.

In a representative profile the surface layer is grayish-brown shaly loam about 4 inches thick. The subsurface layer, to a depth of 9 inches, is light-gray shaly loam. The next layer is very pale brown shaly loam that is 75 percent fractured shale. Below this is hard, fractured shale.

Permeability is moderate, and the available water capacity is low.

Representative profile of Pickens shaly loam, 3 to 15 percent slopes, 1,725 feet south and 50 feet east of the northwest corner of sec. 34, T. 3 N., R. 6 E.

A1—0 to 4 inches, grayish-brown (10YR 5/2) shaly loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; slightly hard, friable; 30 percent, by volume, of this horizon consists of hard, sandy shale fragments ⅛ to ½ inch in diameter and $\frac{1}{16}$ to ¼ inch thick; slightly acid; clear, smooth boundary.

A2—4 to 9 inches, light-gray (10YR 7/2) shaly loam, light brownish gray (10YR 6/2) moist; moderate, fine, granular structure; slightly hard, friable; 25 percent, by volume, of this horizon is hard shale and sandstone fragments ⅛ to ½ inch in diameter and $\frac{1}{16}$ to ¼ inch thick; strongly acid; gradual, irregular boundary.

B—9 to 18 inches, very pale brown (10YR 7/3) shaly loam, brown (10YR 5/3) moist; weak, fine, granular structure; slightly hard, friable; 75 percent, by volume, of this horizon is platy, gray, fractured shale; very strongly acid; clear, wavy boundary.

R—18 to 36 inches, fractured, hard, gray shale; white silt has sifted into the interstices and makes up about 5 percent of material, by volume.

The color of the A1 horizon ranges from gray to very dark grayish brown, and the reaction from medium acid to slightly acid. The color value of the A2 horizon is 1 or 2 points higher than that of the A1 horizon. The amount of shale fragments in the A horizon ranges from 20 to 40 percent. Shale fragments make up 50 percent or more of the B horizon. Reaction is medium acid to very strongly acid. The depth to hard shale is 12 to 20 inches.

In Pickens soils, more than 35 percent of the soil material is coarser than very fine sand. In the associated Claremore, Collinsville, and Talpa soils, such material makes up less than 35 percent.

**Pickens shaly loam, 3 to 15 percent slopes** (PcE).—This soil occurs on uplands. Included in mapping were areas where bedrock is at a depth of 20 to 30 inches. These areas make up 10 percent of the acreage.

This soil is suited to native range. The quality of the native grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit VIs–2; Shallow Savannah range site; woodland suitability group 4)

## Port Series

The Port series consists of deep, nearly level to very gently sloping, well-drained soils on flood plains. These soils are subject to flooding. They formed in loamy alluvium under native vegetation of trees and an understory of tall and mid grasses.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 26 inches thick. The next layer, to a depth of 44 inches, is dark-brown silty clay loam that is more firm than the layer above. The underlying material is brown clay loam.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Port silty clay loam, in a cultivated field, 2,685 feet east and 240 feet south of the northwest corner of sec. 17, T. 2 N., R. 7 E.

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; friable, mildly alkaline; clear, smooth boundary.

A1—9 to 26 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm; mildly alkaline; gradual, smooth boundary.

B—26 to 44 inches, dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure; hard, firm; neutral; gradual, smooth boundary.

C—44 to 72 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; massive; hard, firm; calcareous at a depth of 60 inches, with films and spots of lime.

The color of the A horizon ranges from gray to very dark brown. Reaction ranges from slightly acid to moderately alkaline. The texture of the B horizon is silt loam, loam, or silty clay loam.

The color of the B horizon ranges from grayish brown to dark yellowish brown. Reaction in the B horizon is neutral to moderately alkaline. The depth to lime concretions or spots is 20 to 60 inches.

Port soils have a more clayey profile than the associated Cleora soils. They are well drained and lack the mottles of the somewhat poorly drained associated Arkabutla soils. Port soils are calcareous at a depth of less than 60 inches, unlike the associated Verdigris soils.

**Port silty clay loam** (Po).—This soil occurs on flood plains. It is subject to damaging floods about once in 10 to 12 years. It has the profile described as representative of the series. Included in mapping were areas where the color throughout the soil is grayer, which make up 10 percent of the acreage, and areas where the subsoil is more clayey, which make up 10 percent. Also included were minor areas near stream channels where the profile is sandier.

This soil is suitable for small grains, grain sorghum, corn, cotton, alfalfa, tame pasture, range, and woodland. The main use is for alfalfa.

Management is needed to maintain soil structure and fertility and to protect the soil from damage by flooding from streams. Also needed are diversion terraces for diverting runoff from adjacent uplands. Crop residue should be returned to the soil. (Capability unit IIw–1; Loamy Bottomland range site; woodland suitability group 1)

**Port and Cleora soils, channeled** (Pr).—This undifferentiated group occurs on flood plains that are 50 to 200 yards wide, but ordinarily are about 125 yards wide. The soils are nearly level to very gently sloping. Stream channels meander from hill to hill, become clogged with debris, and flood when filled with rainwater. Damaging floods occur on an average of twice each year. The Cleora soils in this unit have the profile described as representative of the series. The Port soils have a profile similar to that described as representative of the Port series, except that the surface layer is stratified with very fine sand. Included in mapping were areas of Port silty clay loam, which make up 35 percent of the acreage, of Cleora silty clay loam, which make up 35 percent, and of Verdigris silt loam, which make up 10 percent. Also included were areas, which make up 20 percent of the acreage, where the surface layer is less than 10 inches thick and the color is gray to very dark brown.

Most of these areas consist of both Port and Cleora soils; some delineations, however, consist of only one of the soils.

These soils are suited to tame pasture and native range. The quality of the native grasses or tame pasture can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit Vw–2; Loamy Bottomland range site; woodland suitability group 1)

**Port and Cleora soils, frequently flooded** (Ps).—This undifferentiated group occurs on flood plains. The soils are nearly level. They are subject to damaging floods an average of once each year, but in some years they are flooded three times. If flooding is controlled by retarding structures, these soils have few, if any, limitations that restrict their use. Port silty clay loam makes up about 30 percent of the acreage, Cleora fine sandy loam makes up 30 percent, and Verdigris silt loam makes up 10 percent. Included in mapping were areas where the surface layer is less than 10 inches thick, which make up 20 percent of the acreage, and areas where more than 35 percent of the soil material at depths between 10 and 40 inches is clay. Most of these areas consist of both Port and Cleora soils; some delineations, however, consist of only one of the soils.

These soils are suited to tame pasture and native range. The quality of the native grasses or tame pasture can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soils from fire. (Capability unit Vw–2; Loamy Bottomland range site; woodland suitability group 1)

## Rock Outcrop

Rock outcrop is mapped in this county only as part of Talpa-Rock outcrop complex. This land type consists of exposures of bare limestone bedrock.

## Scullin Series

The Scullin series consists of moderately deep, very gently sloping to sloping, well-drained soils on uplands. These soils formed in material weathered from limestone and chert under tall and mid grasses.

In a representative profile the surface layer, to a depth of 6 inches, is dark-brown gravelly loam. About 15 percent, by volume, of this horizon is limestone gravel. The subsoil is 24 inches thick. The upper part, to a depth of 11 inches, is dark-brown gravelly clay loam. About 25 percent of this horizon is gravel. The middle part, to a depth of 18 inches, is dark reddish-brown clay. The lower part, to a depth of 30 inches, is dark reddish-brown gravelly silty clay. Limestone and chert fragments make up about 60 percent of this layer. Below this is hard limestone.

Permeability is moderately slow, and the available water capacity is moderate.

Representative profile of Scullin gravelly loam, from an area of Scullin-Talpa complex, 2 to 6 percent slopes, in an area of range, 810 feet north and 60 feet west of the southeast corner of sec. 23, T. 1 N., R. 6 E.

A1—0 to 6 inches, dark-brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; strong, medium, granular structure; firm, friable; 15 percent, by volume, of this horizon is limestone fragments that are 1/16 to 1/2 inch in diameter; slightly acid; gradual, wavy boundary.

B1—6 to 11 inches, dark-brown (7.5YR 4/2) gravelly clay loam, dark brown (7.5YR 3/2) moist; strong, very fine, subangular blocky structure; hard, very firm; 25 percent, by volume, of this horizon is limestone fragments 1/8 to 1 inch in diameter; slightly acid; gradual, wavy boundary.

B21t—11 to 18 inches, dark reddish-brown (2.5YR 3/4) clay, dark reddish brown (2.5YR 2/4) moist; strong, very fine, subangular blocky structure; 5 percent, by volume, of this horizon is limestone fragments 1/8 to 1 inch in diameter; extremely hard, very firm; clay films on ped faces; slightly acid; gradual, wavy boundary.

B22t—18 to 30 inches, dark reddish-brown (2.5YR 3/4) gravelly silty clay, dark reddish brown (2.5YR 2/4) moist; strong, very fine, subangular blocky structure; extremely hard, extremely firm; 60 percent, by volume, of this horizon is limestone and chert fragments 1/2 inch to 2 inches in diameter; clay films on ped faces; mildly alkaline; gradual, irregular boundary.

R—30 inches +, hard limestone that has 1/2-inch to 2-inch crevices extending to a depth of 3 or 4 feet and spaced 3 to 12 inches apart.

The texture of the A horizon is dominantly gravelly loam, but in some areas it is silt loam. The color of the A1 horizon ranges from very dark grayish brown to reddish brown. Gravel or fragments make up 5 to about 25 percent of this horizon. The color of the B2t horizon ranges from dark brown to dark red. Fragments make up 20 to about 65 percent, by volume, of the B horizon. The average amount of fragments in the uppermost 20 inches of the B horizon is less than 35 percent. The depth to fractured limestone ranges from 20 to 40 inches.

Scullin soils are deeper than the associated Talpa soils and are shallower than the associated Lula and Chigley soils.

**Scullin-Talpa complex, 2 to 6 percent slopes** (ScC).—This complex occurs on uplands. The Scullin soil has the profile described as representative of the series. About 70 percent of the complex is Scullin gravelly loam, and about 10 percent is Talpa stony silty clay loam. Limestone outcrops make up about 5 percent of the acreage. About 10 percent of the complex consists of areas where gravel makes up 50 percent of the subsoil. Included in mapping were small areas of Lula loam.

The primary use of this complex is for native range, although a small acreage is used for cotton, grain sorghum, and annual hay.

Management is needed to maintain fertility and soil structure, control water erosion, and conserve moisture. Terracing, contour farming, and using crop residue are needed to control water erosion, to conserve moisture, and to maintain fertility and soil structure. Crop residue should be returned to the soil, and excessive tillage should be avoided. (Capability unit IVe–2; woodland suitability group 4; Scullin soil in Loamy Prairie range site; Talpa soil in Very Shallow range site)

## Steedman Series

The Steedman series consists of moderately deep, gently sloping to sloping, well-drained soils on uplands. These soils formed in material weathered from shale under tall and mid grasses.

In a representative profile the surface layer is gray silty clay loam about 7 inches thick. The upper part of the subsoil, to a depth of 16 inches, is grayish-brown clay that has a few reddish-brown mottles. The lower part of the subsoil, to a depth of 35 inches, is light olive-brown clay that has lime concretions. The underlying material is gray, alkaline shale.

Permeability is slow, and the available water capacity is moderate to high.

Representative profile of Steedman silty clay loam, 3 to 8 percent slopes, 1,120 feet west and 660 feet south of the center of sec. 12, T. 3 N., R. 7 E.

A1—0 to 7 inches, gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate, medium, granular structure; hard, firm; medium acid; gradual, smooth boundary.

B21t—7 to 16 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; few, fine, prominent, reddish-brown mottles; moderate, medium, blocky structure; extremely hard, extremely firm; clay films on ped faces; slightly acid; gradual, smooth boundary.

B22t—16 to 35 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; moderate, coarse, blocky structure; extremely hard, extremely firm; clay films on ped faces; a few fine, cemented lime concretions and soft limy spots; moderately alkaline; gradual, wavy boundary.

C—35 inches +, gray (2.5Y 5/1) weakly laminar shale, dark gray (2.5Y 4/1) moist; moderately alkaline.

The color of the A horizon ranges from gray to very dark grayish brown. Reaction ranges from medium acid to neutral. The texture of the B2t horizon is clay or silty clay, and reaction ranges from slightly acid to moderately alkaline. The depth to lime concretions ranges from 10 to 30 inches. The depth to alkaline shale is 20 to 40 inches.

Steedman soils are more clayey than the associated Collinsville soils. They are shallower to shale or clay than the associated Dennis, Dwight, and Okemah soils.

**Steedman silty clay loam, 3 to 8 percent slopes** (SdD).—This soil occurs on uplands. Included in mapping were areas where the surface layer is thicker, which make up 10 percent of the acreage, and small areas of Okemah silty clay loam and Collinsville fine sandy loam.

This soil is 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 protecting the soil from fire. (Capability unit VIe–7; Loamy Prairie range site; woodland suitability group 4)

## Stephenville Series

The Stephenville series consists of moderately deep, very gently sloping to moderately steep, well-drained soils on uplands. These soils formed in material weathered from sandstone under forest vegetation and an understory of tall grasses.

In a representative profile the surface layer is pale-brown fine sandy loam to a depth of 6 inches. The subsurface horizon, to a depth of 11 inches, is very pale brown fine sandy loam. The upper part of the subsoil, to a depth of 24 inches, is yellowish-red sandy clay loam. The lower part of the subsoil, to a depth of 35 inches, is reddish-yellow sandy clay loam that has fine, red mottles. Below this is reddish-brown, acid sandstone.

Permeability is moderate, and the available water capacity is moderate to high.

Representative profile of Stephenville fine sandy loam, 3 to 5 percent slopes, 2,400 feet north and 45 feet west of the southeast corner of sec. 26, T. 4 N., R. 6 E.

Ap—0 to 6 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

A2—6 to 11 inches, very pale brown (10YR 7/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

B2t—11 to 24 inches, yellowish-red (5YR 5/8) sandy clay loam, yellowish red (5YR 4/8) moist; moderate, medium, subangular blocky structure; hard, firm; clay films on horizontal faces of peds; medium acid; gradual, smooth boundary.

B3—24 to 35 inches, reddish-yellow (5YR 6/8) sandy clay loam, yellowish red (5YR 5/8) moist; few, fine, faint, red mottles; weak, medium, subangular blocky structure; hard, firm; strongly acid; gradual, wavy boundary.

R—35 inches +, reddish-brown, acid sandstone.

The color of the Ap horizon ranges from light brownish gray to brown. The color value of the A2 horizon is one or two points higher than that of the A1 horizon. The texture of the B2t horizon is mostly sandy clay loam but ranges to sandy loam. The color of the B2t horizon ranges from light reddish brown to yellowish red, and reaction ranges from medium acid to strongly acid. The depth to sandstone ranges from 20 to 40 inches.

Stephenville soils are deeper than the associated Darnell soils, not so deep as the similar Konawa and Dougherty soils, and less clayey in the subsoil than the associated Windthorst soils.

**Stephenville fine sandy loam, 1 to 3 percent slopes** (StB).—This soil occurs on uplands. Included in mapping were areas where the subsoil is yellowish brown, which make up 10 percent of the acreage, and areas of Windthorst fine sandy loam, which make up 10 percent of the acreage. Also included were minor areas of Darnell fine sandy loam.

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

Management is needed to maintain fertility and soil structure and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from 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. Excessive tillage should be avoided. (Capability unit IIe-1; Sandy Savannah range site; woodland suitability group 2)

**Stephenville fine sandy loam, 3 to 5 percent slopes** (StC).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were areas where the subsoil is yellowish brown; areas of Windthorst fine sandy loam, which make up 10 percent of the acreage; and minor areas of Darnell fine sandy loam.

This soil is suited to cotton, peanuts, grain sorghum, tame pasture, range, and woodland. Tame pasture is the major use.

Management is needed to maintain fertility and soil structure, and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from blowing and water erosion. Terracing, contour farming, and using crop residue are needed to conserve moisture and maintain soil structure. (Capability unit IIIe-1; Sandy Savannah range site; woodland suitability group 2)

**Stephenville fine sandy loam, 2 to 5 percent slopes, eroded** (StC2) —This soil occurs on uplands. It has a profile similar to that described as representative for the series, but the combined thickness of the surface and subsurface layers is about 5 to 7 inches less. The present surface layer is a mixture of the surface layer and the subsoil through tillage. The reddish-yellow sandy clay loam subsoil is exposed in about 15 to 20 percent of the acreage. In many places there are shallow rills and gullies 6 to 18 inches deep and 150 to 400 feet apart.

Included in mapping were small areas of Windthorst fine sandy loam; areas where sandstone is at a depth of less than 20 inches, which make up 5 percent of the acreage; and areas where more yellowish colors occur in the subsoil, which make up 10 percent.

This soil is suited to cotton, peanuts, small grains, tame pasture, range, and woodland.

In managing this soil, protection of cultivated areas from severe rill and gully erosion is needed. Intensive management is needed to improve suitability of this soil for cultivation. Suitable practices are terracing, contour farming, returning crop residue, and adding fertilizer. Close-growing crops are better suited than row crops. (Capability unit IIIe-2; Sandy Savannah range site; woodland suitability group 3)

**Stephenville-Darnell fine sandy loams, 3 to 8 percent slopes** (SvD).—This complex occurs on uplands. About 50 percent of the acreage is Stephenville fine sandy loam, and 40 percent is Darnell fine sandy loam. About 10 percent is Windthorst fine sandy loam. There are minor areas of Rock outcrop, which occur as long, narrow strips 10 to 50 feet wide.

This complex is used primarily for range. Some of the acreage has been cleared and is used for tame pasture.

These soils are 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 protecting the soil from fire. (Capability unit VIe-8; woodland suitability group 3; Stephenville soil in Sandy Savannah range site; Darnell soil in Shallow Savannah range site)

## Talpa Series

The Talpa series consists of very shallow, very gently sloping to steep, well-drained soils on uplands. These soils formed in material weathered from limestone under grass vegetation.

In a representative profile the surface layer is dark grayish-brown silty clay loam to a depth of 4 inches. The next layer is a dark grayish-brown clay loam about 4 inches thick. Limestone fragments make up 30 percent of these layers. Below this is hard limestone.

Permeability is moderate, and the available water capacity is low.

Representative profile of Talpa stony silty clay loam, from an area of Talpa-Rock outcrop complex, 5 to 30 percent slopes, 2,640 feet east and 1,200 feet south of the northwest corner of sec. 21, T. 1 N., R. 5 E.

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong, medium, granular structure; slightly hard, friable; 20 percent, by volume, of this horizon is limestone fragments 10 to 20 inches in diameter; neutral; gradual, irregular boundary.

A12&C—4 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; slightly hard, friable; 30 percent, by volume, of this horizon is limestone fragments ½ inch to 3 inches across; moderately alkaline; abrupt, irregular boundary.

R—8 to 60 inches, hard limestone; fractured at intervals of about 1 foot.

The A horizon is silty clay loam, clay loam, or silt loam. Limestone fragments, 1 to 20 inches in diameter, make up as much as 25 percent, by volume, of the A11 horizon. The color of the A horizon ranges from dark grayish brown to brown. Reaction ranges from neutral to moderately alkaline. The depth to hard limestone ranges from 4 to about 10 inches. Fractures in the hard limestone are 1 to 3 feet apart.

Talpa soils are shallower than the associated Claremore soils and are more clayey than the similar Collinsville soils.

**Talpa-Rock outcrop complex, 5 to 30 percent slopes** (TrE).—This complex occurs on uplands. The Talpa soil has the profile described as representative of the series. About 75 percent of the acreage is Talpa stony silty clay loam, and 25 percent is Rock outcrop. Also included were a few small areas of Claremore loam and Lula loam.

This complex is suited to native range. The quality of the native grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit VIIs–2; Very Shallow range site; woodland suitability group 4)

## Vanoss Series

The Vanoss series consists of deep, nearly level to very gently sloping, well-drained soils on uplands or terraces. These soils formed in loamy alluvial sediments under tall and mid grasses.

In a representative profile the surface layer, to a depth of 14 inches, is brown and dark-brown silt loam. The subsoil, to a depth of 45 inches, is brown silty clay loam. The underlying material also is brown silty clay loam.

Permeability is moderate, and the available water capacity is high.

Representative profile of Vanoss silt loam, 0 to 1 percent slopes, in a field 1,720 feet north and 75 feet west of the southeast corner of sec. 23, T. 5 N., R. 8 E.



Ap—0 to 8 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak, medium, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

A12—8 to 14 inches, dark-brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; strong, medium, granular structure; slightly hard, friable; slightly acid; gradual, smooth boundary.

B2t—14 to 45 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; strong, medium, subangular blocky structure; hard, firm; clay films on ped surfaces; slightly acid; gradual, smooth boundary.

C—45 to 85 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; massive; hard, firm; slightly acid.

The color of the A horizon ranges from grayish brown to dark brown. Reaction ranges from moderately alkaline in limed fields to medium acid in unlimed fields. The texture of the B2t horizon ranges from clay loam to silty clay loam. The color of the B2t horizon ranges from brown to dark brown. Reaction in this horizon ranges from slightly acid to mildly alkaline.

Vanoss soils are deeper than the similar Bates soils, and they have a more silty B horizon than those soils or the similar Fitzhugh soils. They have a more silty, less reddish B horizon than the associated Konawa soils, and they lack the A2 horizon that those soils have.

**Vanoss silt loam, 0 to 1 percent slopes** (VaA).—This soil occurs on uplands or terraces. It has the profile described as representative of the series. Included in mapping were areas that have a more sandy subsoil, which make up about 20 percent of the acreage; minor areas of Konawa fine sandy loam; and a few areas where the surface layer is loam.

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

Management is needed to maintain fertility and soil structure. This can be done by 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 suitability group 2)

**Vanoss silt loam, 1 to 3 percent slopes** (VaB).—This soil occurs on uplands or terraces. Included in mapping were areas of Konawa fine sandy loam, which make up 10 percent of the acreage; areas where the subsoil is more sandy, which make up 10 percent; and a few areas where the surface layer is loam.

This soil is suited to small grains, peanuts, corn, grain sorghum (fig. 14), cotton, alfalfa, tame pasture, range, and woodland.

Management is needed to maintain fertility and soil structure, and to protect the soil from erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, and using crop residue. Plant cover is needed during winter and spring to protect the soil from 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 suitability group 2)

## Verdigris Series

The Verdigris series consists of deep, moderately well drained soils on flood plains. These soils are nearly level. They are subject to damaging floods.

*Figure 14.*—**Grain sorghum on Vanoss silt loam, 1 to 3 percent slopes.**

In a representative profile the surface layer, to a depth of 22 inches, is grayish-brown silt loam. The next layer, to a depth of 42 inches, is gray silty clay loam that has yellowish-brown mottles in the lower part. The underlying material is gray silty clay loam.

Permeability is moderate, and the available water capacity is high.

Representative profile of Verdigris silt loam, 2,375 feet west and 140 feet south of the northeast corner of sec. 34, T. 3 N., R. 8 E.

Ap—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine and medium, granular structure; slightly hard, friable; medium acid; clear, smooth boundary.

A12—8 to 22 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; hard, friable; slightly acid; gradual, smooth boundary.

AC—22 to 42 inches, gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) moist; few, fine, faint, yellowish-brown mottles in lower part of horizon; moderate, medium, subangular blocky structure; hard, firm; slightly acid; gradual, smooth boundary.

C—42 to 80 inches, gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) moist; common, medium, faint, yellowish-brown (10YR 5/4) mottles; massive; hard, firm; strongly acid.

The color of the A horizon ranges from very dark gray to grayish brown. Reaction is slightly acid or medium acid. The AC horizon ranges from silt loam to silty clay loam in texture and from gray to dark grayish brown in color.

Verdigris soils have a less sandy AC horizon than the associated Cleora soils.

**Verdigris silt loam** (Vg).—This soil occurs on flood plains. It is subject to damaging floods that occur on an average of once in 1 to 5 years. This soil has the profile described as representative of the series. Included in mapping were areas of Arkabutla silty clay loam, which make up 5 percent of the acreage; areas of Cleora fine sandy loam, which make up 10 percent of the acreage; a few areas where the surface layer is less than 20 inches thick; and a few areas where the surface layer is silty clay loam.

This soil is suitable for alfalfa, cotton, peanuts, corn, small grains, grain sorghum, tame pasture, range, and woodland. It is used mainly for tame pasture and alfalfa.

Management is needed to maintain soil structure and fertility and to protect the soil from damage by flooding. Also needed are diversion terraces for diverting runoff from adjacent uplands. Crop residue should be returned to the soil. (Capability unit IIw-1; Loamy Bottomland range site; woodland suitability group 1)

## Vernon Series

The Vernon series consists of moderately deep, gently sloping to strongly sloping, well-drained soils on uplands. These soils formed in material weathered from clay and shale under short and mid grasses.

In a representative profile the surface layer, to a depth of 5 inches, is reddish-brown clay. The next layer, to a depth of 16 inches, also is reddish-brown clay. The underlying material is reddish-brown, laminated clay that has thin layers of light-gray, soft, calcareous shale.

Permeability is slow, and the available water capacity is moderate.

Representative profile of Vernon clay, 3 to 5 percent slopes, in a pasture 1,590 feet south and 30 feet east of the northwest corner of sec. 19, T. 5 N., R. 5 E.

A1—0 to 5 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; strong, fine, subangular blocky structure; very hard, very firm; mildly alkaline; clear, smooth boundary.
B—5 to 16 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong, fine and medium, subangular blocky structure; very hard, very firm; calcareous; moderately alkaline; gradual, wavy boundary.
C—16 to 30 inches +, laminated reddish-brown (5YR 4/3) clay that has thin strata of light-gray, soft shale; massive; very hard, very firm; calcareous; moderately alkaline.

The color of the A1 horizon ranges from reddish brown to red, and the color of the B horizon ranges from reddish brown to brown. The depth to soft, shaly clay is 14 to 20 inches.

Vernon soils have a thinner solum and a redder surface layer than the associated Clarita soils.

**Vernon clay, 3 to 5 percent slopes** (VrC).—This soil occurs on uplands. It has the profile described as representative of the series. Included in mapping were areas of Clarita clay, which make up about 20 percent of the acreage; minor areas of Durant loam; minor areas where the surface layer is clay loam; and minor areas that are less than 14 inches deep to soft, shaly clay.

This soil is suitable for grain sorghum, small grains, range, and tame pasture.

Management is needed to improve or maintain soil structure and fertility, reduce crusting, increase water intake, and control water erosion. A cropping system is needed to provide crops that produce large amounts of residue, which can be returned to the soil to maintain soil structure and fertility, increase water intake, and limit surface crusting. Tillage is difficult because of the clayey material. It should be timely and kept to a minimum. Terracing and contour farming are needed. (Capability unit IVe–6; Red Clay Prairie range site; woodland suitability group 4)

**Vernon clay, 5 to 12 percent slopes** (VrD).—This soil occurs on uplands. Included in mapping were small areas where the surface layer is grayer than is typical, minor areas of Rock outcrop, a few areas where the surface layer is clay loam, and a few areas that are less than 14 inches deep over soft, shaly clay.

This soil is 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 protecting the soil from fire. (Capability unit VIe–9; Red Clay Prairie range site; woodland suitability group 4)

**Vernon clay, 3 to 8 percent slopes, severely eroded** (VrD3).—This soil occurs on uplands. Most of the original surface layer has been removed by erosion. Gullies, 2 to 30 feet in width and 6 inches to 6 feet in depth, occur on an average of every 120 feet. They make up 15 to 20 percent of the acreage. Included in mapping were areas where the surface layer is grayer than is typical. The included areas make up 20 percent of the acreage.

This soil is so severely eroded that it is not suitable for cultivation. It should be returned to permanent vegetation. Additions of fertilizer, sloping of gully banks, diversion of water from higher lying soils, and mulching are needed for successful establishment of tame pasture or range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit VIe–10; Eroded Red Clay range site; woodland suitability group 4)

## Windthorst Series

The Windthorst series consists of deep, very gently sloping to sloping, moderately well drained soils on uplands. These soils formed in material weathered from interbedded sandstone and clay under forest vegetation and an understory of grasses.

In a representative profile the surface layer is brown fine sandy loam about 4 inches thick. The subsurface layer, to a depth of 8 inches, is very pale brown fine sandy loam. The upper part of the subsoil, to a depth of 34 inches, is yellowish-red clay that has red and very pale brown mottles. The lower part of the subsoil, to a depth of 47 inches, is very pale brown sandy clay. Below this is interbedded sandstone and clay.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Windthorst fine sandy loam, 2 to 5 percent slopes, in a woodland 1,520 feet north and 50 feet west of the southeast corner of the SW¼ sec. 28, T. 4 N., R. 7 E.

A1—0 to 4 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.
A2—4 to 8 inches, very pale brown (10YR 8/3) fine sandy loam, pale brown (10YR 6/3) moist; weak, fine, granular structure; very friable; strongly acid; abrupt, wavy boundary.
B21t—8 to 18 inches, yellowish-red (5YR 5/8) clay, yellowish red (5YR 4/8) moist; strong, fine and very fine, blocky structure; hard, firm; clay films on ped faces; strongly acid; gradual, smooth boundary.
B22t—18 to 34 inches, yellowish-red (5YR 5/8) clay, yellowish red (5YR 4/8) moist; common, medium and fine, distinct, red (2.5YR 5/6) and very pale brown (10YR 7/3) mottles; moderate, medium, blocky structure; very hard, very firm; clay films coat ped surfaces; strongly acid; gradual, smooth boundary.
B23t—34 to 47 inches, very pale brown (10YR 7/3) sandy clay, brown (10YR 5/3) moist; common, medium, faint, brownish-yellow (10YR 6/6) mottles; weak, medium, subangular blocky structure; hard, firm; clay films on ped faces; few soft sandstone fragments; medium acid; abrupt, irregular boundary.
R—47 inches +, acid sandstone and clay.

The color of the A1 horizon ranges from light gray to brown, and the color value of the A2 horizon is one or two points higher. Reaction in the A horizon ranges from slightly acid to strongly acid. The texture of the B2t horizon is clay or sandy clay. The color ranges from yellowish red, reddish yellow and reddish brown to pale brown and very pale brown. Reaction in the B2t horizon ranges from medium acid to strongly acid. The depth to bedrock ranges from 40 to 60 inches.

Windthorst soils have less gravel in the surface layer than the associated Chigley soils, and they have a more clayey subsoil than the associated Stephenville soils.

**Windthorst fine sandy loam, 2 to 5 percent slopes** (WhC).—This soil occurs on uplands. It has the profile described as representative of the series (fig. 15). Included in mapping were areas of Stephenville fine sandy loam, which make up 10 percent of the acreage. In 20 percent of the included acreage, the surface layer has been lost through erosion and the subsoil is exposed.

This soil is suited to peanuts, cotton, tame pasture, range, and woodland.

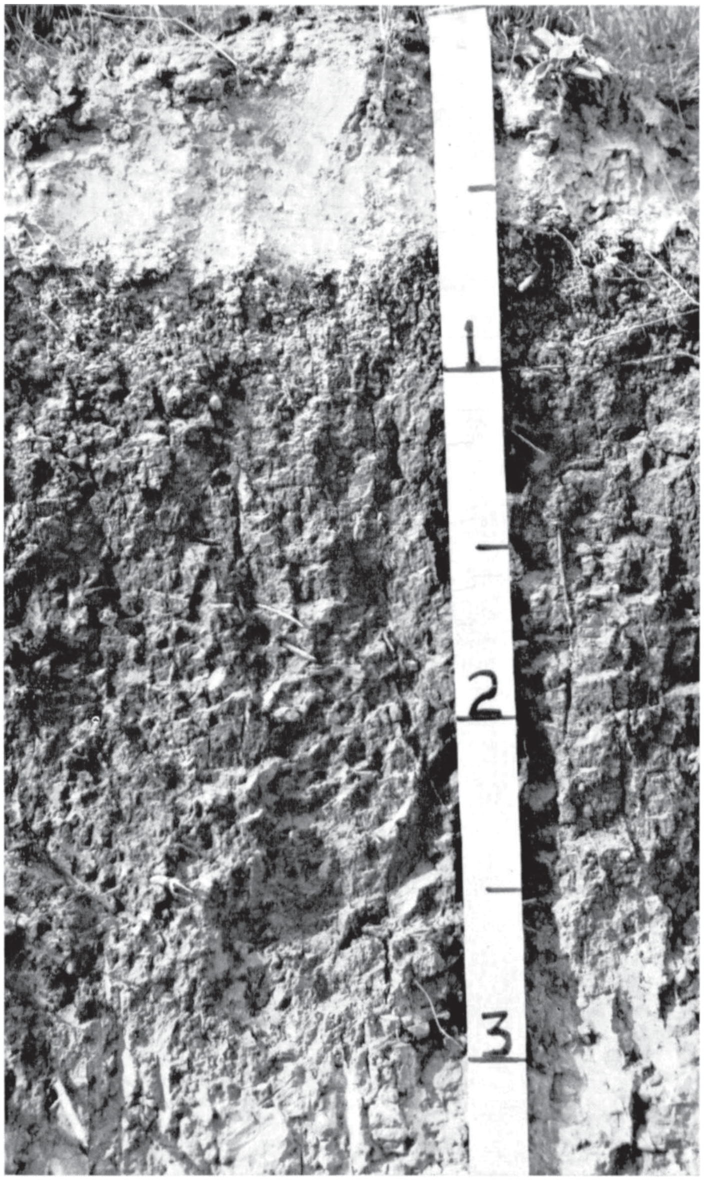


*Figure 15.*—**Profile of Windthorst fine sandy loam.**

Management is needed to maintain or improve soil structure and fertility, increase the water intake rate, and control erosion. Terracing, contour farming, stripcropping, and using crop residue help to control erosion, increase water intake, and improve soil structure and fertility. (Capability unit IIIe-7; Sandy Savannah range site; woodland suitability group 3)

**Windthorst-Stephenville complex, 2 to 6 percent slopes, severely eroded** (WkC3).—This complex occurs on uplands. In about 30 percent of the acreage, the surface layer is less than 3 inches thick. In many places all of the original surface layer has been removed by erosion and the clay or sandy clay loam subsoil is exposed. Gullies occur at intervals averaging 150 feet apart.

About 47 percent of the complex is Windthorst fine sandy loam and 23 percent is Stephenville fine sandy loam. Gullies make up 20 percent of the acreage. Areas where the depth to sandstone and clay is less than 20 inches make up 10 percent of the complex.

These soils are so severely eroded that they are not suitable for cultivation. They should be returned to permanent vegetation. Additions of fertilizer, sloping of gully banks, diversion of overhead water, and mulching are needed for successful establishment of tame pasture or range. The quality of the grasses can be maintained or improved by controlling brush, following suitable grazing practices, and protecting the soil from fire. (Capability unit VIe-2; Eroded Sandy Savannah range site; woodland suitability group 4)

## Woodson Series

The Woodson series consists of deep, nearly level, moderately well drained to somewhat poorly drained soils on uplands. These soils formed in material weathered from clay and soft shale under grass vegetation.

In a representative profile the surface layer is dark-gray silt loam to a depth of 13 inches. The upper part of the subsoil, to a depth of 30 inches, is dark-gray silty clay. The middle part, to a depth of 46 inches, is gray silty clay. The lower part, to a depth of 60 inches, is light olive-brown silty clay.

Permeability is very slow, and the available water capacity is high.

Representative profile of Woodson silt loam, 0 to 1 percent slopes, 550 feet south and 165 feet west of the northeast corner of sec. 35, T. 3 N., R. 6 E.

A1—0 to 13 inches, dark-gray (10YR 4/1) silt loam; very dark gray (10YR 3/1) moist; weak, coarse, granular structure; slightly hard, firm; slightly acid; clear, smooth boundary.

B21tg—13 to 30 inches, dark-gray (10YR 4/1) silty clay; very dark gray (10YR 3/1) moist; moderate, medium, blocky structure; very hard, very firm; clay films coat ped surfaces; silt coatings in uppermost 3 inches; slightly acid; gradual, smooth boundary.

B22tg—30 to 46 inches, gray (10YR 6/1) silty clay, gray (10YR 5/1) moist; many, fine, distinct mottles of brown; weak, coarse, blocky structure; extremely hard, extremely firm; clay films coat surfaces of peds; small pockets of gypsum; neutral; gradual, smooth boundary.

B3—46 to 60 inches, light olive-brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; massive; extremely hard, extremely firm; few fine cemented calcium carbonate concretions; moderately alkaline.

The color of the A horizon ranges from very dark gray to dark gray. The B horizon ranges from clay to silty clay in texture. The uppermost part of the B2t horizon ranges from dark gray to very dark gray in color. The color of the B3 horizon ranges from grayish brown to olive. The depth to shale or unweathered clay is more than 60 inches.

Woodson soils have a grayer A horizon than the associated Parsons soils and lack the A2 horizon that characterizes those soils. They have a grayer B2t horizon than the associated Durant soils.

**Woodson silt loam, 0 to 1 percent slopes** (WoA).—This soil occurs on uplands. Included in mapping were areas of Okemah silty clay loam, which make up 10 percent of the acreage, and of Parsons silt loam, which make up 10 percent. Also included were minor areas of Dwight silt loam and a few areas where the surface layer is silty clay loam.

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

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

## Yahola Series

The Yahola series consists of deep, nearly level to very gently sloping, well-drained soils on flood plains. These soils are subject to damaging flooding.

In a representative profile the surface layer, to a depth of 15 inches, is brown fine sandy loam. The next layer, to a depth of 41 inches, is brown fine sandy loam that has thin strata of clay loam and loamy sand. Below this layer is light-brown loamy fine sand grading to fine sand at a depth of 55 inches.

Permeability is moderately rapid, and the available water capacity is high.

Representative profile of Yahola fine sandy loam, 660 feet south and 105 feet west of the northeast corner of sec. 9, T. 5 N., R. 6 E.

A1—0 to 15 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak, fine, granular structure; soft, very friable; calcareous; gradual, wavy boundary.

C1—15 to 41 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable; stratified with thin strata (1 to 6 inches thick) of dark-brown clay loam and light-brown loamy sand; average texture is fine sandy loam; calcareous; moderately alkaline.

C2—41 to 65 inches, light-brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; massive; loose; grades to fine sand at a depth of 55 inches; calcareous; moderately alkaline.

The texture of the A horizon is fine sandy loam or clay loam. The color of the A horizon ranges from grayish brown to reddish brown, and the color of the C1 horizon ranges from brown to reddish brown. The C1 horizon is stratified, but the average texture is fine sandy loam to light loam. The texture of the C2 horizon ranges from fine sand to clay loam.

Yahola soils are less sandy than the associated Lincoln soils. They are more sandy than the associated Verdigris or Port soils. They are redder than the associated Cleora soils, which are noncalcareous.

**Yahola clay loam** (Yc).—This soil occurs on concave flood plains adjacent to uplands. It is subject to damaging floods once in 1 to 5 years. It receives runoff from higher lying soils, which creates a wetness problem. Except for the clay loam surface layer, this soil has a profile similar to the one described as representative of the series. Included in mapping were areas where the soil has a lower chroma in the surface layer. Also included were minor areas where the average texture is clay loam at depths between 10 and 40 inches.

This soil is suitable for grain sorghum, corn, cotton, alfalfa, tame pasture, range, and woodland.

Management is needed to maintain soil structure and fertility and to protect the soil from damage by flooding. Also needed are terraces for diverting runoff from adjacent uplands. Crop residue needs to be returned to the soil. (Capability unit IIw-1; Loamy Bottomland range site; woodland suitability group 1)

**Yahola fine sandy loam** (Yf).—This soil occurs on flood plains. It is nearly level to very gently sloping. It is subject to damaging flooding once in 1 to 5 years. It has the profile described as representative of the series.

Included in mapping were areas, which make up 10 percent of the acreage, that are less reddish in color and are loamy fine sand in texture. Also included were areas, which make up 15 percent of the acreage, where the surface layer is noncalcareous. In addition, areas were included where the surface layer is grayer and the chroma is lower; these areas make up 7 percent of the acreage.

These soils are suitable for cotton, corn, alfalfa, grain sorghum, peanuts, tame pasture, range, and woodland.

Management is needed to maintain soil structure and fertility, to protect the soil from damage by flooding, and to protect the soil from blowing. Also needed are terraces for diverting runoff from adjacent uplands. Crop residue needs to be returned to the soil. Plant cover is needed during winter and spring to protect the soil from blowing. (Capability unit IIw-2; Loamy Bottomland range site; woodland suitability group 1)

# *Use and Management of the Soils*

This section contains information about the use and management of the soils of Pontotoc County for cultivated crops and tame pasture, range, woodland, wildlife habitat, and engineering. It explains the system of capability classification used by the Soil Conservation Service and gives predicted yields of the principal crops grown in the county under two levels of management. The capability classification of each soil mapped in the county can be learned by referring to the "Guide to Mapping Units." Information about its management is given in the section "Descriptions of the Soils."

This section also groups the soils according to their suitability for range and for woodland, and it discusses the use of the soils for wildlife habitat. In addition, it contains tables that give information about soils significant in engineering.

## Management of the Soils for Crops and Pasture [3]

General practices of management appropriate for nearly all the soils of Pontotoc County are given in this section. Those practices that apply to production of cultivated crops are discussed first, and then those for tame pasture.

### *Management for cultivated crops*

The main limitations of the soils of the county for cultivated crops are the hazard of erosion and the lack of moisture. The main management needs are protection against erosion, conservation of moisture, and maintenance of fertility, organic-matter content, and tilth.

Beneficial practices on most of the cultivated soils of this county include minimum tillage and timely tillage, maximum use of soil-improving crops, minimum use of soil-depleting crops, and utilization of crop residue.

Minimum tillage of all cropped soils is necessary in preparing a seedbed and providing a favorable place for growth of plants. Excessive tillage of such soils as those of the Parsons, Dennis, and Bates series breaks down soil structure and increases soil compaction, surface crusting,

[3] By E. O. HILL, conservation agronomist, and KENNETH YOAKUM, work unit conservationist, Soil Conservation Service.

and the tendency of these soils to puddle. If the Arkabutla soils, for example, are tilled when too wet or too dry, the soil structure breaks down and the surface puddles and crusts. As a result, the capacity of these soils to absorb and store water is impaired. Tilling constantly to the same depth results in the formation of a plowpan in such soils as those of the Vanoss, Bates, and Stephenville series. Varying the depth of tillage and growing deep-rooted legumes and grasses help to prevent formation of a pan and to break up existing pans.

Soil-improving crops are grown on such upland soils as those of the Durant and Konawa series to maintain or improve the physical condition of the soil, control erosion, and maintain fertility. Grasses, legumes, and such other crops as grain sorghum or corn, which produce large amounts of residue, are common soil-improving crops. The crop residue improves tilth of the surface layer, and this, in turn, increases the rate of infiltration and the capacity to store water, controls erosion, and helps to limit crusting. If large amounts of crop residue are worked into the soil, it is desirable to apply 20 to 40 pounds of nitrogen to aid decomposition and ensure adequate available nitrogen for the succeeding crop.

Crops that produce low amounts of residue are soil-depleting crops. The removal of all crop residue and growing clean-tilled crops, especially on the eroded Bates and Konawa soils, leaves the soils susceptible to erosion, deterioration of structure, and reduction of the organic-matter content.

Cover crops are needed for soils such as Konawa loamy fine sand where insufficient residue is left to control wind or water erosion. Vetch and rye or vetch and other small grains are cool-season crops commonly grown as cover crops after peanuts are harvested.

Field terraces, diversion terraces, and grassed waterways are among effective measures used to reduce soil loss on such gently sloping soils as those of the Dennis, Bates, and Fitzhugh series. Contour farming is necessary for efficient control of erosion and for maintenance of terraces and waterways.

Most of the cultivated soils respond to fertilizer and lime. Many eroded soils, such as those of the Dennis and Konawa series, which have been intensively used for soil-depleting crops for many years, are low in fertility. Where alfalfa, sweetclover, or other plants that require much lime are to be grown, applications of lime are needed.

Fertilizer and lime should be applied according to recent recommendations of representatives of local agricultural agencies. The amount should be based on the needs of the crop to be grown, production level desired, inherent productivity of the soil, past use and treatment, and other known factors.

There are other problems that are serious locally although minor on a county-wide basis. These include flooding on bottom-land soils of the Port, Verdigris, and Yahola series and lack of adequate surface drainage on the somewhat poorly drained Arkabutla soils.

### *Management for tame pasture*

Tame pasture is grown on a large acreage in this county. Desirable perennial grasses control excessive erosion and provide palatable forage for livestock. Table 4 shows the suitability of the soils for four tame pasture grasses. In the table a rating of good means that there are no special problems in establishing a stand of grass, and, under good management, production is high. A rating of fair means that the kind of grass can be grown, but good management is needed to obtain average yields. A rating of poor means that the kind of grass can be grown, but that severe problems can be expected in establishing stands. A rating of unsuited means that the kind of grass is not suited to the soils.

Suitable forage plants include bermudagrass, which is suited to most soils of the county and is more widely grown than other tame grasses. Bermudagrass grows well on Stephenville fine sandy loam and Konawa loamy fine sand, for example, and the pastures usually provide green forage from early in May through October. It may be grown alone, but commonly is grown in a mixture with such legumes as Korean lespedeza, black medic, or yellow hop clover. Under good management, on the better soils, improved bermudagrass varieties normally produce 20 to 25 percent more forage than common bermudagrass.

Other common tame pasture grasses are King Ranch bluestem and lovegrass. King Ranch bluestem is better suited to those soils that have a finer texture, where bermudagrass has difficulty establishing a good cover. The deeper rooting system of King Ranch bluestem makes it more resistant to prolonged dry periods and to soils that are naturally droughty, such as Heiden clay.

Soils that have a sandy texture, such as Eufaula loamy fine sand, are better suited to lovegrass than to other tame grasses. Lovegrass is used extensively for stabilization of highway banks in sandy areas. It provides summer grazing but must be kept short, or else it becomes unpalatable.

Tall fescue provides green forage late in fall and early in spring, when bermudagrass is dormant. This grass can also be grazed in May, in June, and early in fall. It is suited to soils that have good fertility and moisture conditions, such as Port silty clay loam. Sericea lespedeza and other legumes are grown in a solid stand for hay and pasture. Annual crops, such as rye and oats, are used for temporary cool-season pasture; sudangrass is used for summer pasture and hay.

Proper use of pasture is necessary if optimum production is desired. Overgrazing reduces the amount of forage produced and may cause loss of the stand. Livestock should be excluded from cool-season pastures during July and August to increase plant vigor. Four to six inches of top growth reduces damage from the hot sun. Controlling undesirable vegetation, applying fertilizer, providing adequate water, rotating the grazing, and proper stocking, aid in proper use of the range. Onsite investigation is needed to select sites suitable for farm ponds on such soils as Dougherty and Eufaula loamy fine sands.

Tame pasture is more successful when fertilized properly. Fertilizer usually is needed for establishment of stands of perennial pasture crops and for maintaining production.

Forested soils, such as those of the Windthorst and Konawa series, must have brush and weed control or pasture plants will be crowded out in a few years. Weeds can be controlled through use of chemicals, mechanical equipment, or a combination of both. Prairie soils, such as Dennis loam, need weed control for maximum production of forage.

TABLE 4.—*Suitability of the soils for commonly grown tame pasture grasses*

| Soil series and map symbols | Bermudagrass | King Ranch bluestem | Weeping lovegrass | Fescue |
|---|---|---|---|---|
| Arkabutla: Ar | Fair | Good | Fair | Good. |
| Bates: BaB, BaC, BaC2 | Good | Good | Good | Fair. |
| Burleson: BuB | Poor | Good | Fair | Poor. |
| Chigley: | | | | |
| CgC, CgD | Fair | Good | Fair | Unsuited. |
| ChD3 | Poor | Fair | Fair | Unsuited. |
| Claremore: ClC | Fair | Good | Fair | Unsuited. |
| Clarita: CnC | Unsuited | Good | Fair | Poor. |
| Collinsville: CoC | Fair | Fair | Fair | Unsuited. |
| Darnell: DaE | Poor | Unsuited | Poor | Unsuited. |
| Dennis: DeB, DeC, DeC2 | Good | Good | Good | Fair. |
| Dougherty: | | | | |
| DoB, DoD | Good | Unsuited | Good | Unsuited. |
| DrE | Poor | Unsuited | Good | Unsuited. |
| Durant: | | | | |
| DuB, DuC | Fair | Good | Fair | Fair. |
| DuC2 | Poor | Good | Fair | Poor. |
| DvC3 | Poor | Good | Poor | Unsuited. |
| Dwight: DwA | Poor | Fair | Poor | Poor. |
| Eufaula: EuB | Fair | Unsuited | Fair | Unsuited. |
| Fitzhugh: FhB, FhC, FhC2 | Good | Good | Good | Fair. |
| Galey: GaB | Good | Fair | Good | Unsuited. |
| Heiden: | | | | |
| HeC | Unsuited | Good | Fair | Unsuited. |
| HeD | Unsuited | Good | Fair | Poor. |
| Hilgrave: HgC | Fair | Good | Unsuited | Unsuited. |
| Konawa: | | | | |
| KoA, KoB, KoC, KsD | Good | Good | Good | Fair. |
| KsD2 | Good | Fair | Fair | Unsuited. |
| KtD3 | Fair | Unsuited | Fair | Unsuited. |
| Lincoln: Ln | Fair | Poor | Fair | Unsuited. |
| Lula: | | | | |
| LuB, LuC, LuC2 | Good | Good | Good | Fair. |
| LxC | Unsuited | Fair | Unsuited | Unsuited. |
| Okemah: OkB | Good | Good | Good | Good. |
| Parsons: PaA, PaB | Fair | Good | Fair | Fair. |
| Pickens: PcE | Unsuited | Poor | Poor | Unsuited. |
| Port: | | | | |
| Po | Good | Good | Good | Good. |
| Pr, Ps | Good | Unsuited | Unsuited | Good. |
| Scullin: ScC | Fair | Good | Fair | Unsuited. |
| Steedman: SdD | Unsuited | Good | Fair | Unsuited. |
| Stephenville: | | | | |
| StB, StC, StC2 | Good | Fair | Good | Poor. |
| SvD | Fair | Fair | Fair | Unsuited. |
| Talpa: TrE | Unsuited | Unsuited | Unsuited | Unsuited. |
| Vanoss: VaA, VaB | Good | Good | Good | Good. |
| Verdigris: Vg | Good | Good | Good | Good. |
| Vernon: VrC, VrD, VrD3 | Unsuited | Fair | Unsuited | Unsuited. |
| Windthorst: | | | | |
| WhC | Fair | Fair | Good | Unsuited. |
| WkC3 | Fair | Fair | Fair | Unsuited. |
| Woodson: WoA | Fair | Good | Fair | Good. |
| Yahola: | | | | |
| Yc | Good | Good | Fair | Good. |
| Yf | Good | Good | Good | Poor. |

## Capability Grouping

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

The capability groups are made according to the limitations 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 for engineering.

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

Capability Classes, the broadest groups, 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 their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-2, or IIIe-6. 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.

The classes, subclasses, and units are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.
- (No subclasses)
  - Unit I-1. Deep, nearly level, well-drained soils that are loamy throughout; on 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 that are subject to moderate erosion if not protected.
  - Unit IIe-1. Deep and moderately deep, very gently sloping, well-drained soils that are loamy throughout; on uplands and terraces.
  - Unit IIe-2. Deep, very gently sloping, moderately well-drained soils that are clayey throughout; on uplands.
  - Unit IIe-3. Deep, very gently sloping, moderately well-drained, loamy soils that have a loamy and clayey subsoil; on uplands.
- Subclass IIw. Soils that have moderate limitations because of seasonal flooding.
  - Unit IIw-1. Deep, nearly level, well-drained to moderately well-drained, moderately rapidly permeable to moderately slowly permeable soils that are loamy throughout; on flood plains.
  - Unit IIw-2. Deep, nearly level to very gently sloping, well-drained, moderately rapidly permeable soils that are loamy throughout; on flood plains.
- Subclass IIs. Soils that have moderate limitations because of very slow permeability.
  - Unit IIs-1. Deep, nearly level, somewhat poorly drained to moderately well drained, loamy soils that have a clayey subsoil; on uplands.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Subclass IIIe. Soils that are subject to severe erosion if they are not protected.
  - Unit IIIe-1. Deep and moderately deep, gently sloping, well-drained soils that are loamy throughout; on uplands.
  - Unit IIIe-2. Deep and moderately deep, very gently sloping to gently sloping, well-drained, moderately eroded soils that are loamy throughout; on uplands.
  - Unit IIIe-3. Deep, very gently sloping to gently sloping, well drained and moderately well drained soils that are clayey throughout; on uplands.
  - Unit IIIe-4. Deep, gently sloping, moderately well drained, loamy soils that have a loamy to clayey subsoil; on uplands.
  - Unit IIIe-5. Deep, very gently sloping, well-drained, sandy soils that have a loamy subsoil; on uplands.
  - Unit IIIe-6. Deep, very gently sloping, somewhat poorly drained to moderately well drained, very slowly permeable, loamy soils that have a clayey subsoil; on uplands.
  - Unit IIIe-7. Deep, very gently sloping to gently sloping, moderately well drained, moderately permeable, loamy soils that have a clayey subsoil; on uplands.
- Subclass IIIw. Soils that have severe limitations because of excess water.
  - Unit IIIw-1. Deep, nearly level, somewhat poorly drained soils that are clayey throughout; on flood plains.

Class IV. Soils that have very severe limitations that reduce 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 and moderately deep, very gently sloping to gently sloping, well drained to moderately well drained, loamy soils that have a loamy to clayey subsoil; on uplands.
  - Unit IVe-2. Very gently sloping to sloping, well-drained, very shallow to shallow soils that are loamy throughout; and moderately deep, loamy soils that have a loamy and clayey subsoil; on uplands.

Unit IVe-3. Deep, gently sloping to sloping, well-drained, sandy soils that have a loamy subsoil; on uplands.

Unit IVe-4. Deep, very gently sloping to gently sloping, moderately well drained, moderately eroded, loamy soils that have a loamy and clayey subsoil; on uplands.

Unit IVe-5. Deep, gently sloping to sloping, well-drained, moderately eroded, sandy soils that have a loamy subsoil; on uplands.

Unit IVe-6. Moderately deep, gently sloping, well-drained soils that are clayey throughout; on uplands.

Subclass IVs. Soils that have very severe limitations because of high sodium content, low available water capacity, or other soil features.

Unit IVs-1. Deep, nearly level, moderately well drained, loamy soils that have a clayey subsoil; on uplands.

Unit IVs-2. Deep, nearly level to very gently sloping, somewhat excessively drained soils that are sandy throughout.

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

Subclass Vw. Soils that are subject to frequent flooding.

Unit Vw-1. Deep, nearly level to very gently sloping, somewhat excessively drained, sandy and loamy soils that have a sandy underlying material; on flood plains.

Unit Vw-2. Deep, nearly level to very gently sloping, well-drained soils that are loamy throughout; on flood plains.

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

Subclass VIe. Soils that are limited chiefly by risk of erosion if protective cover is not maintained.

Unit VIe-1. Deep, sloping to strongly sloping, moderately well drained, loamy soils that have a loamy to clayey subsoil; on uplands.

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

Unit VIe-3. Shallow, very gently sloping to gently sloping, well drained to somewhat excessively drained soils that are loamy throughout; on uplands.

Unit VIe-4. Deep, strongly sloping to moderately steep, well drained and somewhat excessively drained, sandy soils that have a loamy subsoil, and soils that are sandy throughout; on uplands.

Unit VIe-5. Deep to moderately deep, very gently sloping to sloping, well drained to moderately well drained, severely eroded, loamy soils that have a loamy to clayey subsoil, and soils that are loamy throughout; on uplands.

Unit VIe-6. Deep, sloping to strongly sloping, well-drained soils that are clayey throughout; on uplands.



Unit VIe-7. Moderately deep, gently sloping to sloping, well-drained, loamy soils that have a clayey subsoil; on uplands.

Unit VIe-8. Moderately deep to shallow, well drained to somewhat excessively drained soils that are loamy throughout; on uplands.

Unit VIe-9. Moderately deep, sloping to strongly sloping, well-drained soils that are clayey throughout; on uplands.

Unit VIe-10. Moderately deep, gently sloping to sloping, well-drained, severely eroded soils that are clayey throughout; on uplands.

Subclass VIs. Soils that have severe limitations because of depth to hard, underlying material.

Unit VIs-1. Deep to very shallow, very gently sloping to sloping, well-drained soils that are loamy throughout; on uplands.

Unit VIs-2. Shallow, gently sloping to strongly sloping, somewhat excessively drained soils that are loamy throughout; on uplands.

Class VII. Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Subclass VIIs. Soils that are very severely limited by low available water capacity, shallowness, stones, or other soil characteristics.

Unit VIIs-1. Shallow to moderately deep, sloping to moderately steep, well drained to somewhat excessively drained soils that are loamy throughout; on uplands.

Unit VIIs-2. Very shallow, sloping to steep, well-drained soils that are loamy throughout, and rock outcrop; on uplands.

Class VIII. Soils and landforms that have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes. (None in this county)

## Predicted Yields

The predicted long-time average yields per acre of important crops and pasture under two levels of management are given in table 5.

The predicted yields given in columns A can be expected under customary management. This management normally includes:

1. Proper rates of seeding, proper dates of planting, and efficient methods of harvesting.
2. Control of weeds, insects, and diseases sufficient to encourage plant growth.
3. Terracing and contour farming where necessary.
4. Use of lime and fertilizer in small amounts.

The predicted yields given in columns B can be expected under improved management. This management includes:

1. Proper rates of seeding, proper dates of planting, and efficient methods of harvesting.
2. Control of weeds, insects, and diseases sufficient to encourage plant growth.
3. Terracing and contour farming where necessary.
4. Use of lime and fertilizer in amounts needed for high production.
5. Use of adapted, improved varieties.

TABLE 5.—*Predicted average yields per acre of principal crops*

[Yields in columns A are those obtained under customary management; those in columns B are obtained under improved management. Absence of a yield figure indicates the crop is not commonly grown on the soil at the level of management specified]

| Soil | Corn | | Peanuts | | Grain sorghum | | Cotton (lint) | | Alfalfa hay | | Bermudagrass | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A | B | A | B | A | B | A | B | A | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Lb.* | *Lb.* | *Tons* | *Tons* | *A.U.M.*[1] | *A.U.M.*[1] |
| Arkabutla silty clay loam | | | | | 20 | 30 | 180 | 275 | | | 2.9 | 4.5 |
| Bates fine sandy loam, 1 to 3 percent slopes | 28 | 42 | 25 | 38 | 30 | 46 | 225 | 380 | 1.4 | 2.5 | 4.0 | 5.6 |
| Bates fine sandy loam, 3 to 5 percent slopes | 22 | 35 | 22 | 34 | 25 | 42 | 175 | 300 | | | 3.9 | 5.3 |
| Bates fine sandy loam, 2 to 5 percent slopes, eroded | | | 15 | 25 | 20 | 32 | 150 | 250 | | | 3.2 | 4.5 |
| Burleson clay, 1 to 3 percent slopes | | | | | 35 | 50 | 200 | 400 | 2.0 | 3.0 | | |
| Chigley gravelly sandy loam, 1 to 5 percent slopes | | | 15 | 25 | 15 | 25 | 110 | 200 | | | 2.5 | 3.5 |
| Chigley gravelly sandy loam, 5 to 12 percent slopes | | | | | | | | | | | 2.3 | 3.1 |
| Chigley soils, 2 to 8 percent slopes, severely eroded | | | | | | | | | | | 1.8 | 2.5 |
| Claremore loam, 2 to 5 percent slopes | | | | | 15 | 25 | | | | | 2.4 | 3.0 |
| Clarita clay, 2 to 5 percent slopes | | | | | 20 | 40 | 150 | 250 | | | | |
| Collinsville fine sandy loam, 2 to 5 percent slopes | | | | | | | | | | | 2.3 | 2.8 |
| Dennis loam, 1 to 3 percent slopes | 30 | 42 | 25 | 45 | 36 | 50 | 240 | 380 | 2.0 | 3.0 | 4.0 | 6.0 |
| Dennis loam, 3 to 5 percent slopes | | | 22 | 38 | 32 | 44 | 200 | 350 | | | 3.8 | 5.8 |
| Dennis loam, 2 to 5 percent slopes, eroded | | | 15 | 30 | 23 | 36 | 150 | 275 | | | 3.5 | 5.3 |
| Dougherty loamy fine sand, 1 to 3 percent slopes | | | 18 | 36 | | | 200 | 300 | | | 2.5 | 4.5 |
| Dougherty loamy fine sand, 3 to 8 percent slopes | | | 15 | 30 | | | 150 | 270 | | | 2.2 | 3.8 |
| Dougherty-Eufaula loamy fine sands, 8 to 20 percent slopes | | | | | | | | | | | 2.0 | 3.5 |
| Durant loam, 1 to 3 percent slopes | 28 | 38 | 22 | 40 | 32 | 42 | 220 | 350 | | | 3.5 | 5.6 |
| Durant loam, 3 to 5 percent slopes | | | 20 | 34 | 28 | 35 | 200 | 350 | | | 3.4 | 5.2 |
| Durant loam, 2 to 5 percent slopes, eroded | | | 12 | 25 | 25 | 32 | 150 | 275 | | | 3.0 | 4.8 |
| Durant and Bates soils, 2 to 6 percent slopes, severely eroded | | | | | | | | | | | 1.8 | 2.5 |
| Dwight silt loam, 0 to 1 percent slopes | | | | | 15 | 20 | 100 | 175 | | | 1.8 | 2.4 |
| Eufaula loamy fine sand, 0 to 3 percent slopes | | | 15 | 28 | | | | | | | 2.5 | 3.8 |
| Fitzhugh fine sandy loam, 1 to 3 percent slopes | 28 | 42 | 30 | 45 | 32 | 46 | 250 | 400 | 2.0 | 3.0 | 4.2 | 5.8 |
| Fitzhugh fine sandy loam, 3 to 5 percent slopes | 22 | 35 | 25 | 40 | 28 | 45 | 190 | 325 | | | 4.0 | 5.5 |
| Fitzhugh fine sandy loam, 3 to 5 percent slopes, eroded | | | 20 | 35 | 22 | 34 | 175 | 275 | | | 3.4 | 4.6 |
| Galey loamy fine sand, 1 to 3 percent slopes | 20 | 40 | 25 | 45 | 25 | 40 | 200 | 375 | | | 3.4 | 5.7 |
| Heiden clay, 3 to 5 percent slopes | | | | | 20 | 40 | 150 | 250 | | | | |
| Hilgrave gravelly sandy loam, moderately shallow variant, 1 to 5 percent slopes | | | 10 | 20 | | | 100 | 200 | | | 2.3 | 3.5 |
| Konawa fine sandy loam, 0 to 1 percent slopes | 35 | 55 | 35 | 55 | 30 | 50 | 230 | 400 | 2.2 | 3.5 | 4.2 | 6.1 |
| Konawa fine sandy loam, 1 to 3 percent slopes | 30 | 50 | 32 | 50 | 28 | 45 | 220 | 380 | 2.0 | 3.0 | 4.0 | 5.8 |
| Konawa fine sandy loam, 3 to 5 percent slopes | 20 | 40 | 25 | 45 | 25 | 40 | 200 | 325 | | | 3.8 | 5.3 |
| Konawa loamy fine sand, 3 to 5 percent slopes | | | 20 | 40 | 20 | 35 | 190 | 300 | | | 3.3 | 4.2 |
| Konawa loamy fine sand, 3 to 8 percent slopes, eroded | | | 15 | 35 | 15 | 30 | 180 | 250 | | | 2.8 | 3.8 |
| Konawa soils, 3 to 8 percent slopes, severely eroded | | | | | | | | | | | 2.0 | 3.3 |
| Lincoln soils | | | | | | | | | | | 2.8 | 3.5 |
| Lula loam, 1 to 3 percent slopes | 30 | 45 | 30 | 45 | 35 | 50 | 250 | 400 | 2.2 | 3.3 | 4.2 | 5.8 |
| Lula loam, 3 to 5 percent slopes | 22 | 35 | 25 | 40 | 28 | 45 | 190 | 325 | | | 4.0 | 5.5 |
| Lula loam, 2 to 5 percent slopes, eroded | | | 20 | 35 | 22 | 34 | 175 | 275 | | | 3.4 | 4.5 |
| Okemah silty clay loam, 1 to 3 percent slopes | 30 | 45 | | | 36 | 50 | 250 | 400 | 2.0 | 2.7 | 4.1 | 6.2 |
| Parsons silt loam, 0 to 1 percent slopes | 22 | 37 | 14 | 22 | 25 | 40 | 200 | 300 | | | 2.8 | 4.0 |
| Parsons silt loam, 1 to 3 percent slopes | 26 | 36 | 10 | 20 | 20 | 35 | 175 | 250 | | | 2.3 | 3.8 |
| Pickens shaly loam, 3 to 15 percent slopes | | | | | | | | | | | 2.0 | 3.0 |
| Port silty clay loam | 40 | 70 | | | 45 | 65 | 350 | 500 | 3.2 | 4.4 | 5.0 | 8.0 |
| Port and Cleora soils, channeled | | | | | | | | | | | 5.0 | 7.2 |
| Port and Cleora soils, frequently flooded | | | | | | | | | | | 5.0 | 6.0 |
| Scullin-Talpa complex, 2 to 6 percent slopes | | | | | | | | | | | 2.1 | 3.2 |
| Stephenville fine sandy loam, 1 to 3 percent slopes | 20 | 40 | 21 | 40 | 28 | 45 | 220 | 375 | | | 2.8 | 5.6 |
| Stephenville fine sandy loam, 3 to 5 percent slopes | | | 20 | 35 | 20 | 32 | 200 | 350 | | | 2.4 | 5.0 |
| Stephenville fine sandy loam, 2 to 5 percent slopes, eroded | | | 15 | 25 | | | 150 | 300 | | | 2.1 | 4.5 |
| Stephenville-Darnell fine sandy loams, 3 to 8 percent slopes | | | | | | | | | | | 2.0 | 3.2 |
| Vanoss silt loam, 0 to 1 percent slopes | 45 | 65 | 28 | 52 | 38 | 52 | 250 | 450 | 2.4 | 3.8 | 4.5 | 6.2 |
| Vanoss silt loam, 1 to 3 percent slopes | 40 | 50 | 26 | 45 | 35 | 50 | 225 | 400 | 2.2 | 3.1 | 4.2 | 6.0 |
| Verdigris silt loam | 50 | 70 | 30 | 55 | 45 | 65 | 250 | 450 | 3.2 | 4.0 | 5.0 | 7.5 |
| Vernon clay, 3 to 5 percent slopes | | | | | 12 | 18 | | | | | | |
| Windthorst fine sandy loam, 2 to 5 percent slopes | | | 18 | 30 | | | 150 | 250 | | | 2.0 | 4.5 |
| Windthorst-Stephenville complex, 2 to 6 percent slopes, severely eroded | | | | | | | | | | | 1.8 | 3.0 |
| Woodson silt loam, 0 to 1 percent slopes | 30 | 45 | 10 | 20 | 35 | 50 | 250 | 300 | 2.5 | 3.5 | 3.2 | 4.6 |
| Yahola clay loam | 50 | 70 | | | 35 | 60 | 250 | 400 | 3.0 | 4.0 | 5.0 | 8.0 |
| Yahola fine sandy loam | 40 | 60 | 40 | 60 | 30 | 45 | 250 | 450 | 2.0 | 3.0 | 5.0 | 8.0 |

[1] A.U.M. stands for animal-unit-month. The figures represent the number of months that 1 acre will provide grazing for one animal unit (one cow, steer, or horse; five hogs, or seven sheep) without injury to the pasture.

6. Surface drainage where required.
7. Residue management and tillage methods that control erosion, maintain soil structure, increase water infiltration, and aid seedling emergence.
8. A cropping system fitted to the operator's goals and the specific needs of soils.
9. Tame pasture management that includes periodic fertilization, rotation grazing, brush control, and renovation of pastures.

Yields are not predicted for soils that are unsuitable for crops or pasture. Crop failures were taken into consideration in preparing the yield predictions. The yields at specific management levels were based on consultations with farmers and personnel of the Oklahoma State University, on research information applicable to the crops and soils of Pontotoc County, and on field observations.

## Use of the Soils for Range [4]

The potential plant community on soils used for range is composed principally of native grasses, forbs, and shrubs valuable for forage and in sufficient quantity to support grazing. It includes natural grassland, savannah, and certain kinds of woodland.

About 70 to 80 percent of the county is used for range. The deeper, smoother soils have been used for cultivated crops, and the more shallow, or steep and stony soils, for range.

Much of the acreage presently used for range is in small livestock farms, but there are several large ranches. The major livestock enterprise is the raising of beef cattle and the marketing of weaner calves and feeder steers. The range is commonly grazed the year around, but the forage is supplemented by protein and hay or tame pasture.

### *Management principles and practices for rangeland*

The potential production of forage on a range site depends largely on the kinds of soil in the site. The actual production of forage depends mainly on the condition of the range and the amount of moisture available to plants during the growing season.

Good range management requires that the range be maintained in excellent or good condition. This conserves water, maintains or improves yields, and protects the soil. A major problem in managing the range is recognizing important changes in the kinds of plant cover. These changes take place so gradually that they are easily overlooked or misinterpreted. Rapid growth that has been encouraged by heavy rainfall may cause the appearance of the range to be good when the cover is actually weedy and the potential production is in a downward trend. On the other hand, areas that have been closely grazed for a relatively short period under the supervision of a careful manager may have a deteriorated appearance that temporarily conceals the quality of the range and its ability to recover.

Trends in range condition are indicated by the vigor of the plants, the abundance of desirable seedlings, changes in plant composition (fig. 16), accumulation of plant residue, and the condition of the soil at the surface.

[4] By Neal Stidham, range conservationist, Soil Conservation Service.

***Figure 16.*—An area of Loamy Prairie range site. Persimmon trees have invaded the site. The soil, Dennis loam, 1 to 3 percent slopes, is capable of producing much more decreaser vegetation (bluestem) if competition for moisture and sunlight is reduced.**

### *Range sites and condition classes*

Effective range management requires knowledge of the capabilities of the different kinds of soils and the kinds and amounts of herbage that can be produced. It also requires the ability to evaluate the present condition of the range vegetation in relation to its potential for production.

For the purpose of classifying range resources, soils are placed in groups called range sites. Range sites are distinctive kinds of rangeland, each of which produces a significantly different kind and amount of native forage plants, or climax vegetation. A significant difference is one that necessitates a difference in management to maintain or improve the present vegetation. Climax vegetation is the stabilized plant community on any given range site; it reproduces itself and does not change so long as the environment does not change.

The plants on a given range site are grouped, according to their response to grazing, as decreasers, increasers, and invaders (fig. 17). Decreasers are plants in the potential plant community that tend to decrease if they are heavily grazed. These plants are generally the most palatable and most productive perennials. Increasers are plants in the potential plant community that normally increase as the decreasers decline. These plants are generally the shorter, less productive, less palatable plants. Under prolonged heavy grazing, the increasers become dominant. Invaders are plants that are not part of the potential plant community but that become established if both the decreasers and the increasers decline. They may be woody plants, herbaceous perennials, or annuals, and they may originate nearby or at a great distance.

Range condition refers to the composition of the existing native vegetation on a given site in relation to what the site is capable of producing. It is expressed in terms of condition classes. The condition class represents the degree to which the existing plant composition has departed from

*Figure 17.*—**An area of Loamy Prairie range site. Proper grazing has maintained a vigorous stand of decreasers (bluestem) in one pasture. Overgrazing has weakened the stand in the other pasture, and invaders (ragweed) are numerous. The soil is Lula loam, 1 to 3 percent slopes.**

the potential plant community. It is determined by estimating the relative production, by weight, of the species making up the 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 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.

A range site in excellent condition is at or near its maximum productivity. It has a plant cover that adequately protects the soil, encourages the absorption of moisture, and helps to maintain fertility. A site in good condition has lost a few decreaser plants, but it is still productive and can be maintained and improved by good management. A site in fair condition has a severely altered plant community in which increasers are dominant and invaders are becoming prominent. Generally, the litter is inadequate for protection against compaction and erosion. It is usually necessary to exclude grazing animals for an entire season to effect rapid improvement of the range. A site in poor condition has lost almost all of the desirable forage plants. Few, if any, of the original species remain, and invaders are numerous.

### *Descriptions of range sites*

The soils of Pontotoc County have been grouped in 16 range sites. The description of each range site gives significant soil characteristics, lists the principal range plants, and gives estimates of annual yield to be expected when the range is in excellent condition. The estimates are based on air-dry weight of herbage clipped at ground level. They are not intended to reflect usable or grazable forage. Shrubs and trees were not included in the estimates.

The yields given for the savannah sites are yields of grasses and forbs. They do not include the leaves, flowers, fruit, or stems of woody plants.

The names of the soil series represented are mentioned in the description of each range site, but the listing of the series name does not necessarily indicate that all the soils of a series are in the same range site. The range site in which each soil of the county has been placed can be learned by referring to the "Guide to Mapping Units."

#### BLACK CLAY PRAIRIE RANGE SITE

This site consists of very gently sloping to strongly sloping, clayey soils of the Burleson, Clarita, and Heiden series. These soils occur on uplands.

If this site is in excellent condition, about 80 percent of the vegetation consists of a mixture of little bluestem, big bluestem, indiangrass, switchgrass, and eastern gamagrass. There are a few woody plants, such as leadplant, prairie rose, and Osage-orange. About 20 percent of the climax vegetation is made up of such increasers as side-oats grama, Texas wintergrass, and buffalograss.

Prolonged overgrazing will usually thin out the decreasers and increasers and allow invaders to become prominent. Common invaders are silver bluestem, windmillgrass, tumblegrass, annual three-awn, Japanese brome, western ragweed, common broomweed, basketflower, and leavenworth eryngo.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 7,000 pounds per acre in years when rainfall is favorable and about 3,500 pounds per acre in years when rainfall is below normal.

#### CLAYPAN PRAIRIE RANGE SITE

This site consists of nearly level to very gently sloping soils of the Parsons and Woodson series. These soils occur on uplands. They have a loamy surface layer and a clayey subsoil. The subsoil restricts penetration of water and roots.

If this site is in excellent condition, decreasers make up about 70 percent of the vegetation. These are little bluestem, big bluestem, indiangrass, switchgrass, purpletop, gayfeather, sunflowers, and black sampson. The other 30 percent is a mixture of increaser plants such as meadow tall dropseed, Scribner panicum, wild-indigo, slimflower scurfpea, and goldenrod.

Under prolonged overgrazing, invaders become abundant. The more common species are broomsedge, annual three-awn, narrowleaf sumpweed, lanceleaf ragweed, bitter sneezeweed, common persimmon, and hawthorn.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 5,000 pounds per acre in years when rainfall is favorable and about 2,500 pounds per acre in years when rainfall is below normal.

#### DEEP SAND SAVANNAH RANGE SITE

This site consists of nearly level to moderately steep, sandy soils of the Dougherty, Eufaula, Galey, and Konawa series. These soils occur on uplands. They have the potential for producing oaks and a mixture of tall grasses.

If this site is in excellent condition, about 75 percent of the vegetation consists of a mixture of grasses and forbs and about 25 percent is woody species. The decreasers are little bluestem, big bluestem, indiangrass, and switchgrass. The increasers are meadow tall dropseed, Scribner panicum, bearded skeletongrass, and Texas bullnettle.

Under prolonged heavy grazing, the better plants lose their vigor, and allow the invaders, such as broomsedge, splitbeard bluestem, annual three-awn, showy partridgepea, ragweed, camphorweed, and white snakeroot, to become prominent.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 4,000 pounds per acre in years when rainfall is favorable, and about 2,000 pounds per acre in years when rainfall is below normal.

#### ERODED PRAIRIE RANGE SITE

This site consists of very gently sloping to sloping, severely eroded soils of the Durant and Bates series. These soils occur on uplands. Severe sheet erosion has removed much of the surface layer. This layer is subject to crusting.

Much of this site has been cultivated and abandoned, which encourages natural revegetation; some has been reseeded to grasses. The site can produce a mixture of such tall grasses as indiangrass, little bluestem, and big bluestem.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 3,000 pounds per acre in years when rainfall is favorable, and about 1,500 pounds per acre in years when rainfall is below normal.

#### ERODED RED CLAY RANGE SITE

This site consists only of Vernon clay, 3 to 8 percent slopes, severely eroded. This soil occurs on uplands.

Much of this site was formerly cultivated. The available water capacity is low because the surface layer is thin and the subsoil is clayey. Revegetation is difficult.

Desirable grasses on this site are indiangrass, little bluestem, switchgrass, and side-oats grama. Invaders are windmillgrass, tumblegrass, hairy tridens, Japanese brome, little barley, common broomweed, and western ragweed.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 1,500 pounds per acre in years when rainfall is favorable, and about 750 pounds per acre in years when rainfall is below normal.

#### ERODED SANDY SAVANNAH RANGE SITE

This site consists of very gently sloping to sloping, severely eroded, loamy soils of the Chigley, Konawa, Stephenville, and Windthorst series. These soils occur on uplands.

If this site is in excellent condition, decreasers make up about 50 percent of the vegetation. These are big bluestem, indiangrass, and little bluestem. Invaders are broomsedge, splitbeard bluestem, three-awn, and ragweed. This site is limited to formerly cultivated areas; it generally needs to be reseeded to restore the soil to production within a reasonable number of years.

Proper grazing, deferred grazing, range seeding, and fire control are needed to restore a productive cover of native grasses on the severely eroded Konawa soils.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,500 pounds per acre in years when rainfall is favorable, and about 1,250 pounds per acre in years when rainfall is below normal.

#### HEAVY BOTTOMLAND RANGE SITE

This site consists only of Arkabutla silty clay loam. This is a loamy soil on flood plains. It is subject to flooding. Water is absorbed very slowly, and only water-tolerant plants are native to the site.

A large part of the climax vegetation on this site grows during the cool season, mainly wildrye, uniola, and sedges and rushes. If this site is in excellent condition, other plants that grow in abundance on the better drained parts are switchgrass, prairie cordgrass, big bluestem, and Florida paspalum. American elm, pecan, walnut, poison-ivy, and indigobush make up 30 to 40 percent of the vegetation, and herbaceous plants make up about 60 to 70 percent.

Plants in abundance if the site is in poor condition are seacoast sumpweed, buffalograss, meadow tall dropseed, ragweed, windmillgrass, hawthorn, elm, persimmon, ash, pecan sprouts, and trumpetvine.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 7,000 pounds per acre in years when rainfall is favorable, and about 3,500 pounds per acre in years when rainfall is below normal.

#### LOAMY BOTTOMLAND RANGE SITE

This site consists of nearly level to very gently sloping, loamy soils of the Cleora, Port, Verdigris, and Yahola series. These soils occur on flood plains, and they are subject to flooding.

Desirable range plants are a mixture of such tall grasses as eastern gamagrass, prairie cordgrass, big bluestem, switchgrass, broadleaf uniola, and wildrye, and such woody plants as pecan, walnut, indigobush, passionvine, and trumpetvine. The grasses make up about 65 percent of the vegetation, and the woody species 35 percent.

If range condition declines to poor, the plant cover is a combination of johnsongrass, bermudagrass, pecan sprouts, trumpetvine, seacoast sumpweed, marestail, ragweed, white snakeroot, hawthorn, and persimmon, with only a scattering of indiangrass, big bluestem, and switchgrass. Areas in poor condition are generally those that were formerly cultivated but have been abandoned because of flooding.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 8,500 pounds per acre in years when rainfall is favorable, and about 4,250 pounds per acre in years when rainfall is below normal.

#### LOAMY PRAIRIE RANGE SITE

This site consists of nearly level to sloping, loamy soils of the Bates, Claremore, Dennis, Durant, Fitzhugh, Lula, Okemah, Scullin, Steedman, and Vanoss series. These soils occur on uplands. Their texture and depth are such that soil-moisture relationships are favorable for the growth of highly productive tall grasses.

If this site is in excellent condition, about 80 percent of the vegetation consists of a mixture of big bluestem, little bluestem, indiangrass, and switchgrass (fig. 18).

About 15 percent of the vegetation is made up of such increasers as meadow tall dropseed, purpletop, joint tail, side-oats grama, wildindigo, goldenrod, and heath aster. Legumes and other forbs, such as tickclover, leadplant,

*Figure 18.*—**The area of Loamy Prairie range site in the foreground occurs on Lula loam, 1 to 3 percent slopes. The water facility was developed in a lightly grazed area to encourage grazing. The light spots in the background are side-oats grama, blue grama, and silver bluestem on the Talpa part of the Scullin-Talpa complex, 2 to 6 percent slopes, which is in the Very Shallow range site.**

gayfeather, and black sampson, make up the other 5 percent.

Invaders that become common following prolonged overgrazing are broomsedge, splitbeard bluestem, annual three-awn, ragweed, common broomweed, hawthorn, prairie crabapple, and winged elm.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 6,500 pounds per acre in years when rainfall is favorable, and about 3,250 pounds per acre in years when rainfall is below normal.

### RED CLAY PRAIRIE RANGE SITE

This site consists of gently sloping to strongly sloping, clayey soils of the Vernon series. These soils occur on uplands. They are slowly permeable, but they absorb water fairly well if the surface is protected by a grass mulch. As a result of grazing abuse, the litter is easily lost and erosion readily occurs. Very careful grazing management is needed to maintain moderate productivity.

The principal decreaser is little bluestem. The main increasers are side-oats grama, buffalograss, and lesser amounts of meadow tall dropseed, Texas grama, Scribner panicum, hairy grama, and tall grama.

If the site is in poor condition, common invaders are broomweed, western ragweed, croton, tumblegrass, and annual three-awn.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,700 pounds per acre in years when rainfall is favorable, and about 1,350 pounds per acre in years when rainfall is below normal.

### SANDY BOTTOMLAND RANGE SITE

This site consists of nearly level to very gently sloping sandy soils of the Lincoln series. These soils occur on flood plains. They are subject to flooding.

The climax vegetation is about 70 percent lowland switchgrass, switchgrass, indiangrass, and big bluestem. Lesser grasses and forbs make up about 10 percent of the vegetation; these are purpletop, beaked panicum, fringeleaf paspalum, tickclover, bundleflower, and lespedeza. Woody species make up about 20 percent; these are cottonwood, willow, sand plum, and wild grape.

Common invaders are sandbur, sand dropseed, Texas bullnettle, snakecotton, camphorweed, annual wild buckwheat, and bagpod. The bagpod is a vigorous annual poisonous legume. Much cattle loss can be expected if the cattle eat the beans.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 4,000 pounds per acre in years when rainfall is favorable, and about 2,000 pounds per acre in years when rainfall is below normal.

#### SANDY SAVANNAH RANGE SITE

This site consists of nearly level to moderately steep, loamy soils of the Chigley, Hilgrave, Konawa, Stephenville, and Windthorst series. These soils occur on uplands. In excellent condition, the site has a mixture of tall grasses and a few oaks. Hardwoods make up about 25 percent of the climax vegetation. The major species of trees are post oak and blackjack oak, and the minor species are red oak and hickory.

If the site is in excellent condition, the principal decreasers are little bluestem, big bluestem, indiangrass, tephrosia, and slender lespedeza.

In poor condition, this site has the appearance of a solid stand of scrub oaks. Annual fires, followed by overgrazing, weaken the stand of grasses. The space once occupied by grasses thus becomes a "filled in" savannah, supporting essentially the same species, but in a much thicker stand (fig. 19).

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 5,000 pounds per acre in years when rainfall is favorable, and about 2,500 pounds per acre in years when rainfall is below normal.

#### SHALLOW CLAYPAN RANGE SITE

This site consists only of Dwight silt loam, 0 to 1 percent slopes. This soil occurs on uplands.

The surface layer is about 6 inches thick and abruptly overlies a clayey subsoil that has a high sodium content.

Mixed mid and tall grasses occur on this site if it has never been in cultivation. The better plants are switchgrass, rushes, sedges, and wildrye.

Following prolonged heavy grazing or cultivation, invaders occupy this site. These plants are longspike tridens, tumblegrass, buffalograss, annual panicum, western ragweed, and seacoast sumpweed.

***Figure 19.*—On one side of the fence, thick oak growth on Stephenville fine sandy loam, 3 to 5 percent slopes, cleared by a "saw-dozer," which leaves such grasses as little bluestem, big bluestem, indiangrass, and side-oats grama to reestablish themselves. On the other side of the fence, low-potential, scrubby sprouts have developed a semisolid canopy that shades out the native grasses.**

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,000 pounds per acre in years when rainfall is favorable, and about 1,000 pounds per acre in years when rainfall is below normal.

#### SHALLOW PRAIRIE RANGE SITE

This site consists only of Collinsville fine sandy loam, 2 to 5 percent slopes, a gently sloping to moderately steep, loamy soil on uplands. This site produces about the same species as the Loamy Prairie site, but the yields are smaller.

If this site is in excellent condition, decreasers make up about 70 percent of the vegetation. These are little bluestem, big bluestem, indiangrass, tephrosia, sensitivebrier, and perennial sunflower. The increasers that make up about 30 percent of the mixture are side-oats grama, meadow tall dropseed, hairy grama, purpletop, jointtail, ashy sunflower, sticky goldenrod, and coralberry.

Overgrazing weakens the stands of climax plants and allows other species to invade the vacant areas. If the range condition deteriorates, the species that are abundant are annual brome, annual three-awn, and such increasers as persimmon, coralberry, sticky goldenrod, hairy grama, and silver bluestem.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 4,500 pounds per acre when rainfall is favorable, and 2,250 pounds per acre in years when rainfall is below normal.

#### SHALLOW SAVANNAH RANGE SITE

This site consists of shallow, gently sloping to moderately steep, loamy soils of the Darnell and Pickens series. These soils occur on uplands.

If the site is in excellent condition, about 70 percent of the vegetation is grasses and forbs and about 30 percent is woody species.

Common decreasers are big bluestem, little bluestem, indiangrass, switchgrass, slender lespedeza, tephrosia, tickclover, and black sampson.

If the site is in excellent condition, the trees are typical of the Savannah type. Post oaks and blackjack oaks have a short bole and a wide-spreading canopy. These species make up more than 90 percent of the trees (fig. 20).

***Figure 20.*—An area of Shallow Savannah range site. The two post oaks in the foreground are 12 to 16 inches in diameter at breast height. The understory is 90 percent big bluestem and little bluestem. The soil is the Darnell part of Darnell-Stephenville fine sandy loams, 5 to 20 percent slopes.**

When range condition declines to poor, the young trees that grow naturally from root sprouts and seeds become dominant. The trees average 5,000 per acre in many places, and consequently, the grass production is reduced severely.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage is about 4,000 pounds per acre in years when rainfall is favorable, and about 2,000 pounds per acre in years when rainfall is below normal.

#### VERY SHALLOW RANGE SITE

This site consists of very shallow, very gently sloping to steep, loamy soils of the Talpa series and of Rock outcrop. These soils occur on uplands. About 30 percent of the surface layer is limestone fragments.

Decreasers make up about 50 percent of the plant cover if the site is in excellent condition. These are little bluestem, big bluestem, indiangrass, and perennial sunflower. Increasers make up about 50 percent of the plant cover; these are side-oats grama, blue grama, hairy grama, buffalograss, hairy dropseed, seep muhly, and silver bluestem.

If the condition declines to poor, annual three-awn, silver bluestem, windmillgrass, common broomweed, and ragweed are prominent. Also, stands of such brush plants as hawthorn, persimmon, and sumac become much more dense.

If this site is in excellent condition, the estimated annual yield of air-dry herbage is about 2,000 pounds per acre in years when rainfall is favorable, and about 1,000 pounds per acre in years when rainfall is below normal.

## Use of the Soils for Woodland [5]

Natural stands of hardwood trees grow along the Canadian River and its principal tributary streams. Stands of scrubby oak and some hickory and elm occupy the steeper, stony and coarse-textured upland soils.

The woodlands along the river and main tributaries still include species of trees that have commercial value, in spite of a lack of protection and management. Native trees are bur oak, red oak, water oak, pin oak, ash, black walnut, pecan, hackberry, sycamore, cottonwood, and eastern redcedar. Osage-orange, a tree that has superior lasting qualities for use as fence posts, grows along the streams in the clay prairie areas.

Technical assistance in planning a program of conservation and improvement is available from the local soil and water conservation district office, the county extension director, or the forestry division of the State Department of Agriculture.

### *Windbreaks and post lots*

There is little need or demand for field windbreaks in Pontotoc County. Multiple-row plantings are usually preferred around farmsteads. One of the faster growing trees, such as cottonwood, sycamore, pecan, or American elm is desirable. The fast-growing species should not be planted in the same row with trees of intermediate height, such as ash, hackberry, mulberry, walnut, black locust, thornless honeylocust, and evergreens. One or more rows of evergreens furnish year-round protection and are attractive in the planting. Suitable evergreens include Austrian pine, shortleaf pine, loblolly pine, Arizona cypress, and eastern redcedar. The pines and Arizona cypress should be planted on deep soils that have a fine sandy loam or loamy fine sand texture. Eastern redcedar has a wide range of suitability and will grow in nearly any area naturally suitable for trees.

The principal trees suitable for planting as post lots are black locust, eastern redcedar, red mulberry, Osage-orange, and catalpa. Black locust is suited to more kinds of soil than the other species. Osage-orange grows well on the finer textured soils. Infrequent or moderate flooding is not a hazard to newly planted Osage-orange and catalpa seedlings, but it is damaging to the other species. Catalpa requires deep, well-drained soils.

Where natural woodlands are lacking, farmstead windbreaks contribute to the comfort of the home and provide bad-weather protection for livestock. Tree plantings can be established on all of the soils suitable for farmstead or stock-shelter windbreaks. These kinds of tree plantings can be made on many of the soils in the county.

### *Woodland suitability groups*

The soils of this county are grouped according to their suitability for windbreaks and post lots. The woodland suitability groups indicate what kinds of trees can be grown, and the degree of suitability to be expected on different soils. Soils in group 1 have slight limitations for use as woodland. Trees grow best and live longest on the soils of this group. Soils in group 4 are not suitable for windbreaks or post lots. In groups 2 and 3 are soils that have moderate or severe limitations for woodland, but establishment of trees is feasible.

The names of the soil series represented are mentioned in the description of each woodland suitability group, but the listing of the series name does not necessarily indicate that all the soils of a series are in the same woodland suitability group. The woodland suitability group for each soil in the county is shown in the "Guide to Mapping Units."

#### WOODLAND SUITABILITY GROUP 1

This group consists of soils of the Cleora, Lincoln, Port, Verdigris, and Yahola series. These are deep soils on bottom lands. They range from loamy fine sand to silty clay loam in texture. They are moderately well drained to excessively drained.

All trees climatically suited to Pontotoc County grow well on the soils of this group. The soils have few characteristics that inhibit tree growth, and they are suitable for both windbreaks and post lots.

Trees and shrubs that are suitable for windbreaks and the height they can be expected to attain in 20 years are:

| | Feet | | Feet |
|---|---|---|---|
| Cottonwood | 50–60 | Shortleaf pine | 25–35 |
| Sycamore | 50–60 | Austrian pine | 25–35 |
| Pecan | 25–35 | Loblolly pine | 25–35 |
| American elm | 25–35 | Arizona cypress | 25–35 |
| Ash | 25–35 | Eastern redcedar | 25–35 |
| Mulberry | 25–35 | Common lilac | 10–15 |
| Black walnut | 25–35 | American plum | 10–15 |
| Honeylocust | 25–35 | Juniper | 10–15 |

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

Native timber that has fair to good commercial potential grows on most of these soils.

Trees suitable for post lots include eastern redcedar, catalpa, black locust, Osage-orange, and red mulberry. Port and Cleora soils, frequently flooded, are suitable for plantings of Osage-orange.

#### WOODLAND SUITABILITY GROUP 2

This group consists of soils of the Dennis, Dougherty, Eufaula, Fitzhugh, Galey, Konawa, Lula, Okemah, Stephenville, and Vanoss series. These are moderately deep and deep soils on uplands. They have a sandy and loamy texture and are moderately well drained to well drained. Root penetration is a limitation on some soils.

The soils are suitable for post lots and windbreaks, but some tree species are restricted to certain soils.

Trees and shrubs that are suitable for windbreaks and the height they can be expected to attain in 20 years are:

| | Feet | | Feet |
|---|---|---|---|
| American elm | 20–25 | Loblolly pine | 20–25 |
| Siberian elm | 20–25 | Eastern redcedar | 20–25 |
| Mulberry | 20–25 | Common lilac | 5–10 |
| Honeylocust | 20–25 | American plum | 5–10 |
| Shortleaf pine | 20–25 | Low-growing varieties of juniper | 5–10 |
| Austrian pine | 20–25 | | |

Trees suitable for post lots include eastern redcedar, black locust, red mulberry and Osage-orange. Osage-orange should be planted only on soils of the Dennis and Okemah series.

#### WOODLAND SUITABILITY GROUP 3

This group consists of soils of the Arkabutla, Bates, Burleson, Chigley, Claremore, Clarita, Collinsville, Dennis, Dougherty, Durant, Fitzhugh, Heiden, Konawa, Lula, Parsons, Stephenville, Windthorst, and Woodson series. These are moderately deep and deep soils on uplands. They are moderately well drained and well drained. These soils have characteristics that severely restrict root penetration and availability of moisture. Eroded soils are included.

Soils in this group have severe limitations and are not generally suitable for windbreaks or post lots.

Farmstead windbreaks can be established, but extra care and maintenance are required. Difficulty in securing satisfactory initial survival, slow growth, and limitations of tree species are some of the hazards to be expected.

Suitable tree species for windbreaks are American elm, Siberian elm, mulberry, honeylocust, eastern redcedar, American plum, and common lilac. A height of 25 to 30 feet is attained in 20 years.

#### WOODLAND SUITABILITY GROUP 4

This group consists of soils of the Bates, Chigley, Darnell, Durant, Dwight, Heiden, Hilgrave, Konawa, Lula, Pickens, Scullin, Steedman, Stephenville, Talpa, Vernon, and Windthorst series. These are very shallow to deep soils that are loamy and clayey in texture. Some of the limitations are low available water capacity, shallowness to rock, a clayey subsoil, strong slopes, or severe erosion.

These soils are not suitable for tree plantings in windbreaks or post lots.

421-680—73——5

## Use of the Soils for Wildlife Habitat [6]

The wildlife population of any area depends upon the availability of food, cover, and water in a suitable combination. Good wildlife habitat can be created, improved, or maintained by establishing desirable vegetation and developing water supplies in suitable places.

In table 6 each soil in Pontotoc County is rated as to its suitability for elements of wildlife habitat and also for three kinds of wildlife. These ratings refer only to the suitability of the soil and do not take into account the climate, the present use of the soil, 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 6 are defined as follows: Well suited means that habitat generally is easily created, 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 created, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that moderate intensity of management and fairly frequent attention may be required for satisfactory results.

Poorly suited means that habitat can be created, improved, or maintained in most places; that the soil has rather severe limitations; that habitat management is difficult and expensive and requires intensive effort; and that results are not always satisfactory.

Unsuited indicates that it is impractical or impossible to create, improve, or maintain habitat, and that unsatisfactory results are probable.

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

"Grasses and legumes" refers to domestic grasses and legumes that furnish food and cover for wildlife. These plants can be established by planting. The grasses include such species as weeping lovegrass, johnsongrass, ryegrass, and panicgrass. The legumes include such species as clover, annual lespedeza, and bush lespedeza.

"Wild herbaceous upland plants" refers to native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Examples of these are beggarweed, perennial lespedeza, wildbean, pokeberry, and cheatgrass.

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

"Coniferous woody 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 they can be planted. Included are pines, cedars, and ornamentals.

[6] Prepared with the assistance of JEROME SYKORA, biologist, Soil Conservation Service.

TABLE 6.—*Suitability of the soils*

| Soil series and map symbols | Elements of wildlife habitat | | | | |
|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous upland plants | Hardwoods and woody plants | Coniferous woody plants |
| Arkabutla: Ar | Suited | Suited | Well suited | Suited | Poorly suited |
| Bates: BaB, BaC, BaC2 | Suited | Well suited | Well suited | Suited | Suited |
| Burleson: BuB | Well suited | Well suited | Suited | Poorly suited | Poorly suited |
| Chigley: | | | | | |
| CgC | Suited | Suited | Suited | Suited | Suited |
| CgD, ChD3 | Poorly suited | Suited | Suited | Suited | Suited |
| Claremore: ClC | Poorly suited | Poorly suited | Suited | Suited | Suited |
| Clarita: CnC | Poorly suited | Suited | Suited | Poorly suited | Poorly suited |
| Collinsville: CoC | Poorly suited | Poorly suited | Suited | Poorly suited | Poorly suited |
| Darnell: DaE | Poorly suited | Poorly suited | Suited | Suited | Suited |
| Dennis: DeB, DeC, DeC2 | Well suited | Well suited | Suited | Suited | Suited |
| Dougherty: | | | | | |
| DoB, DoD | Well suited | Well suited | Well suited | Well suited | Well suited |
| DrE | Suited | Suited | Suited | Suited | Suited |
| Durant: | | | | | |
| DuB, DuC, DuC2 | Well suited | Well suited | Suited | Poorly suited | Unsuited |
| DvC3 | Poorly suited | Poorly suited | Poorly suited | Poorly suited | Unsuited |
| Dwight: DwA | Poorly suited | Suited | Suited | Poorly suited | Poorly suited |
| Eufaula: EuB | Poorly suited | Suited | Suited | Suited | Poorly suited |
| Fitzhugh: FhB, FhC, FhC2 | Suited | Well suited | Well suited | Suited | Suited |
| Galey: GaB | Well suited | Well suited | Suited | Suited | Suited |
| Heiden: | | | | | |
| HeC | Suited | Well suited | Suited | Poorly suited | Poorly suited |
| HeD | Poorly suited | Suited | Suited | Poorly suited | Poorly suited |
| Hilgrave: HgC | Poorly suited | Poorly suited | Suited | Suited | Poorly suited |
| Konawa: | | | | | |
| KoA, KoB, KoC | Well suited | Well suited | Well suited | Suited | Suited |
| KsD, KsD2 | Suited | Suited | Suited | Suited | Suited |
| KtD3 | Unsuited | Suited | Suited | Suited | Suited |
| Lincoln: Ln | Poorly suited | Suited | Suited | Suited | Poorly suited |
| Lula: | | | | | |
| LuB, LuC, LuC2 | Well suited | Well suited | Suited | Suited | Suited |
| LxC | Poorly suited | Suited | Poorly suited | Poorly suited | Unsuited |
| Okemah: OkB | Well suited | Well suited | Well suited | Suited | Suited |
| Parsons: PaA, PaB | Well suited | Well suited | Well suited | Poorly suited | Poorly suited |
| Pickens: PcE | Poorly suited | Poorly suited | Poorly suited | Suited | Suited |
| Port: | | | | | |
| Po | Well suited | Well suited | Well suited | Well suited | Suited |
| Pr, Ps | Poorly suited | Suited | Suited | Well suited | Suited |
| Scullin: ScC | Poorly suited | Suited | Poorly suited | Poorly suited | Unsuited |
| Steedman: SdD | Unsuited | Suited | Suited | Unsuited | Poorly suited |
| Stephenville: | | | | | |
| StB, StC, StC2 | Suited | Well suited | Well suited | Well suited | Well suited |
| SvD | Poorly suited | Suited | Suited | Suited | Suited |
| Talpa: TrE | Unsuited | Poorly suited | Poorly suited | Unsuited | Unsuited |
| Vanoss: VaA, VaB | Well suited | Well suited | Well suited | Well suited | Well suited |
| Verdigris: Vg | Well suited | Well suited | Well suited | Well suited | Poorly suited |
| Vernon: VrC, VrD, VrD3 | Poorly suited | Suited | Suited | Poorly suited | Suited |
| Windthorst: | | | | | |
| WhC | Suited | Suited | Suited | Suited | Suited |
| WkC3 | Poorly suited | Suited | Suited | Suited | Suited |
| Woodson: WoA | Well suited | Suited | Suited | Poorly suited | Suited |
| Yahola: Yc, Yf | Well suited | Well suited | Well suited | Well suited | Suited |

*for elements of wildlife habitat*

| Elements of wildlife habitat—Continued | | | Kinds of wildlife | | |
|---|---|---|---|---|---|
| Wetland food and cover plants | Shallow-water developments | Ponds | Openland | Woodland | Wetland |
| Well suited | Well suited | Suited | Suited | Well suited | Well suited. |
| Unsuited | Unsuited | Poorly suited | Well suited | Suited | Unsuited. |
| Unsuited | Unsuited | Well suited | Well suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Suited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Suited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Poorly suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Poorly suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Suited | Poorly suited | Suited | Unsuited. |
| Unsuited | Unsuited | Suited | Well suited | Suited | Poorly suited. |
| Unsuited | Unsuited | Poorly suited | Well suited | Well suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Well suited | Well suited | Poorly suited | Poorly suited. |
| Unsuited | Unsuited | Poorly suited | Poorly suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Poorly suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Suited | Well suited | Suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Well suited | Well suited | Unsuited. |
| Unsuited | Unsuited | Well suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Well suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Poorly suited | Suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Well suited | Well suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Suited | Well suited | Suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Suited | Well suited | Suited | Unsuited. |
| Poorly suited | Poorly suited | Suited | Well suited | Poorly suited | Poorly suited. |
| Unsuited | Unsuited | Unsuited | Poorly suited | Suited | Unsuited. |
| Unsuited | Poorly suited | Poorly suited | Well suited | Suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Poorly suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Well suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Suited | Well suited | Unsuited. |
| Unsuited | Unsuited | Suited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Unsuited | Poorly suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Suited | Well suited | Well suited | Unsuited. |
| Poorly suited | Poorly suited | Poorly suited | Well suited | Well suited | Poorly suited. |
| Unsuited | Unsuited | Suited | Suited | Poorly suited | Unsuited. |
| Unsuited | Unsuited | Suited | Suited | Suited | Unsuited. |
| Unsuited | Unsuited | Suited | Suited | Suited | Unsuited. |
| Poorly suited | Poorly suited | Suited | Well suited | Poorly suited | Poorly suited. |
| Unsuited | Poorly suited | Poorly suited | Well suited | Well suited | Poorly suited. |

"Wetland food and cover plants" are annual and perennial, wild herbaceous plants that grow on moist to wet sites. These plants furnish food and cover, mostly for wetland wildlife. Included are smartweed, wild millet, spikerush and other rushes, sedges, and burreed. Submersed or floating aquatic plants are not included.

"Shallow-water developments" refer to low dikes and water control structures established to create habitat principally for waterfowl. These may be designed to be drained, planted, and flooded, or they may be permanent impoundments used to grow submersed aquatic plants. Both fresh water and brackish water situations are included.

"Ponds" are locations where water of suitable depth and quality can be impounded, primarily for fish production.

"Openland wildlife" are quail, doves, cottontail rabbits, foxes, meadowlarks, field sparrows, and other birds and mammals that normally inhabit cropland, pasture, meadow, lawns, and other openland areas where grasses, herbs, and shrubby plants grow.

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

"Wetland wildlife" are ducks, geese, rails, herons, shore birds, mink, muskrat, and other birds and mammals that normally live in wet areas, marshes, and swamps.

## Engineering Uses of the Soils[7]

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. It gives information about those properties of the soils that affect construction and maintenance of roads and airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal systems. Among the soil properties most important in engineering are permeability, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties is furnished in tables 7, 8, and 9.

The estimates and interpretations of soil properties in these tables can be used in:

1. Planning and designing agricultural drainage systems, farm ponds, irrigation systems, diversion terraces, and structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

[7] By FORREST MCCLUNG, civil engineer, Soil Conservation Service.

TABLE 7.—*Estimated engineering*

| Soil series and map symbols | Depth to— Bedrock | Depth to— Seasonal high water table | Permeability of least permeable layer | Depth from surface in typical profile | Classification: USDA texture |
|---|---|---|---|---|---|
| | *Inches* | *Feet* | *Inches per hour* | *Inches* | |
| Arkabutla: Ar | 72 or more | 0–1 | 0. 63–2. 00 | 0–72 | Silty clay loam |
| Bates: BaB, BaC, BaC2 | 20–40 | >6 | 0. 63–2. 00 | 0–12 | Fine sandy loam |
| | | | | 12–36 | Loam |
| | | | | 36 | Sandstone. |
| Burleson: BuB | 72 or more | >6 | <0. 06 | 0–72 | Clay |
| Chigley: CgC, CgD, ChD3 | 40–72 | >6 | 0. 06–0. 20 | 0–10 | Gravelly sandy loam |
| | | | | 10–24 | Sandy clay |
| | | | | 24–60 | Sandy clay loam |
| | | | | 60 | Conglomerate rock. |
| Claremore: ClC | 10–20 | >6 | 0. 63–2. 00 | 0–10 | Loam |
| | | | | 10–16 | Clay loam |
| | | | | 16 | Limestone. |
| Clarita: CnC | 50 or more | >6 | <0. 06 | 0–50 | Clay |
| | | | | 50 | Clayey shale |
| Cleora (Mapped only in an undifferentiated group with Port soils) | 60 or more | >6 | 2. 00–6. 30 | 0–60 | Fine sandy loam |
| Collinsville: CoC | 8–20 | >6 | 2. 00–6. 30 | 0–15 | Fine sandy loam |
| | | | | 15 | Sandstone. |
| Darnell: DaE (See Stephenville series for Stephenville part of DaE) | 8–20 | >6 | 2. 00–6. 30 | 0–15 | Fine sandy loam |
| | | | | 15 | Sandstone. |

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.

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*

The two systems most commonly used in classifying soils for engineering purposes are the AASHO system (*1*) adopted by the American Association of State Highway Officials, and the Unified system (*8*) used by the Soil Conservation Service, Department of Defense, and others.

The AASHO system is used to classify soils according to those properties that affect use in highway construction. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation), and, in group A–7 are clayey soils that have low strength when wet, or the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are subdivided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. If soil material is near a classification boundary, it is given a symbol showing both classes; for example, A–2 or A–4. Within each group, the relative engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The AASHO classification for tested soils, with index numbers in parentheses, is shown in table 9; the estimated classification for all soils mapped in the county is given in table 7.

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. In this system, soils are identified as coarse grained (GW, GP, GM, GC, SW, SP, SM, and SC); fine grained (ML, CL, OL, MH, CH, and OH); and highly organic (Pt). Soils on the borderline between two classes are designated by symbols for both classes; for example, CH–MH.

### *Estimated engineering properties*

Table 7 gives estimates of soil properties important in engineering. The estimates are based on field classification and descriptions, test data given in table 9, test data from comparable soils in adjacent areas, and on detailed experience in working with the individual kinds of soil in Pontotoc County.

*properties of the soils*

| Classification—Continued | | Percentage passing sieve— | | | | Available water capacity | Reaction | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|
| Unified | AASHO | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | | | |
| | | | | | | *Inches per inch of soil* | *pH* | |
| CL | A–6 or A–7 | 100 | 100 | 95–100 | 85-95 | 0. 17 | 5. 1–6. 5 | Moderate. |
| SM or ML | A–4 | 100 | 98-100 | 95–100 | 45–65 | . 12 | 5. 6–6. 5 | Low. |
| ML or CL | A–4 | 100 | 100 | 100 | 55–85 | . 14 | 5. 1–6. 5 | Low. |
| MH or CH | A–7 | 100 | 95–100 | 100 | 85–100 | . 17 | 5. 6–8. 4 | High. |
| SM or SC | A–2 or A–4 | 75–95 | 75–95 | 55–90 | 25–40 | . 12 | 5. 6–6. 5 | Low. |
| SC, MH or CH | A–6 or A–7 | 85–100 | 85–100 | 60–85 | 45–65 | . 17 | 5. 6–7. 3 | Moderate. |
| SC or ML–CL | A–6 or A–7 | 75–100 | 75–100 | 60–90 | 45–65 | . 14 | 5. 6–7. 3 | Low. |
| ML or CL | A–4 | 100 | 100 | 100 | 55–85 | . 14 | 6. 1–6. 5 | Low. |
| CL | A–6 | 100 | 100 | 100 | 75–95 | . 17 | 6. 1–6. 5 | Moderate. |
| CH | A–7 | 100 | 100 | 100 | 90–98 | . 17 | 7. 9–8. 4 | High. |
| CH | A–7 | 100 | 90–100 | 85–100 | 80–90 | . 17 | 7. 9–8. 4 | High. |
| SM or ML | A–2 or A–4 | 100 | 100 | 90–100 | 30–65 | . 12 | 5. 6–6. 5 | Low. |
| SM or ML | A–4 | 100 | 100 | 90–100 | 40–60 | . 12 | 5. 1–6. 5 | Low. |
| SM or ML | A–4 | 100 | 100 | 90–100 | 45–65 | . 12 | 5. 1–6. 5 | Low. |

TABLE 7.—*Estimated engineering*

| Soil series and map symbols | Depth to— | | Permeability of least permeable layer | Depth from surface in typical profile | Classification |
|---|---|---|---|---|---|
| | Bedrock | Seasonal high water table | | | USDA texture |
| | *Inches* | *Feet* | *Inches per hour* | *Inches* | |
| Dennis: DeB, DeC, DeC2 | 60 or more | 1–2 | 0.06–0.20 | 0–12<br>12–17<br>17–70 | Loam<br>Clay loam<br>Clay |
| Dougherty: DoB, DoD, DrE<br>(See Eufaula series for Eufaula part of DrE) | 72 or more | >6 | 0.63–2.00 | 0–26<br>26–45<br>45–72 | Loamy fine sand<br>Sandy clay loam<br>Fine sandy loam |
| Durant: DuB, DuC, DuC2, DvC3<br>(See Bates series for Bates part of DvC3) | 50 or more | 1–2 | <0.06 | 0–12<br>12–55<br>55–70 | Loam<br>Clay<br>Clay and shale. |
| Dwight: DwA | 60 or more | 5–6 | <0.06 | 0–6<br>6–72 | Silt loam<br>Clay |
| Eufaula: EuB | 80 or more | >6 | 6.30–20.00 | 0–6<br>6–80 | Loamy fine sand<br>Fine sand |
| Fitzhugh: FhB, FhC, FhC2 | 50 or more | >6 | 0.63–2.00 | 0–12<br>12–20<br>20–60<br>60–72 | Fine sandy loam<br>Loam<br>Clay loam<br>Sandstone. |
| Galey: GaB | 72 or more | 3–4 | 0.63–2.00 | 0–14<br>14–72 | Loamy fine sand<br>Sandy clay loam |
| Heiden: HeC, HeD | 40–60 | >6 | <0.06 | 0–72 | Clay |
| Hilgrave: HgC | 20–36 | >6 | 2.00–6.30 | 0–11<br>11–24<br>24–30 | Gravelly sandy loam<br>Gravelly clay loam<br>Very gravelly conglomerate |
| Konawa:<br>KsD, KsD2, KtD3 | 75 or more | >6 | 0.63–2.00 | 0–14<br>14–62<br>62–75 | Loamy fine sand<br>Sandy clay loam<br>Loamy fine sand |
| KoA, KoB, KoC | 75 or more | >6 | 0.63–2.00 | 0–12<br>12–75 | Fine sandy loam<br>Sandy clay loam |
| Lincoln: Ln | 72 or more | 3–4 | 6.30–20.00 | 0–9<br>9–72 | Loamy fine sand<br>Fine sand |
| Lula: LuB, LuC, LuC2, LxC<br>(See Talpa series for Talpa part of LxC) | 40–60 | >6 | 0.63–2.00 | 0–12<br>12–22<br>22–48<br>48 | Loam<br>Clay loam<br>Silty clay loam<br>Limestone. |
| Okemah: OkB | 72 or more | 1–2 | 0.06–0.20 | 0–20<br>20–72 | Silty clay loam<br>Clay |
| Parsons: PaA, PaB | 60 or more | 0–1 | <0.06 | 0–12<br>12–72<br>72 | Silt loam<br>Clay<br>Shale. |
| Pickens: PcE | 12–20 | >6 | 0.63–2.00 | 0–18<br>18–36 | Shaly loam<br>Shale. |
| Port: Po, Pr, Ps<br>(See Cleora series for Cleora part of Pr, Ps) | 72 or more | >6 | 0.20–0.63 | 0–44<br>44–72 | Silty clay loam<br>Clay loam |
| Scullin: ScC<br>(See Talpa series for Talpa part of ScC) | 20–40 | >6 | 0.20–0.63 | 0–6<br>6–11<br>11–18<br>18–30<br>30 | Gravelly loam<br>Gravelly clay loam<br>Clay<br>Gravelly silty clay<br>Limestone. |

*properties of the soils*—Continued

| Classification—Continued | | Percentage passing sieve— | | | | Available water capacity | Reaction | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|
| Unified | AASHO | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | | | |
| | | | | | | *Inches per inch of soil* | *pH* | |
| ML or CL | A-4 | 100 | 100 | 100 | 60–75 | .14 | 5.6–6.0 | Low. |
| CL | A-6 | 100 | 100 | 100 | 75–95 | .17 | 5.1–6.0 | Moderate. |
| CL or CH | A-7 | 100 | 100 | 100 | 90–98 | .17 | 5.6–6.5 | High. |
| | | | | | | | | |
| SM | A-2 | 100 | 100 | 65–80 | 13–30 | .07 | 5.6–6.5 | Low. |
| SC or CL | A-4 | 100 | 100 | 90–100 | 40–60 | .14 | 5.1–6.0 | Low. |
| SM or ML | A-2 or A-4 | 100 | 100 | 90–100 | 30–60 | .12 | 5.1–6.0 | Low. |
| | | | | | | | | |
| CL or ML-CL | A-4 | 100 | 100 | 95–100 | 55–85 | .14 | 5.6–6.5 | Low. |
| MH-CH or CL | A-7 | 100 | 100 | 95–100 | 75–98 | .17 | 5.6–7.8 | Moderate to high. |
| | | | | | | | | |
| ML | A-4 | 100 | 100 | 100 | 75–90 | .14 | 6.1–7.3 | Low. |
| CH or MH | A-7 | 100 | 100 | 100 | 90–98 | .17 | 6.1–8.4 | High. |
| | | | | | | | | |
| SM | A-2 | 100 | 100 | 65–80 | 13–30 | .07 | 5.6–6.5 | Low. |
| SM or SP-SM | A-2 or A-3 | 100 | 100 | 65–80 | 5–10 | .05 | 5.6–6.5 | Low. |
| | | | | | | | | |
| SM or ML | A-4 | 100 | 100 | 90–100 | 40–65 | .12 | 5.6–6.5 | Low. |
| ML or CL | A-4 | 100 | 100 | 100 | 70–90 | .14 | 5.1–6.5 | Low. |
| CL | A-6 | 100 | 100 | 90–100 | 75–95 | .17 | 5.1–6.5 | Moderate. |
| | | | | | | | | |
| SM | A-2 | 100 | 100 | 65–80 | 13–30 | .07 | 5.6–6.5 | Low. |
| SC or CL | A-4 | 100 | 100 | 90–100 | 40–60 | .14 | 5.1–6.0 | Low. |
| | | | | | | | | |
| CH | A-7 | 100 | 100 | 100 | 90–98 | .17 | 7.9–8.4 | High. |
| | | | | | | | | |
| SM | A-2 | 60–80 | 60–80 | 55–65 | 15–35 | .12 | 5.6–7.3 | Low. |
| GM or GC | A-2 or A-4 | 50–65 | 50–65 | 50–65 | 30–50 | .17 | 5.6–7.3 | Low. |
| GM or GC | A-2 | 40–50 | 40–50 | 40–50 | 25–35 | .12 | 5.6–7.3 | Low. |
| | | | | | | | | |
| SM | A-2 | 100 | 100 | 65–98 | 13–30 | .07 | 5.6–6.5 | Low. |
| SM-SC, or ML-CL | A-4 or A-6 | 100 | 100 | 90–100 | 40–60 | .14 | 5.1–6.0 | Low. |
| SM | A-2 or A-3 | 100 | 100 | 65–98 | 13–30 | .07 | 5.1–6.0 | Low. |
| | | | | | | | | |
| SM | A-4 | 100 | 100 | 90–100 | 36–50 | .12 | 5.6–6.5 | Low. |
| SC or ML-CL | A-4 or A-6 | 100 | 100 | 90–100 | 40–60 | .14 | 5.1–6.0 | Low. |
| | | | | | | | | |
| SM | A-2 | 100 | 90–100 | 55–75 | 15–35 | .07 | 7.9–8.4 | Low. |
| SM | A-3 | 100 | 100 | 65–80 | 5–10 | .05 | 7.9–8.4 | Low. |
| | | | | | | | | |
| ML-CL | A-4 | 100 | 100 | 100 | 55–85 | .14 | 5.6–6.5 | Low. |
| ML-CL | A-4 or A-6 | 100 | 100 | 100 | 75–95 | .17 | 5.1–6.5 | Moderate. |
| ML-CL | A-4 or A-6 | 100 | 100 | 100 | 75–95 | .17 | 5.1–6.5 | Moderate. |
| | | | | | | | | |
| ML or CL | A-6 or A-7 | 100 | 100 | 100 | 85–95 | .17 | 6.1–7.3 | Moderate. |
| CL or CH | A-7 | 100 | 100 | 100 | 90–100 | .17 | 6.1–8.4 | High. |
| | | | | | | | | |
| ML | A-4 | 100 | 100 | 100 | 75–85 | .14 | 5.1–6.0 | Moderate. |
| CL or CH | A-7 | 100 | 100 | 100 | 90–100 | .17 | 5.6–7.3 | High. |
| | | | | | | | | |
| ML or CL | A-4 | 100 | 70–90 | 65–80 | 55–75 | .14 | 4.5–6.5 | Low. |
| | | | | | | | | |
| ML-CL | A-6 | 100 | 100 | 100 | 85–100 | .17 | 6.1–8.4 | Moderate. |
| ML or CL | A-6 | 100 | 100 | 100 | 85–100 | .17 | 6.6–8.4 | Moderate. |
| | | | | | | | | |
| ML or CL | A-4 | 70–85 | 60–85 | 60–80 | 60–75 | .14 | 6.1–6.5 | Low. |
| CL | A-6 | 65–75 | 65–75 | 60–70 | 51–65 | .17 | 6.1–6.5 | Moderate. |
| CL or CH | A-6 or A-7 | 85–95 | 85–95 | 85–95 | 85–95 | .17 | 6.1–6.5 | High. |
| GC or CL | A-2 or A-4 | 35–80 | 20–65 | 20–65 | 20–65 | .17 | 7.4–7.8 | Moderate. |

TABLE 7.—*Estimated engineering*

| Soil series and map symbols | Depth to— | | Permeability of least permeable layer | Depth from surface in typical profile | Classification |
|---|---|---|---|---|---|
| | Bedrock | Seasonal high water table | | | USDA texture |
| | *Inches* | *Feet* | *Inches per hour* | *Inches* | |
| Steedman: SdD | 20–40 | 1–2 | 0. 06–0. 20 | 0–7 | Silty clay loam |
| | | | | 7–35 | Clay |
| | | | | 35 | Shale. |
| Stephenville: StB, StC, StC2, SvD (See Darnell series for Darnell part of SvD) | 20–40 | >6 | 0. 63–2. 00 | 0–11 | Fine sandy loam |
| | | | | 11–35 | Sandy clay loam |
| | | | | 35 | Sandstone. |
| Talpa: TrE (Properties not given for Rock outcrop part; material too variable for evaluation) | 4–10 | >6 | 0. 63–2. 00 | 0–4 | Stony silty clay loam |
| | | | | 4–8 | Stony clay loam |
| | | | | 8–60 | Limestone. |
| Vanoss: VaA, VaB | 85 or more | >6 | 0. 63–2. 00 | 0–14 | Silt loam |
| | | | | 14–85 | Silty clay loam |
| Verdigris: Vg | 80 or more | 3–4 | 0. 63–2. 00 | 0–22 | Silt loam |
| | | | | 22–80 | Silty clay loam |
| Vernon: VrC, VrD, VrD3 | 20–36 | >6 | 0. 06–0. 20 | 0–16 | Clay |
| Windthorst: WhC, WkC3 (See Stephenville series for Stephenville part of WkC3) | 40–60 | >6 | 0. 20–0. 63 | 0–8 | Fine sandy loam |
| | | | | 8–34 | Clay |
| | | | | 34–47 | Sandy clay |
| | | | | 47 | Sandstone. |
| Woodson: WoA | 60 or more | 0–1 | <0. 06 | 0–13 | Silt loam |
| | | | | 13–60 | Silty clay |
| Yahola: | | | | | |
| Yc | 65 or more | >6 | 2. 00–6. 30 | 0–13 | Clay loam |
| | | | | 13–30 | Fine sandy loam |
| | | | | 30–50 | Loamy fine sand |
| Yf | 65 or more | >6 | 2. 00–6. 30 | 0–41 | Fine sandy loam |
| | | | | 41–65 | Loamy fine sand |

USDA texture refers to the U.S. Department of Agriculture system of classifying soils. This system is primarily useful in agriculture, but also in engineering. In this system, soils are classified according to the proportional amounts of different sizes of mineral particles. A soil that is 40 percent or more clay particles, for example, is called clay. Beginning with the largest, the particle sizes are designated as stones, cobblestones, gravel, sand, silt, and clay.

Permeability, as used in table 7, refers only to movement of water downward through undisturbed and uncompacted soil. It does not include lateral seepage. The estimates are based on structure and porosity of the soil. Plowpans, surface crusts, and other properties resulting from the use of the soils were not considered.

Available water capacity is 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.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and relative terms used to describe soil reaction are given in the Glossary.

Shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

### *Engineering interpretations*

Table 8 contains information useful to engineers and others who plan to use soil material in construction of highways, farm facilities, buildings, and sewage disposal systems. Detrimental or undesirable features are emphasized, but very important desirable features are also given. The ratings and other interpretations in this table are based on estimated engineering properties of the soils given in table 7; on available test data, including those in table 9; and on field experience. Although the information applies only to depths indicated in table 7, it is reasonably reliable to a depth of about 6 feet for most soils, and several feet more for some.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily rich in organic-matter content, used *properties of the soils*—Continued

| Classification—Continued | | Percentage passing sieve— | | | | Available water capacity | Reaction | Shrink-swell potential |
|---|---|---|---|---|---|---|---|---|
| Unified | AASHO | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | | | |
| | | | | | | *Inches per inch of soil* | *pH* | |
| CL or ML | A–6 or A–7 | 100 | 100 | 100 | 85–95 | .17 | 5.6–7.3 | Moderate. |
| CH | A–7 | 100 | 100 | 100 | 90–100 | .17 | 6.1–8.4 | High. |
| SM or ML | A–4 | 100 | 100 | 90–100 | 40–65 | .12 | 6.1–6.5 | Low. |
| SC or CL | A–4 | 100 | 100 | 90–100 | 40–60 | .14 | 5.1–6.0 | Low. |
| ML or CL | A–6 | 100 | 90–100 | 90–100 | 60–95 | .17 | 6.6–8.4 | Moderate. |
| ML or CL | A–6 | 65–75 | 65–75 | 65–75 | 60–70 | .12 | 6.6–8.4 | Moderate. |
| ML | A–4 | 100 | 100 | 100 | 75–90 | .14 | 5.6–8.4 | Low. |
| ML or CL | A–6 | 100 | 100 | 100 | 85–95 | .17 | 6.1–8.4 | Moderate. |
| ML | A–4 | 100 | 100 | 100 | 75–90 | .14 | 5.6–6.5 | Low. |
| ML or CL | A–4 or A–6 | 100 | 100 | 100 | 85–95 | .17 | 5.1–6.5 | Moderate. |
| CL or CH | A–7 | 100 | 100 | 100 | 90–100 | .17 | 7.4–8.4 | High. |
| SM or ML | A–2 or A–4 | 100 | 100 | 90–100 | 30–60 | .12 | 5.1–6.5 | Low. |
| ML–CL | A–6 or A–7 | 100 | 100 | 100 | 70–85 | .17 | 5.1–6.0 | High. |
| SC or CL | A–6 | 100 | 100 | 90–100 | 40–60 | .17 | 5.1–6.0 | Moderate. |
| ML | A–4 | 100 | 100 | 100 | 75–90 | .14 | 6.1–6.5 | Low. |
| CL or CH | A–7 | 100 | 100 | 100 | 90–100 | .17 | 6.1–8.4 | High. |
| CL | A–6 | 100 | 100 | 100 | 75–95 | .17 | 7.4–8.4 | Moderate. |
| SM or ML | A–4 | 100 | 100 | 90–100 | 40–70 | .12 | 7.9–8.4 | Low. |
| SM | A–4 | 100 | 100 | 50–90 | 36–50 | .07 | 7.9–8.4 | Low. |
| SM or ML | A–4 | 100 | 100 | 90–100 | 40–70 | .12 | 7.9–8.4 | Low. |
| SM | A–4 | 100 | 100 | 50–90 | 36–50 | .07 | 7.9–8.4 | Low. |

as a topdressing for lawns, gardens, roadbanks, and the like. The ratings indicate suitability for such use.

Sand and gravel ratings are based on the probability that delineated areas of the soil contain deposits of sand and gravel. The ratings do not indicate quality or size of the deposits.

Road fill is material used to build embankments. The ratings indicate performance of soil material moved from borrow areas for this purpose.

Septic tank filter fields are affected mainly by permeability, location of water table, depth to rock, slope, and susceptibility to flooding. The degree of limitation and principal reason for assigning moderate or severe limitations are given.

Sewage lagoons are influenced chiefly by soil features, such as permeability, location of water table, and slope. The degree of limitation and principal reasons for assigning moderate or severe limitations are given.

Highway location is influenced by features of the undisturbed soil that affect construction and maintenance of highways. The soil features, favorable as well as unfavorable, are the principal ones that affect location of highways.

Farm pond reservoir areas are affected mainly by seepage loss of water, and the soil features are those that influence such seepage.

Farm pond embankments serve as dams. The soil features of both subsoil and substratum are those important for constructing embankments.

Foundations for low buildings are affected chiefly by features of the undisturbed soil that influence its capacity to support low buildings that have normal foundation loads. Estimates of bearing strength are not assigned.

The hydrologic soil group is a group of soils having the same runoff potential under similar storm and cover conditions. Group A has the lowest runoff potential, and group D has the highest runoff potential. Definitions of all four hydrologic groups are as follows:

*Group A* consists of soils that have a high infiltration rate even when thoroughly wet. These soils are chiefly well drained to excessively drained sand or gravel or both. They have a high rate of water transmission and a low runoff potential.

*Group B* consists of soils that have a moderate infiltration rate when thoroughly wet. These soils are chiefly moderately deep to deep, moderately well drained

TABLE 8.—*Engineering*

| Soil series and map symbols | Suitability as a source of— | | | Degree and kind of limitations for sewage disposal | | Soil features affecting— |
|---|---|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Septic tank filter field | Sewage lagoons | Highway location |
| Arkabutla: Ar | Fair to good | Unsuitable: fine-grained material. | Poor: A-6 or A-7 material. | Severe: somewhat poorly drained; subject to flooding. | Severe: subject to flooding. | Unstable material; subject to flooding. |
| Bates: BaB, BaC, BaC2. | Good | Unsuitable: fine-grained material. | Fair: sandstone at a depth of 20 to 40 inches. | Severe: sandstone at a depth of 20 to 40 inches. | Severe: sandstone at a depth of 20 to 40 inches. | Sandstone at a depth of 20 to 40 inches. |
| Burleson: BuB | Poor: too clayey. | Unsuitable: fine-grained material. | Poor: A-7 material. | Severe: very slow permeability. | Slight to moderate: slope. | High shrink-swell potential; deep A-7 material. |
| Chigley: CgC, CgD, ChD3. | Poor: too gravelly. | Good: surface only. | Good in gravelly material. | Severe: slow permeability. | Moderate: slope; rock at a depth of 40 to 72 inches. | Plastic material in subsoil. |
| Claremore: ClC | Fair: limestone at a depth of 10 to 20 inches. | Unsuitable: limestone at a depth of 10 to 20 inches. | Poor: limestone at a depth of 10 to 20 inches. | Severe: limestone at a depth of 10 to 20 inches. | Severe: limestone at a depth of 10 to 20 inches. | Limestone at a depth of 10 to 20 inches. |
| Clarita: CnC | Poor: too clayey. | Unsuitable: fine-grained material. | Poor: A-7 material. | Severe: very slow permeability. | Moderate: slope. | High shrink-swell potential. |
| Cleora (Mapped only in an undifferentiated group with Port soils) | Fair: large quantity of material. | Unsuitable: fine-grained material. | Good: A-2 to A-4 material. | Severe: subject to flooding. | Severe: flooding and moderately rapid permeability. | Subject to flooding; A-2 to A-4 material. |
| Collinsville: CoC | Poor: sandstone at a depth of 8 to 20 inches. | Unsuitable: sandstone at a depth of less than 20 inches. | Good: limited amount of material. | Severe: sandstone at a depth of 8 to 20 inches. | Severe: sandstone at a depth of 8 to 20 inches. | Sandstone at a depth of less than 20 inches. |
| Darnell: DaE (See Stephenville series for Stephenville part of DaE) | Poor: limited amount of material. | Unsuitable: sandstone at a depth of less than 20 inches. | Fair: limited amount of material. | Severe: sandstone at a depth of 8 to 20 inches. | Severe: sandstone at a depth of 8 to 20 inches. | Sandstone at a depth of 8 to 20 inches. |
| Dennis: DeB, DeC, DeC2. | Good in surface layer. | Unsuitable: fine-grained material. | Poor: A-4 material in surface layer; A-6 or A-7 material in subsoil. | Severe: slow permeability. | Slight to moderate: slope. | Moderate to high shrink-swell potential. |
| Dougherty: DoB, DoD, DrE. (See Eufaula series for Eufaula part of DrE) | Poor: easily eroded. | Fair: surface is poorly graded. | Good: large quantity of material. | Slight: moderate permeability. | Severe: high seepage potential. | Cuts are easily eroded; variable slopes. |

*interpretations*

| Soil features affecting—Continued | | | | | | Foundations for low buildings | Hydrologic soil group |
|---|---|---|---|---|---|---|---|
| Farm ponds | | Agricultural drainage | Irrigation | Terraces and diversions | Grassed waterways | | |
| Reservoir area | Embankment | | | | | | |
| Nearly level; sites limited to dug ponds. | Unstable when wet. | Somewhat poorly drained. | Somewhat poorly drained; subject to flooding. | Nearly level; subject to flooding. | Nearly level | Somewhat poorly drained; moderate shrink-swell potential; subject to flooding. | C |
| Limited depth to sandstone. | Limited borrow material. | Well drained | Slope; limited root zone. | Features favorable. | Features favorable. | Sandstone at a depth of 20 to 40 inches. | B |
| Features favorable. | Unstable when wet. | Moderately well drained. | Slow intake rate. | Very slow permeability. | Features favorable. | High shrink-swell potential; A–7 material. | D |
| Features favorable. | Features favorable. | Moderately well drained. | Slow intake rate; variable slope. | Some strong slopes; easily eroded. | Easily eroded | High shrink-swell potential. | C |
| Limestone at a depth of 10 to 20 inches. | Limited amount of material. | Well drained | Limited root zone. | Limestone at a depth of 10 to 20 inches. | Limited root zone. | Limestone at a depth of 10 to 20 inches. | D |
| Features favorable. | Unstable when wet. | Moderately well drained. | Slow intake rate. | Very slow permeability. | Features favorable. | High shrink-swell potential; A–7 material. | D |
| Subject to flooding. | Features favorable. | Well drained | Subject to flooding. | Subject to flooding. | Subject to flooding. | Subject to flooding. | B |
| Sandstone at a depth of less than 20 inches. | Limited amount of material. | Well drained to somewhat excessively drained. | Limited root zone. | Sandstone at a depth of 8 to 20 inches. | Limited root zone. | Sandstone at a depth of 8 to 20 inches. | C |
| Sandstone at a depth of 8 to 20 inches. | Limited amount of material. | Well drained to somewhat excessively drained. | Limited root zone. | Sandstone at a depth of 8 to 20 inches. | Limited depth of soil. | Sandstone at a depth of 8 to 20 inches. | C |
| Features favorable. | Features favorable. | Moderately well drained. | Sloping; slow intake rate. | Features favorable. | Features favorable. | Moderate to high shrink-swell potential. | C |
| Seepage potential at a depth of 45 inches. | Slopes need to be stabilized. | Well drained | High intake rate; sloping. | Erodible; low stability. | Sandy surface layer; easily eroded. | Surface layer has poor stability. | A |

TABLE 8.—*Engineering*

| Soil series and map symbols | Suitability as a source of— | | | Degree and kind of limitations for sewage disposal | | Soil features affecting— |
|---|---|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Septic tank filter field | Sewage lagoons | Highway location |
| Durant: DuB, DuC, DuC2, DvC3. (See Bates series for Bates part of DvC3) | Good in surface layer. | Unsuitable: fine-grained material. | Poor: A–4 material in surface layer, A–7 material in subsoil. | Severe: very slow permeability. | Slight to moderate: slope. | Moderate to high shrink-swell potential. |
| Dwight: DwA | Poor: very limited amount of material. | Unsuitable: fine-grained material. | Poor: A–7 material in subsoil dispersed. | Severe: very slow permeability. | Slight: very slow permeability. | Very plastic when wet; dispersed subsoil. |
| Eufaula: EuB | Poor: too sandy. | Good: sand only. | Good when binder is added. | Moderate: rapid permeability. | Severe: rapid permeability. | Cuts are easily eroded. |
| Fitzhugh: FhB, FhC, FhC2. | Fair: more than 50 inches to rock. | Unsuitable: fine-grained material. | Fair to good: rock at a depth of 50 inches or more. | Moderate: 50 inches or more to rock. | Moderate: sandstone at a depth of 50 inches or more. | Sandstone at a depth of 50 inches or more; some lateral seepage. |
| Galey: GaB | Poor in sandy surface layer; good in subsoil. | Unsuitable: fine-grained material in subsoil. | Good: large quantity of material. | Slight: moderate permeability. | Severe: high seepage potential. | Cuts erode easily. |
| Heiden: HeC, HeD | Poor: too clayey. | Unsuitable: fine-grained material. | Poor: A–7 material. | Severe: very slow permeability. | Moderate to severe: slope. | Gently sloping to strongly sloping; high shrink-swell potential. |
| Hilgrave: HgC | Poor: too gravelly. | Good: gravel only. | Good: gravelly material. | Severe: conglomerate rock at a depth of 20 to 36 inches. | Severe: gravelly conglomerate rock at a depth of 20 to 36 inches. | Features favorable. |
| Konawa: KsD, KsD2, KtD3 | Poor in sandy surface layer; good in subsoil. | Poor: fine-grained material in subsoil. | Good: large quantity of material. | Slight: moderate permeability. | Severe: high seepage potential. | Erodible slopes; some areas are severely gullied. |
| KoA, KoB, KoC | Fair in surface layer; good in subsoil. | Unsuitable: fine-grained material. | Good: large quantity of material. | Slight: moderate permeability. | Severe: high seepage potential. | Erodible slopes |
| Lincoln: Ln | Poor: too sandy. | Good: large quantities of material. | Good when stabilized. | Severe: subject to flooding; rapid permeability. | Severe: rapid permeability; subject to flooding. | Subject to flooding. |
| Lula: LuB, LuC, LuC2, LxC. (See Talpa series for Talpa part of LxC) | Good: 40 to 60 inches to rock. | Good: crushed rock at a depth below 40 inches. | Fair: A–4 to A–6 material; limestone at a depth of 40 to 60 inches. | Moderate to severe: limestone at a depth of 40 to 60 inches. | Moderate: limestone at a depth of 40 to 60 inches. | Limestone at a depth of 40 to 60 inches. |

*interpretations*—Continued

| Soil features affecting—Continued: Farm ponds: Reservoir area | Farm ponds: Embankment | Agricultural drainage | Irrigation | Terraces and diversions | Grassed waterways | Foundations for low buildings | Hydrologic soil group |
|---|---|---|---|---|---|---|---|
| Features favorable. | Features favorable. | Moderately well drained. | Slow intake rate; slope. | Features favorable. | Features favorable. | Moderate to high shrink-swell potential. | D |
| Features favorable, except soil is dispersed. | Low shear strength; cracks when dry. | Moderately well drained; very slow permeability. | Slow intake rate; high sodium content. | Thin surface layer over clay; very slow permeability. | Thin surface layer; vegetation difficult to establish. | High shrink-swell potential. | D |
| High seepage potential; sandy. | High seepage potential; easily eroded. | Somewhat excessively drained. | Low available water capacity; high intake rate. | Easily eroded; rapid permeability. | Easily eroded; rapid permeability. | Low stability; rapid permeability. | A |
| Sandstone at a depth of 50 inches or more. | Features favorable | Well drained | Variable slope; moderate intake rate. | Features favorable. | Features favorable. | Low to moderate shrink-swell potential. | B |
| Seepage potential at a depth of about 52 inches. | Slopes need to be stabilized. | Well drained | Moderate intake rate. | Subject to soil blowing and water erosion. | Easily eroded | Poor stability in surface layer. | B |
| Features favorable. | Unstable when wet. | Very slow permeability; well drained. | Slow intake rate. | Very slow permeability. | Vegetation difficult to establish in clayey material. | High shrink-swell potential. | D |
| Conglomerate rock at a depth of about 20 to 36 inches; high seepage potential. | Limited amount of material. | Well drained | Limited root zone. | Limited material over conglomerate rock. | Limited root zone. | Features favorable. | B |
| Seepage potential at a depth of about 75 inches. | Erodes easily | Well drained | Moderate intake rate; some areas severely gullied. | Easily eroded; some areas severely gullied. | Erodes easily | Poor stability in surface layer. | B |
| Seepage potential at a depth of about 75 inches. | Erodes easily | Well drained | Moderate intake rate; some sloping areas. | Features favorable. | Features favorable. | Features favorable. | B |
| High seepage potential. | Easily eroded; high seepage potential. | Somewhat excessively drained. | High intake rate; subject to flooding. | Subject to flooding; rapid permeability. | Subject to flooding. | Subject to flooding. | A |
| Limestone at a depth of 40 to 60 inches; seepage potential. | Features favorable. | Well drained | Sloping | Features favorable. | Features favorable. | Limestone at a depth of 40 to 60 inches. | B |

TABLE 8.—*Engineering*

| Soil series and map symbols | Suitability as a source of— Topsoil | Suitability as a source of— Sand and gravel | Suitability as a source of— Road fill | Degree and kind of limitations for sewage disposal: Septic tank filter field | Degree and kind of limitations for sewage disposal: Sewage lagoons | Soil features affecting— Highway location |
|---|---|---|---|---|---|---|
| Okemah: OkB | Good in surface layer; poor in subsoil. | Unsuitable: fine-grained material. | Poor: A–6 or A–7 material. | Severe: slow permeability. | Moderate to slight: slope. | Unstable material; high shrink-swell potential. |
| Parsons: PaA, PaB | Poor: clay at a depth of 1 foot. | Unsuitable: fine-grained material. | Poor: A–7 material in subsoil. | Severe: very slow permeability. | Slight to moderate: slope. | High shrink-swell potential in subsoil; very slow permeability. |
| Pickens: PcE | Poor: shaly material. | Unsuitable: good source of shale. | Poor: shaly A–4 material over shale. | Severe: hard shale at a depth of 12 to 20 inches. | Severe: slope; shale at a depth of 12 to 20 inches. | Some moderately steep slopes. |
| Port: Po, Pr, Ps (See Cleora series for Cleora part of Pr, Ps) | Good: large quantity of material. | Unsuitable: fine-grained material. | Fair to poor: A–6 material. | Moderate to severe: subject to flooding. | Moderate to severe: subject to flooding. | Unstable material. |
| Scullin: ScC (See Talpa series for Talpa part of ScC) | Poor: gravelly | Unsuitable: fine-grained material. | Fair to good: limestone at a depth of 20 to 40 inches. | Severe: moderately slow permeability; limestone at a depth of 20 to 40 inches. | Severe: limestone at a depth of 20 to 40 inches. | Limestone at a depth of 20 to 40 inches. |
| Steedman: SdD | Poor: clay at a depth of about 1 foot. | Unsuitable: fine-grained material. | Poor: A–6 or A–7 material in surface layer, A–7 material in subsoil. | Severe: slow permeability. | Severe: shale at a depth of 20 to 40 inches. | Unstable subsoil; shale at a depth of 20 to 40 inches. |
| Stephenville: StB, StC, StC2, SvD. (See Darnell series for Darnell part of SvD) | Fair to poor rock at a depth of 20 to 40 inches. | Unsuitable: fine-grained material. | Good: sandstone at a depth of 20 to 40 inches. | Severe: sandstone at a depth of 20 to 40 inches. | Severe: sandstone at a depth of 20 to 40 inches. | Sandstone at a depth of 20 to 40 inches. |
| Talpa: TrE Interpretations not given for Rock outcrop part; material too variable for evaluation. | Poor: limestone at a depth of less than 1 foot. | Unsuitable: fine-grained material. | Poor: limestone at a depth of 4 to 10 inches. | Severe: limestone at a depth of 4 to 10 inches. | Severe: limestone at a depth of 4 to 10 inches. | Limestone at a depth of 4 to 10 inches. |
| Vanoss: VaA, VaB | Good | Unsuitable: fine-grained material. | Fair: A–4 and A–6 material. | Slight: moderate permeability. | Moderate: moderate permeability; slope. | Unstable when wet. |
| Verdigris: Vg | Good | Unsuitable: fine-grained material. | Fair to poor: A–4 or A–6 material. | Severe: subject to flooding. | Severe: subject to flooding. | Subject to flooding. |
| Vernon: VrC, VrD, VrD3. | Unsuitable: clay. | Unsuitable: fine-grained material. | Poor: A–7 material. | Severe: slow permeability. | Moderate to severe: slope. | Highly plastic soil material. |

*interpretations*—Continued

| Soil features affecting—Continued: Farm ponds: Reservoir area | Farm ponds: Embankment | Agricultural drainage | Irrigation | Terraces and diversions | Grassed waterways | Foundations for low buildings | Hydrologic soil group |
|---|---|---|---|---|---|---|---|
| Features favorable. | Features favorable. | Moderately well drained. | Slow intake rate; sloping. | Features favorable. | Features favorable. | Moderate to high shrink-swell potential. | C |
| Features favorable. | Unstable when wet; high shrink-swell potential. | Moderately well drained to somewhat poorly drained. | Slow intake rate. | Very slow permeability. | Features favorable. | High shrink-swell potential. | D |
| Fractured shale at a depth of 12 to 20 inches. | Limited amount of material; seepage potential. | Somewhat excessively drained. | Limited root zone. | Shale at a depth of 12 to 20 inches. | Limited root zone. | Shale at a depth of 12 to 20 inches. | D |
| Nearly level; limited to dug ponds. | Features favorable. | Well drained | Features favorable, except flooding. | Nearly level; subject to flooding. | Nearly level; subject to flooding. | Unstable material; subject to flooding. | B |
| Limestone at a depth of 20 to 40 inches. | Limited amount of material. | Well drained | Limited root zone. | Rock outcrops | Limited root zone; rock outcrops. | Rock at a depth of 20 to 40 inches. | C |
| Shale at a depth of 20 to 40 inches. | Unstable when wet; limited amount of material. | Well drained | Sloping; slow intake rate. | Variable slope | Variable slope | High shrink-swell potential. | D |
| Sandstone at a depth of 20 to 40 inches; seepage potential. | Features favorable. | Well drained | Variable slope | Features favorable. | Features favorable. | Sandstone at a depth of 20 to 40 inches. | B |
| Limestone at a depth of 4 to 10 inches. | Limited amount of material; limestone at a depth of 4 to 10 inches. | Well drained | Limestone at a depth of 4 to 10 inches. | Limestone at a depth of 4 to 10 inches. | Limestone at a depth of 4 to 10 inches. | Limestone at a depth of 4 to 10 inches. | D |
| Features favorable. | Features favorable. | Well drained | Features favorable. | Features favorable. | Features favorable. | Features favorable. | B |
| Features favorable. | Features favorable. | Moderately well drained. | Subject to flooding. | Nearly level; subject to flooding. | Nearly level | Subject to flooding. | B |
| Features favorable. | Unstable when wet. | Well drained | Some strong slopes; slow intake rate. | Some strong slopes; slow permeability. | Vegetation difficult to establish in clayey material. | High shrink-swell potential. | C |

TABLE 8.—*Engineering*

| Soil series and map symbols | Suitability as a source of— | | | Degree and kind of limitations for sewage disposal | | Soil features affecting— |
|---|---|---|---|---|---|---|
| | Topsoil | Sand and gravel | Road fill | Septic tank filter field | Sewage lagoons | Highway location |
| Windthorst: WhC, WkC3. (See Stephenville series for Stephenville part of WkC3) | Poor: depth of less than 1 foot to clay. | Unsuitable: fine-grained material. | Poor: mostly A–6 or A–7 material. | Severe: moderately slow permeability. | Moderate: slope. | Subsoil is unstable clay. |
| Woodson: WoA | Poor: clay at a depth of about 1 foot. | Unsuitable: fine-grained material. | Poor: mostly A–7 material. | Severe: very slow permeability. | Slight: very slow permeability. | High shrink-swell potential; very slow permeability. |
| Yahola: Yc, Yf | Fair in surface layer. | Good at a depth below 3 feet. | Good: large quantity of material. | Severe: subject to flooding. | Severe: subject to flooding; moderately rapid permeability. | Subject to flooding. |

to well drained, and moderately fine textured to moderately coarse textured. They have a moderate rate of water transmission.

*Group C* consists of soils that have a slow rate of infiltration when thoroughly wet, chiefly soils that have a layer that impedes downward movement of water. These soils are moderately fine textured to fine textured. They have a slow rate of transmission.

*Group D* consists of soils that have a very slow rate of infiltration when thoroughly wet, chiefly clay soils that have a high swelling potential, a permanently high water table, and a claypan or clay layer at or near the surface. These soils are shallow to nearly impervious material. They have a very slow rate of water transmission.

### *Engineering test data*

Table 9 contains the results of engineering tests performed by Oklahoma Department of Highways on several important soils in Pontotoc County. The table shows the location where the sample was taken, the depth of sampling, and the results of tests to determine particle-size distribution and other properties significant in engineering.

Shrinkage limit is the percentage of moisture 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.

Volume change from field moisture equivalent 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.

Mechanical analysis shows the percentages, by weight, of soil particles that pass sieves of specified sizes. Sand and other coarse material do not pass the No. 200 sieve. Silt is that material larger than 0.002 millimeter in diameter that passes the No. 200 sieve, and clay is that fraction passing the No. 200 sieve that is 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 a solid 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 solid 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.

# *Formation and Classification of the Soils*

In this section are discussed the factors of soil formation, the processes of soil formation, and the classification of the soils. Table 10 gives the classification of each soil series of Pontotoc County by higher categories.

*interpretations*—Continued

| Soil features affecting—Continued | | | | | | Foundations for low buildings | Hydrologic soil group |
|---|---|---|---|---|---|---|---|
| Farm ponds | | Agricultural drainage | Irrigation | Terraces and diversions | Grassed waterways | | |
| Reservoir area | Embankment | | | | | | |
| Features favorable. | Features favorable. | Moderately well drained. | Slow intake rate; some areas severely eroded. | Variable slope | Vegetation difficult to establish in clayey material. | High shrink-swell potential. | C |
| Features favorable. | Unstable when wet. | Moderately well drained to somewhat poorly drained. | Slow intake rate; nearly level. | Nearly level; very slow permeability. | Nearly level | High shrink-swell potential. | D |
| Seepage potential at a depth below 30 inches. | Slopes need to be stabilized. | Well drained | Features favorable, except subject to flooding. | Subject to flooding. | Subject to flooding. | Subject to flooding. | B |

## Factors of Soil Formation

Soil is the product of five major factors of soil formation—climate, living organisms (especially vegetation), parent material, relief, and time. The factors of soil formation are so closely interrelated that few generalizations can be made regarding the effect of any one factor because the effect of each is modified by the other four. Climate and living organisms are the active factors of soil formation.

### *Climate*

The moist, subhumid, continental climate of Pontotoc County is characterized by rains of high intensity. Moisture and warm temperatures have been sufficient to promote the formation of distinct horizons in many of the soils. Differences in soils, however, cannot be attributed to climate, because the climate is uniform throughout the county. Heavy rains have caused rapid runoff that has severely eroded many of the soils. This erosion is an indirect effect of climate.

### *Living organisms*

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 of the Bates, Durant, Vanoss, and Lula series formed on the prairie under native grasses. The fibrous roots of these native grasses promote a good granular structure and add organic matter to the soil. Large amounts of plant nutrients are not lost from soils that formed under native grasses, because roots take in nutrients from deep in the soil and return a large part of these when the grass dies. Also, soils that formed on the prairie under native grasses generally are less acid than soils that formed under trees. Soils of the Darnell and Stephenville series developed under scrub oaks, and they are more acid and lower in content of organic matter than soils that formed on the prairie under grasses.

Man has altered the natural soil-forming processes in much of the county. His clearing and cultivation of the soils have resulted in tremendous loss of soil through sheet and gully erosion. The severely eroded Konawa, Chigley, and Vernon soils are in areas where much of the surface layer has been removed.

### *Parent material*

Except for climate, parent material is the most influential factor of soil formation in Pontotoc County. It sets the limits of the chemical and mineralogical composition of the soil, as well as influencing the rate of soil development.

Pontotoc County has many kinds of parent material, all producing soils of a different quality. Soils that formed in material weathered from Pennsylvania shale, such as those of the Dennis series, have a subsoil that is generally high in clay, and a surface layer that has high organic-matter content. The soils formed in material weathered from Pennsylvanian sandstone have a more loamy subsoil. Soils that formed in material weathered from limestone of the Ordovician period have an adequate supply of bases. In places where relief is gentle, they are deep and have a loamy subsoil and a surface layer that is high in organic-matter content. Soils that formed in conglomerate parent material generally contain fragments of the less weatherable rocks in the soil profile. An example is Chigley soils, which have a large amount of particles of sand and gravel size in an otherwise well-developed soil.

TABLE 9.—*Engineering*

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

| Soil name and location | Parent material | Report No. | Depth from surface | Shrinkage | | Volume change from field moisture equivalent |
|---|---|---|---|---|---|---|
| | | | | Limit | Ratio | |
| | | *SO-* | *In.* | *Pct.* | | *Pct.* |
| Bates fine sandy loam: 1,675 feet W. and 75 feet N. of SE. cor. sec. 30, T. 4 N., R. 8 E. (modal). | Sandstone. | 4572 | 0–12 | 21 | 1.69 | 16 |
| | | 4573 | 20–30 | 16 | 1.85 | 24 |
| | | 4574 | 30–40 | 16 | 1.84 | 18 |
| Chigley gravelly sandy loam: 2,375 feet E. and 50 feet N. of SW. cor. sec. 22, T. 3 N., R. 4 E. (modal). | Conglomerate rock. | 4560 | 0–10 | 17 | 1.76 | 9 |
| | | 4561 | 10–24 | 11 | 1.96 | 76 |
| | | 4562 | 24–60 | 14 | 1.86 | 54 |
| Durant loam: 700 feet W. and 200 feet S. of NE. cor. sec. 16, T. 4 N., R. 4 E. (modal). | Shale. | 4563 | 0–10 | 16 | 1.82 | 32 |
| | | 4564 | 15–30 | 9 | 2.03 | 80 |
| | | 4565 | 40–55 | 10 | 2.03 | 70 |
| Konawa loamy fine sand: 475 feet E. and 120 feet N. of SW. cor. SE¼ sec. 5, T. 4 N., R. 5 E. (modal). | Loamy alluvium. | 4551 | 0–6 | (6) | (6) | (6) |
| | | 4552 | 14–35 | 15 | 1.84 | 31 |
| | | 4553 | 62–75 | (6) | (6) | (6) |
| Lula loam: 900 feet E. and 60 feet N. of SW. cor. sec. 18, T. 1 N., R. 6 E. (modal). | Limestone. | 4566 | 0–12 | 18 | 1.80 | 10 |
| | | 4567 | 12–22 | 14 | 1.89 | 33 |
| | | 4568 | 22–40 | 13 | 1.94 | 45 |
| Windthorst fine sandy loam: 2,600 feet W. and 1,000 feet S. of NE. cor. sec. 13, T. 3 N., R. 7 E. (modal). | Sandstone and clay. | 4569 | 0–4 | 17 | 1.78 | 17 |
| | | 4570 | 14–24 | 13 | 1.89 | 49 |
| | | 4571 | 24–30 | 14 | 1.85 | 39 |

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

[2] Based on AASHO Designation M 145–49. Oklahoma Department of Highways classification procedure further subdivides the AASHO A–2–4 subgroup as follows: A–2–3(0) if the soil is nonplastic; A–2(0) if the plasticity index ranges from nonplastic to 5; and A–2–4(0) if the plasticity index ranges from 5 to 10.

Soil color is also affected by parent material. Those soils that formed in material weathered from the reddish, calcareous, Permian shale have soil colors that are dominantly reddish brown. Examples are soils of the Vernon and Clarita series.

The alluvium of Pontotoc County is of Recent and Pleistocene origin. Such soils as those of the Konawa and Galey series formed in older alluvium of Pleistocene origin; soils of the Lincoln, Yahola, and Port series formed in loamy deposits of Recent origin.

### *Relief*

Relief affects the formation of soils through its influence on drainage, erosion, temperature of the soil, and plant cover. In Pontotoc County relief is determined largely by the resistance of underlying rock formations to weathering and geologic erosion. About 16 percent of Pontotoc County consists of nearly level soils on flood plains, and about 84 percent consists of nearly level to steep soils on uplands.

The effects of relief are apparent in soils of the Parsons, Dennis, and Steedman series, all of which developed in clayey material but have differing profile characteristics. Nearly level Parsons soils have less surface runoff; hence, more water percolates through the profile to influence the loss, gain, or transfer of soil constituents. The more sloping Dennis and Steedman soils, which are associated with Parsons soils, are less well developed.

Stephenville and Darnell soils formed in similar sandstone parent material. Relief is also a controlling factor in the development of these two soils. The moderately deep Stephenville soils are less sloping, as compared to the shallow, more sloping Darnell soils. The more sloping relief of Darnell, Vernon, Collinsville, and Talpa soils is such that much of the rainfall runs off, rather than moving through the profile to influence development of a thicker solum.

### *Time*

Time as a factor in soil formation cannot be measured strictly in years. The length of time needed for the de-

*test data*

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

| Mechanical analysis [1] | | | | | | Liquid limit | Plasticity index | Classification | |
|---|---|---|---|---|---|---|---|---|---|
| Percentage passing sieve— | | | Percentage smaller than— | | | | | | |
| No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | 0.05 mm. | 0.005 mm. | 0.002 mm. | | | AASHO [2] | Unified [3] |
| | | | | | | Pct. | | | |
| 100 | 99 | 53 | 42 | 14 | 10 | 26 | 2 | A-4(4) | ML |
| ---------- | 100 | 55 | 45 | 25 | 22 | 29 | 9 | A-4(4) | CL |
| ---------- | 100 | 54 | 41 | 27 | 23 | 28 | 9 | A-4(4) | CL |
| [4] 84 | 59 | 28 | 26 | 13 | 10 | 22 | 2 | A-2(0) | SM |
| [5] 97 | 84 | 60 | 55 | 43 | 40 | 59 | 27 | A-7-5(14) | MH-CH |
| 100 | 88 | 55 | 48 | 36 | 30 | 47 | 19 | A-7-6(8) | ML-CL |
| 100 | 98 | 76 | 64 | 29 | 25 | 36 | 10 | A-4(8) | ML-CL |
| 100 | 99 | 87 | 78 | 50 | 51 | 57 | 27 | A-7-5(18) | MH-CH |
| [5] 96 | 91 | 79 | 74 | 45 | 37 | 47 | 22 | A-7-6(14) | MH-CH |
| 100 | 97 | 26 | 13 | 4 | 3 | (6) | (6) | A-2-3(0) | SM |
| 100 | 99 | 50 | 36 | 31 | 28 | 35 | 13 | A-6(4) | SM-SC |
| 100 | 98 | 22 | 15 | 12 | 9 | (6) | (6) | A-2-3(0) | SM |
| 100 | 99 | 72 | 60 | 22 | 17 | 25 | 6 | A-4(7) | ML-CL |
| ---------- | 100 | 78 | 72 | 33 | 27 | 30 | 9 | A-4(8) | ML-CL |
| ---------- | 100 | 76 | 66 | 43 | 38 | 39 | 13 | A-6(9) | ML-CL |
| 100 | 99 | 81 | 41 | 25 | 23 | 27 | 7 | A-4(8) | ML-CL |
| ---------- | 100 | 77 | 62 | 46 | 43 | 44 | 17 | A-7-6(12) | ML-CL |
| ---------- | ------------ | 73 | 53 | 36 | 33 | 39 | 16 | A-6(10) | CL |

[3] SCS and BPR have agreed to consider that all soils having plasticity indexes within 2 points from A-line are to be given a borderline classification. Examples of borderline classifications so obtained are ML-CL and SM-SC.
[4] 100 percent passed the ¾-inch sieve.
[5] 100 percent passed the ⅜-inch sieve.
[6] Nonplastic.

velopment of genetic horizons depends on the intensity and interaction of the soil-forming factors in promoting the losses, gains, transfers, or transformations of soil constituents that are necessary for forming soil horizons. Soils without definite genetic horizons are young or immature. Mature or older soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils of Pontotoc County range from young to old. Some of the old, mature soils are those of the Dennis, Parsons, and Lula series on the uplands. Soils of the Vanoss and Konawa series are younger, but they have well-expressed horizons. Soils of the Vernon, Talpa, and Darnell series are young soils. They have had sufficient time to develop well-expressed horizons, but because they are sloping, geologic erosion has taken away soil material as fast, or almost as fast, as it has formed. Soils of the Yahola, Port, and Lincoln series are on flood plains and have been developing for such a short time that they show little horizon development.

## Processes of Soil Formation

Processes that have influenced the formation of horizons in the soils of Pontotoc County are (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, and (3) translocation of silicate clay minerals. In most soils, more than one of these processes has been active in the development of horizons. Some processes have retarded horizon differentiation.

By adding organic matter to the surface layer, native grasses have contributed to the granular structure of that layer in soils on the prairie. These granular surface layers that are high in organic-matter content, such as the surface layer of Okemah soils, are called mollic epipedons in the classification system. Stephenville soils formed in material weathered from sandstone under native trees. They contain less organic matter than Okemah soils, and their surface layer is called an ochric epipedon.

TABLE 10.—*Classification of soil series*

| Series | Family | Subgroup | Order |
|---|---|---|---|
| Arkabutla [1] | Fine-silty, mixed, acid, thermic | Aeric Fluventic Haplaquepts | Inceptisols. |
| Bates | Fine-loamy, siliceous, thermic | Typic Argiudolls | Mollisols. |
| Burleson [2] | Fine, montmorillonitic, thermic | Udic Pellusterts | Vertisols. |
| Chigley | Fine, mixed, thermic | Ultic Paleustalfs | Alfisols. |
| Claremore | Loamy, mixed, thermic | Lithic Argiudolls | Mollisols. |
| Clarita | Fine, montmorillonitic, thermic | Udic Pellusterts | Vertisols. |
| Cleora | Coarse-loamy, mixed, thermic | Fluventic Hapludolls | Mollisols. |
| Collinsville | Loamy, siliceous, thermic | Lithic Hapludolls | Mollisols. |
| Darnell | Loamy, siliceous, thermic, shallow | Udic Ustochrepts | Inceptisols. |
| Dennis | Fine, mixed, thermic | Aquic Paleudolls | Mollisols. |
| Dougherty | Loamy, mixed, thermic | Arenic Haplustalfs | Alfisols. |
| Durant | Fine, montmorillonitic, thermic | Vertic Argiustolls | Mollisols. |
| Dwight [3] | Fine, montmorillonitic, mesic | Typic Natrustolls | Mollisols. |
| Eufaula | Sandy, siliceous, thermic | Psammentic Paleustalfs | Alfisols. |
| Fitzhugh | Fine-loamy, mixed, thermic | Typic Argiudolls | Mollisols. |
| Galey | Fine-loamy, mixed, thermic | Ultic Paleustalfs | Alfisols. |
| Heiden | Fine, montmorillonitic, thermic | Udic Chromusterts | Vertisols. |
| Hilgrave | Loamy-skeletal, mixed, thermic | Udic Haplustalfs | Alfisols. |
| Konawa | Fine-loamy, mixed, thermic | Ultic Haplustalfs | Alfisols. |
| Lincoln | Sandy, mixed, thermic | Typic Ustifluvents | Entisols. |
| Lula | Fine-silty, mixed, thermic | Typic Argiudolls | Mollisols. |
| Okemah | Fine, mixed, thermic | Aquic Paleudolls | Mollisols. |
| Parsons | Fine, mixed, thermic | Mollic Albaqualfs | Alfisols. |
| Pickens | Loamy-skeletal, mixed, thermic | Lithic Dystrochrepts | Inceptisols. |
| Port | Fine-silty, mixed, thermic | Cumulic Haplustolls | Mollisols. |
| Scullin | Fine, mixed, thermic | Udic Argiustolls | Mollisols. |
| Steedman | Fine, montmorillonitic, thermic | Vertic Haplustalfs | Alfisols. |
| Stephenville | Fine-loamy, siliceous, thermic | Ultic Haplustalfs | Alfisols. |
| Talpa | Loamy, mixed, thermic | Lithic Haplustolls | Mollisols. |
| Vanoss | Fine-silty, mixed, thermic | Udic Argiustolls | Mollisols. |
| Verdigris | Fine-silty, mixed, thermic | Cumulic Hapludolls | Mollisols. |
| Vernon | Fine, mixed, thermic | Typic Ustochrepts | Inceptisols. |
| Windthorst | Fine, mixed, thermic | Ultic Paleustalfs | Alfisols. |
| Woodson | Fine, mixed, thermic | Abruptic Argiaquolls | Mollisols. |
| Yahola | Coarse-loamy, mixed, calcareous, thermic | Typic Ustifluvents | Entisols. |

[1] These soils are taxadjuncts to the Arkabutla series. They differ from those soils by having a slightly higher soil reaction, but they are enough like Arkabutla soils in morphology, composition, and behavior that a new series is not warranted.

[2] These soils are taxadjuncts to the Burleson series. They differ from the Burleson soils by having a chroma of 2 at a depth below 30 inches.

[3] These soils are taxadjuncts to the Dwight series. They have a mean annual soil temperature of more than 59° F. at a depth of 20 inches.

Leaching of calcium carbonates and bases is active in the development of soils. The accumulation of calcium carbonates and bases in the lower part of the B horizon of the Durant soils indicates the depth to which water has percolated. The Vanoss, Dennis, and Lula soils have been leached to the extent that they have no accumulation of calcium carbonates. Konawa, Dougherty, and Eufaula soils have a distinct A2 horizon that has been leached of bases. The B horizon of these soils has had much leaching of bases that is reflected by moderately low base saturation.

Young alluvial Lincoln and Yahola soils are recharged with bases during each flood. The acid Cleora soils have not been leached, but their sediments come from the leached, acid soils. The Vernon soils, which formed in Permian red beds, are high in carbonates. Calcium carbonates in Vernon soils are related to the nature of the parent material, rather than to leaching.

The translocation of silicate clay minerals is very important in the properties and classification of soils. Argillic horizons are diagnostic for classification. Clay films on ped surfaces and bridging sand grains, and moderate increases in total clay are used in the field as evidence of argillic horizons. The argillic horizon occurs in Dennis, Durant, and Stephenville soils. The varying degrees of translocation of silicate clay minerals and the kind of parent material have resulted in wide variation in the texture and other properties of the argillic horizons of soils in Pontotoc County. The Stephenville, Konawa, Dougherty, and Eufaula soils have a surface layer that is more intensely leached of silicate clay minerals than the surface layer of other soils in the county.

The grasses on the soils of the prairie bring bases to the surface and thus retard complete leaching and formation of an A2 horizon. Geological erosion on gently sloping to strongly sloping Vernon and Collinsville soils hinders horizonation through soils losses. The sediments of the Yahola, Verdigris, and other soils on flood plains were deposited so recently that there has not been enough time for the formation of horizons.

## Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*5*) and later revised (*4*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967 and in September 1968 (*7*). This system is under continual study, and readers interested in the development of the system should refer to the latest literature available.

The current system defines classes in terms of observable or measurable properties of soils (*3*). The properties chosen are primarily those that permit the grouping of soils that are similar in genesis. The classification system is designed to encompass all soils. It has six categories. Beginning with the most inclusive, they are the order, the suborder, the great group, the subgroup, the family, and the series. These are briefly defined in the following paragraphs.

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

Entisols are recent soils in which there has been no horizon development. This order is represented in Pontotoc County by soils of the Lincoln series.

Inceptisols occur mostly on young, but not recent, land surfaces. This order is represented by soils of the Darnell, Pickens, and Arkabutla series.

Mollisols have a thick, dark-colored surface layer. Most of these soils formed under grass. This order is represented by soils of the Bates series.

Vertisols are soils in which churning or inversion of material takes place, mainly through swelling and shrinking of clays. This order is represented by soils of the Burleson series.

Alfisols have a clay-enriched B horizon and a medium amount of base saturation. This order is represented by soils of the Stephenville and Konawa series.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that indicate genetic similarity. The suborders have a narrower climatic range than the order. The criteria for suborders reflect either the presence or absence of waterlogging, or soil differences resulting from climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in kind and sequence of genetic horizons. The great group is not shown in table 10 because the name of the great group is the same as the last word in the name of the subgroup.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) concept of the group, and other groups, called intergrades, that have properties of one great group but also one or more properties of another great group.

FAMILY.—Families are established within subgroups, primarily on the basis of properties important to plant growth. Some of these properties are texture, mineralogy, reaction, soil temperature, permeability, consistence, and thickness of horizons.

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.

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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.

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

**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.

**Calcareous soil.** A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

**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.

**Claypan.** A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

**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.

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

**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 profiles.

*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 beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

*Somewhat poorly drained* soils are wet for significant periods but not all the time, and some soils commonly have mottlings at a depth below 6 to 16 inches.

*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.

**Flood plain.** Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

**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 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.

**Mottling, soil.** Irregularly marked 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.

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

**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.

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

**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 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.

**Variant, soil.** A soil having properties sufficiently different from those other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

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