SOIL SURVEY OF

Ochiltree County, Texas

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

Issued January 1973

Major fieldwork for this soil survey was done in the period 1962 to 1964. Soil names and descriptions were approved in 1966. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1964. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Ochiltree 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 and ranches; 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 Ochiltree 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 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 capability unit and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and capability units.

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

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 test data, estimates of soil properties, and information about soil features that affect engineering practices.

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

Newcomers in Ochiltree County may be interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "General Nature of the County," which gives additional information about the county.

Cover: An area of Spur soils. These soils occur on flood plains.

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BY FRANKIE F. WHEELER, SOIL CONSERVATION SERVICE

SOILS SURVEYED BY FRANKIE F. WHEELER, ARLO D. MOSS, AND HARRY F. McEWEN, SOIL CONSERVATION SERVICE

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

OCHILTREE COUNTY is in the northwestern part of Texas, at the northern edge of the Texas Panhandle (fig. 1). Perryton, the county seat, is about 7 miles south of the Texas-Oklahoma State line on U.S. Highway 83. The town serves a productive farming, ranching, and oil-producing area. In 1960 the population of the county was 9,380; it is gradually increasing.

The county is about 30 miles square and has a total area of 907 square miles, or 580,480 acres. About 70 percent of the county is cropland, and the remaining 30 percent is rangeland. Growing winter wheat and grain sorghum and raising beef cattle are the principal farming enterprises. Wheat farming is the most extensive enterprise, and production of grain sorghum is second. Most of the cultivated acreage is dryfarmed, but approximately 43,000 acres was irrigated in 1966.

The oil and natural gas industry is also an important source of income in the county. Many people are employed by companies that drill and service oil and gas wells.

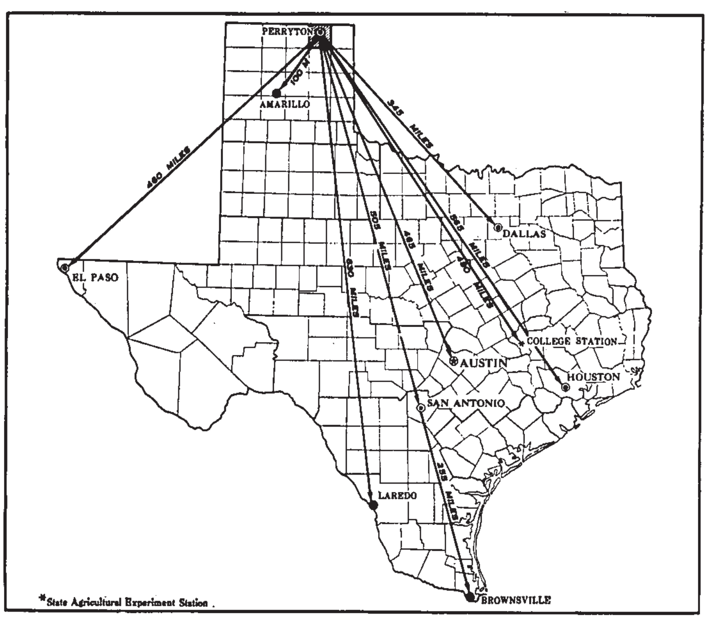

Figure 1.—Location of Ochiltree County in Texas.

Ochiltree County is in the High Plains Land Resource Area. Most of the soils in the county formed under grass vegetation. They are dominantly dark colored, loamy and clayey. Most of the soils are susceptible to blowing unless they are protected. All but the nearly level soils are susceptible to sheet and gully erosion unless they are protected.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Ochiltree County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*6*).[1]

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. Pullman and Richfield, 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

[1] Italic numbers in parentheses refer to Literature Cited, p. 45.

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, Pullman clay loam, 0 to 1 percent slopes, is one of several phases within the Pullman 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. One such mapping unit, shown on the soil map of Ochiltree County, is the soil complex.

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. Potter-Mansker complex, 0 to 8 percent slopes, is an example.

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

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of range, 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 current 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 Ochiltree County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

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

The general soil map of Ochiltree County shows five soil associations. These associations are described briefly in this section. The terms for texture used in the descriptive heading of the associations apply to the surface layer. For example, in the heading for association 1, the words "loamy and clayey" refer to texture of the surface layer.

1. Pullman-Randall association

Deep, nearly level to gently sloping, loamy and clayey soils

This association (fig. 2) is on nearly level to gently sloping upland plains. It is the largest in the county and occupies about 50 percent of the total area. Pullman soils make up about 90 percent of the association, and Randall soils, about 5 percent. Roscoe, Ulysses, and Richfield soils make up the rest.

Pullman soils are deep and nearly level to gently sloping. They occupy broad upland plains. Randall soils are deep and clayey. They occupy the bottoms of enclosed depressions or intermittent lakes (playas) that dot the broad constructional plain.

In the Pullman soils the surface layer is noncalcareous, grayish-brown clay loam about 5 inches thick. This layer rests abruptly on the next layer of firm, dark grayish-brown to brown clay that is noncalcareous in the upper part and calcareous in the lower part. This layer is about 25 inches thick. The next layer is clay loam that is pale brown in the upper part and light brown in the lower part. At a depth below 72 inches is pink silty clay loam.

In the Randall soils the surface layer is very firm, gray clay about 18 inches thick. This layer grades to a layer of extremely firm gray clay. This layer is about 30 inches thick, and it is underlain by very firm, light-gray clay that contains distinct pale-yellow mottles.

Roscoe soils occupy slightly concave bench positions around the playas. Ulysses soils are on gently sloping knolls that rise above the broad constructional plain and on ridges around the playas. They are sloping in areas leading to the drainageways of the upland plains. Richfield soils are nearly level to gently sloping, and they occur along the edge of the upland plains.

Most of this association is cultivated. Some of the Randall soils are cultivated in areas where the soils are not under water for extended periods. Some of the smaller

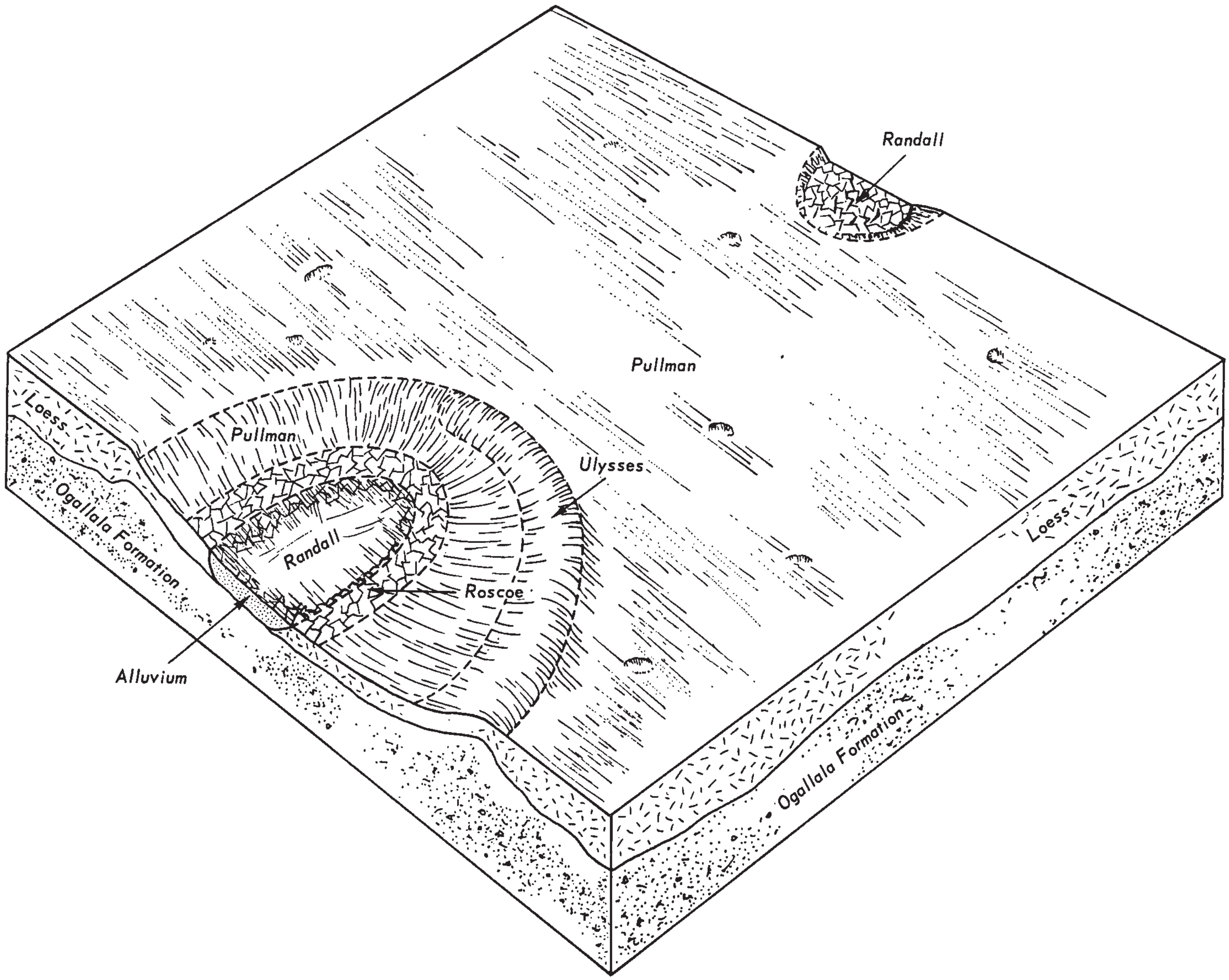

Figure 2.—**Representative pattern of soils in the Pullman-Randall association.**

playas are drained and used in the same way as the surrounding Pullman soils.

Generally, these soils are slightly susceptible to soil blowing. Most water erosion is caused by water that flows from large, nearly level areas to the playas and drainageways.

2. *Ulysses-Richfield association*

Deep, nearly level to gently sloping, loamy soils

This association (fig. 3) is on nearly level to gently sloping upland plains. It occupies about 24 percent of the county. Ulysses soils make up about 45 percent of the association, and Richfield soils about 45 percent. Mansker, Pullman, Randall, and Roscoe soils make up the rest.

Ulysses soils are mainly gently sloping. They occupy smooth, convex knolls; oval rims or ridges around playas; and sloping areas leading to natural drainageways. Richfield soils are nearly level to gently sloping.

In the Ulysses soils the surface layer is calcareous, grayish-brown silty clay loam about 10 inches thick. The next layer is calcareous, friable, pale-brown silty clay loam about 10 inches thick. Below this is very pale brown silty clay loam that is about 5 percent visible calcium carbonate. This layer is about 22 inches thick. It is underlain by calcareous, pink silty clay loam that begins at a depth of about 42 inches.

In the Richfield soils the surface layer is noncalcareous, grayish-brown to dark grayish-brown clay loam about 8 inches thick. The next layer is friable, noncalcareous, dark grayish-brown silty clay loam about 6 inches thick. Beginning at a depth of about 14 inches is brown silty clay loam about 20 inches thick. This is underlain by calcareous, pale-brown silty clay loam, 14 inches thick, that is about 5 percent visible calcium carbonate. Below this, beginning at a depth of about 48 inches, is pink silty clay loam.

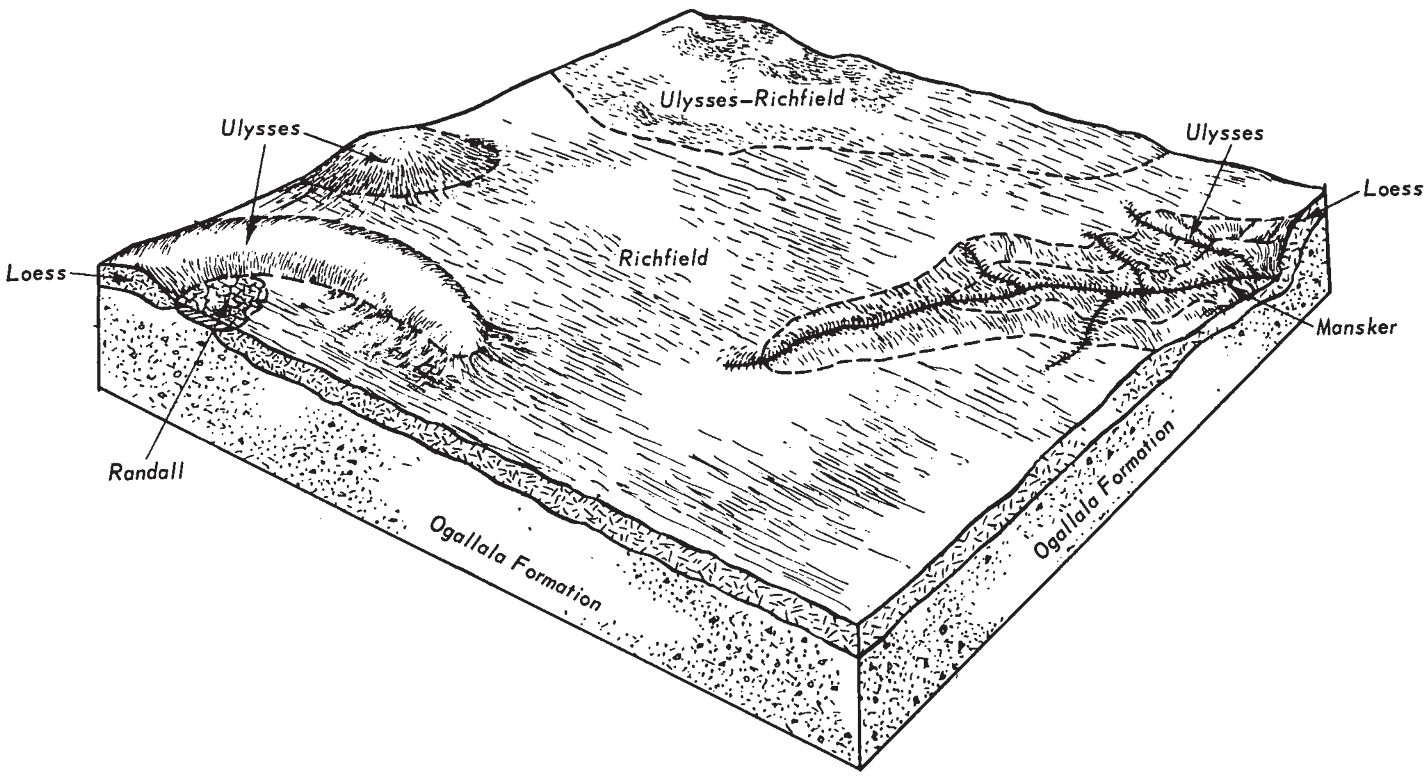

Figure 3.—**Representative pattern of soils in the Ulysses-Richfield association.**

Mansker soils are gently sloping to sloping. They occupy areas between the nearly level soils on upland plains and the very shallow soils along the High Plains escarpment. Pullman soils are nearly level to gently sloping. They occupy areas on the upland plains. Randall soils occupy the bottoms of playas. Roscoe soils are slightly concave. They occupy bench positions around the playas.

Most of this association is cultivated.

Generally, these soils are slightly to moderately susceptible to soil blowing. Susceptibility to water erosion is slight to moderately severe. Most water erosion is caused by water that flows from large, nearly level areas to the drainageways and draws that drain the upland plains.

3. *Potter-Mansker-Berthoud association*

Very shallow to deep, nearly level to steep, loamy soils

This association (fig. 4) is on the nearly level to steep areas along the High Plains escarpment or remnants of it, on the rough dissected breaks, and on the foot slopes leading to the valleys or bottom lands below. It occupies about 23 percent of the county. Potter soils make up about 35 percent of the association; Mansker soils, about 30 percent; and Berthoud soils, about 10 percent. Bippus, Mobeetie, and Spur soils and Rough broken land make up the rest.

Potter soils are gently sloping to steep. They occupy ridges, knobs, and mesas along the escarpment, and also some ridges and knobs below the escarpment. Mansker soils are nearly level to sloping. They occupy areas leading to the drainageways, and pockets or mesas, generally above the High Plains escarpment. Berthoud soils occupy concave to plane foot slopes below the escarpment.

In the Potter soils the surface layer is calcareous, grayish-brown gravelly loam about 7 inches thick over a layer of white, slightly platy caliche. At a depth below 14 inches the caliche layer grades to a layer that is about 70 percent caliche fragments and about 30 percent pale-brown calcareous loam.

In the Mansker soils the surface layer is calcareous, brown clay loam about 10 inches thick. The next layer is friable, calcareous, pale-brown clay loam about 6 inches thick. The next layer is very pale brown clay loam that is about 25 percent visible calcium carbonate.

In the Berthoud soils the surface layer is calcareous, grayish-brown loam about 10 inches thick. This layer grades to a layer of friable, light brownish-gray loam about 12 inches thick. The next layer is light-gray loam that is about 3 percent visible calcium carbonate. An underlying layer of calcareous, light brownish-gray loam begins at a depth of about 42 inches.

Bippus and Spur soils occupy alluvial valley floors. Mobeetie soils occupy positions on the landscape similar to those occupied by Berthoud soils. Rough broken land occupies steep escarpments and rough, dissected areas. It includes steep canyon walls, severely eroded areas of loamy calcareous earth, indurated caliche outcrops, and loamy alluvial material. It also includes small areas of Ulysses and Richfield soils.

A few areas of the Mansker soils in this association are cultivated. Most of the association, however, is used for range.

The hazard of soil blowing is moderate, and the hazard of water erosion is slight to severe.

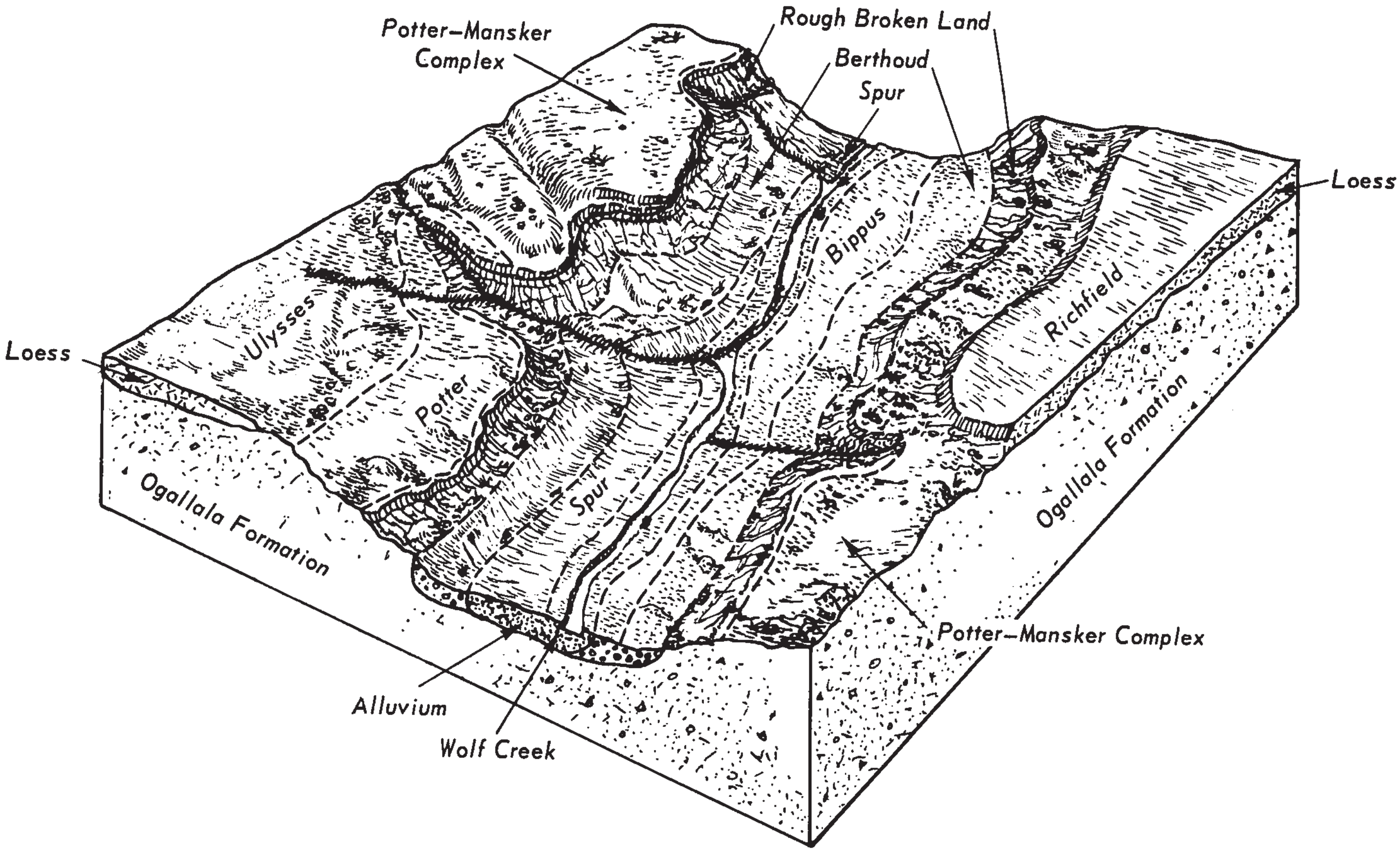

Figure 4.—**Representative pattern of soils in the Potter-Mansker-Berthoud association.**

4. Bippus-Spur association

Deep, nearly level to gently sloping, loamy soils that formed in alluvium

This association is on the nearly level to gently sloping alluvial valley floors and flood plains. It occupies about 2 percent of the county. Bippus soils make up about 40 percent of the association, and Spur soils, about 40 percent. Small areas of Berthoud and Mobeetie soils make up the rest. Lake Fryer, the largest area of water in Ochiltree County, is in this association.

Bippus soils are gently sloping. They occupy low foot slopes and valley floors. Spur soils are nearly level; they are on flood plains in slightly lower positions than Bippus soils. Some of the Spur soils in low positions are broken by streambanks, old scar channels, and present stream channels of the major creeks.

In the Bippus soils the surface layer is dark grayish-brown clay loam about 18 inches thick. This layer grades to calcareous, friable, brown clay loam about 14 inches thick. Below this is brown clay loam that is about 1 percent visible calcium carbonate.

In the Spur soils the surface layer is calcareous, dark grayish-brown clay loam about 18 inches thick. The subsurface layer is calcareous, brown clay loam about 18 inches thick. The underlying material is calcareous, pale-brown clay loam.

Berthoud and Mobeetie soils occupy concave to plane foot slopes above and adjacent to Bippus soils.

Most areas of Bippus soils and about 30 percent of the acreage of Spur soils are cultivated. The broken areas of Spur soils in low positions are used for range.

Generally, there is a slight hazard of soil blowing on this association, and a slight to moderately severe hazard of water erosion.

5. Mobeetie-Vona association

Deep, gently sloping to sloping, loamy and sandy soils

This association (fig. 5) occupies gently sloping to sloping or gently rolling uplands. It occupies about 1 percent of the county. Mobeetie soils occupy about 60 percent of the association, and Vona soils, about 30 percent. Most of the Lincoln soils and small areas of Berthoud, Mansker, Potter, and Spur soils make up the rest.

Mobeetie soils occupy concave foot slopes below the High Plains escarpment. Mobeetie soils also are intermingled with Vona soils. In areas where these soils occur together, they are undulating or gently rolling. Mobeetie soils occupy narrow ridges and divides, and the Vona soils occupy narrow areas leading to the draws or drainageways.

In the Mobeetie soils the surface layer is calcareous, grayish-brown fine sandy loam about 10 inches thick. This layer grades to a subsurface layer of very friable, calcareous, light brownish-gray fine sandy loam about 12 inches thick. This layer is underlain by a layer of very friable, light brownish-gray fine sandy loam that is about 1 percent visible calcium carbonate.

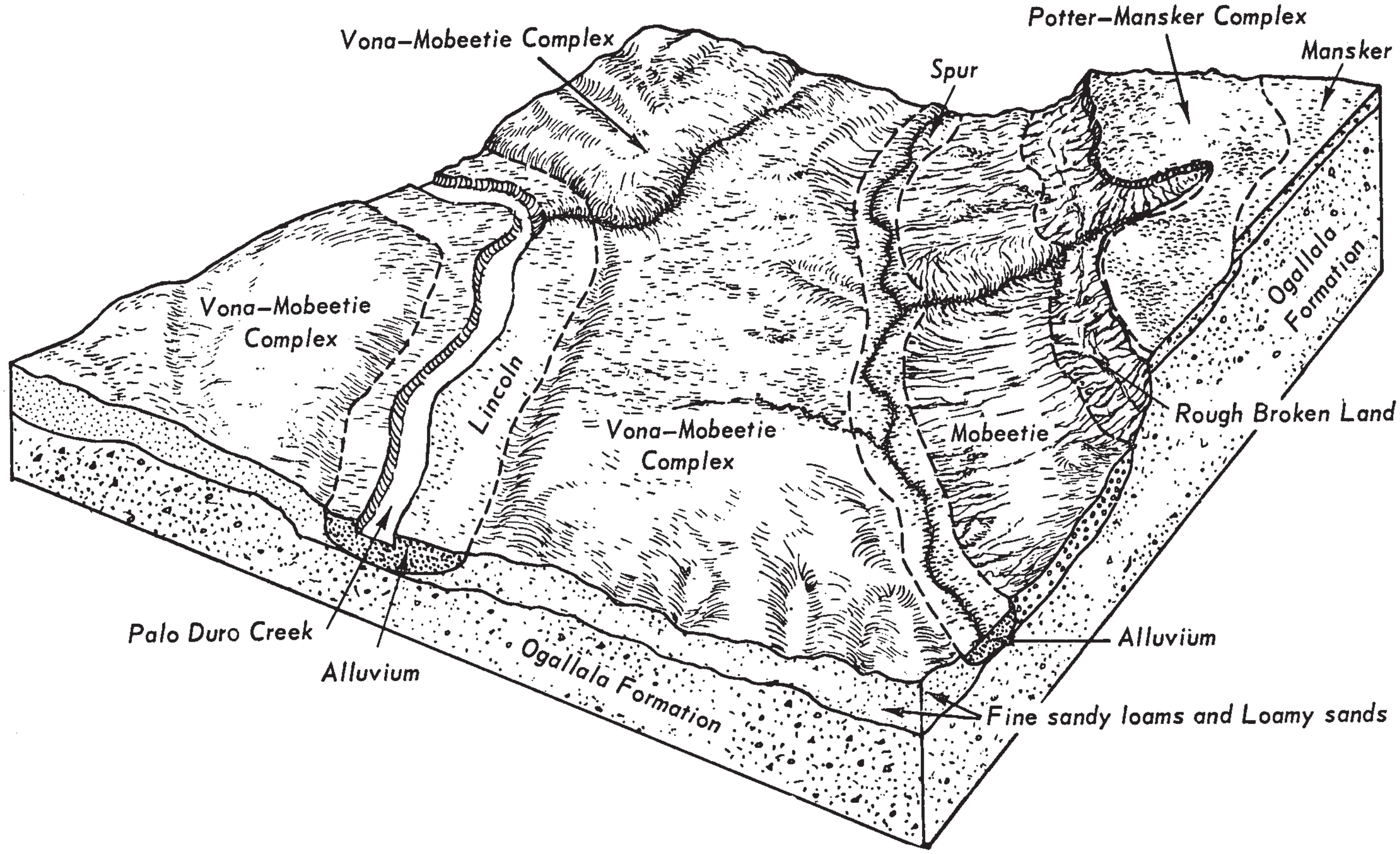

Figure 5.—**Representative pattern of soils in the Mobeetie-Vona association.**

In the Vona soils the surface layer is brown loamy sand about 8 inches thick overlying very friable, brown fine sandy loam about 14 inches thick. The underlying material is calcareous, very friable, pale-brown and very pale brown loamy sand.

Lincoln soils occupy sandy alluvial flood plains. Berthoud soils occupy positions similar to those occupied by Mobeetie soils. Mansker soils and Potter soils occupy knobs and ridges where the loamy and sandy material is thin or absent. Spur soils occupy narrow draws.

Most of this association is used for range.

The hazard of soil blowing is moderate to severe.

Descriptions of the Soils

This section describes the soil series and mapping units in Ochiltree County. The soil series is described first 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. The consistence terms used in the narrative description of the profile apply to a moist soil.

As mentioned in "How This Survey Was Made," not all mapping units are members of a soil series. Rough broken land, for example, does not belong to a 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 is the capability unit and range site in which the mapping unit has been placed. The page on which the range sites and capability units 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 1. Many of the terms used in describing soils can be found in the Glossary.

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

Soil	Acres	Percent
Berthoud loam, 3 to 8 percent slopes	13, 509	2. 3
Bippus clay loam, 1 to 3 percent slopes	3, 224	. 6
Bippus clay loam, 3 to 5 percent slopes	1, 626	. 3
Lincoln soils	365	(1)
Mansker clay loam, 0 to 1 percent slopes	989	. 2
Mansker clay loam, 1 to 3 percent slopes	9, 364	1. 6
Mansker clay loam, 3 to 5 percent slopes	6, 364	1. 1
Mansker clay loam, 5 to 8 percent slopes	5, 507	1. 0
Mansker-Ulysses complex, 2 to 6 percent slopes	20, 298	3. 5
Mobeetie fine sandy loam, 5 to 8 percent slopes	2, 421	. 4
Potter-Mansker complex, 0 to 8 percent slopes	39, 923	6. 9
Potter soils	24, 094	4. 2
Pullman clay loam, 0 to 1 percent slopes	283, 431	48. 8
Pullman clay loam, 1 to 3 percent slopes	8, 357	1. 4
Randall clay	15, 277	2. 6
Richfield clay loam, 0 to 1 percent slopes	43, 012	7. 4
Richfield clay loam, 1 to 3 percent slopes	16, 428	2. 8
Richfield clay loam, 3 to 5 percent slopes	1, 307	. 2
Roscoe clay	5, 909	1. 0
Rough broken land	9, 851	1. 7
Spur clay loam	1, 269	. 2
Spur soils, broken	3, 517	. 6
Ulysses silty clay loam, 0 to 1 percent slopes	11, 525	2. 0
Ulysses silty clay loam, 1 to 3 percent slopes	31, 302	5. 4
Ulysses silty clay loam, 3 to 5 percent slopes	12, 226	2. 2
Ulysses-Richfield clay loams, 0 to 3 percent slopes	5, 875	1. 0
Vona-Mobeetie complex, 2 to 8 percent slopes	3, 424	. 6
Water area (Lake Fryer)	86	(1)
Total	580, 480	100. 0

1 Less than 0.1 percent.

Berthoud Series

The Berthoud series consists of deep, friable, calcareous, loamy soils (fig. 6). These soils occupy concave to plane foot slopes below the High Plains escarpment.

In a representative profile the surface layer is calcareous, grayish-brown loam about 10 inches thick. The next layer is friable, light brownish-gray loam that extends to a depth of about 22 inches. The next layer, about 20 inches thick, consists of light-gray loam that is about 3 percent visible calcium carbonate. The underlying layer is calcareous, light brownish-gray loam.

Berthoud soils are well drained. Runoff is medium to rapid. Permeability is moderate, and the available water capacity is high. Soil blowing is a moderate hazard. Water erosion is a moderately severe hazard.

Representative profile of Berthoud loam, 3 to 8 percent slopes, in native range, 2,112 feet south of road, from a point 2,475 feet west of its intersection with county road, from a point 6.1 miles northwest of its intersection with Farm Road 1267, from a point 11.2 miles west of its intersection with U.S. Highway 83, which is about 1.8 miles north of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton:

A1—0 to 10 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, medium and fine, granular structure; slightly hard, friable; many worm casts; few fine and very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B2—10 to 22 inches, light brownish-gray (10YR 6/2) loam, dark, grayish brown (10YR 4/2) moist; moderate, medium and fine, granular structure; slightly hard, friable; many worm casts; films and threads and a few very fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

B3ca—22 to 42 inches, light-gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak, fine, subangular blocky structure; slightly hard, friable; common worn casts; many films and threads and a few fine and very fine concretions of visible calcium carbonate that make up about 3 percent by volume; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—42 to 62 inches +, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive (structureless); slightly hard, friable; few worm casts; a few films and threads and fine concretions of calcium carbonate; calcareous; moderately alkaline.

Figure 6.—Profile of Berthoud loam.

The A1 horizon ranges from 8 to 10 inches in thickness, and from light brownish gray to grayish brown in color. The B2 horizon ranges from 12 to 23 inches in thickness, and from light brownish gray to grayish brown in color. The B3ca horizon ranges from 6 inches to several feet in thickness. Visible calcium carbonate of the Cca horizon ranges from 1 to about 8 percent by volume.

Berthoud loam, 3 to 8 percent slopes (BeD).—This soil occurs below the High Plains escarpment and occupies plane and concave foot slopes (fig. 7). These foot slopes occur below the Potter soils along the escarpment and above the Bippus soils on the valley floors. Along some of the more narrow drainageways, the Bippus soils are absent and the Berthoud soils extend to the escarpment on either side of the valley. Slopes range from 3 to 8 percent, but are dominantly about 5 percent. The areas are irregular in shape and average about 100 acres in size, but some areas are as large as several hundred acres.

Included in mapping were small areas of Mobeetie fine sandy loam, Bippus clay loam, Mansker clay loam, gully scarps of soils that resemble Mansker soils, Potter soils, and Spur soils.

The soil is used for range. A few areas where the slope is 3 or 4 percent are cultivated. (Nonirrigated capability unit VIe-1; not in an irrigated capability unit; Hardland Slopes range site)

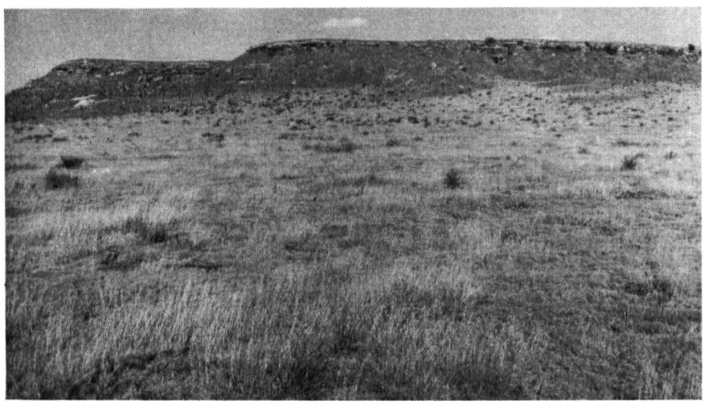

Figure 7.—Foot slopes of Berthoud loam, 3 to 8 percent slopes, in the foreground. An area of Potter soils is in the background.

Bippus Series

The Bippus series consists of deep, friable, well-drained soils. These soils occur below the High Plains escarpment and occupy low foot slopes and valley floors.

In a representative profile the surface layer is dark grayish-brown clay loam about 18 inches thick. Below this is friable, brown clay loam. This layer is about 14 inches thick and is underlain by brown clay loam that is about 1 percent visible calcium carbonate.

Bippus soils receive runoff, but they are well drained. Permeability is moderate, and the available water capacity is high. Soil blowing is a slight hazard. Water erosion is a moderate to moderately severe hazard.

Representative profile of Bippus clay loam, 1 to 3 percent slopes, in native range 264 feet northwest of road from a point 0.3 mile northeast of its intersection with U.S. Highway 83, which is about 17.2 miles southeast of the intersection of U.S. Highway 83 and Farm Road 377 in Perryton:

A11—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium and fine, granular structure and moderate, medium, subangular blocky; hard, friable; common fine pores; common worm casts; few rounded concretions of calcium carbonate; mildly alkaline; gradual, smooth boundary.

A12—6 to 18 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, friable; few fine pores; common worm casts; few, fine, rounded concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B2—18 to 32 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, friable; few worm casts; a few films and threads and fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—32 to 60 inches +, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; slightly hard, friable; a few films and threads and fine soft masses of visible calcium carbonate make up about 1 percent by volume; calcareous; moderately alkaline.

The A1 horizon ranges from 12 to 24 inches in thickness, from loam to clay loam in texture, and from dark grayish brown to very dark grayish brown in color. The depth to calcareous material ranges from 0 to 24 inches. The B2 horizon ranges from 10 to 20 inches in thickness and from light brownish gray to dark brown in color. The depth to the Cca horizon ranges from 22 to 44 inches. Calcium carbonate in the Cca horizon makes up a few films and threads to about 3 percent by volume.

Bippus soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Bippus clay loam, 1 to 3 percent slopes (BrB).—This soil occupies plane and concave areas between the more sloping Bippus soils or Berthoud soils on foot slopes and the nearly level Spur soils on the flood plains. Along some of the more narrow drainageways, it covers the entire valley and extends to the more sloping foot slopes or escarpments on each side (fig. 8). Areas are long and have smooth boundaries. They average about 50 acres in size. Slopes range from 1 to 3 percent, but are dominantly about 2 percent.

This soil has the profile described as representative of the series.

Included in mapping were small areas of Berthoud loam, Mansker clay loam, Potter soils, and Spur soils.

This soil is well suited to most crops grown in the county, and also to range. Water erosion is a moderate hazard. (Nonirrigated capability unit IIIe-2; irrigated capability unit IIe-1; Deep Hardland range site)

Bippus clay loam, 3 to 5 percent slopes (BrC).—This soil occupies plane and concave foot slopes below the High Plains escarpment. Slopes range from 3 to 5 percent, but they are dominantly about 4 percent. Areas are oblong shaped and average about 30 acres in size, but some are as large as 100 acres.

This soil has a thinner surface layer than that in the profile described as representative. The surface layer is dark grayish-brown friable clay loam about 14 inches thick. It is noncalcareous in the upper few inches, but it contains free lime in the lower part. This layer grades to friable, brown clay loam that is about 10 inches thick. The next layer is brown, limy, friable clay loam.

Included in mapping were small areas of Berthoud loam, Mansker clay loam, Potter soils, and Spur soils.

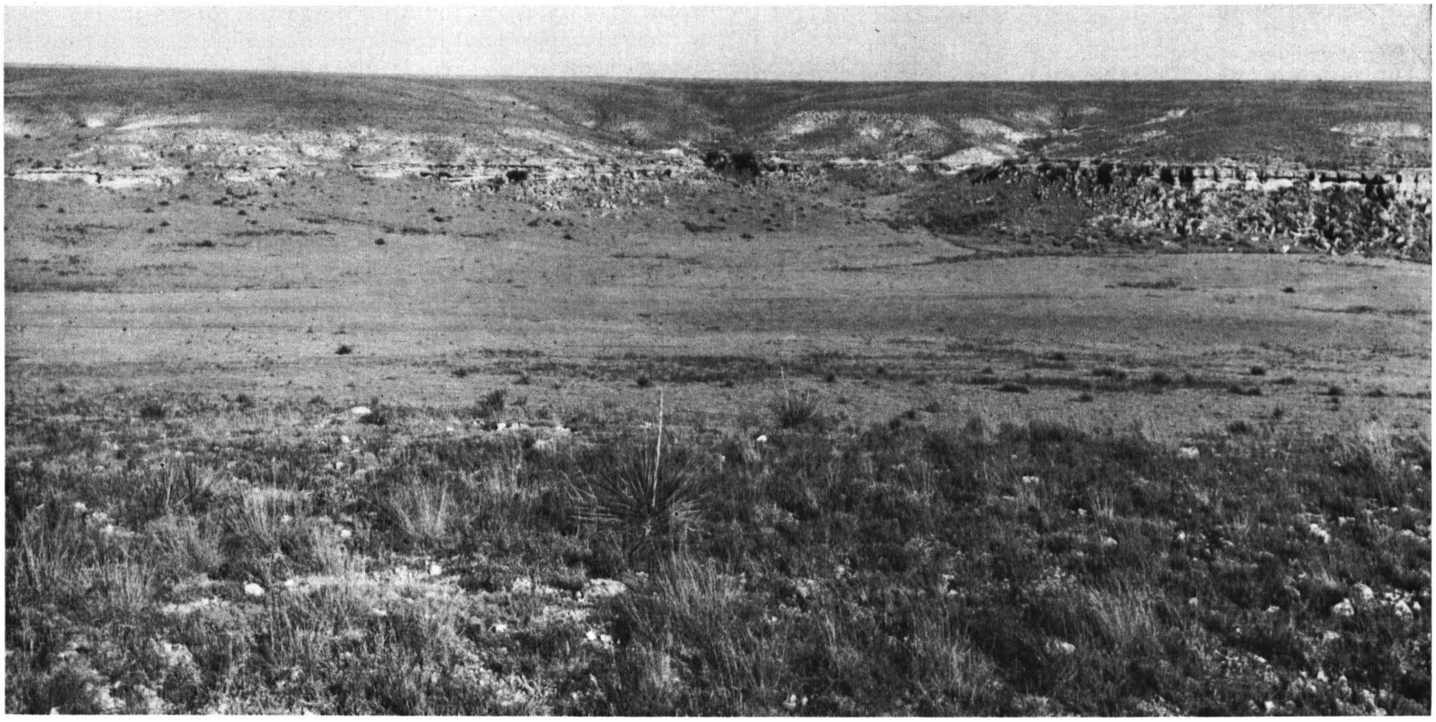

Figure 8.—**Bippus clay loam, 1 to 3 percent slopes, occurs in the valley. In the distance is an area of Potter soils. Small areas of Berthoud loam, 3 to 8 percent slopes, occur below the scarp of indurated caliche outcrops.**

Also included were a few eroded areas. These areas show signs of sheet erosion and contain a few gullies. These inclusions can occur in one or in many places.

This soil is used mostly for range, but some areas are cultivated. The hazard of water erosion is moderately severe. (Nonirrigated capability unit IVe–2; irrigated capability unit IVe–1; Deep Hardland range site)

Lincoln Series

The Lincoln series consists of deep, very friable, calcareous, sandy soils that have visible bedding planes. These soil formed in calcareous, stratified, sandy alluvium. They occupy flood plains.

In a representative profile the surface layer is pale-brown loamy fine sand about 14 inches thick. The underlying material, to a depth of 60 inches, is very pale brown fine sand that has bedding planes.

Lincoln soils occupy areas where the slope is less than 2 percent. These soils are subject to frequent flooding. Permeability is rapid, and the available water capacity is low. Soil blowing is a severe hazard.

Representative profile from an area of Lincoln soils in native range, 100 feet west of road (on east side of Palo Duro Creek), from a point 3.2 miles southwest of its intersection with county road, from a point 6.1 miles northwest of its intersection with Farm Road 1267, from a point 11.2 miles west of its intersection with U.S. Highway 83, which is about 1.8 miles north of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton:

A1—0 to 14 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; weak, fine, granular structure; soft, very friable; few thin (½ inch thick) strata of silt loam and fine sandy loam; calcareous; moderately alkaline; gradual, smooth boundary.

C—14 to 60 inches +, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose dry or moist; strata of silt loam and fine sandy loam; visible bedding planes; calcareous; moderately alkaline.

The A1 horizon ranges from 10 to 15 inches in thickness, from fine sand to loamy fine sand in texture, and from pale brown to grayish brown in color. The C horizon is loamy fine sand or a coarser texture, and it ranges from very pale brown to light yellowish brown in color. The depth to the water table ranges from 4 to 20 feet in most places.

Lincoln soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Lincoln soils (Ln).—These soils occupy flood plains. They are mainly nearly level, but in places the surface is slightly undulating. The slopes range from 0 to about 2 percent but are dominantly about 0.8 percent. In places the surface is dissected by channel scars or partly filled old stream channels. The lower slopes are flooded during high-intensity rains. Areas of these soils are oblong, and they have smooth boundaries. They average about 30 acres in size, but some are up to 100 acres.

Included in mapping were areas of riverwash in adjoining channels. Also included were small areas of Vona loamy sand and Mobeetie fine sandy loam.

These soils are not suitable for cultivation. They are used mostly for range. They are subject to frequent flooding, washing, and deposition of new soil material. The water table is at a depth of 4 to 20 feet in most places. (Nonirrigated capability unit Vw–2; not in an irrigated capability unit; Sandy Bottomland range site)

Mansker Series

The Mansker series consists of calcareous, loamy soils (fig. 9). These soils are nearly level to sloping. They are on uplands.

In a representative profile the surface layer is calcareous, brown clay loam about 10 inches thick. The next layer is friable, calcareous, pale-brown clay loam in the upper 6 inches. The lower part, to a depth of 60 inches, is very pale brown clay loam that is about 25 percent visible calcium carbonate.

Soil blowing is a moderate hazard. Water erosion is a slight to moderately severe hazard. Permeability is moderate, and the available water capacity is high.

Representative profile of Mansker clay loam, 1 to 3 percent slopes, in native range, 30 feet north of road, from a point 2.4 miles northwest of its intersection with county road, from a point 0.8 mile northwest of its intersection with Farm Road 1267, from a point 11.2 miles west of its intersection with U.S. Highway 83, which is about 1.8 miles north of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton:

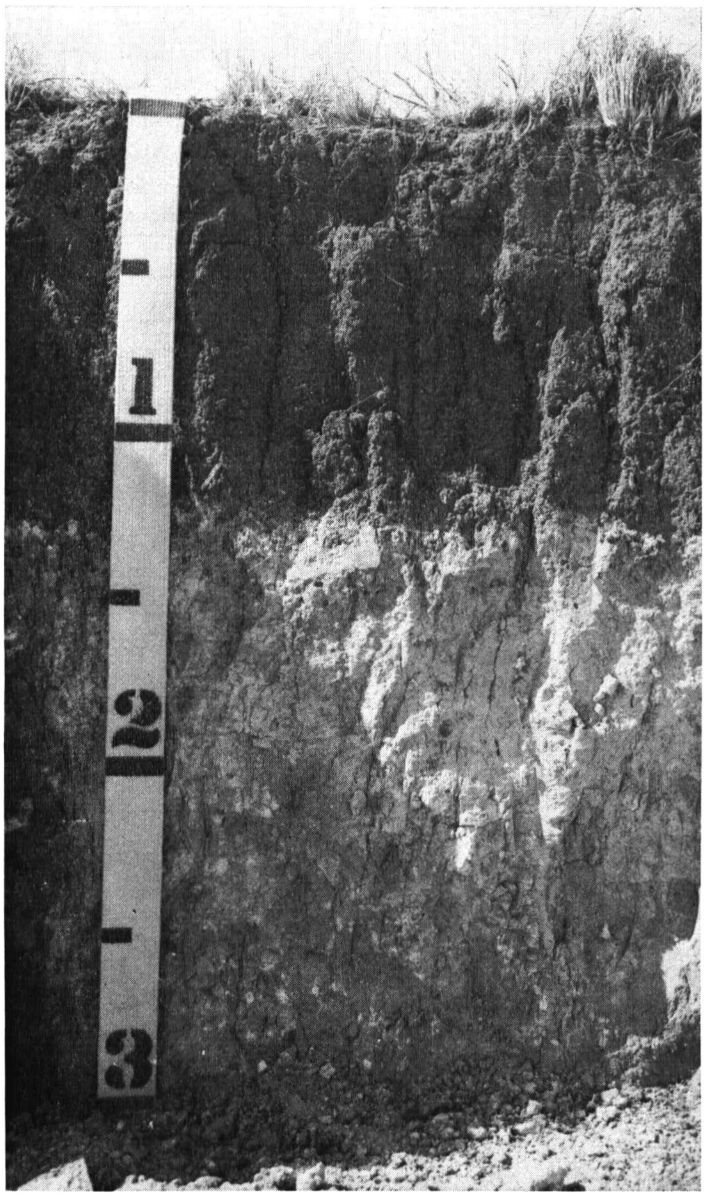

Figure 9.—Profile of Mansker clay loam. A distinct Cca horizon begins at a depth of 14 inches.

A1—0 to 10 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate, fine, granular structure; slightly hard, friable; common worm casts; few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B21ca—10 to 16 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate, fine, granular structure; slightly hard, friable; many worm casts; visible calcium carbonate is about 6 percent by volume, in the form of strongly and weakly cemented concretions and films and threads; calcareous; moderately alkaline; clear, wavy boundary.

B22ca—16 to 34 inches, very pale brown (10YR 8/3) clay loam, very pale brown (10YR 7/3) moist; weak, fine, granular structure; hard, friable; soft masses and weakly cemented concretions of calcium carbonate that make up about 25 percent by volume; calcareous; moderately alkaline; gradual, wavy boundary.

B23tca—34 to 60 inches +, very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; moderate, coarse, prismatic structure parting to weak, medium, subangular blocky; hard, friable; patchy clay films on ped surfaces; many, medium and fine, weakly cemented concretions of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 7 to 16 inches in thickness, from clay loam to loam in texture, and from brown to dark brown in color. The Bca horizon extends to a depth of more than 60 inches, and it is very pale brown to brown in color. Visible calcium carbonate in the Bca horizon makes up 6 to 60 percent by volume.

Mansker soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Mansker clay loam, 0 to 1 percent slopes (MaA).—This soil is on uplands. The areas are oval shaped, and have slightly convex slopes that are dominantly about 0.6 percent. The average size of the areas is about 40 acres, but some are as large as 250 acres.

This soil has a slightly thicker surface layer than that in the profile described as representative. In this soil the surface layer, about 14 inches thick, is grayish-brown clay loam that contains free lime. The next layer is pale-brown friable clay loam about 8 inches thick. The next layer, which begins at a depth of about 22 inches, is 18 inches thick. It consists of very pale brown clay loam that is about 25 percent visible calcium carbonate. Below this is limy, very pale brown clay loam.

Included in mapping were small areas of Richfield clay loam and Ulysses silty clay loam.

About 80 percent of the acreage is used for crops. The rest is used for range.

Water erosion is a slight hazard. (Nonirrigated capability unit IVe-9; irrigated capability unit IIIe-10; Hardland Slopes range site)

Mansker clay loam, 1 to 3 percent slopes (MaB).—This soil occupies ridges around the playas, areas leading to the drainageways, and low ridges on the High Plains. Below the High Plains escarpment, it occupies ridges and hillsides. Areas are oblong shaped and average about 30 acres in size, but some are as large as 200 acres. Slopes are smooth and slightly convex, and they are dominantly about 2 percent.

This soil has the profile described as representative of the series.

Included in mapping were small areas of Richfield clay loam, Ulysses silty clay loam, and Potter soils.

About 70 percent of the acreage is used for crops. The rest is used for range.

Water erosion is a moderate hazard. (Nonirrigated capability unit IVe-9; irrigated capability unit IIIe-10; Hardland Slopes range site)

Mansker clay loam, 3 to 5 percent slopes (MaC).—This soil occupies areas leading to the natural drainageways and convex ridges on the upland plains. A few areas occupy narrow ridges around the playas. Areas below the High Plains escarpment occur on ridges and hillsides. Areas are oblong shaped and average about 30 acres in size, but some are as large as 175 acres. Slopes are dominantly about 4 percent.

This soil has a slightly thinner surface layer than that described in the representative profile of the series. In this soil the surface layer is brown clay loam about 8 inches thick. This layer contains free lime. The next layer is pale-brown, limy, friable clay loam about 4 inches thick. The next layer, which begins at a depth of about 12 inches, is about 16 inches thick. It consists of very pale brown clay loam that is about 25 percent visible calcium carbonate. Below this is limy, very pale brown clay loam.

Included in mapping were small areas of Richfield clay loam, Ulysses silty clay loam, Berthoud loam, Potter soils, and gully scarps. In a few places there are small eroded areas.

Most of the acreage is used for range, but a few areas are cultivated.

Water erosion is a moderately severe hazard. (Nonirrigated capability unit IVe-2; not in an irrigated capability unit; Hardland Slopes range site)

Mansker clay loam, 5 to 8 percent slopes (MaD).—This soil occupies areas leading to the drainageways and a few areas on convex ridges. Slopes range from 5 to 8 percent, but they are dominantly about 7 percent. Areas of these soils are oblong shaped and average about 30 acres in size, but some are as large as 150 acres.

This soil has a slightly thinner surface layer than that described in the representative profile of the series. In this soil the surface layer is brown clay loam about 8 inches thick. It contains free lime. The next layer is a limy, pale-brown, friable clay loam about 4 inches thick. The next layer, which begins at a depth of about 12 inches, is about 16 inches thick. It consists of very pale brown clay loam that is about 25 percent visible calcium carbonate. Below this is limy, very pale brown clay loam.

Included in mapping were small areas of Ulysses silty clay loam, Berthoud loam, Potter soils, and gully scarps of soils that resemble Mansker soils. The scarps occur on each side of the drainageways and in places appear as steplike benches.

This soil is not suitable for cultivation, but is used for range.

There is a hazard of soil blowing and water erosion if this soil is not protected by a cover of vegetation. Runoff is rapid because of excess slope. (Nonirrigated capability unit VIe-1; not in an irrigated capability unit; Hardland Slopes range site)

Mansker-Ulysses complex, 2 to 6 percent slopes (MnC).—This complex occurs on upland plains. It occupies relatively smooth areas between the deep, nearly level soils on the High Plains and the thin soils along the escarpment. These soils occupy ridges and slopes along the drainageways. The ridges have slopes of 2 to 3 percent that are convex. They are 50 to 900 feet wide and 200 feet to several hundred feet long. The slopes along the drainageways are 4 to 6 percent, and they are plane to slightly convex. They are 150 to 800 feet in length. Areas of this complex are irregular in shape and average about 200 acres in size, but some areas are as large as several hundred acres.

Mansker clay loam makes up about 55 percent of the complex. It dominantly is gently sloping and occupies broad ridgetops. Generally, slopes are 2 to 3 percent. Ulysses silty clay loam makes up about 35 percent of the complex. It is dominantly sloping and occupies areas leading to the drainageways. Generally, slopes are 4 to 6 percent. The remaining 10 percent of the complex is made up of closely associated soils. The soils in this complex occur in such an intricate pattern that they generally are used and managed alike.

The Mansker soil has a profile similar to that described as representative of the series. In this soil the surface layer is brown clay loam about 9 inches thick. It contains free lime. The next layer is pale-brown, very limy, friable clay loam about 6 inches thick. The next layer, which begins at a depth of about 15 inches, is about 18 inches thick. It consists of very pale brown clay loam that is about 25 percent visible calcium carbonate. Below this is limy, very pale brown clay loam.

The Ulysses soil has a thinner surface layer than that of the representative profile. In this soil the surface layer, about 8 inches thick, is grayish-brown silty clay loam. It contains free lime. The next layer is pale-brown, limy, friable silty clay loam about 8 inches thick. The next layer, which begins at a depth of about 16 inches, is about 20 inches thick. It consists of very pale brown silty clay loam that is about 5 percent visible calcium carbonate. The underlying material is limy, pink silty clay loam.

Small areas of Richfield clay loam, Bippus clay loam, Potter soils, and shallow scarps along the drainageways make up the remaining 10 percent of this complex.

These soils are used for range.

Soil blowing is a moderate hazard, and water erosion is a moderate to moderately severe hazard. (Nonirrigated capability unit IVe-9; irrigated capability unit IVe-1; the Mansker soil is in the Hardland Slopes range site and the Ulysses soil is in the Deep Hardland range site)

Mobeetie Series

The Mobeetie series consists of deep, very friable, calcareous, loamy soils. These soils occur below the High Plains escarpment and occupy concave to plane foot slopes.

In a representative profile the surface layer is calcareous, grayish-brown fine sandy loam about 10 inches thick. The next layer is very friable, calcareous, light brownish-gray fine sandy loam. At a depth below about 22 inches there is light brownish-gray fine sandy loam that is about 1 percent visible calcium carbonate.

Mobeetie soils are well drained. Runoff is medium. Permeability is moderately rapid, and the available water capacity is moderate. Soil blowing is a moderate hazard. Water erosion is a moderately severe hazard.

Representative profile of Mobeetie fine sandy loam, 5 to 8 percent slopes, in native range 1,000 feet north of Lake Fryer Road from a point 5.5 miles east of its intersection with U.S. Highway 83, which is about 12.4 miles southeast of the intersection of U.S. Highway 83 and Farm Road 377 in Perryton:

A1—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; slightly hard, very friable; common worm casts; few fine fragments of calcium carbonate, which have pitted, irregular surfaces; calcareous; moderately alkaline; gradual, smooth boundary.

B2—10 to 22 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, fine, granular structure; slightly hard, very friable; many worm casts; many fine and very fine pores; few films, threads, and fine, strongly cemented concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B3ca—22 to 60 inches +, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak, fine, granular structure; slightly hard, very friable; many worm casts; films, threads, and fine, strongly cemented concretions of calcium carbonate visibly make up about 1 percent by volume; calcareous; moderately alkaline.

The A1 horizon ranges from 8 to 16 inches in thickness, and from light brownish gray to grayish brown in color. The B2 horizon ranges from 10 to 24 inches in thickness, and from very pale brown to grayish brown in color. The depth to the B3ca horizon ranges from 20 to 40 inches. Visible calcium carbonate in the B3ca horizon ranges from 1 to about 6 percent by volume.

Mobeetie soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Mobeetie fine sandy loam, 5 to 8 percent slopes (MoD).—This soil occurs below the High Plains escarpment and occupies plane and concave foot slopes. The foot slopes occur below the Potter soils along the escarpment and above the Bippus soils on the valley floors. Slopes range from 5 to 8 percent, but are dominantly about 7 percent. Areas of this soil are irregular in shape and average about 80 acres in size, but a few are as large as several hundred acres.

Included in mapping were some small areas of Berthoud loam, Bippus clay loam, Mansker clay loam, Vona loamy sand, gully scarps of soils that resemble Mansker soils, Potter soils, and Spur soils.

This soil is not suitable for cultivation. It is used for range. (Nonirrigated capability unit VIe-2; not in an irrigated capability unit; Mixedland Slopes range site)

Potter Series

The Potter series consists of calcareous, loamy soils. These soils are very shallow over a layer of calcium carbonate (fig. 10) that has a hardness of less than 3 on Mohs scale. The soils are gently sloping to steep and occupy areas along the High Plains escarpment and throughout the rough, dissected breaks below.

In a representative profile the surface layer is calcareous, grayish-brown, gravelly loam about 7 inches thick over white, slightly platy caliche. Between depths of 14 and 30 inches the material is composed of about 70 percent caliche fragments and of about 30 percent pale-brown calcareous loam.

Potter soils are well drained. Runoff is medium to rapid. Permeability is moderate, and the available water capacity

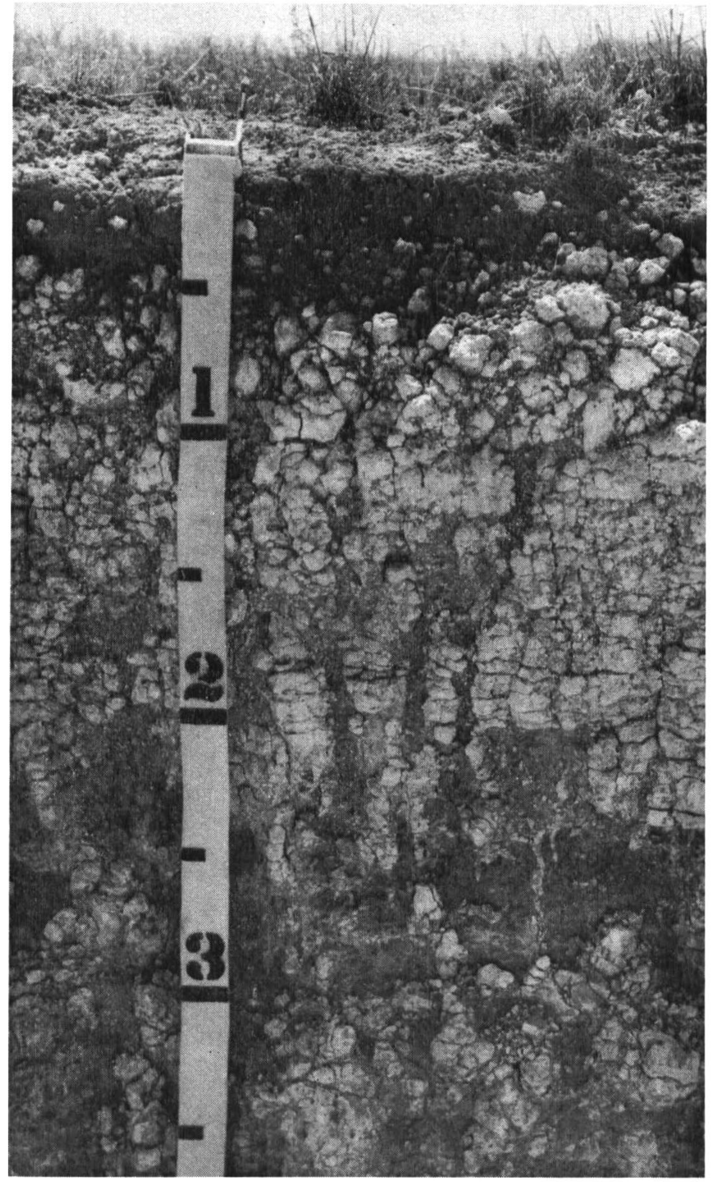

***Figure 10.*—Profile of Potter soils.**

is low. Water erosion is a moderate to severe hazard. Soil blowing is a moderate hazard.

Representative profile of Potter gravelly loam in an area of Potter-Mansker complex, 0 to 8 percent slopes, in native range, 50 feet north of county road, from a point 0.95 mile west of its intersection with Texas Highway 70, from a point 1.0 mile southwest of its intersection with U.S. Highway 83, which is about 5.9 miles south of the intersection of U.S. Highway 83 and Farm Road 377 in Perryton:

A1—0 to 7 inches, grayish-brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) moist; moderate, medium and fine, granular structure; slightly hard, friable; few worm casts; many medium and fine visible fragments of caliche, which make up about 12 percent by volume; calcareous; moderately alkaline; clear, smooth boundary.

C1ca—7 to 14 inches, white (10YR 8/2), slightly platy caliche that has a hardness of slightly less than 3 on Mohs scale; plates are fractured; undersides of plates have pendants of calcium carbonate that are about ¼ to ½ inch long; few roots between plates; calcareous; moderately alkaline; clear, smooth boundary.

C2ca—14 to 30 inches +, mixture of about 70 percent by volume of whitish caliche fragments that have a hardness of slightly less than 3 on Mohs scale, and about 30 percent of pale-brown, calcareous loam; the ratio of loam to caliche fragments increases with depth; the caliche fragments are about ⅛ inch to 6 inches across the long axis.

The A1 horizon ranges from 4 to 12 inches in thickness, from gravelly clay loam to fine sandy loam in texture, and from light brownish gray to dark grayish brown in color. The amount of caliche fragments in the A1 horizon ranges from 0 to 35 percent. The C horizon ranges from platy caliche that has a hardness of slightly less than 3 on Mohs scale and grades to soft caliche that has intermingled pockets of pinkish loamy material to continuous caliche beds many feet thick.

Potter soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Potter-Mansker complex, 0 to 8 percent slopes (PmD).—This complex consists of nearly level to sloping soils above and along the edge of the High Plains escarpment (fig. 11) or remnants of it, and along the drainageways for the upland plains. Areas are irregular in shape and average about 200 acres in size, but some are as large as 900 acres. Slopes are dominantly convex and are dominantly about 5 percent.

The Potter soil makes up about 60 percent of the complex. It is gently sloping to sloping, and it occupies convex ridges and knobs. The Mansker soil makes up about 30 percent of the complex. It occurs in areas between the knobs of the Potter soil and on convex areas along the drainageways. The remaining 10 percent of the complex is made up of closely associated soils. The soils in this complex occur in such an intricate pattern that they are generally used and managed alike.

The Potter soil has the profile described as representative of the series.

The Mansker soil has a surface layer of brown clay loam about 8 inches thick. It contains free lime. The next layer is pale-brown, limy, friable clay loam about 4 inches thick. The next layer is about 16 inches thick. It consists of very pale brown clay loam that is about 25 percent visible calcium carbonate. Below this is limy, very pale brown clay loam.

Small areas of Ulysses silty clay loam, Berthoud loam, and Mobeetie fine sandy loam make up the remaining 10 percent of closely associated soils. In a few places there are small areas of caliche exposed at the surface.

The soils in this complex are not suitable for cultivation. They are used for range.

Soil blowing is a moderate hazard. Water erosion is a moderate to severe hazard. (Nonirrigated capability unit VIIs-1; not in an irrigated capability unit; the Potter soil is in the Very Shallow range site, and the Mansker soil is in the Hardland Slopes range site)

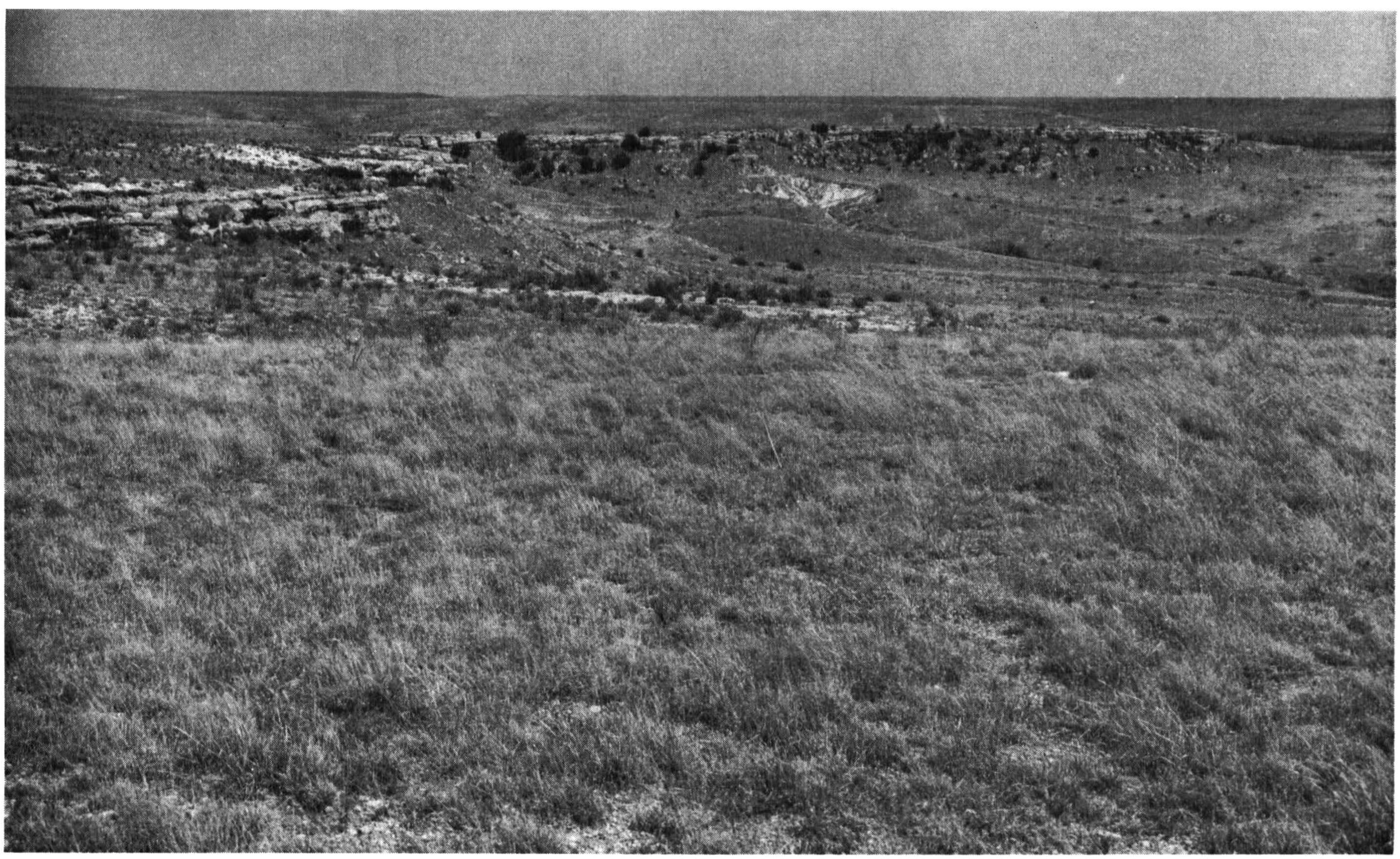

Figure 11.—**Potter-Mansker complex, 0 to 8 percent slopes, in the foreground and in the distance above the indurated caliche escarpment.**

Potter soils (Po).—These soils are sloping to steep along the High Plains escarpment or remnants of it, and along drainageways leading to the valleys below. Areas average about 250 acres in size, but some are as large as several hundred acres. Generally, slopes are 7 to 20 percent, but they are dominantly about 12 percent.

The Potter soils have a profile similar to that described as representative of the series, except the surface layer ranges from gravelly clay loam to fine sandy loam in texture.

Closely associated soils and miscellaneous land generally make up about 15 percent of the mapping unit, but they range from 10 to 20 percent. Included in mapping were Mansker clay loam, Berthoud loam, Mobeetie fine sandy loam, and Bippus clay loam. Also included were small areas of steep escarpments, indurated caliche outcrops, loamy calcareous soils, and steep soils that resemble Mansker soils on gully scarps. In some areas there are narrow breaks that resemble Rough broken land, but they are too narrow to map separately.

These soils are not suitable for cultivation. They are used for range. Most of this unit is accessible to livestock. Some areas are well suited to food and cover for wildlife.

Water erosion is a severe hazard. (Nonirrigated capability unit VIIs–1; not in an irrigated capability unit; Very Shallow range site)

Pullman Series

The Pullman series consists of deep, well-drained soils that are clayey below the surface. These soils developed from eolian deposits of silty and clayey material. They are nearly level to gently sloping. They occupy the High Plains part of the county, which is easily identified by the lack of a defined drainage system. Runoff is retained by the numerous playas that occur in the broad constructional plain.

In a representative profile the surface layer is noncalcareous, grayish-brown clay loam about 5 inches thick. The next layer is very firm, dark grayish-brown to brown clay, which is noncalcareous in the upper part and calcareous in the lower part. This layer is about 25 inches thick. The next layer is clay loam that is pale brown in the upper part and light brown in the lower part. At a depth of 72 inches there is pink silty clay loam.

Soil blowing is a slight hazard. Water erosion is a moderate hazard on slopes of more than 1 percent. Permeability is very slow, and the available water capacity is high.

Representative profile of Pullman clay loam, 0 to 1 percent slopes, in a cultivated field 60 feet east of county road from a point 1.95 miles north of its intersection with Texas Highway 15, which is about 8.3 miles southwest of the intersection of Texas Highway 15 and U.S. Highway 83 in Perryton:

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

B21t—5 to 10 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, blocky structure; very hard, firm, sticky and plastic; continuous thin clay films on ped surfaces; few very fine pores; mildly alkaline; clear, smooth boundary.

B22t—10 to 22 inches, brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate, medium, blocky structure; extremely hard, very firm, sticky and plastic; peds have more distinct horizontal cleavage than vertical; continuous thin clay films on ped surfaces; few very fine pores; noncalcareous in upper part, calcareous in lower 2 inches; moderately alkaline; clear wavy boundary.

B23tca—22 to 30 inches, brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate, medium, blocky structure; very hard, very firm; few very fine pores; discontinuous thin clay films on ped surfaces; common films and threads and few soft masses of calcium carbonate, mostly between peds; calcareous; moderately alkaline; gradual, smooth boundary.

B24t—30 to 42 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak, fine, blocky structure; hard, firm; few fine and very fine pores; few thin clay films on ped surfaces; common films and threads of calcium carbonate, mostly between ped surfaces; calcareous; moderately alkaline; gradual, smooth boundary.

B25t—42 to 72 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak, medium and fine, blocky structure; hard, firm; few fine and very fine pores; discontinuous clay films on ped surfaces; a few horizontal krotovinas about 4 inches in diameter and 2 feet long, consisting of stratified silty material; many films and threads of calcium carbonate in lower part; calcareous; moderately alkaline; clear, wavy boundary.

B26tca—72 to 85 inches, pink (7.5YR 8/4) silty clay loam, pink (7.5YR 7/4) moist; weak, medium, blocky structure; hard, friable; many films, threads, and soft masses of visible calcium carbonate that is about 40 percent by volume; resembles soft caliche that consists of impure calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B27tca—85 to 120 inches +, pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; weak, medium, blocky structure; hard, friable; many films, threads, and soft masses of visible calcium carbonate that is about 20 percent by volume; calcareous; moderately alkaline.

The A horizon ranges from 4 to 8 inches in thickness, from clay loam to silty clay loam in texture, and from brown to dark grayish brown in color. The combined B21t and B22t horizons range from 18 to 38 inches in thickness. They are dominantly clay, and they range from brown to dark grayish brown in color. The depth to calcareous material ranges from 16 to 28 inches below the surface. The B23tca horizon is generally underlain by brown or reddish-brown clay loam and silty clay loam.

Pullman soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Pullman clay loam, 0 to 1 percent slopes (PuA).—This soil is on the upland plains. Individual soil areas are large and continuous except for the numerous playas that occur as depressions in the broad constructional plain. Slopes are smooth to slightly convex and are dominantly about 0.4 percent. In some areas small depressions are scattered over the surface. They are generally circular in shape, from 200 to 500 feet in diameter, and from 6 to 18 inches in depth. They are crossable with tillage implements.

This soil has a profile like that described as representative of the series.

Included in mapping were small areas of Richfield clay loam, Roscoe clay, Randall clay, and Ulysses silty clay loam.

This soil is cultivated and is well suited to nonirrigated and irrigated crops. Water erosion is a slight hazard. Sheet and rill erosion occurs in some areas where the slope is more than 0.7 percent, but the evidence of erosion is generally obliterated during cultivation. (Nonirrigated capability unit IIIce–1; irrigated capability unit IIs–1; Deep Hardland range site)

Pullman clay loam, 1 to 3 percent slopes (PuB).—This soil occurs along the edge of the High Plains and along drainageways for these plains, on low ridges throughout the plains, and in narrow areas around the more clearly defined playas. Areas are oblong and oval shaped and average about 50 acres in size, but some areas are as large as 200 acres. Slopes are plane to slightly convex, and are dominantly about 2 percent.

The profile of this soil is like that described for the Pullman series, except the surface layer is slightly thinner.

The surface layer is noncalcareous, grayish-brown clay loam about 4 inches thick. It rests abruptly on a layer of firm, brown clay that is noncalcareous in the upper part and limy in the lower part. This layer is about 20 inches thick and is underlain by limy, pink clay loam.

Included in mapping were small areas of Richfield clay loam, Roscoe clay, Randall clay, and Ulysses silty clay loam. Also included were a few small eroded areas.

Most of this soil is cultivated. Nonirrigated and irrigated crops are grown. Sheet and rill erosion occur in a few areas, but the signs of erosion are generally obliterated during cultivation. (Nonirrigated capability unit IIIe–1; irrigated capability unit IIIe–1; Deep Hardland range site)

Randall Series

The Randall series consists of deep, clayey soils that occupy the floors of enclosed depressions or intermittent lakes, commonly called playas.

In a representative profile the surface layer is very firm, gray clay about 18 inches thick over gray clay that is very compact and extremely firm. This second layer is about 30 inches thick. The next layer is very firm light-gray clay that contains distinct pale-yellow mottles.

The high clay content of Randall soils is responsible for a high coefficient of expansion and contraction as moisture changes, which results in gilgai microrelief. These soils crack when dry.

Randall soils are somewhat poorly drained. After heavy rains they remain under water for extended periods. Most of the water evaporates. Permeability is very slow, and the available water capacity is high. Soil blowing is a slight to moderate hazard.

Representative profile of Randall clay in playa 1,056 feet west of road from a point 1.7 miles south of its intersection with county road, from a point 5.0 miles east of its intersection with U.S. Highway 83, which is about 3.1 miles south of the intersection of U.S. Highway 83 and Farm Road 377 in Perryton:

A1—0 to 18 inches, gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; weak, medium, angular blocky structure; surface mulch of very hard, fine, discrete aggregates; very hard, very firm, very sticky; few very fine pores; few small black concretions due to segregated iron or manganese; few roots; calcareous; mildly alkaline; gradual, wavy boundary.

AC—18 to 48 inches, gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; few, fine, faint brown mottles; wedge-shaped peds in the upper part, and parallelepipeds in the lower part, with the long axes tilted more than 10 degrees from the horizon; very compact; extremely hard, extremely firm, very sticky; few very fine pores; few small black concretions of segregated iron or manganese; calcareous; mildly alkaline; gradual, wavy boundary.

C—48 to 62 inches +, light-gray (10YR 7/1) clay, gray (10YR 5/1) moist; common, medium, distinct pale-yellow mottles; massive; very hard, very firm; few small black concretions of segregated iron or manganese; few films, threads, and fine concretions of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 12 to 30 inches in thickness and from gray to dark gray in color. The AC horizon ranges from 15 to 35 inches in thickness and from light gray to gray in color.

The depth to the C horizon ranges from about 40 to 60 inches. Mottling ranges from few, fine, faint to many, medium, distinct. The mottles range from pale yellow to brown.

Randall soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Randall clay (Ra).—This soil occurs on the upland plains as round or oval concave depressions. The bottoms of the playas are 1 to 25 feet below the surrounding plains. Areas of this soil, which generally cover the entire lake bottom, are a few acres in size to more than 500 acres, but are dominantly nearly 80 acres. Slopes range from 0 to about 0.5 percent. In areas of range, the surface has small depressions, or gilgai relief, caused by cracking, sloughing, and swelling of this soil under alternate cycles of drying and wetting.

Included in mapping were some small areas of Roscoe clay that occupy the lake benches a few feet above the lake bottoms. Also included were narrow slopes on the shore of the lake that are less than 200 feet wide. These slopes range from 1 to about 5 percent.

This unit is used mostly as range, but some of the small shallow playas are cultivated. The larger, deeper playas can be cultivated if special provisions are made to intercept seasonal floodwaters.

This soil floods and receives small amounts of sediments added by runoff from adjacent slopes of Roscoe. Pullman, and Richfield soils. It remains flooded for a long period, or until the water evaporates. (Nonirrigated capability unit VIw–1; not in an irrigated capability unit; not in a range site, but included in the surrounding range site)

Richfield Series

The Richfield series consists of deep, well-drained soils. These soils developed in calcareous, moderately fine textured loess. They are nearly level to gently sloping and occupy upland plains.

In a representative profile the surface layer is mainly grayish-brown clay loam about 8 inches thick over friable, dark grayish-brown silty clay loam. Below this, at a depth of about 14 inches, is a layer of brown silty clay loam about 20 inches thick. This layer is underlain by firm, pale-brown silty clay loam that contains about 5 percent visible calcium carbonate. At a depth of about 48 inches is pink silty clay loam.

The available water capacity is high, and permeability is moderately slow. Soil blowing is a slight hazard. The hazard of water erosion is slight on slopes of less than 1 percent, moderate on slopes of 1 to 3 percent, and moderately severe on slopes of more than 3 percent.

Representative profile of Richfield clay loam, 0 to 1 percent slopes, in a cultivated field, 660 feet south of county road running along the State line, from a point 1.5 miles west of its intersection with U.S. Highway 83, which is about 7.0 miles north of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton:

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

A12—5 to 8 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine and very fine, subangular blocky structure; hard, friable; few very fine pores; few worm casts; neutral; clear, smooth boundary.

B1—8 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium and fine, subangular blocky structure; hard, friable; many fine and very fine pores; common worm casts; neutral; clear, smooth boundary.

B22t—14 to 22 inches, brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, blocky structure; very hard, firm; common very fine pores; few worm casts; thin discontinuous clay films on ped surfaces; mildly alkaline; gradual, smooth boundary.

B23t—22 to 34 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate, medium, blocky structure; very hard, firm; few worm casts; common fine and very fine pores; thin discontinuous clay films on ped surfaces; few films, threads, and very fine weakly cemented concretions of calcium carbonate; calcareous; mildly alkaline; gradual, wavy boundary.

C1ca—34 to 48 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak, fine, subangular blocky structure; very hard, firm; few worm casts; common fine and very fine pores; many films and threads and common soft masses of visible calcium carbonate that is about 5 percent by volume; calcareous; moderately alkaline; diffuse, wavy boundary.

C2—48 to 72 inches +, pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; weak, fine, subangular blocky structure; hard, friable; common fine and very fine pores; common films and threads and a few soft masses of calcium carbonate; less calcium carbonate than in C1ca horizon; calcareous; moderately alkaline.

The A1 horizon ranges from 6 to 8 inches in thickness, from clay loam to silty clay loam in texture, and from grayish brown to dark grayish brown in color. The Bt horizon ranges from 14 to 38 inches in thickness, from clay loam to silty clay in texture, and from reddish brown to dark grayish brown in color. The depth to calcareous material ranges from 16 to 26 inches. The depth to the Cca horizon ranges from 20 to 50 inches. Visible calcium carbonate in the Cca horizon ranges from 1 to about 35 percent.

Richfield soils, as mapped in Ochiltree County, are outside the range of the series in that they are dark colored to a greater depth than is typical.

Richfield clay loam, 0 to 1 percent slopes (RcA).—This soil occurs on the upland plains. It is nearly level, and slopes are dominantly about 0.6 percent. Surfaces generally are not so flat and smooth as those of Pullman clay loam, 0 to 1 percent slopes. In some areas, gentle swells and depressions give the surface a slight undulating appearance. Areas of this soil are oval and average about 200 acres in size, but some areas are as large as several hundred acres.

This soil has a profile like that described as representative of the series.

Included in mapping were small areas of Pullman clay loam, Randall clay, Roscoe clay, and Ulysses silty clay loam.

This soil is well suited to cultivation, and both nonirrigated and irrigated crops are grown. Soil blowing and water erosion are slight hazards. (Nonirrigated capability unit IIIce-2; irrigated capability unit IIe-4; Deep Hardland range site)

Richfield clay loam, 1 to 3 percent slopes (RcB).—This soil occupies narrow areas around the more clearly defined playas and along the edge of the upland plains. It also occurs on ridges and along drainageways on the upland plains. Areas are oblong and oval, and they are plane to slightly convex. Slopes are dominantly about 2 percent. Areas average about 50 acres in size, but some are as large as 500 acres.

This soil has a slightly thinner surface layer than that described as representative. The surface layer is friable clay loam about 6 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The next layer is about 20 inches thick, and it consists of dark grayish-brown silty clay loam in the upper part and limy, brown silty clay loam in the lower part. The next layer is pale-brown silty clay loam about 12 inches thick. It is about 5 percent visible calcium carbonate. Below this is limy, pink silty clay loam.

Included in mapping were small areas of Pullman clay loam and Ulysses silty clay loam. Also included were small eroded areas that generally occur where slopes are nearly 3 percent.

Most of this soil is cultivated. Only a small percentage is irrigated. Water erosion is a moderate hazard. (Nonirrigated capability unit IIIe-2; irrigated capability unit IIe-2; Deep Hardland range site)

Richfield clay loam, 3 to 5 percent slopes (RcC).—This soil is on ridges, divides, and areas leading to the drainageways. Areas are oblong in shape and average about 40 acres in size, but some are as large as 200 acres. Slopes are convex and dominantly about 4 percent.

This soil has a thinner surface layer than that in the profile described as representative of the series.

The surface layer is friable clay loam about 6 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The next layer is about 18 inches thick, and it consists of dark grayish-brown silty clay loam in the upper part and limy, reddish-brown silty clay loam in the lower part. The next layer is pale-brown silty clay loam about 12 inches thick, and it contains about 10 percent visible calcium carbonate. Below this is limy, pink silty clay loam.

Included in mapping were small areas of Pullman clay loam, Mansker clay loam, and Ulysses silty clay loam. Also included were small eroded areas along the drainageways.

Most of this soil is cultivated. Very little is irrigated. Water erosion is a moderately severe hazard. (Nonirrigated capability unit IVe-1; irrigated capability unit IIIe-2; Deep Hardland range site)

Roscoe Series

The Roscoe series consists of deep, clayey soils. These soils are nearly level. They occur on upland plains and occupy slightly concave benches around the more clearly defined playas.

In a representative profile the surface layer is very firm, dark-gray clay about 15 inches thick. This layer is over calcareous, extremely firm gray clay that is about 33 inches thick. The underlying material is very firm, calcareous, gray clay.

These soils are characterized by a surface mulch of very hard discrete aggregates, and virgin Roscoe soils generally have gilgai microrelief. When dry, these soils crack.

Roscoe soils are rarely flooded, but they receive small amounts of sediment from runoff. Permeability is very slow, and the available water capacity is high. Soil blowing is a slight hazard.

Representative profile of Roscoe clay in native range, 100 feet west of county road from a point 2.2 miles north of its intersection with Farm Road 377, which is about 5.0 miles east of the intersection of Farm Road 377 and U.S. Highway 83 in Perryton:

A1—0 to 15 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate, fine, angular blocky structure; surface mulch of very hard, fine, discrete aggregates; very hard, very firm; few worm casts; few surface cracks; mildly alkaline; gradual, smooth boundary.

AC—15 to 48 inches, gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate, medium, angular blocky structure in the upper part, common parallelepipeds in the lower part with their long axes tilted more than 10 degrees from the horizon; extremely hard, extremely firm, sticky and plastic; few fine pores; common grooved intersecting slickensides in the lower part; calcareous; moderately alkaline; gradual, wavy boundary.

C—48 to 60 inches +, gray (10YR 6/1) clay, gray (10YR 5/1) moist; massive; extremely hard, very firm; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 12 to 24 inches in thickness and from gray to dark gray in color. The AC horizon ranges from 18 to 36 inches in thickness and from gray to dark gray in color. The C horizon ranges from clay to silty clay loam in texture and from light gray to grayish brown in color. The depth to the C horizon ranges from 40 to about 60 inches.

Roscoe soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions. Also, soils of this series are now restricted to soils that are browner colored in the lower layers.

Roscoe clay (Re).—This soil occurs on the upland plains and occupies benches around the more clearly defined playas. These benches generally occur 1 to 8 feet above the adjacent lake bottoms and are slightly concave to smooth. The soils are nearly level and have slopes ranging from 0 to about 0.8 percent. In areas of range, small depressions, or gilgai relief, are caused on the surface by cracking, sloughing, and swelling of this soil under alternate cycles of drying and wetting. Areas of this soil are oblong and average about 75 acres in size, but some are as large as 300 acres.

Included in mapping were small areas of Pullman clay loam, Richfield clay loam, Ulysses silty clay loam, and Randall clay. Also included were narrow sloping areas along the lakeshore.

Most of this soil is cultivated. It is well suited to both nonirrigated and irrigated crops. It is scoured where runoff flows across it on the way to the playas. (Nonirrigated capability unit IIIce-1; irrigated capability unit IIs-1; Deep Hardland range site)

Rough Broken Land

Rough broken land (Ro) consists of nearly vertical escarpments along the caprock or remnants of the escarpment, of steep canyon walls, of severely eroded areas, and of rough, dissected breaks leading to the valleys below. Caliche or parent material is exposed in more than 20 percent of the area. Some identifiable soils are intermingled with the exposed parent material and occur as pockets, knobs, mesas, and foot slopes.

Generally, the areas are strongly sloping to steep, but slopes range from 1 percent to more than 60 percent. The areas are long and narrow and have irregular boundaries. The average size of the areas is 100 acres, but some areas are as large as 500 acres in size. Entire canyons are generally mapped as one delineation. These canyons are heads of large drainageways that begin along the High Plains escarpment and extend to creeks and rivers below (fig. 12). The canyons are 20 to 200 feet deep.

The caprock along the upper edge is 1 to several feet thick. Sheer drops of 10 to 70 feet occur in some places. In most places, however, the canyon walls are convex on the upper half and concave on the lower half. Narrow strips of Spur soils occupy some of the canyon floors.

This unit consists of about 60 percent Rough broken land, 15 percent Berthoud soils, 7 percent Mobeetie soils, 8 percent Mansker soils, and 10 percent unclassified, very shallow soils and alluvial land. The proportion of each may vary 35 percent or more from place to place.

This land type is not suitable for cultivation. It is used mostly for range. Some of the areas are so steep and rough that they are not readily accessible to livestock. The hazard of water erosion is severe. (Nonirrigated capability unit VIIs-2; not in an irrigated capability unit; Rough Breaks range site)

Spur Series

The Spur series consists of deep, friable, calcareous, well-drained, loamy soils. The soils occupy flood plains. Spur soils formed in calcareous, loamy alluvium.

In a representative profile the surface layer is dark grayish-brown clay loam about 18 inches thick over brown clay loam about 18 inches thick. The underlying material is pale-brown clay loam.

Spur soils occur as nearly level to broken areas and are subject to flooding. Permeability is moderate, and the available water capacity is high. Soil blowing is a slight hazard.

Figure 12.—**Area of Rough broken land, spotted with yucca, catclaw, and redberry juniper. This is one of several canyons that occur at the heads of large drainageways.**

Representative profile of Spur clay loam in a cultivated field 75 feet south of county road (Lake Fryer road) from a point 0.25 miles east of its intersection with U.S. Highway 83, which is about 12.4 miles southeast of the intersection of U.S. Highway 83 and Farm Road 377 in Perryton:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, friable; many worm casts; calcereous; moderately alkaline; abrupt, smooth boundary.

A12—6 to 18 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, friable; many worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B2—18 to 36 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, subangular blocky structure; hard, friable; common worm casts and insect cavities; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

C—36 to 60 inches +, pale-brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate, medium and fine, subangular blocky structure; hard, friable; few thin strata of silt loam and sandy loam; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A1 horizon ranges from 11 to 20 inches in thickness, from clay loam to silty clay loam in texture, and from grayish brown to dark brown in color. The B2 horizon ranges from 15 to 20 inches in thickness, from clay loam to silty clay loam in texture, and from light brownish gray to dark brown in color. The depth to the C horizon ranges from 26 to 40 inches. The C horizon ranges from pale brown to brown in color. The C horizon is stratified with thin layers ranging from sandy loam to silt.

Spur soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

Spur clay loam (Sc).—This nearly level soil occupies flood plains. Slopes range from 0 to about 2.0 percent, but they are dominantly about 0.6 percent. Areas of this soil are oblong and have smooth boundaries. They average about 60 acres in size, but some areas are as large as 200 acres.

This soil has the profile described as representative of the series.

Included in mapping were small areas of Bippus clay loam and Berthoud loam.

Most of this soil is cultivated. It is also well suited to pasture and range.

Areas of this soil flood about once every 5 to 10 years. Floodwater stands less than about 24 hours. Crop damage as a result of flooding is only minor. (Nonirrigated capability unit IIe–1; irrigated capability unit IIe–5; Loamy Bottomland range site)

Spur soils, broken (Sp).—This unit consists of low bottom lands, streambanks, and stream channels of the major creeks and their tributaries. It occupies flood plains and is subject to damaging floods. These soils are nonarable because of frequent flooding, deposition of soil material, and meandering of the stream channels. These creeks and tributaries drain large areas of Bippus, Berthoud, Mansker, and Potter soils along and below the High Plains escarpment.

Areas of these soils are long and narrow, and they have smooth boundaries. They average about 100 acres in size. Width of the areas ranges from 150 feet to more than 1,500 feet. Some of the wider areas are often old scar channels, 2 to 12 feet above the present channel. They function as a part of the channel during rainy periods. The present stream channels are less than 100 feet wide and have banks 2 to 15 feet high.

These soils have a thinner surface layer than that described as representative of the series. The surface layer, about 14 inches thick, is dark brown. It varies in texture from clay loam to silty clay loam. The next layer is brown clay loam about 15 inches thick. The underlying material is pale-brown clay loam.

Included in mapping were small areas less than 5 acres in size of Bippus clay loam and Berthoud loam.

These soils are used mainly for range. The wooded areas along the streams are good for wildlife habitat. (Nonirrigated capability unit Vw–1; not in an irrigated capability unit; Loamy Bottomland range site)

Ulysses Series

The Ulysses series consists of deep, well-drained, friable, loamy soils. These soils developed in calcareous silty loess on the broad upland plains. They are nearly level to gently sloping. They occupy low knolls surrounded by Pullman soils and Richfield soils, rims or ridges around playas, and areas leading to the natural drainageways.

In a representative profile the surface layer is grayish-brown silty clay loam, about 10 inches thick. It overlies a layer of pale-brown silty clay loam about 10 inches thick. The next layer is about 22 inches thick and consists of very pale brown silty clay loam that is about 5 percent visible calcium carbonate. Underlying this horizon is pink silty clay loam.

Permeability is moderate, and the available water capacity is high. Soil blowing is a moderate hazard. Water erosion is a slight to moderately severe hazard.

Representative profile of Ulysses silty clay loam, 1 to 3 percent slopes, in a cultivated field 660 feet west of U.S. Highway 83 from a point about 4.75 miles north of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton:

Ap—0 to 5 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; slightly hard, friable; calcareous; mildly alkaline; abrupt, smooth boundary.

A12—5 to 10 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, fine and very fine, subangular blocky; hard, friable; many worm casts; few films and threads of calcium carbonate; calcareous; mildly alkaline; clear, smooth boundary.

B2—10 to 20 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, friable; many worm casts; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

B3ca—20 to 42 inches, very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; moderate, fine, subangular blocky structure; hard, friable; few worm casts; many films and threads and common, fine and very fine, soft masses of visible calcium carbonate that make up about 5 percent of horizon, by volume; calcareous; moderately alkaline; diffuse, wavy boundary.

C—42 to 72 inches +, pink (7.5YR 7/4) silty clay loam, brown (7.5YR 5/4) moist; weak, fine, subangular blocky structure; hard, friable; a few krotovinas, 6 to 8 inches in diameter, that consist of stratified silty material; films, threads, and a few weakly cemented concretions, less than 2 millimeters in size, of calcium carbonate; calcareous; mildly alkaline.

The A1 horizon ranges from 8 to 12 inches in thickness, from silt loam to silty clay loam in texture, and from dark grayish brown to brown in color. The depth to calcareous material ranges from 0 to 10 inches. The B2 horizon ranges from 8 to 12 inches in thickness, from silty clay loam to clay loam in texture, and from pale brown to brown in color. The depth to the B3ca horizon ranges from 16 to 24 inches. Visible calcium carbonate in the B3ca horizon makes up 5 to 15 percent of this horizon, by volume.

Ulysses silty clay loam, 0 to 1 percent slopes (UcA).—This soil is on the upland plains. It occurs as low, oval mounds that rise above the broad constructional plain of Pullman soils and Richfield soils. The surface is slightly convex, and dominant slopes are about 0.5 percent. The areas average about 50 acres in size, but some are as large as 300 acres.

This soil has a slightly thicker and slightly darker surface layer than that of the profile described as representative of the series, and the next layer is slightly more clayey. In this soil the surface layer is dark grayish brown and about 12 inches thick. It is noncalcareous silty clay loam in the upper part and limy silty clay loam in the lower part. The next layer is limy, pale-brown, friable silty clay loam about 12 inches thick. The next layer, about 24 inches thick, consists of very pale brown silty clay loam that is about 5 percent visible calcium carbonate. The underlying material is limy, pink silty clay loam.

Included in mapping were small areas of Mansker clay loam, Richfield clay loam, Pullman clay loam, and Randall clay.

Most of this soil is cultivated. Little of the acreage is irrigated. Water erosion is a slight hazard. (Nonirrigated capability unit IIIce–3; irrigated capability unit IIe–3; Deep Hardland range site)

Ulysses silty clay loam, 1 to 3 percent slopes (UcB).—This soil is on the upland plains. It occurs as convex knolls or oval-shaped hills that extend above the broad constructional plain of Pullman soils and Richfield soils. Individual knolls or hills have a vertical height of 1 to 20 feet and cover an area of 5 to 40 acres. In places several of these knolls or hills occur together in one area. This soil also occurs as gently sloping areas along drainageways that drain the upland plains. Such areas are oblong and have convex to plane surfaces. This soil also occurs as narrow, gently sloping ridges around the more clearly defined playas. Slopes are dominantly about 2 percent. The areas average about 40 acres in size, but some are as large as 250 acres.

This soil has the profile described as representative of the series.

Included in mapping were small areas of Mansker clay loam, Richfield clay loam, and Pullman clay loam. Also included were small, eroded areas where the slopes are nearly 3 percent.

About 70 percent of the acreage is cultivated, some is irrigated, and part is used for range.

Both soil blowing and water erosion are moderate hazards. (Nonirrigated capability unit IIIe–3; irrigated capability unit IIIe–4; Deep Hardland range site)

Ulysses silty clay loam, 3 to 5 percent slopes (UcC).—This soil occurs along ridges and drainageways. It also occurs as narrow ridges around the more clearly defined playa lakes on the nearly level upland plains. The areas are oblong and oval. They average about 30 acres in size, but some areas are as large as 150 acres. Slopes are plane to convex and are dominantly about 4 percent.

This soil has a slightly thinner surface layer than that of the profile described as representative of the series. The surface layer is grayish-brown silty clay loam about 8 inches thick. It contains free lime. The next layer is limy, pale-brown, friable silty clay loam about 8 inches thick. The next layer, about 20 inches thick, consists of very pale brown silty clay loam that is about 5 percent visible calcium carbonate. The underlying material is limy, pink silty clay loam.

Included in mapping were small areas of Mansker clay loam and Richfield clay loam. Also included were small areas eroded by wind along the ridges, and small areas eroded by water along the drainageways.

About 70 percent of the acreage is cultivated, and some of the cultivated areas are irrigated. The remaining 30 percent is used for range.

Water erosion is a moderately severe hazard. (Nonirrigated capability unit IVe–2; irrigated capability unit IVe–1; Deep Hardland range site)

Ulysses-Richfield clay loams, 0 to 3 percent slopes (UrB).—This complex consists of nearly level to gently undulating soils on the smooth parts of upland plains. The areas average 250 acres in size, but some are as large as 900 acres. The slopes are plane, concave, and convex. They range from 0 to 3 percent, but are dominantly about 2 percent.

Ulysses silty clay loam and Richfield clay loam are the major soils in this complex. The Ulysses soil makes up about 55 percent of the complex. It dominantly occupies convex knolls or oval-shaped hills. Slopes generally range from 1 to 3 percent. The Richfield soil makes up about 40 percent of the complex. It dominantly occupies gently concave, valleylike depressions and intervening flats between knolls of the Ulysses soil. Slopes of the Richfield soil generally range from 0 to 1 percent. The remaining 5 percent of the complex is made up of closely associated soils. The soils in this complex occur in such an intricate pattern that they are generally used and managed alike.

The Ulysses soil in this complex has a profile similar to that described as representative of the series. The surface layer is grayish-brown silty clay loam, about 9 inches thick. It contains free lime. The next layer is limy, pale-brown, friable silty clay loam about 9 inches thick. The next layer is about 22 inches thick. It consists of very pale brown silty clay loam that is about 5 percent visible calcium carbonate. The underlying material is limy, pink silty clay loam.

The Richfield soil has a profile similar to that described as representative of the series. The surface layer is friable clay loam about 8 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The next layer is about 25 inches thick and consists of noncalcareous, dark grayish-brown silty clay loam in the upper part and limy, brown silty clay loam in the lower part. The next layer is pale-brown silty clay loam about 14 inches thick. It is about 5 percent visible calcium carbonate. The underlying material is limy, pink silty clay loam.

Small areas of Pullman clay loam, Randall clay, Roscoe clay, and Mansker clay loam make up the 5 percent that consists of closely associated soils.

Most areas of this complex are cultivated. Permeability ranges from moderate to moderately slow. Both the soil blowing and water erosion are slight to moderate hazards. (Nonirrigated capability unit IIIe-3; irrigated capability unit IIIe-4; Deep Hardland range site)

Vona Series

The Vona series consists of deep, very friable, well-drained, sandy soils formed in calcareous loamy sand, probably of eolian origin. These are gently sloping to sloping soils on uplands.

In a representative profile the surface layer is brown loamy sand about 8 inches thick over very friable, brown fine sandy loam about 14 inches thick. The underlying material consists of calcareous, very friable, pale-brown and very pale brown loamy sand.

Vona soils have very little runoff. Permeability is moderately rapid, and the available water capacity is low. Soil blowing is a severe hazard.

Representative profile of Vona loamy sand in an area of Vona-Mobeetie complex, 2 to 8 percent slopes, in native range, 80 feet south of road from a point 2.6 miles southwest of its intersection with county road, from a point 6.1 miles northwest of its intersection with Farm Road 1267, from a point 11.2 miles west of its intersection with U.S. Highway 83, which is about 1.8 miles north of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton:

A1—0 to 8 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; massive; hard, very friable; neutral; gradual, smooth boundary.

B2t—8 to 22 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; hard, very friable; thin discontinuous clay films on faces of prisms; few worm casts; mildly alkaline; gradual, smooth boundary.

C1ca—22 to 35 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; single grain (structureless); slightly hard, very friable; few films and threads of calcium carbonate; calcareous; moderately alkaline; diffuse, wavy boundary.

C2—35 to 60 inches +, very pale brown (10YR 7/3) loamy sand, light yellowish brown (10YR 6/4) moist; single grain (structureless); slightly hard, very friable; less visible segregated calcium carbonate than that in horizon above; calcareous; moderately alkaline.

The A1 horizon ranges from 6 to 12 inches in thickness, from loamy sand to sandy loam in texture, and from light brownish gray to brown in color. The B2t horizon ranges from 12 to 20 inches in thickness, and from pale brown to brown in color. The C1ca horizon ranges from 10 to 14 inches in thickness, from loamy sand to sandy loam in texture, and from light brownish gray to pale brown in color. The depth to the C1ca horizon ranges from 18 to 32 inches. Visible calcium carbonate in the C1ca horizon ranges from 1 to 5 percent by volume.

Vona soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to drier regions.

Vona-Mobeetie complex, 2 to 8 percent slopes (VmD).—This complex occupies dissected erosional upland plains. Slopes range from 2 to 8 percent. Surfaces are plane to convex and are dominantly about 5 percent. Areas average about 450 acres in size, but one area is more than 1,500 acres.

The Vona soil makes up about 60 percent of the complex. It is the more sloping soil of the complex, and it mainly occurs near the streams and in the draws leading to the streams. The Mobeetie soil makes up about 35 percent of the complex. It occupies foot slopes, convex ridges, and other less sloping parts of the complex. The remaining 5 percent of the complex is occupied by closely associated soils. The soils in this complex occur in such an intricate pattern that the component soils are generally used and managed alike.

The Vona soil has the profile described as representative of the series.

The Mobeetie soil has a grayish brown, very friable fine sandy loam surface layer that contains free lime. It is about 10 inches thick. This layer grades to very friable, light brownish-gray fine sandy loam about 16 inches thick. The underlying material is light brownish-gray, limy, very friable fine sandy loam.

Included in mapping were small areas of Lincoln, Potter, and Mansker soils.

The soils in this complex are not suitable for cultivation. They are used mostly for range. (Nonirrigated capability unit VIe-5; not in an irrigated capability unit; the Vona soil is in the Sandyland range site, and the Mobeetie soil is in the Mixedland Slopes range site)

Use and Management of the Soils

In this section the system of land capability classification used by the Soil Conservation Service is briefly discussed. Then the general management of nonirrigated crops is discussed, followed by a discussion of the general management of irrigated crops. Yield predictions for a high level of management are given for all soils in the county that are suitable for cultivation.

Also discussed are the use of soils for range, wildlife habitat, and for engineering.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The 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 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 or 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, defined as follows:

- Class I soils have few limitations that restrict their use. (None in this county.)
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, or wildlife.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in this county.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows 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-1 or IIIe-2. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In Ochiltree County the capability units are numbered according to a Statewide system of capability classification. Not all of the capability units in this system are represented in Ochiltree County. For this reason not all the unit numbers given below are consecutive.

In the following pages management of nonirrigated crops is described. This discussion is followed by a listing of the nonirrigated capability units. Then management of irrigated crops is given. This discussion is followed by a listing of the irrigated capability units.

Management of Nonirrigated Cropland

In 1966 there were approximately 341,000 acres of nonirrigated cropland in Ochiltree County. Most of the acreage occurred in the nearly level to sloping High Plains area.

The main crops grown on nonirrigated cropland in this county are wheat, grain sorghum, and forage sorghum. Among the practices needed to grow these crops successfully under nonirrigated farming are a cropping system that conserves soil and water, good management of crop residue, contour farming, stubble mulching, and emergency tillage.

Field terraces, diversion terraces, and grassed waterways are also needed on some of the soils. Tillage should be kept to a minimum; the soils should be tilled only when necessary to prepare the seedbed and to control weeds. The application of these practices to specific soils or groups of soils is discussed in the capability units.

CAPABILITY UNIT IIe-1, NONIRRIGATED

Spur clay loam is the only soil in this unit. This is a deep, nearly level soil on flood plains.

Soil blowing and flooding are slight hazards.

This soil is used mainly for crops. The main cultivated crops are winter wheat and grain sorghum. Small acreages of forage sorghum, oats, and barley are also grown.

Cropping systems that include crops that have a large amount of residue, such as wheat, are well suited. The residue from such crops help to control soil blowing, adds organic matter to the surface layer, and helps maintain good tilth.

In places diversion terraces and grassed waterways are needed to protect this soil from runoff from higher lying soils. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIIce-1, NONIRRIGATED

This unit consists of deep, nearly level, loamy and clayey soils in upland positions on the broad High Plains.

The available water capacity is high. The hazard of soil blowing is slight.

Most of the acreage is cultivated. These soils occur in large areas, and they are well suited to large-scale farming. Winter wheat and grain sorghum are the principal crops. Small acreages of forage sorghum, oats, and barley are also grown.

Cropping systems that include crops that leave a large amount of residue, such as wheat or grain sorghum, are well suited. Keeping the crop residue on the surface reduces crusting, control erosion, and holds rainwater or snow until it soaks into the soil. After the critical period of soil blowing, the residue can be worked into the soil to improve the structure and tilth.

In places diversion terraces and grassed waterways are needed to break up concentrations of floodwater and to protect the soil from water erosion. Emergency tillage is needed to help control soil blowing in fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIIce-2, NONIRRIGATED

Richfield clay loam, 0 to 1 percent slopes, is the only soil in this unit. This is a deep soil on uplands.

The available water capacity is high. Soil blowing is a slight hazard.

This soil is used mainly for grain sorghum and winter wheat. Small acreages of forage sorghum, oats, and barley are also grown.

A cropping system that includes crops that leave a large amount of residue, such as wheat, is well suited. The crop residue helps to control soil blowing, adds organic matter to the surface layer, helps to increase water intake, and helps to control surface crusting.

In places diversion terraces and grassed waterways are needed to protect this soil from concentrations of floodwater. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIIce-3, NONIRRIGATED

Ulysses silty clay loam, 0 to 1 percent slopes, is the only soil in this unit. This is a deep soil on uplands.

The available water capacity is high. The hazard of soil blowing is moderate.

Most of the acreage is cultivated. Wheat and grain sorghum are the principal crops, but forage sorghum, oats, and barley are also grown on a small acreage.

A cropping system that includes grain sorghum, wheat, or other crops that produce a large amount of residue is well suited. If the residue is kept on the surface, it provides good control of erosion. After the critical period of soil blowing in spring, the residue can be worked into the soil.

Emergency tillage is needed to control soil blowing in fields that do not have an adequate cover of plants or crop residue. Grassed waterways and diversion terraces help to control erosion from runoff.

CAPABILITY UNIT IIIe-1, NONIRRIGATED

Pullman clay loam, 1 to 3 percent slopes, is the only soil in this unit. It occupies uplands.

The available water capacity is high. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

Most of the acreage is cultivated. Wheat and grain sorghum are the main crops, but other crops grown in the county are also well suited.

A cropping system that includes crops that leave a large amount of residue, such as grain sorghum, is well suited. The residue from such crops helps to control soil blowing and water erosion, adds organic matter to the surface layer, and helps maintain good tilth.

Terracing and contour farming are needed to control water erosion in cultivated areas. Grassed waterways and diversion terraces help to control erosion from runoff. Emergency tillage is needed to help control soil blowing on fields where the vegetation does not provide enough protection.

CAPABILITY UNIT IIIe-2, NONIRRIGATED

This unit consists of deep, gently sloping clay loams. These soils occupy uplands on the High Plains and valley floors below the High Plains escarpment.

The available water capacity is high. The hazard of soil blowing is slight, and the hazard of water erosion is moderate.

These soils are used for cultivated crops and for range. They are good for farming, but they are limited by their gentle slopes that allow loss of some of the water through runoff. Grain sorghum and winter wheat are the principal crops, but other crops grown in the county are also well suited.

A cropping system that includes wheat, grain sorghum, or other crops that produce a large amount of residue is well suited. After the critical period of erosion in spring, the residue can be worked into the soil to improve the structure and tilth of the surface layer.

Emergency tillage can be used to control soil blowing in fields that have an inadequate cover of plants or crop residue. Contour farming and terracing are needed to control water erosion in cultivated areas. Diversion terraces and grassed waterways help to control runoff in areas susceptible to water erosion.

CAPABILITY UNIT IIIe-3, NONIRRIGATED

This unit consists of deep, nearly level to gently sloping, loamy soils on uplands.

The available water capacity is high. The hazard of soil blowing is slight to moderate, and the hazard of water erosion is slight to moderate.

About 70 percent of the acreage is used for crops. The rest is used for range. The chief cultivated crops are wheat and grain sorghum.

Cropping systems that include crops that leave a large amount of residue, such as wheat, are well suited. The residue from such crops helps to control soil blowing and water erosion, helps to increase water intake rate, and improves tilth.

Terracing and contour farming are needed to control water erosion in cutivated areas. Grassed waterways and diversion terraces help to control erosion from runoff. Emergency tillage is needed to help control soil blowing on fields where the vegetation does not provide enough protection.

CAPABILITY UNIT IVe-1, NONIRRIGATED

Richfield clay loam, 3 to 5 percent slopes, is the only soil in this unit. It occupies ridgetops and slopes that lead to the draws or drainageways.

The available water capacity is high. The hazard of soil blowing is slight, and the hazard of water erosion is moderately severe.

Most of the acreage is cultivated. Wheat is the principal crop.

A cropping system of continuous crops that leave a large amount of residue, such as wheat, is needed for adequate soil protection. Erosion control and such moisture-conserving practices as terracing and contour farming are needed if this soil is cultivated.

Waterways vegetated with native grasses help to protect this soil from erosion where runoff is concentrated. Emergency tillage is needed to help control soil blowing in fields where vegetation does not provide enough protection.

CAPABILITY UNIT IVe-2, NONIRRIGATED

This unit consists of deep, gently sloping clay loams and silty clay loams. These soils are on uplands. The slope is 3 to 5 percent.

The available water capacity is high. The hazard of soil blowing is slight to moderate, and the hazard of water erosion is moderately severe.

About 70 percent of the acreage is cultivated. Winter wheat is the principal crop, but grain sorghum does well when moisture is adequate.

Cropping systems that include continuous crops that leave a large amount of residue, such as wheat, are needed if these soils are cultivated. Keeping the crop residue on the surface helps to control soil blowing and water erosion, slows runoff, and allows more water to soak into the soil. After the critical period of erosion in spring, the residue can be worked into the surface layer to improve tilth and structure.

Terracing and contour farming are needed for moisture conservation and erosion control. Vegetated waterways help to protect these soils from erosion by runoff. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IVe-9, NONIRRIGATED

This unit consists of deep, nearly level to sloping clay loams and silty clay loams.

The hazard of water erosion ranges from slight to moderately severe according to the slope gradient. The hazard of soil blowing is moderate.

About 30 percent of the acreage of these soils is cultivated. The main crops are winter wheat and grain sorghum.

A cropping system of continuous crops that leave a large amount of residue, such as wheat, is needed for adequate soil protection. Terracing and contour farming are needed on slopes of more than 1 percent to control water erosion and conserve moisture.

Vegetated waterways help to protect these soils from water erosion where runoff is concentrated. Emergency tillage is needed to help control soil blowing in fields where vegetation does not provide enough protection.

CAPABILITY UNIT Vw-1, NONIRRIGATED

Spur soils, broken, are the only soils in this unit. These soils are deep and nearly level. They occupy flood plains of the major streams and tributaries.

These soils receive runoff from surrounding higher lying soils. They are cut up by scar channels and are subject to the hazards of frequent flooding, washing, and deposition of new soil material.

These soils are not suitable for cultivation.

CAPABILITY UNIT Vw-2, NONIRRIGATED

Lincoln soils are the only soils in this unit. These soils are deep and nearly level. They occupy flood plains.

These soils have a surface layer of calcareous loamy fine sand. The layers are fine sand that is rapidly permeable and low in available water capacity.

The hazard of soil blowing is severe if areas are not protected. The water table is 4 to 20 feet below the surface in most places.

These soils are not suitable for cultivation.

CAPABILITY UNIT VIe-1, NONIRRIGATED

This unit consists of well-drained, gently sloping to sloping loams and clays loams. The soils occupy sloping areas leading to the drainageways that drain the uplands. They also occupy foot slopes below the High Plains escarpment.

The available water capacity is high. If these soils are not protected, the hazard of soil blowing is moderate, and the hazard of water erosion is moderately severe.

These soils are not suitable for cultivation.

CAPABILITY UNIT VIe-2, NONIRRIGATED

Mobeetie fine sandy loam, 5 to 8 percent slopes, is the only soil in this unit. It occupies concave foot slopes between the High Plains escarpment and valley floors.

The available water capacity is moderate. The hazard of soil blowing is moderate, and the hazard of water erosion is moderately severe.

This soil is not suitable for cultivation.

CAPABILITY UNIT VIe-5, NONIRRIGATED

This unit consists of the Vona-Mobeetie complex, 2 to 8 percent slopes. The soils occupy dissected erosional plains.

The available water capacity ranges from low to moderate.

These soils are not suitable for cultivation.

CAPABILITY UNIT VIw-1, NONIRRIGATED

Randall clay is the only soil in this unit. This is a deep, somewhat poorly drained soil that occupies the beds of intermittent lakes, or playas.

This soil receives runoff from the surrounding areas, and it is flooded in most years for several months at a time. When the vegetation is drowned out, soil blowing becomes a hazard as the playas dry out. Emergency tillage is needed to keep these areas from blowing.

Generally, this soil is unsuitable for cultivation, but in dry years a number of the smaller lake bottoms are farmed or grazed.

CAPABILITY UNIT VIIs-1, NONIRRIGATED

This unit consists of deep to very shallow, calcareous, nearly level to steep loams. These soils have a surface layer of clay loam to gravelly loam. They occupy uplands along the High Plains escarpment and throughout the rough, dissected breaks below the escarpment.

The available water capacity ranges from low to high. The hazard of soil blowing is moderate, and the hazard of water erosion ranges from slight to moderately severe.

These soils are used for range.

CAPABILITY UNIT VIIs-2, NONIRRIGATED

This unit consists of Rough broken land. Included in mapping were the nearly vertical caprock along the High Plains escarpment and the rough, dissected areas below and adjacent to the escarpment.

This land type is made up of loamy areas that have little or no soil material. Runoff is rapid, and susceptibility to water erosion is severe.

This unit is not suitable for cultivation and is of limited use for grazing. Most of the grass grows in small pockets of soil material that occur on benches, mesas, and foot slopes.

Management of Irrigated Cropland

Irrigation is a fairly new enterprise in Ochiltree County. There were approximately 45 irrigation wells in the county before 1955. Since then, several times that many wells have been drilled. Approximately 43,000 acres were irrigated in 1966.

Many of the soils are suitable for irrigation, but water is not available everywhere. One large area, which extends diagonally across the county from the southwest to the northeast, is underlain by varying amounts of water that is suitable for irrigation.

Wells are drilled into the beds of alluvial sandy clay, sand, and gravel of the Ogallala Formation, which overlies the uneven surface of the Permian red beds. The wells range from 360 to 700 feet in depth. Production from most of the wells varies from 270 to 2,000 gallons per minute. The more productive wells are in the southwestern part of the county. Water is more scarce, and the flow is less dependable, in the northeastern part of the county. There are exceptions, however, and a few large wells pump 1,000 gallons per minute.

Surface irrigation systems are the most common type used on the irrigated cropland of the county. These are the level-furrow, graded-furrow (fig. 13), level-border, and graded-border systems. The design of the system is based on the rate of intake, on permeability and the available water capacity of the soils, and on the supply of available water.

The main crops grown on the irrigated soils in the county are wheat, grain sorghum, forage sorghum, and alfalfa. Among the practices needed to grow these crops successfully under irrigated farming are a cropping system that conserves soil and water, good management of crop residue, and maintenance of fertility. Fertilizer is needed.

CAPABILITY UNIT IIe-1, IRRIGATED

Bippus clay loam, 1 to 3 percent slopes, is the only soil in this unit. It occupies low foot slopes and slightly undulating valley floors below the High Plains escarpment.

Wheat and grain sorghum are the principal crops, but alfalfa and forage sorghum are also grown. Midland bermudagrass, switchgrass, and indiangrass are the principal pasture plants.

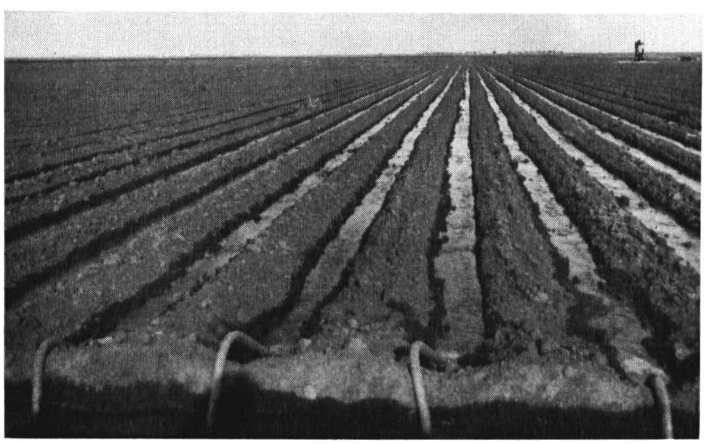

Figure 13.—**Graded-furrow systm of surface irrigation on Pullman clay loam, 0 to 1 percent slopes. The flow of water through the furrows can be regulated for proper management of irrigation water.**

Proper use of irrigation water through use of surface or sprinkler systems, returning large quantities of crop residue to the soil, and maintenance of fertility are measures that are needed. Such crops as sorghum and wheat produce growing cover and adequate residue to protect the soil from blowing and from water erosion during critical erosion periods.

Diversion terraces and grassed waterways help to control erosion where runoff is excessive. Emergency tillage is needed to control soil blowing on fields where vegetative cover is not adequate.

CAPABILITY UNIT IIe-2, IRRIGATED

Richfield clay loam, 1 to 3 percent slopes, is the only soil in this unit. This is a deep, gently sloping soil on uplands in the High Plains.

The principal crops are winter wheat and grain sorghum, but the soil is also well suited to alfalfa, Midland bermudagrass, and switchgrass.

Proper use of irrigation water through use of a surface or sprinkler irrigation system, returning a large amount of crop residue to the soil, and maintenance of fertility are needed. Such crops as alfalfa and sorghum provide a cover of growing plants and enough residue to protect the soil from blowing and from water erosion during critical erosion periods.

Diversion terraces and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to control soil blowing on fields that do not have an adequate cover of plants or crop residue.

CAPABILITY UNIT IIe-3, IRRIGATED

Ulysses silty clay loam, 0 to 1 percent slopes, is the only soil in this unit. This is a deep, nearly level soil on uplands.

Grain sorghum and winter wheat are the principal crops. Midland bermudagrass, switchgrass, and indiangrass are the main pasture plants.

Proper use of irrigation water through use of a surface or sprinkler system, returning large quantities of crop residue to the soil, and maintenance of fertility are measures that are needed. Such crops as sorghums and wheat produce growing cover and adequate residue to protect the soil from blowing and water erosion during critical erosion periods.

Diversion terraces and grassed waterways help to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIe-4, IRRIGATED

Richfield clay loam, 0 to 1 percent slopes, is the only soil in this unit. This is a deep, nearly level soil on uplands in the High Plains.

This soil is easily managed to maintain the intake and the movement of water.

Winter wheat and grain sorghum are the principal irrigated crops, but alfalfa and forage sorghum are also grown. Midland bermudagrass, switchgrass, and indiangrass are the principal pasture plants.

Proper use of irrigation water through use of a surface or sprinkler irrigation system, returning a large amount of crop residue to the soil, and maintenance of fertility are needed measures. Such crops as sorghum and wheat provide a cover of growing plants and enough residue to protect the soil from blowing and water erosion during critical erosion periods.

Diversion terraces and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing in fields where vegetative cover is not adequate.

CAPABILITY UNIT IIe-5, IRRIGATED

Spur clay loam is the only soil in this unit. This is a deep, nearly level soil on flood plains. There is a slight hazard of flooding.

Alfalfa is the principal crop, but grain sorghum, forage sorghum, and winter wheat are also grown. Midland bermudagrass, switchgrass, and indiangrass are the principal pasture plants.

Proper use of irrigation water through use of a surface or sprinkler irrigation system, returning a large amount of crop residue to the soil, and maintenance of fertility are needed. Such crops as alfalfa and sorghum provide a cover of growing plants and enough residue to protect the soil from blowing and water erosion during critical erosion periods.

Diversion terraces and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIs-1, IRRIGATED

This unit consists of deep, nearly level clay loams and clays. These soils occupy uplands in the broad High Plains.

Winter wheat and grain sorghum (fig. 14) are the principal crops. Alfalfa and forage sorghum also are grown. Midland bermudagrass, switchgrass, and indiangrass are principal pasture plants.

Proper use of irrigation water through use of a surface or sprinkler irrigation system, returning a large amount of crop residue to the soil, and maintenance of fertility are needed practices. Such crops as alfalfa and sorghum provide a cover of growing plants and enough residue to protect the soils from blowing and from water erosion during critical erosion periods.

Diversion terraces and grassed waterways help to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIIe-1, IRRIGATED

Pullman clay loam, 1 to 3 percent slopes, is the only soil in this unit. This is a deep, gently sloping soil on uplands.

Winter wheat and grain sorghum are the principal crops. Alfalfa and forage sorghum are also grown. Midland ber-

***Figure 14.*—Harvesting irrigated grain sorghum on Pullman clay loam, 0 to 1 percent slopes.**

mudagrass, switchgrass, and indiangrass are the principal pasture plants.

Proper use of irrigation water through use of a surface system, returning large quantities of crop residue to the soil, and maintenance of fertility are measures that are needed. Such crops as sorghum and wheat produce growing cover and adequate residue to control soil blowing and water erosion during critical erosion periods.

Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection. Terraces and grassed waterways are needed to control erosion where runoff is excessive.

CAPABILITY UNIT IIIe-2, IRRIGATED

Richfield clay loam, 3 to 5 percent slopes, is the only soil in this unit. This is a deep, gently sloping soil on ridgetops and slopes leading to the draws or drainageways.

Alfalfa, Midland bermudagrass, switchgrass, and indiangrass are well suited.

Proper use of irrigation water through use of a sprinkler system, returning large quantities of crop residue to the soil, and maintenance of fertility are measures that are needed.

Terraces, contour farming, and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIIe-4, IRRIGATED

This unit consists of deep, nearly level to gently sloping silty clay loams and clay loams. These soils are on uplands around the playa lakes and in slightly undulating areas.

Winter wheat and grain sorghum are the main cultivated crops. Midland bermudagrass, switchgrass, and indiangrass are the principal pasture plants.

Proper use of irrigation water through use of a surface or sprinkler irrigation system, returning a large amount of crop residue to the soil, and maintenance of fertility are needed. Such crops as alfalfa and sorghum provide a cover of growing plants and enough residue to protect the soil from blowing and from water erosion during critical erosion periods.

Terraces and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing in fields where vegetation does not provide enough protection.

CAPABILITY UNIT IIIe-10, IRRIGATED

This unit consists of deep, nearly level to gently sloping clay loams. These soils are on uplands.

Most areas of this unit are within larger areas of soils that are more desirable for irrigation. Grain sorghum and winter wheat are the principal crops, and Midland bermudagrass, switchgrass, and indiangrass are the principal pasture plants.

Proper use of irrigation water through use of a surface or sprinkler irrigation system, returning a large amount of crop residue to the soil, and maintaining fertility are needed practices. Such crops as alfalfa and sorghum provide a cover of growing plants and enough residue to protect the soils from blowing and water erosion during critical erosion periods.

Diversion terraces and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

CAPABILITY UNIT IVe-1, IRRIGATED

This unit consists of deep, gently sloping to sloping clay loams and silty clay loams. These soils occupy ridgetops and sloping areas leading to the drainageways on uplands and on low foot slopes below the High Plains escarpment.

Areas of these soils are small, but they are well suited to grasses. Midland bermudagrass, switchgrass, and indiangrass are the main pasture plants.

Proper use of irrigation water through use of a sprinkler system, returning large quantities of crop residue to the soil, and maintenance of fertility are measures that are needed.

Terracing, contour farming, and grassed waterways are needed to control erosion where runoff is excessive. Emergency tillage is needed to help control soil blowing on fields where vegetation does not provide enough protection.

Predicted Yields

Table 2 gives the predicted average yields per acre, under nonirrigated and irrigated farming, for the principal crops grown in the county. The predictions are based on the results of research and on information received in interviews with farmers and others who have knowledge of the soils and yields in the county.

The yield predictions in table 2 are for wheat, grain sorghum, forage sorghum, and alfalfa on soils under a high level of management. Yield predictions for alfalfa are given only for irrigated soils. Only the major cultivated soils and the principal crops are listed in table 2.

Under a high level of management, all the following practices are used on nonirrigated soils:

1. Rainfall is conserved and effectively used.
2. Soil blowing is controlled through use of residue and occasional emergency tillage.
3. Water erosion is controlled through use of residue and properly maintained mechanical measures.
4. Tilth is maintained at an optimum level by returning an adequate supply of organic material to the soil, and by performing minimum but timely tillage operations at various depths and at moisture conditions to avoid soil compaction.
5. Insects, diseases, and weeds are effectively controlled.
6. Improved crop varieties and strains are used.

Under a high level of management, all the following practices are used on irrigated soils:

1. Irrigation water is uniformly applied at intervals and in amounts according to soil and crop needs.
2. Rainfall is conserved and effectively used.
3. Soil blowing is controlled through use of residue and occasional emergency tillage.
4. Water erosion is controlled through use of residue and properly maintained mechanical measures.

TABLE 2.—*Predicted average yields per acre of principal crops grown under a high level of management*

[Absence of a yield figure indicates that the crop is generally not grown on the soil or that the crop is not commonly grown under the kind of management indicated]

Soil	Wheat		Grain sorgum		Forage sorghum		Alfalfa
	Non-irrigated	Irrigated	Non-irrigated	Irrigated	Non-irrigated	Irrigated	Irrigated
	Bu.	*Bu.*	*Lb.*	*Lb.*	*Tons*	*Tons*	*Tons*
Bippus clay loam, 1 to 3 percent slopes	14	50	1, 400	6, 000	1. 5	16	5. 0
Bippus clay loam, 3 to 5 percent slopes	10		1, 000		1. 3		
Mansker clay loam, 0 to 1 percent slopes	10	37	900	4, 000	1. 4	16	
Mansker clay loam, 1 to 3 percent slopes	9	37	800	4, 000	1. 3	16	
Mansker clay loam, 3 to 5 percent slopes	8		600		1. 0		
Mansker-Ulysses complex, 2 to 6 percent slopes	9		800		1. 3		
Pullman clay loam, 0 to 1 percent slopes	14	55	1, 400	6, 500	2. 0	22	5. 5
Pullman clay loam, 1 to 3 percent slopes	13	45	1, 200	5, 600	1. 5	16	5. 0
Richfield clay loam, 0 to 1 percent slopes	15	50	1, 500	6, 700	2. 0	22	5. 5
Richfield clay loam, 1 to 3 percent slopes	13	50	1, 300	5, 600	1. 5	16	5. 0
Richfield clay loam, 3 to 5 percent slopes	10	45	1, 000	5, 600	1. 3	16	4. 5
Roscoe clay	13	50	1, 400	6, 000	1. 9	22	5. 5
Spur clay loam	20	55	1, 600	6, 700	2. 2	22	6. 0
Ulysses silty clay loam, 0 to 1 percent slopes	13	50	1, 400	6, 000	1. 8	22	5. 0
Ulysses silty clay loam, 1 to 3 percent slopes	12	45	1, 300	5, 600	1. 5	20	4. 5
Ulysses silty clay loam, 3 to 5 percent slopes	9		700		1. 3		
Ulysses-Richfield clay loams, 0 to 3 percent slopes	14	45	1, 400	5, 800	1. 8	21	5. 0

5. Fertility is maintained by timely application of fertilizer based on soil tests and crop needs, and by including legumes in the rotation where feasible.
6. Tilth is maintained at an optimum level by returning an adequate supply of organic material to the soil, and by performing minimum but timely tillage operations at various depths and at moisture conditions to avoid soil compaction.
7. Insects, diseases, and weeds are effectively controlled.
8. Improved crop varieties and strains are used.
9. The length and degree of the slope are considered when planning the length of the irrigation run and when applying water.

Use of the Soils for Range [2]

In this section the use of native grassland and cropland for grazing in Ochiltree County is first discussed, and then the range sites and condition classes. Each range site is briefly described, the plants in the climax vegetation are named, the principal invaders are listed, and the range in annual yield for the site is given.

Ranching and livestock farming in the county

At the time of the survey, about 174,000 acres of grassland was used for ranching and livestock farming. An average ranch was about 2,900 acres in size.

Livestock enterprises in the county are diversified, but the winter stocker operation is the most important. The number of animals run annually depends on the amount of wheat pasture available. The number of stock purchased is smaller in years of low rainfall and large in years of high rainfall. Most stock obtained in the fall is disposed of the following spring. Cow-calf operations rank second in significance, and summer stockers third. There are a few feedlot operations in business, and this kind of operation is increasing. Interest is increasing in the development of summer irrigated pasture consisting of bermudagrass, switchgrass, and indiangrass.

Range sites and condition classes

Range sites are distinctive kinds of rangeland that have different potentials for producing native forage plants. Range sites within a given climate differ only in the kind or amount of vegetation they can produce. The differences result from different soil characteristics, among which are depth, texture, structure, topographic position, and to a lesser extent, exposure and elevation.

The kind and the amount of vegetation a given site can produce depend on the fertility and aeration of the soil and the amount of water that is taken in and retained in the soil profile. A deep, fertile, bottom-land range site that receives water from flooding, in addition to water from normal rainfall, produces taller grasses in greater numbers than an upland site or a shallow site that receives less water.

Grass, like all other plants, manufactures its food in the green leaves and tender stems. Thus, the continued growth and production of range plants is directly affected by the amount of grazing the range receives. Heavy use, or overgrazing, reduces or destroys the leaf and stem surface and thus reduces the amount of food produced by the plant for its maintenance and growth. If overgrazing is continued over a period of successive years, many plants will be killed. The most palatable and nutritious plants are grazed most by animals and are therefore damaged or depleted first. These plants decrease under continued grazing and are called decreasers.

As the decreasers are reduced or eliminated by continued grazing, the plants that were not grazed first increase.

[2] By JOE B. NORRIS, range conservationist, Soil Conservation Service.

These plants are called increasers. As grazing continues, the successively less desirable plants dominate the site. As the decreasers and the increasers are thinned or eliminated, plants from other sites or areas farther away invade the site. These plants are called invaders.

By this process the range site changes in the composition of vegetation from the best plants to the poorest. These successive changes are referred to by ranchers as range condition. If 76 to 100 percent of the composition is the original, or climax, vegetation, the range condition is excellent; if 51 to 75 percent is climax, the condition is good; if 26 to 50 percent is climax, the condition is fair; and if 25 percent or less is climax, the condition is poor.

Descriptions of range sites

Since range sites have distinguishing characteristics and are easily recognized, they are significant for planning rangeland treatment and management. Each site responds to climatic conditions and to the extent of grazing. The extent of grazing depends on the habits of the various kinds of livestock and on the palatability of the forage on the site.

Although there are generally several range sites in a pasture, usually one site receives grazing preference. This is the key site, and it can be used as a basis for managing and evaluating grazing of the entire pasture. If grazing of the key site is managed correctly, the rest of the pasture will improve.

In some places soils are so intermingled that they cannot feasibly be mapped separately. A mixture of range sites often results from such a complex of soils. In a few places, each of the soils that make up the complex are in the same range site. Randall clay was not placed in a range site, because it dominantly occurs as small areas and is used the same as the soils in the surrounding range site.

In Ochiltree County there are eight range sites that are significant to range management and livestock production. They are discussed in the following pages.

LOAMY BOTTOMLAND RANGE SITE

This site is made up of deep, nearly level to broken, loamy soils. These soils occupy flood plains along streambeds and in draws or valleys. Their surface layer is clay loam to fine sandy loam.

The soils receive runoff from adjacent areas and support an excellent growth of plants. If they are not protected by plant cover, however, they are subject to scouring and flooding. They are under water for only short periods. Any damage to vegetation, therefore, is ordinarily from sedimentation, rather than from wetness.

The composition of the climax vegetation varies from place to place, depending on the origin of the alluvial deposits. About 70 percent of the vegetation consists of original decreasers. These are big bluestem, sand bluestem, little bluestem, indiangrass, switchgrass, Canada wildrye, and side-oats grama. Climax increasers are western wheatgrass, vine-mesquite, silver bluestem, blue grama, and buffalograss, which make up the remaining 30 percent. A few woody plants, chiefly elm, hackberry, and cottonwood, occur in the climax vegetation on some of the bottom lands.

If the climax vegetation is not maintained, the site is invaded by noxious plants that develop from seed washed in from outlying areas. These invaders, ordinarily annuals common in cultivated fields, include sunflower, cocklebur, buffalo-bur, hairy caltrop, common broomweed, croton, thistle, and sandbur. Other common invaders are sand dropseed, three-awn, windmillgrass, hairy tridens, and perennial forbs.

This site is capable of high production if it is not overwashed by clay sediments. The total annual herbage yield, expressed as air-dry weight, ranges from 2,100 to 3,800 pounds per acre if the site is in excellent condition.

SANDY BOTTOMLAND RANGE SITE

This site is made up of only Lincoln soils. These are nearly level, sandy soils on flood plains. Their surface layer is loamy fine sand.

The growth of vegetation is excellent on this site because the soils receive runoff from adjacent areas. If the soils are not protected by a cover of plants, however, they are subject to scouring and blowing. Some areas are subject to flooding and deposition.

The vegetation is mainly mid and tall grasses. Indiangrass, switchgrass, and sand bluestem were dominant on the site in its original condition. Other decreasers are side-oats grama, little bluestem, Canada wildrye, Texas bluegrass, and big sandreed. About 70 percent of the original vegetation was made up of these species. A few woody plants, such as sand plum, cottonwood, and willow trees, sand sagebrush, and skunkbush were on this site in its original condition.

Any deterioration in vegetation caused by overgrazing results in a rapid spread of such increasers as vine-mesquite, three-awn, sand dropseed, and blue grama.

Further degeneration in the plant cover results in an invasion of gummy lovegrass, annual three-awn, tumble lovegrass, low-growing paspalum, and numerous annuals. Other woody invaders are yucca and groundsel.

Once the climax vegetation is grazed out, this highly productive site deteriorates immediately. The total annual herbage yield, expressed as air-dry weight, ranges from 2,100 to 3,700 pounds per acre if the site is in excellent condition.

SANDYLAND RANGE SITE

The Vona part of the Vona-Mobeetie complex, 2 to 8 percent slopes, is the only soil in this site. This soil occupies smooth and gently sloping areas to sloping and rolling areas. It is loamy sand in the surface layer.

This soil is highly susceptible to soil blowing. The intake of water is high, and there is only a small amount of runoff. Deterioration caused by overgrazing is rapid on this site, but the grasses respond well to good grazing management.

If properly managed, this soil produces a good stand of mid and tall grasses. About 75 percent of the plant community consists of climax decreasers—sand bluestem, switchgrass, indiangrass, little bluestem, Canada wildrye, sand lovegrass, side-oats grama, and Texas bluegrass. Approximately 25 percent of the plants are climax increasers—silver bluestem, sand dropseed, hairy grama, blue grama, and perennial three-awn. On some areas of this site, a few woody plants, such as skunkbush, sand plum, and sand sagebrush are part of the climax vegetation.

Any deterioration in this site results in a rapid increase of small soapweed (yucca) and annuals. Invading grasses include annual three-awn, fringed signalgrass, tumble windmillgrass, gummy lovegrass, red lovegrass, tumble lovegrass, and low-growing paspalum. The chief invading forbs are common ragweed, wax goldenweed, tumble ringwing, annual wild buckwheat, rosering gaillardia, prairie sunflower, woollywhite, beebalm, pricklepoppy, curlycup gumweed, Riddell groundsel, and stillingia.

Production drops rapidly once the climax vegetation is overgrazed. Recovery is rapid, however, if brush is controlled and grazing deferred, since there is generally a source of seed and live root buds present.

The total annual herbage yield, expressed as air-dry weight, ranges from 1,800 to 3,350 pounds per acre if the site is in excellent condition.

MIXEDLAND SLOPES RANGE SITE

This site is made up of Mobeetie fine sandy loam, 5 to 8 percent slopes, and of the Mobeetie part of the Vona-Mobeetie complex, 2 to 8 percent slopes. These soils occupy gently sloping to sloping areas and foot slopes below the High Plains escarpment. Their surface layer is fine sandy loam.

If these soils are not protected by a cover of plants, they are susceptible to soil blowing and water erosion. The abundance of side-oats grama and yucca in climax condition differentiates the Mixedland Slopes range site from other sites that have similar topography.

The site consists predominantly of mid grasses and lesser amounts of tall grasses. Short grasses occur only in small amounts. Small soapweed (yucca) increases when competitive vegetation is reduced by heavy grazing.

Climax decreasers are side-oats grama, little bluestem, sand bluestem, and Canada wildrye. Increasers are numerous and include blue grama, buffalograss, yucca, silver bluestem, black grama, hairy grama, and three-awn. Invading vegetation consists of pricklypear, western ragweed, sand sagebrush, sand muhly, and annuals.

The soils respond favorably to management. The total annual herbage yield (excluding the yield of woody species), expressed as air-dry weight, ranges from 1,900 to 2,950 pounds per acre if the site is in excellent condition.

DEEP HARDLAND RANGE SITE

The soils of this site are nearly level to sloping. They are deep clays, clay loams, and silty clay loams. In some places the intake of moisture is reduced by surface crusting and by compacted layers, or "hoof pans," caused by trampling. If these soils are not protected by plant cover, they are susceptible to soil blowing and water erosion.

The climax vegetation on this site consists of mid and short grasses. Blue grama makes up about 70 percent of the vegetation in climax condition. Other decreaser plants occurring in limited numbers are western wheatgrass, vine-mesquite, and side-oats grama. Increasers make up about 30 percent of the climax vegetation. Important increasers are buffalograss and silver bluestem.

Continuous overgrazing results in a decrease in side-oats grama, followed by a decrease in blue grama and an increase in buffalograss. Further deterioration of the range results in invasion by perennial three-awn, hairy tridens, sand dropseed, tumblegrass, pricklypear, and numerous annuals. In years in which there is a wet spring, invading annuals occupy bare spots. The most common of these are Texas filaree, evax, various plantains, bladderpod, plains greenthread, bitterweed actinea, common broomweed, little barley, and Japanese brome. The common invading perennial forbs are western ragweed, silverleaf nightshade, and Dakota verbena.

A large amount of litter and cover is needed to reduce surface crusting and to control erosion. Once the range is in poor condition, recovery is slow because of the lack of seed plants of desirable climax species and because of crusted soils. The total annual herbage yield, expressed as air-dry weight, ranges from 1,600 to 2,600 pounds per acre if the site is in excellent condition.

HARDLAND SLOPES RANGE SITE

The soils in this site are nearly level to sloping. They occupy nearly level areas on the broad constructional plain, sloping areas around the playa lakes, sloping areas leading to the natural drainageways, and foot slopes below the High Plains escarpment. These soils are deep loams and clay loams that are limy throughout the profile.

If these soils are not protected by a cover of plants, they are susceptible to soil blowing and water erosion. This site deteriorates slowly, and turf can be maintained even under heavy grazing. The grasses respond to good grazing management (fig. 15). In some areas this site occurs with Deep Hardland range sites and Very Shallow range sites.

The vegetation in climax condition is mid and short grasses on the deeper soils, but the mid grasses occur on soils that have a high-lime layer near the surface.

The vegetation consists of such decreasers as side-oats grama, vine-mesquite, and desirable forbs. The increasers in limited amounts are blue grama, buffalograss, silver bluestem, three-awn, and sand dropseed. Invader plants are western ragweed, sand muhly, pricklypear, and annuals.

The total annual herbage yield, expressed as air-dry weight, ranges from 1,900 to 2,750 pounds per acre if the site is in excellent condition.

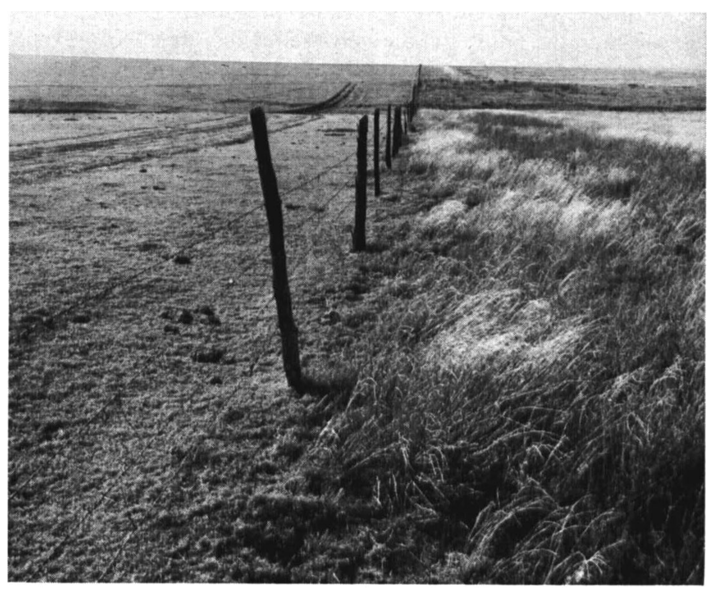

***Figure 15.*—Fence line contrast showing that occasional deferment of grazing results in increased vigor and more pounds of herbage produced. The soil is Mansker-Ulysses complex, 2 to 6 percent slopes, which is in Hardland Slopes and Deep Hardland range sites.**

VERY SHALLOW RANGE SITE

This site is made up of Potter soils and the Potter part of the Potter-Mansker complex, 0 to 8 percent slopes. These soils are nearly level to rolling or hilly. They are in transitional areas between the deep soils and breaks. Some knolls or narrow steep escarpments are included in this site.

If unprotected by vegetation, the sloping areas are susceptible to water erosion.

The vegetation is generally sparse. It has the appearance of a mid grass site where side-oats grama is the dominant grass. Other decreasers are blue grama and little bluestem. On the northern slopes and in places where moisture is more favorable, the vegetation is sand bluestem, indiangrass, vine-mesquite, plains bristlegrass, and other decreasers. Decreasers make up about 70 percent of the climax vegetation.

The numerous increasers include hairy grama, black grama, buffalograss, silver bluestem, sand dropseed, perennial three-awn, and slim or rough tridens.

Invaders include hairy tridens, sand muhly, tumblegrass, mesquite, pricklypear, yucca, annuals, and, in places, redberry juniper.

The total annual herbage yield, expressed as air-dry weight, ranges from 850 to 1,750 pounds per acre if the site is in excellent condition.

ROUGH BREAKS RANGE SITE

Rough broken land makes up this site. This land type occupies steep escarpments (fig. 16) and remnants of escarpment, ridges, and gullied areas. The areas are made in pockets on mesas, and on foot slopes. A thin mantle of soil material is also interspersed with areas of exposed parent material. This site is generally very steep, and the soil is highly susceptible to water erosion. Some areas are not accessible to livestock.

The vegetation is predominantly mid grasses, but there is a small amount of tall and short grasses. Decreasers in the climax vegetation are chiefly side-oats grama, little bluestem, and blue grama. Switchgrass, sand bluestem, indiangrass, and Canada wildrye grow in places where moisture conditions are more favorable. Increasers make up about 30 percent of the original vegetation. These plants consist of hairy grama, perennial three-awn, slim tridens, and sand dropseed. Increaser woody species on the slopes are redberry juniper, feather dalea, skunkbush, and cat claw acacia. Invader plants are hairy tridens, sand muhly, yucca, and numerous annuals.

If the site is in excellent condition, the plant cover is generally sparse. Under heavy use, these steep slopes lose their protective vegetation and erosion is accelerated. Intensive management and protection are needed to stabilize the slopes. The total potential yield of vegetation on this site is negligible when compared to surrounding sites. Consequently, overgrazing on this site results in deterioration of the entire pasture.

The total annual herbage yield, expressed as air-dry weight, ranges from 550 to 950 pounds per acre if the site is in excellent condition.

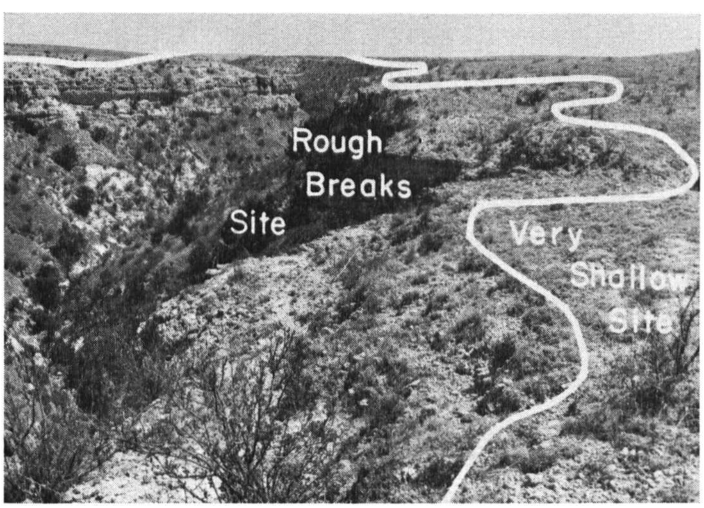

Figure 16.—An area of Rough Breaks range site, which includes steep escarpments, rock outcrops, and steep slopes. The mapping unit is Rough broken land.

Use of the Soils for Wildlife

Most of the soils in Ochiltree County are suited to and support one or more species of wildlife. Ochiltree County is nearly level to rolling, open prairie country, with a few small wooded streams that dissect the landscape. About 30 percent of the county remains in native grassland and 70 percent is cultivated.

The early settlers found an abundance of wildlife in Ochiltree County. Antelope, buffalo, prairie chicken, and quail were once numerous. Deer, turkey, and squirrels were plentiful along the wooded streams. The buffalo were exterminated by hunters about the time the county was settled. After the county was settled and livestock were introduced, overgrazing, fencing, and cultivation limited the numbers of antelope, deer, squirrel, turkey, and prairie chicken. Prairie dogs, once numerous, are now almost extinct. A large number of quail, dove, songbirds, small animals, and predators still inhabit the county. The playa lakes, streams, ponds, and grainfields attract many ducks and geese during migration. Habitats for fish are limited to artificial impoundments, such as Lake Fryer and some ponds on ranches.

In recent years, people have begun to realize the value and importance of wildlife. More and more people are looking to the land for recreation, and hunting and fishing are becoming more important each year. The county has a moderate potential for an economic return from the development of hunting, fishing, or recreation areas.

The soils of this county have been placed in three wildlife sites. Each site has distinctive topography, and the soils that make up the site are similar in productivity, in kinds and amounts of vegetation, and in principal species of wildlife that inhabit the site. The sites are generally coextensive with soil associations, which are described in the section "General Soil Map."

WILDLIFE SITE 1

This site is mainly coextensive with the Pullman-Randall and Ulysses-Richfield associations. The soils are deep, nearly level to gently sloping, and loamy and clayey. Most of the acreage is cultivated. The native vegetation consists mainly of such short grasses as buffalograss, blue grama, and western wheatgrass, and associated legumes and forbs. Water-tolerant grasses, sedges, and forbs grow in and around the playas. The principal kinds of wildlife on this site are antelope, badger, coyote, and rabbit. Among the species of birds are doves, ducks, geese, quail, and songbirds.

WILDLIFE SITE 2

This site is mainly coextensive with the Potter-Mansker-Berthoud and Bippus-Spur associations. The soils are very shallow to deep, nearly level to steep, and loamy. Much of the acreage is used for range. The native vegetation consists of buffalograss, blue grama, side-oats grama, little bluestem, sand bluestem, switchgrass, and indiangrass. A few scattered trees, such as elm, hackberry, cottonwood, and willow, grow on this site.

Antelope, deer, squirrel, bobcat, raccoon, rabbit, coyote, opossum, and badger inhabit this site. The main kinds of birds are turkey, dove, quail, prairie chicken, ducks, geese, and songbirds.

WILDLIFE SITE 3

This site is mainly coextensive with the Mobeetie-Vona association. The soils are deep, gently sloping to sloping, and loamy and sandy. Most of the acreage is in range. The native vegetation is mainly mid and tall grasses, such as switchgrass, indiangrass, sand bluestem, little bluestem, sand lovegrass, and side-oats grama. Sand sagebrush, skunkbush, and wild plum grow on this site. Deer, squirrel, raccoon, rabbit, bobcat, and coyote are the principal animals on this site. Among the species of birds are turkey, quail, dove, prairie chicken, ducks, geese, and songbirds.

Engineering Uses of the Soils [3]

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. In this section are discussed 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, waterholding capacity, grain-size distribution, plasticity, and reaction. Information concerning these and related soil properties are furnished in tables 3, 4, and 5. Table 3 gives estimated engineering properties, table 4 gives engineering interpretations, and table 5 gives engineering test data. 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 other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of topsoil for topdressing or road fill suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.
5. Determining the suitability of soils for the cross-country movement of vehicles and construction equipment.
6. Obtaining supplemental information from other published maps, reports, and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.
7. Developing other preliminary estimates for construction purposes pertinent to the particular area.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. The estimated values for bearing capacity and traffic-supporting capacity expressed in words should not be assigned specific values. Estimates are generally made for cuts to a depth of about 5 feet, and interpretations do not apply to greater depths. There are small areas of other soils and contrasting situations included in the mapping units that may have different engineering properties than those listed. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

Some terms used in this survey have a special meaning in soil science and a different meaning in engineering. Many of these terms, such as sand, silt, and clay, are defined in the Glossary.

Engineering classification of the soils

Soil scientists of the U.S. Department of Agriculture classify soils according to texture, color, and structure. This system is useful as the initial step in making engineering classifications of soils. The engineering properties of a soil must be determined or estimated after the initial classifications have been made. The two systems most commonly used in classifying samples of soil horizons for engineering use are the AASHO system adopted by the American Association of State Highway Officials, and the Unified system used by the Soil Conservation Service, Department of Defense, and others. These systems are explained briefly in the following paragraphs.

In the AASHO system (*1*), 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, and at the other extreme, in group A–7, are clay soils that have low strentgh when wet. The best soils for subgrade are classified as A–1, the next best A–2, and so on to class A–7, 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 divided 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 5; the estimated AASHO classification for all soils mapped in the survey area is given in table 3.

[3] By JOHN W. JACKSON, civil engineer, Soil Conservation Service.

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TABLE 3.—*Estimated*

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

Soil series and map symbols	Hydrologic group	Depth from surface	Classification		
			USDA texture	Unified	AASHO
		In.			
Berthoud: BeD	B	0–62	Loam	CL, ML–CL	A–6, A–4
Bippus: BrB, BrC	B	0–60	Clay loam	CL	A–6
Lincoln: Ln	A	0–14	Loamy fine sand	SM	A–2
		14–60	Fine sand	SM	A–2
*Mansker: MaA, MaB, MaC, MaD, MnC. For Ulysses part of MnC, see Ulysses series.	B	0–60	Clay loam	CL	A–6 or A–7
Mobeetie: MoD	B	0–60	Fine sandy loam	ML-CL, ML	A–4
*Potter: PmD, Po. For Mansker part of PmD, see Mansker series.	C	0–7	Gravelly loam	ML or CL	A–4 or A–6
		7–30	Slightly platy caliche.		
Pullman: PuA, PuB	D	0–5	Clay loam	CL	A–6
		5–30	Clay	CH	A–7
		30–72	Clay loam	CL or CH	A–7 or A–6
		72–120	Silty clay loam	CL	A–6
Randall: Ra	D	0–62	Clay	CH	A–7
Richfield: RcA, RcB, RcC	C	0–8	Clay loam	CL	A–6
		8–14	Silty clay loam	CL	A–6 or A–7
		14–72	Silty clay loam	CL or CH	A–6 or A–7
Roscoe: Re	D	0–60	Clay	CH	A–7
Rough broken land: Ro. Too variable for reliable evaluation.					
Spur: Sc, Sp	B	0–60	Clay loam	CL	A–6
*Ulysses: UcA, UcB, UcC, UrB. For Richfield part of UrB, see Richfield series.	C	0–72	Silty clay loam	CL	A–6 or A–7
*Vona: VmD. For Mobeetie part of VmD, see Mobeetie series	B	0–8	Loamy sand	SM	A–2
		8–22	Fine sandy loam	SM–SC	A–4
		22–60	Loamy sand	SM	A–2

engineering properties

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions column of this table. The symbol < means less than]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
				In./hr.	*In./in. of soil*	*pH*	
100	95–100	85–95	60–70	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
100	95–100	90–100	60–70	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	Low.
100	90–100	70–80	25–35	6. 3–20. 0	0. 06–0. 10	7. 9–8. 4	Low.
100	90–100	65–80	15–25	6. 3–20. 0	0. 03–0. 07	7. 9–8. 4	Low.
95–100	95–100	90–100	60–90	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
98–100	95–100	70–85	50–60	2. 0–6. 3	0. 10–0. 13	7. 9–8. 4	Low.
80–100	75–90	65–80	50–70	0. 63–2. 0	0. 12–0. 16	7. 9–8. 4	Low.
100	95–100	90–100	90–95	0. 2–0. 63	0. 16–0. 20	6. 6–7. 3	Moderate.
100	95–100	90–100	95–100	<0. 06	0. 15–0. 19	7. 4–8. 4	Moderate.
100	95–100	90–100	90–100	0. 06–0. 2	0. 15–0. 18	7. 9–8. 4	Moderate.
100	95–100	90–100	85–95	0. 06–0. 2	0. 15–0. 18	7. 9–8. 4	Moderate.
100	100	90–100	85–100	<0. 06	0. 14–0. 18	7. 4–8. 4	High.
100	95–100	90–100	80–95	0. 2–0. 63	0. 16–0. 18	6. 6–7. 3	Moderate.
100	95–100	90–100	80–95	0. 2–0. 63	0. 16–0. 18	6. 6–7. 3	Moderate.
95–100	90–100	85–100	85–100	0. 2–0. 63	0. 16–0. 18	7. 4–8. 4	Moderate.
100	100	90–100	85–100	<0. 06	0. 14–0. 18	7. 4–8. 4	High.
100	95–100	90–100	75–95	0. 63–2. 0	0. 14–0. 17	7. 9–8. 4	Moderate.
100	95–100	90–100	80–100	0. 63–2. 0	0. 14–0. 18	7. 4–8. 4	Moderate.
100	90–100	50–75	15–25	6. 3–20. 0	0. 06–0. 10	6. 6–7. 3	Low.
100	90–100	70–85	35–50	6. 3–20. 0	0. 08–0. 10	7. 4–7. 8	Low.
100	90–100	50–75	15–25	6. 3–20. 0	0. 06–0. 10	7. 9–8. 4	Low.

TABLE 4.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different

Soil series and map symbols	Suitability as a source of—		Degree and kind of limitation for—					
	Topsoil	Road subgrade	Highway location	Foundations for low buildings [1]	Septic tank filter fields	Sewage lagoons	Farm ponds	
							Reservoir areas	Embankments
Berthoud: BeD	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	None to slight where slope is 3 to 5 percent; moderate where slope is 5 to 8 percent.	Moderate where slope is 3 to 7 percent; moderate permeability; severe where slope is 7 to 8 percent.	Moderate: moderate permeability.	Moderate: medium compressibility.
Bippus: BrB, BrC	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight to moderate: moderate permeability.	Moderate: moderate permeability; slope is 1 to 5 percent.	Moderate: moderate permeability.	Moderate: medium compressibility.
Lincoln: Ln	Poor: loamy fine sand texture.	Good	Severe: floods more often than once in 5 years.	Severe: frequent flooding.	Severe: frequent flooding; inadequate filtration.	Severe: rapid permeability.	Severe: rapid permeability.	Severe: poor resistance to piping and erosion.
*Mansker: MaA, MaB, MaC, MaD, MnC. For Ulysses part of MnC, see Ulysses series.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Slight	Moderate where slope is 2 to 7 percent; moderate permeability; severe where slope is 7 to 8 percent.	Moderate: moderate permeability.	Moderate: medium compressibility.
Mobeetie: MoD	Good	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	None to slight where slope is 2 to 5 percent; moderate where slope is 5 to 8 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.	Moderate: poor resistance to piping and erosion.
*Potter: PmD, Po. For Mansker part of PmD, see Mansker series.	Poor: 12 percent fragments; 4 to 6 inches of loam material.	Poor: 4 to 12 inches of suitable material.	Severe: slightly platy caliche at a depth of 4 to 12 inches.	Severe: slightly platy caliche at a depth of 4 to 12 inches.	Severe: slightly platy caliche at a depth of 4 to 12 inches.	Severe: slightly platy caliche at a depth of 4 to 12 inches.	Severe: slightly platy caliche at a depth of 4 to 12 inches.	Severe: slightly platy caliche at a depth of 4 to 12 inches.
Pullman: PuA, PuB	Fair: clay loam texture.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Severe: poor traffic-supporting capacity.	Moderate: fair bearing capacity.	Severe. very slow permeability.	Slight	None to slight	Moderate: high compressibility.

See footnote at end of table.

interpretations

properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Degree and kind of limitation for—Continued				Soil features affecting—			Corrosivity class and contributing soil features	
Recreation								
Campsites	Picnic areas	Playgrounds	Paths and trails	Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
None to slight	None to slight	Moderate where slope is 3 to 6 percent; severe where slope is 6 to 8 percent.	None to slight	Slope	Slope	Highly erodible	Low	Low.
Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture; slope is 1 to 5 percent.	Moderate: clay loam texture.	Moderate intake rate.	Receives outside water.	All features favorable.	Moderate: clay loam texture.	Low.
Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	Severe: frequent flooding.	High water table; slight to strong salinity.	Severe: hazard of soil blowing; sand texture; frequent flooding.	Highly erodible	High: high conductivity.	Moderate: moderate amount of sodium salts.
Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate where slope is 2 to 6 percent; clay loam texture; severe where slope is more than 6 percent.	Moderate: clay loam texture.	Caliche at a depth of 7 to 16 inches.	Caliche at a depth of 7 to 16 inches.	All features favorable.	Moderate: clay loam texture.	Low.
None to slight	None to slight	Moderate where slope is 2 to 6 percent; severe where slope is 6 to 8 percent.	None to slight	Moderate intake rate.	Moderate: soil blowing and hazard of water erosion.	Highly erodible; steep slopes.	Low	Low.
Slight where slope is 1 to 8 percent; moderate where slope is 8 to 15 percent; severe where slope is 15 to 20 percent.	Slight where slope is 1 to 8 percent; moderate where slope is 8 to 15 percent; severe where slope is 15 percent or more.	Severe: slightly platy caliche at a depth of 4 to 12 inches; slope is 6 to 20 percent.	Slight where slope is 1 to 15 percent; moderate where slope is 15 to 20 percent.	Nonarable soil	Nonarable soil	Nonarable soil	Low	Low.
Severe: very slow permeability.	Moderate: clay loam texture.	Severe: very slow permeability.	Moderate: clay loam texture.	Very slow intake rate.	All features favorable.	All features favorable.	High: high conductivity.	Low.

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TABLE 4.—*Engineering*

Soil series and map symbols	Suitability as a source of—		Degree and kind of limitation for—				Farm ponds	
	Topsoil	Road subgrade	Highway location	Foundations for low buildings [1]	Septic tank filter fields	Sewage lagoons	Reservoir areas	Embankments
Randall: Ra	Poor: clay texture; wetness.	Poor: poor traffic-supporting capacity; high shrink-swell potential; wetness.	Severe: poor traffic-supporting capacity; high shrink-swell potential; wetness; flood hazard.	Severe: poor bearing capacity; high shrink-swell potential; wetness; flood hazard.	Severe: very slow permeability; flood hazard.	Slight	None to slight	Moderate: high compressibility; fair stability.
Richfield: RcA, RcB, RcC	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderately slow permeability	Slight where slope is 0 to 2 percent; moderate where slope is 2 to 5 percent.	Moderate: moderately slow permeability.	Moderate: medium compressibility.
Roscoe: Re	Poor: clay texture.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor bearing capacity; high shrink-swell potential.	Severe: very slow permeability.	Slight	None to slight	Moderate: high compressibility; fair stability.
Rough broken land: Ro. Too variable for reliable evaluation.								
Spur: Sc, Sp	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity; flood hazard.	Severe: occasional flooding.	Severe: occasional flooding.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: medium com- compressibility.
*Ulysses: UcA, UcB, UcC, UrB. For Richfield part of UrB, see Richfield series.	Fair: silty clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Moderate: fair bearing capacity.	Moderate: moderate permeability.	Moderate: moderate permeability; slope.	Moderate: moderate permeability.	Moderate: medium compressibility.
Vona: VmD. For Mobeetie part of VmD, see Mobeetie series.	Poor: loamy sand texture.	Good	None to slight	Moderate: fair bearing capacity.	None to slight where slope is 2 to 5 percent; moderate where slope is 5 to 8 percent.	Severe: rapid permeability.	Severe: rapid permeability.	Moderate: poor resistance to piping and erosion.

[1] Engineers and others should not apply specific values to the estimates given for bearing capacity of soils.

interpretations—Continued

Degree and kind of limitation for—Continued				Soil features affecting—			Corrosivity class and contributing soil features	
Recreation								
Campsites	Picnic areas	Playgrounds	Paths and trails	Irrigation	Terraces and diversions	Waterways	Uncoated steel	Concrete
Severe: clay texture and very slow permeability.	Severe: clay texture; wetness.	Severe: clay texture; very slow permeability.	Severe: clay texture.	Very slow intake rate; ponded.	Depressional topography.	Depressional topography.	High: clay texture; wetness; conductivity.	Low.
Moderate: clay loam texture; moderately slow permeability.	Moderate: clay loam texture.	Moderate: clay loam texture; slow permeability; slope is 2 to 5 percent.	Moderate: clay loam texture.	All features favorable.	All features favorable.	All features favorable.	Moderate: silty clay loam texture.	Low.
Severe: clay texture; very slow permeability.	Severe: clay texture.	Severe: clay texture; very slow permeability.	Severe: clay texture.	Very slow intake rate.	Depressional topography.	Depressional topography.	High: clay texture; wetness.	Low.
Severe: occasional flooding.	Moderate: occasional flooding; clay loam texture.	Moderate: occasional flooding.	Moderate: occasional flood hazard; clay loam texture.	Occasional flood hazard.	Occasional flood hazard.	Occasional flood hazard.	Moderate: clay loam texture.	Low.
Moderate: silty clay loam texture.	Moderate: silty clay loam texture.	Moderate: silty clay loam texture; slope.	Moderate: silty clay loam texture.	All features favorable.	All features favorable.	All features favorable.	Moderate: silty clay loam texture.	Low.
Moderate: loamy sand texture.	Moderate: loamy sand texture.	Moderate where slope is 2 to 6 percent; loamy sand texture; severe where slope is more than 6 percent.	Moderate: loamy sand texture.	Rapid intake rate.	Sandy texture.	Soil blowing; sandy texture.	Low.	Low.

TABLE 5.—*Engineering*

[Tests performed by the Texas State Highway Department in accordance with standard

Soilname and loca tion	Parent material	Texas report No.	Depth from surface	Shrinkage		
				Limit	Lineal	Ratio
			Inches	*Percent*	*Percent*	*Percent*
Mansker clay loam:						
0.55 mile S. and 0.4 mile E. of NW. cor. sec. 143, block 13, Texas and New Orleans Railroad Company Survey. (Modal profile)	Calcareous, fine-textured sediments.	64–210–R 64–211–R	7–16 16–48	15 13	11. 3 13. 4	1. 82 1. 90
0.125 mile N. and 0.525 mile E. of SW. cor. sec. 17, block 44, Texas Western Narrow Gage Railroad Company Survey. (More clayey than in modal profile)		64–212–R 64–213–R	6–16 16–40	14 12	11. 7 14. 9	1. 85 1. 93
0.6 mile S. and 0.4 mile E. of NW. cor. sec. 136, block 43, Houston and Texas Central Railroad Company Survey. (More silty than in modal profile)		64–214–R 64–215–R	8–17 17–42	16 13	10. 7 11. 3	1. 80 1. 91
Pullman clay loam:						
0.45 mile N. and 20 yards E. of SW. cor. sec. 7, block 12, Houston and Great Northern Railroad Company Survey. (Modal profile)	Calcareous, fine-textured, eolian sediments.	64–192–R 64–193–R	10–22 42–60	14 13	18. 2 14. 8	1. 91 1. 95
0. 725 mile S. and 0.15 mile W. of NE. cor. sec. 22, block 12, Houston and Great Northern Railroad Company Survey. (More clayey than in modal profile)		64–194–R 64–195–R	10–22 48–65	13 13	18. 0 17. 4	1. 91 1. 96
0.275 mile S. and 0.45 mile W. of NE. cor. sec. 1007, block 43, Houston and Texas Central Railroad Company Survey. (More silty than in modal profile)		64–196–R 64–197–R	10–22 50–68	12 14	18. 4 15. 0	1. 94 1. 89
Richfield clay loam:						
600 feet S. of county road running along the State line, from a point 1.5 miles W. of its intersection with U.S. Highway 83, which is about 7.0 miles N. of the intersection of U.S. Highway 83 and Texas Highway 15 in Perryton. (Modal profile)	Calcareous, fine-textured loess.	64–198–R 64–199–R	14–22 34–48	12 13	18. 0 16. 7	1. 94 1. 94
0.1 mile S. and 0.2 mile W. of NE. cor, sec. 129, block 13, Texas and New Orleans Railroad Company Survey. (More calcium carbonate than in modal profile)		64–200–R 64–201–R	14–26 36–50	13 14	15. 6 11. 8	1. 92 1. 89
0.55 mile W. and 35 yds. N. of SE. cor. sec. 33, block 4, Galveston, Houston, and Henderson Railroad Company Survey. (More silt in B2t horizon than in modal profile)		64–202–R 64–203–R	10–20 30–48	12 13	16. 3 12. 1	1. 93 1. 90
Ulysses silty clay loam:						
0.075 mile S. and 0.125 mile W. of NE. cor. sec. 9, block 11, Wahrenbeck & Bro. Co. Survey. (Modal profile)	Calcareous, fine-textured loess.	64–204–R 64–205–R	8–16 32–72	14 11	15. 4 13. 2	1. 88 1. 97
0.275 mile N. and 0.25 mile W. of SE. cor. sec. 1092, block 43, Houston and Texas Central Railroad Co. Survey. (More clayey than in modal profile)		64–208–R 64–209–R	8–16 48–60	14 13	15. 5 15. 9	1. 88 1. 91
0.2 mile S. and 0.2 mile W. of NE. cor. sec. 140, block 10, Southern Pacific Railroad Company Survey. (More sandy than in modal profile)		64–206–R 64–207–R	7–15 36–60	15 12	13. 0 14. 4	1. 86 1. 96

[1] Mechanical analyses according to AASHO Designation T 88–57 (*1*). Results by this procedure frequently differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service. 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

test data

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—					AASHO	Unified
⅜ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.	*Percent*			
100	99	98	95	82	74	30	25	39	23	A-6(13)	CL
---	100	99	98	89	76	37	30	41	26	A-7-6(15)	CL
---	100	99	96	83	71	37	30	39	23	A-6(13)	CL
---	---	100	98	89	80	41	35	44	29	A-7-6(16)	CL
100	99	98	95	88	79	36	30	38	20	A-6(12)	CL
100	99	96	93	89	79	40	33	35	21	A-6(12)	CL
---	---	---	100	99	95	52	44	57	38	A-7-6(19)	CH
---	---	100	99	97	87	42	36	44	29	A-7-6(16)	CL
---	---	---	100	95	95	50	42	56	37	A-7-6(19)	CH
---	---	---	100	95	90	47	40	52	35	A-7-6(18)	CH
---	---	---	100	99	94	49	44	55	38	A-7-6(19)	CH
---	100	99	99	97	90	43	38	48	31	A-7-6(18)	CL
---	---	---	100	98	94	49	42	54	37	A-7-6(19)	CH
---	---	---	100	94	87	52	43	50	33	A-7-6(18)	CL
---	---	---	100	94	86	46	42	48	32	A-7-6(18)	CL
[2] 98	95	93	88	86	81	44	34	38	23	A-6(13)	CL
---	---	---	100	94	88	43	37	48	32	A-7-6(18)	CL
100	99	99	98	89	83	52	40	38	23	A-6(13)	CL
---	---	100	99	98	86	46	38	49	31	A-7-6(18)	CL
---	---	100	98	91	71	43	36	38	26	A-6(14)	CL
---	---	100	98	94	89	45	35	49	33	A-7-6(18)	CL
---	---	100	99	94	81	40	36	49	33	A-7-6(18)	CL
---	---	100	99	90	83	43	34	42	24	A-7-6(14)	CL
---	---	---	100	94	81	48	40	42	28	A-7-6(16)	CL

the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for naming textural classes for soils.

[2]100 percent passes the ¾-inch sieve.

In the Unified system (*9*) soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are 8 classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; 6 classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and 1 class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL-CH.

Estimated engineering properties

Table 3 provides estimates of soil properties important in engineering. The estimates are based on field classification and descriptions, on physical and chemical tests of selected representative samples, on test data from comparable soils in Hansford County (*8*), and on experience in working with the individual kinds of soil in the county.

Permeability, as used in table 3, relates 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 use of the soils are not considered.

The 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. For example, a layer of Bippus clay loam, 1 inch thick, will hold 0.17 inch of available water when wet to field capacity.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH of a neutral soil is 7.0, of an acid soil is less than 7.0, and of alkaline soil is more than 7.0. For a description of the pH values used in table 3, see 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 cause much damage to building foundations, roads, and other structures. Roscoe clay has a high shrink-swell potential, so there are hazards in the maintenance of structures constructed in, on, or with this soil. By contrast, Potter gravelly loam, which is nonplastic and very shallow to caliche, has a low shrink-swell potential.

In the column headed "Hydrologic group," the soils are placed in one of four groups on the basis of intake of water at the end of long-duration storms that occur after prior wetting and opportunity for swelling and without the protective effects of vegetation. The groups range from open sands (lowest runoff potential—Group A) to heavy clays (highest runoff potential—Group D). Descriptions of these four groups are as follows:

Group A consists of soils that have a high infiltration rate even when thoroughly wetted. These are chiefly deep, well-drained to excessively drained sands, gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Group B consists of soils that have a moderate infiltration rate when thorough wetted. These are chiefly moderately deep to deep, moderately well drained to well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C consists of soils that have a slow infiltration rate when thoroughly wetted. These are chiefly (1) soils that have a layer that impedes the downward movement of water, or (2) soils that have a moderately fine texture to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission.

Group D consists of soils that have a very slow infiltration rate when thoroughly wetted. These are chiefly (1) clay soils that have a high swelling potential; (2) soils that have a high permanent water table; (3) soils that have a claypan or clay layer at or near the surface; and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

In Ochiltree County the depth to bedrock for most of the soils is well beyond depths to which soils were investigated in the field mapping. Hard caliche (it has a rating of less than 3 according to Mohs scale of hardness) underlies the Potter soils at depths of 4 to 12 inches. Limestone outcrops are common throughout the areas of Rough broken land.

The depth to the seasonal high water table is more than 20 feet in most soils of the county. Lincoln, Spur, and Randall soils are subject to occasional flooding, but only the Lincoln soils have a seasonal water table. The depth to the water table in the Lincoln soils ranges from 4 to 20 feet in most profiles. Spur soils are well drained, and the water table is generally more than 20 feet below the surface. Randall soils are practically impervious when wet, so that floodwaters remain on the surface until evaporated.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

The percentage passing sieve estimates are given for a range in percentage of soil material passing several different sieve sizes. In some soils a range is given also for both AASHO and Unified systems, because each soil has a defined range in soil properties. This information is useful in helping to determine suitability of the soil as a source of material for construction purposes.

Engineering interpretations

Table 4 contains selected 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. The ratings and other interpretations in this table are based on estimated engineering properties of the soils in table 3; on available test data, including those in table 5; and on field experience. Although the information applies only to soil depths indicated in table 3, it is reasonably reliable to a depth of about 6 feet for most soils, and several more for some.

Topsoil is fertile soil material that ordinarily is rich in organic matter. It is used to topdress areas where vegetation is to be established and maintained. Such areas are roadbanks, dams, disturbed areas, gardens, and lawns. Normally, only the surface layer is removed for topsoil, but other layers also may be suitable sources.

Road subgrade refers to soil material useful for building up road grades for supporting base layers. The suitability of a soil for road subgrade depends largely on its texture, plasticity, shrink-swell potential, traffic-supporting capacity, inherent erodibility, compaction characteristics, and natural water content. Many of the soils in the county are rated fair as a source of road subgrade.

Highway location is influenced by features of the undisturbed soil that affect construction and maintenance of highways. Those features that adversely affect highway location were selected on the basis of estimated soil classification. Soils that have a plastic clay layer have a high shrink-swell potential that affects the design and location of highways.

The factors considered for foundations for low buildings are those features and qualities of undisturbed soils that affect suitability for supporting foundations of buildings less than three stories high. The foundation of a building transmits the weight of the structure onto the natural undisturbed soils. It is the substratum of the soil that usually provides the base for foundations, and, therefore, that is the material that should be evaluated. The Unified classification system was used for evaluating the soils in terms of their bearing capacity, shrink-swell potential, and shear strength.

The septic tank filter field is a part of the septic tank soil absorption system for sewage disposal. It is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the natural soil. In an efficient septic tank disposal system, soil material is required that is permeable enough to permit moderate to rapid percolation of effluent. Soils are not suitable if they are subject to flooding.

A sewage lagoon is a shallow lake used to hold sewage for the time required for bacterial decomposition. The soils should (1) serve as a floor for the impounded area, and (2) serve as material for the dam. The effectiveness of a lagoon disposal system, therefore, depends largely on the permeability, depth, and slope of the soils to be used. Also important are the flooding hazard and the proximity to streams or other bodies of water.

The suitability of the soils for reservoir areas depends primarily on the seepage rate. The highly plastic soils have a low seepage rate; the coarse-textured soils do not have any binding or sealing characteristics, and they have a high seepage rate. The factors considered for farm pond embankments are those features and qualities of disturbed soils that affect their suitability for constructing embankments. Both the subsoil and substratum are evaluated when they are contrasting in character and have significant thickness for use as borrow material. The primary features that affect suitability are stability, compaction characteristics, susceptibility to piping, shrink-swell potential, permeability when compacted, compressibility, erodibility, and gypsum content.

Items considered in establishing ratings for campsite areas are wetness hazard, flooding hazard, permeability, slope, surface layer texture, percentage of coarse fragments, and stoniness or rockiness. These ratings apply to areas suitable for tent and camp trailer sites and the accompanying activities for outdoor living. The sites are used frequently during the camping season. These areas require little site preparation and should be suitable for unsurfaced parking for cars and camp trailers, for heavy foot traffic, for vehicular traffic, and for horseback riding. The soils should be free of coarse fragments and rock outcrops.

Items considered in establishing ratings for picnic areas are wetness hazard, flooding hazard, slope, texture of the surface layer, stoniness, and rockiness. These ratings are based on soil features only and do not include other features, such as presence of trees or lakes, which may affect the desirability of a site.

Items considered in establishing ratings for playgrounds are wetness hazard, flooding hazard, permeability, slope, texture of the surface layer, depth to hard bedrock, stoniness, and content of coarse fragments. These soil areas are to be developed for playgrounds and organized games, such as baseball, football, and badminton. They are subject to intensive foot traffic. Areas selected for this use generally have a nearly level surface, good drainage, and a soil texture and consistence that give a firm surface. The most desirable soil is free of rock outcrops and coarse fragments. It is assumed that good vegetative cover can be established and maintained where needed.

Items considered in establishing ratings for paths and trails are wetness hazard, flooding hazard, slope, texture of the surface layer, and surface stoniness or rockiness. These areas are used for trails, cross-country hiking, bridle paths, and nonintensive uses that allow for random movement of people. It is assumed that these areas are to be used as they occur in nature, and little soil needs to be moved or excavated for the planned recreational use. Ratings are based on soil features only and do not include other items that may be important in the selection of a site for this use. Soils rated as having severe limitations may be best from the natural beauty or use standpoint, but they require more preparation or maintenance for such use.

Suitability of the soils for irrigation depends largely on intake rate, water-holding capacity, depth, slope, and flooding hazard.

Soil features that affect the suitability of a soil for terraces and diversions are slope, depth to bedrock or other unfavorable material, and soil blowing.

Some of the soils of the county are not well suited to waterways, because they are highly erodible or are hard to stabilize. Windblown material that accumulates in waterways in areas of highly erodible soils makes maintenance difficult. If the windblown material covers the permanent vegetation in the waterways, the water-carrying capacity is reduced.

Structural materials, such as metal or concrete pipe, corrode when buried in soil, and a given material will corrode in some soils more rapidly than in others. Soil corrosivity differs with the general character of the soil. To be meaningful, corrosivity must be given in relation to a specific structural material.

Corrosion of uncoated steel pipe is a physical-biochemical process converting iron into its ions. Soil moisture is needed to form solutions with soluble salts in an environment having differential concentrations before the process can operate. This constitutes a corrosion cell. Any factors influencing the soil solution or the oxidation-reduction reactions taking place in the soil will influence the operation of the corrosion cell. Some of these factors are soil moisture content, conductivity of soil solution, hydrogen-ion activity of soil solutions (pH value), oxygen concentration (aeration), and activity of organisms capable of causing oxidation-reduction reactions. The corrosivity of soil for untreated steel pipe is commonly determined by (1) electrical resistivity or resistance to flow of current, (2) total acidity, (3) soil drainage, and (4) soil texture.

Concrete placed in soil material deteriorates to varying degrees. Special cements and methods of manufacturing may be used to reduce rate of deterioration in soils of high corrosivity. The rate of deterioration depends on (1) soil texture and soil acidity, (2) amount of sodium or magnesium sulfate present in the soil singly or in combination, and (3) amount of sodium chloride in the soil.

Engineering test data

Table 5 contains the results of engineering tests performed by the Texas State Highway Department on four soils of Ochiltree County. The table shows the specific location where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

As moisture is removed, the volume of a soil decreases in direct proportion to the loss of moisture, until equilibrium, called the shrinkage limit, is reached. Beyond the shrinkage limit, more moisture may be removed, but the volume of the soil does not change. In general, the lower the number indicated for the shrinkage limit, the higher the content of clay.

Lineal shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the stipulated percentage to the shrinkage limit.

The shrinkage ratio is the volume change, expressed as a percentage of the volume of soil material, divided by the amount of moisture lost through drying. This ratio is expressed numerically.

Mechanical analysis shows the percentages, by weight, of soil particles that would pass sieves of specified sizes. Sand and coarser materials do not pass the No. 200 sieve. Silt and clay 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. In tests conducted on these samples, the clay fraction was determined by the hydrometer method, rather than the pipette method most soil scientists use in determining the clay content of soil samples.

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 semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from a semisolid to a 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

This section explains how soils form and what factors are involved in their formation. It describes briefly the system of classification and shows how the soils of Ochiltree County have been classified.

Factors of Soil Formation

Soil is produced by the action of soil-forming factors on material deposited or accumulated by geologic agents. The characteristics of the soil at any given point are determined by five main factors: (1) The physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time these forces have acted on the material. All five of these factors influence the characteristics of every soil, but the significance of each varies from one place to another. In one area one factor may dominate the formation of a soil, and in another area a different factor may be more important.

The interrelationship among these five factors is complex, and the effects of any one factor cannot be isolated and completely evaluated. It is convenient to discuss each factor separately, however, and to indicate the probable effects of each. The five factors are discussed as they are related to the soils of Ochiltree County.

Parent material

Parent material is the unconsolidated mass from which soil is formed. It determines the limits of the chemical and mineralogical composition of the soil. In Ochiltree County nearly all of the parent material consists of unconsolidated calcareous material. The Pullman soils, Richfield soils, Ulysses soils, and Mansker soils developed in calcareous, silty or clayey material that mantles the nearly level Ogallala constructional plain. These materials are probably loess of Nebraskan or later age of the Pleistocene epoch (*3*). The Berthoud soils, Mobeetie soils, and Bippus soils developed in local alluvium of the Ogallala Formation. The Vona soils developed from eolian sandy earth of more recent origin. In general, the parent material of all the soils in Ochiltree County is high in minerals.

Climate

The climate is subhumid (warm and moist, but seasonally dry). The dominant influence of climate on soil development in the county has been the amount and distribution of precipitation. The low rainfall has retarded soil development, but it has been sufficient to allow the growth of a good grass cover. The limited rainfall seldom wets the soil below the area of living roots.

Wind has also affected soil development in this county from the time it deposited silt and sand over the preexisting land surface in the Pleistocene epoch to the present time, when it continues to shift sand, silt, and clay on exposed surfaces.

Plant and animal life

Plant and animal life in various forms influence the development of soils. In this county, plants, micro-organisms, earthworms, and other forms of living organisms have contributed to this development. Variations in the content of organic matter and nitrogen in the soil and in the supply of plant nutrients, and changes in structure and porosity are among the changes caused by plant and animal life.

Vegetation, dominantly short and mid grasses, has affected soil formation in Ochiltree County more than other living organisms. The climax vegetation was effective in contributing toward accumulation of organic matter and darkening of such soils as those of the Bippus and Spur series.

Relief

Relief affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. In this county the degree of profile development depends mainly on the average amount of moisture in the soil.

The soils that receive excess water, such as the Randall soils in the playa bottoms, developed in clay. They are poorly drained and have deep self-mulching characteristics, so that only slight horizonation is evident. Such steep soils as the Potter soils absorb less moisture and have less well developed profiles than the smooth, nearly level to gently sloping soils on the uplands, such as the Pullman and Richfield soils. The nearly level areas are resistant to geologic erosion, and soil development can proceed normally. On the steeper slopes geologic erosion is active and soil development is retarded.

Plant cover is thin on many of the steep slopes. This increases susceptibility to erosion and retards soil formation.

Soil temperature varies slightly with position of the slopes. Northern slopes are slightly cooler in summer than southern slopes.

Time

The length of time that soil-forming factors have acted upon parent material determines, to a large extent, the characteristics of the soil. This applies mainly to soils that are in favorable positions for development. Where soil-forming factors have been active for only a short time, the soils show little development. Examples are the Spur and Lincoln soils. Soils that have been subject to soil-forming processes for a long period of time show greater development and are deeper. Examples are Pullman and Richfield soils.

Time has less effect on soils that form on steeper slopes. Many of the shallow soils on steep slopes have been developing as long as the deep, well-developed soils in more nearly level areas, but other factors of soil formation have influenced their development. On these soils relief is the major factor, and geologic erosion has offset soil development. The Potter soils are an example.

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 (*2*) and later revised (*5*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. This system is under continual study, and readers who are interested in development of the system should refer to available literature (*4, 7*).

In table 6, each soil series in Ochiltree County is placed in its family, subgroup, and order of the current classification system. Placement of some soil series in the current system, particularly in families, may change as more precise information becomes available.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The categories of the current classification system 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

TABLE 6.—*Classification of soil series*

Soil series	Family	Subgroup	Order
Berthoud	Fine-loamy, mixed, mesic	Typic Ustochrepts	Inceptisols.
Bippus [1]	Fine-loamy, mixed, thermic	Cumulic Haplustolls	Mollisols.
Lincoln [1]	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Mansker [1]	Fine-loamy, mixed, thermic	Aridic Calciustolls	Mollisols.
Mobeetie [1]	Coarse-loamy, mixed, thermic	Typic Ustochrepts	Inceptisols.
Potter [1]	Loamy, carbonatic, thermic, shallow	Ustollic Calciorthids	Aridisols.
Pullman [1]	Fine, mixed, thermic	Pachic Paleustolls	Mollisols.
Randall [1]	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Richfield [2]	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Roscoe [1, 3]	Fine, montmorillonitic, thermic	Typic Pellusterts	Vertisols.
Spur [1]	Fine-loamy, mixed, thermic	Fluventic Haplustolls	Mollisols.
Ulysses	Fine-silty, mixed, mesic	Aridic Haplustolls	Mollisols.
Vona [4]	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.

[1] These soils, as mapped in Ochiltree County, are outside the range of the series in that they are restricted to warmer regions.

[2] These soils, as mapped in Ochiltree County, are outside the range of the series in that they are dark colored to a greater depth than is typical.

[3] These soils, as mapped in Ochiltree County, are outside the range of the series in that the Roscoe series is now restricted to soils that are browner colored in the lower layers.

[4] These soils, as mapped in Ochiltree County, are outside the range of the series in that the Vona series is restricted to drier regions.

that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Five of the ten orders are represented in Ochiltree County: Inceptisols, Mollisols, Entisols, Aridisols, and Vertisols.

Inceptisols are young soils in which genetic horizons have just started to form. This order is represented by soils of the Berthoud and Mobeetie series.

Mollisols have a thick, dark-colored surface layer. This order is represented by soils of the Bippus, Mansker, Pullman, Richfield, Spur, and Ulysses series.

Entisols are recent soils in which there has been no horizon development. This order is represented by soils of the Lincoln series.

Aridisols are primarily soils of dry places. This order is represented by soils of the Potter and Vona series.

Vertisols are high in content of clay, which causes the soils to swell and crack in some seasons. This order is represented by soils of the Randall and Roscoe series.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that indicate genetic similarity. Mainly, these are characteristics that reflect either the presence or absence of waterlogging or soil differences resulting from climate or vegetation. The suborders have a narrower climatic range than the order.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in kind and sequence of major horizons and similarity of the significant features of corresponding horizons. The horizons considered are those in which clay, iron, or humus has accumulated and those that have pans that interfere with the growth of roots or the movement of water. The features selected are the self-mulching properties of clays, soil temperature, chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in the table; 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. They consist of the central (typic) segment or intergrades that have properties of one great group and also one or more properties of another great group, suborder, or order.

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

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

General Nature of the County

This section was prepared mainly for those who want general information about Ochiltree County. It discusses history and settlement, climate, and natural resources.

History and Settlement

In 1876 the Texas Legislature established Ochiltree County from the Bexar Territory. The county was organized 13 years later, in 1889. The population of the county was 198 at that time.

Although the county was established in 1876, there were no actual settlements until the 1880's. Wawaka (present spelling, Waka) was settled by German immigrants about 1885, and Grogan was a post office on the stage route to Liberal, Kansas.

The economy of the county was first based on ranching. The Jones and Plummer Trail crossed the county in the 1880's, and by 1885 the Bar G Ranch had large holdings in the area and had headquarters at Wolf Creek. Wheat became a major crop in 1900, and the wheat-cattle combination is the major source of farm income today.

In 1919 the North Texas and Santa Fe Railroad was built through the county. As a result, the county seat was moved from the town of Ochiltree to Perryton, along the rail route.

The exploration for and production of oil and gas in the Anadarko Basin during the late 1950's has greatly increased economic activity in the county, and brought about a rapid increase in population. The population of Perryton increased from 4,417 in 1950 to 7,903 in 1960.

Climate [4]

Ochiltree County has a dry steppe climate with mild winters. The average precipitation is 21.13 inches annually.

Rainfall occurs most frequently in the form of thundershowers, and monthly and annual amounts are extremely variable. Thundershower activity reaches its peak late in spring and early in summer. Three-fourths of the average annual precipitation falls during the period May through October, and almost half of the average annual amount falls within the period May through July. The monthly rainfall drops off significantly in the colder months, November through March, as frequent "northers" cut off the supply of moisture from the Gulf of Mexico. Table 7 shows temperature and precipitation data. The variability of the rainfall pattern is emphasized by the fact that in one year out of every ten on an average, the total annual rainfall is likely to be more than 28 inches. During exceptionally wet years, much of the precipitation is received in the form of heavy thundershowers that produce excessive runoff.

The mean annual snowfall is 15.1 inches, but the seasonal values have ranged from no snow at all in 1950 to 32.8 inches in 1958. Occasional heavy snows, such as the one that left 14 inches on the ground February 4, 1964, distort the averages and decrease the usefulness of this particular statistic. An even snow cover is unusual, because strong winds frequently cause considerable blowing and drifting. Except where it is piled in drifts on northern slopes, snow usually remains on the ground only 2 or 3 days.

Prolonged droughts have occurred in the periods 1916 to 1917, 1933 to 1935, and 1952 to 1956. Other exceptionally dry years were 1910, 1924, 1940, and 1945. The year 1910 was the driest on record with only 10.27 inches. Periods of two to three weeks without rain are fairly common.

Ochiltree County is subject to sudden and pronounced temperature changes, especially in winter and early in spring, when cold fronts from the northern Rocky Moun-

[4] By ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

TABLE 7.—*Temperature and precipitation data*

[Precipitation data from Perryton (elevation 2,930 feet) based on records for the period 1935 through 1964. Temperature data from station at Spearman in adjacent Hansford County based on records for the period 1937 through 1966]

Month	Temperature		Precipitation								
					Mean number of days			Snow and sleet		One year in 10 will have	
	Average daily maximum	Average daily minimum	Mean	Greatest daily	Equal to or more than 0.1 inch	Equal to or more than 0.5 inch	Equal to or more than 1 inch	Mean	Monthly maximum	Equal to or less than—	Equal to or greater than—
	°*F.*	°*F.*	*In.*	*In.*				*In.*	*In.*	*In.*	*In.*
January	48	19	0.59	1.73	1	[1]	0	3.1	13.0	0	1.30
February	53	24	.66	1.24	1	[1]	0	3.8	19.0	.05	1.59
March	60	29	1.01	1.69	2	1	[1]	2.3	20.5	.02	1.72
April	71	40	1.39	2.31	3	1	[1]	.9	10.3	.26	3.00
May	79	51	3.69	3.80	6	3	1	0	0	1.20	5.89
June	89	60	3.09	2.59	5	2	1	0	0	.93	4.99
July	97	65	3.52	3.88	5	3	1	0	0	.29	5.99
August	93	64	2.20	3.46	4	1	1	0	0	.93	3.68
September	86	56	1.89	3.30	3	1	1	0	0	.05	3.60
October	75	44	1.62	2.60	3	1	[1]	.1	2.0	.13	3.78
November	60	30	.77	2.60	2	1	[1]	1.0	5.2	0	2.13
December	51	22	.70	2.26	2	1	0	3.9	18.0	0	1.45
Year	72	42	21.13	3.88	37	15	5	15.1	20.5	14.11	28.15

[1] Less than half a day.

tains and the Plains States sweep across the Oklahoma and Texas Panhandles at speeds up to 40 miles per hour. Temperature drops of 50° to 60° F. within a 12-hour period are not uncommon. January is the coldest month, with a mean minimum temperature of about 22°. Summer days are hot, but good wind motion and low humidity keep the temperature from being uncomfortable. The mean July maximum temperature is about 95°, and the mean July minimum is about 66°.

Winds are strongest during intense thunderstorms, but these are squalls of short duration. The strongest continuous winds occur during March and April. These are associated with strong low-pressure centers and sometimes cause blowing dust or duststorms.

The average length of the growing season (freeze-free period) is 191 days. The average date of the last freeze (32°) in spring is April 18; the average date of the first freeze (32°) in fall is October 26.

Sunshine is abundant the year around; it averages 70 to 75 percent of the daylight hours annually. Relative humidity averages 70 to 75 percent annually at 6:00 a.m. and 40 to 45 percent annually at 6:00 p.m. Evaporation from a class "A" pan averages 90 to 95 inches annually; the mean annual lake evaporation is 62 to 64 inches.

Natural Resources

The most important natural resource in Ochiltree County is soil, which is used to produce crops and provide grazing for livestock.

Water, particularly ground water, is also important. The largest amount of water is used for irrigation and occurs in the nearly level High Plains area. In the High Plains area the water is soft and of good quality. In the more sloping areas of the county, which are used principally for range, the water is of the same quality, but the quantity is smaller. There is sufficient water for livestock. Most of the water for livestock is pumped by windmills.

Ochiltree County is centrally located in a prolific oil- and gas-producing region known as the Panhandle-Hugoton Area. This region has the highest wildcat well success ratio (82 percent) in the county. Oil production in the county exceeded two million barrels in 1958. Many wells have been brought into production since that time, and the search for other wells continues. The average gas production from 1954 through 1958 was nearly 3½ billion cubic feet. The hydrocarbon liquid, which refers to the lighter crude oils produced simultaneously with the gas, was 86,827 barrels in the same 5-year period. The oil and gas industry has increased the income of many county residents by providing royalties as well as work.

A few deposits of caliche are excavated for road surfacing and other construction work.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus.

(2) BALDWIN, M., KELLOGG, C. E., and THORP, J.
1938. SOIL CLASSIFICATION. U.S. Dept. Agr. Ybk., 979–1001, illus.

(3) FRYE, JOHN C. and LEONARD, A. BYRON.
1957. ECOLOGICAL INTERPRETATIONS OF PLIOCENE AND PLEISTOCENE STRATIGRAPHY IN THE GREAT PLAINS REGION. Amer. Jour. Sci. 255: 1–11, illus.

(4) SIMONSON, ROY W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Science 137: 1027–1034.

(5) Thorp, James and Smith, Guy D.
1949. higher categories of soil classification: order, suborder, and great soil groups. Soil Sci. 67: 117–126.
(6) United States Department of Agriculture.
1951. soil survey manual. U.S. Dept. Agr. Handbook 18, 503 pp., illus.
(7) ———
1960. soil classification, a comprehensive system, 7th approximation. 265 pp., illus. [Supplements issued in March 1967 and September 1968]
(8) ———
1960. soil survey, hansford county, texas. Series 1957, No. 3, 41 pp., illus.
(9) United States Department of Defense.
1968. unified soil classification system for roads, airfields, embankments and foundations. MIL–STD–619B, 30 pp., illus.

Glossary

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

Available water capacity. The capacity of a soil to hold water in a form available to plants. Amount of moisture held in soil between field capacity (about one-third atmosphere of tension) and the wilting coefficient (about 15 atmospheres of tension).

Buried soil. A developed soil, once exposed, but now overlain by a more recently formed 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.

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

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

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

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

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

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

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

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

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

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

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gilgai. Typically, the microrelief of Vertisols—clayey soils that have a high coefficient of expansion and contraction with changes in moisture; usually a succession of microbasins and microknolls in nearly level areas, or of microvalleys and microridges that run with the slope.

Gravel. A soil separate, rounded or angular, 2.0 millimeters to 80 millimeters in diameter. The content of gravel is not used in determining the textural class of the soil, but if the soil is 20 percent or more gravel, the word "gravelly" is applied as a prefix to the textural soil name.

High Plains. Land resource area in northwest Texas that occupies a vast high plateau. It is a physiographic area of rather dark soils that have mostly clay loam texture and brown to reddish-brown clay in the subsoil.

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 residue.

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

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

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

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

Immature soil. A soil lacking clearly defined horizons because the soil-forming forces have acted on the parent material only a relatively short time since it was deposited or exposed.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Mature soil. Any soil with well-developed soil horizons having characteristics produced by the natural processes of soil formation and in near equilibrium with its present environment.

Microrelief. Minor surface configurations of the land.

Mohs scale of hardness. Relative hardness of minerals ranging from a rating of 1 for the softest (talc) to 10 for the hardest (diamond). Calcite has a hardness of 3 and can be scratched with a copper coin.

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.

Noncalcareous. A soil that may or may not be alkaline but that does not contain enough free lime to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Outwash. Soil material, washed from the High Plains and Rocky Mountains by melt water, that was carried by streams and deposited on the Permian red beds during the Pleistocene epoch.

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

Permeability. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Playas. Undrained basins that are generally dry but contain water for periods following rains.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

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

Recent. The current epoch of geologic time; a division of the Quaternary period.

Relief. The elevations or inequalities of a land surface, considered collectively.

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

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.

Self-mulching soil. A soil that cracks deeply and becomes so granular at the surface as it dries that the granular mulch works into the cracks when rains begin. As the soil becomes moist, it swells enough to force material upward between former cracks. The surface layer of a self-mulching soil may become so well aggregated that it does not crust and seal under the impact of rain.

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

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging 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 millimeters); *coarse sand* (1.0 to 0.5 millimeters); *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).

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

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).

Substratum. Technically, the part of the soil below the solum.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

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

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

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

Topography. The shape of the ground surface, including the position of its streams, lakes, hills, plains, and other features.

Underlying material. Parent material; the weathered rock or partly weathered soil material from which a soil has formed; the C horizon in the soil profile.

Upland (geology). Land consisting of material unworked by water in recent geologic time and, in general, land lying at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or range site, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, p. 7.
Predicted yields, table 2, p. 27.
Engineering uses of the soils, tables 3, 4, and 5, pp. 32 through 39.

Map symbol	Mapping unit	Page	Nonirrigated capability unit		Irrigated capability unit		Range site	
			Symbol	Page	Symbol	Page	Name	Page
BeD	Berthoud loam, 3 to 8 percent slopes	8	VIe-1	23	------	--	Hardland Slopes	29
BrB	Bippus clay loam, 1 to 3 percent slopes	8	IIIe-2	22	IIe-1	24	Deep Hardland	29
BrC	Bippus clay loam, 3 to 5 percent slopes	8	IVe-2	23	IVe-1	26	Deep Hardland	29
Ln	Lincoln soils	9	Vw-2	23	------	--	Sandy Bottomland	28
MaA	Mansker clay loam, 0 to 1 percent slopes	10	IVe-9	23	IIIe-10	26	Hardland Slopes	29
MaB	Mansker clay loam, 1 to 3 percent slopes	10	IVe-9	23	IIIe-10	26	Hardland Slopes	29
MaC	Mansker clay loam, 3 to 5 percent slopes	11	IVe-2	23	------	--	Hardland Slopes	29
MaD	Mansker clay loam, 5 to 8 percent slopes	11	VIe-1	23	------	--	Hardland Slopes	29
MnC	Mansker-Ulysses complex, 2 to 6 percent slopes	11						
	Mansker soil	--	IVe-9	23	IVe-1	26	Hardland Slopes	29
	Ulysses soil	--	IVe-9	23	IVe-1	26	Deep Hardland	29
MoD	Mobeetie fine sandy loam, 5 to 8 percent slopes	12	VIe-2	23	------	--	Mixedland Slopes	29
PmD	Potter-Mansker complex, 0 to 8 percent slopes	13						
	Potter soil	--	VIIs-1	23	------	--	Very Shallow	30
	Mansker soil	--	VIIs-1	23	------	--	Hardland Slopes	29
Po	Potter soils	14	VIIs-1	23	------	--	Very Shallow	30
PuA	Pullman clay loam, 0 to 1 percent slopes	14	IIIce-1	21	IIs-1	25	Deep Hardland	29
PuB	Pullman clay loam, 1 to 3 percent slopes	15	IIIe-1	22	IIIe-1	25	Deep Hardland	29
Ra	Randall clay	15	VIw-1	23	------	--	(1/)	--
RcA	Richfield clay loam, 0 to 1 percent slopes	16	IIIce-2	22	IIe-4	24	Deep Hardland	29
RcB	Richfield clay loam, 1 to 3 percent slopes	16	IIIe-2	22	IIe-2	24	Deep Hardland	29
RcC	Richfield clay loam, 3 to 5 percent slopes	16	IVe-1	22	IIIe-2	26	Deep Hardland	29
Re	Roscoe clay	17	IIIce-1	21	IIs-1	25	Deep Hardland	29
Ro	Rough broken land	17	VIIs-2	23	------	--	Rough Breaks	30
Sc	Spur clay loam	18	IIe-1	21	IIe-5	25	Loamy Bottomland	28
Sp	Spur soils, broken	18	Vw-1	23	------	--	Loamy Bottomland	28
UcA	Ulysses silty clay loam, 0 to 1 percent slopes	19	IIIce-3	22	IIe-3	24	Deep Hardland	29
UcB	Ulysses silty clay loam, 1 to 3 percent slopes	19	IIIe-3	22	IIIe-4	26	Deep Hardland	29
UcC	Ulysses silty clay loam, 3 to 5 percent slopes	19	IVe-2	23	IVe-1	26	Deep Hardland	29
UrB	Ulysses-Richfield clay loams, 0 to 3 percent slopes	19	IIIe-3	22	IIIe-4	26	Deep Hardland	29
VmD	Vona-Mobeetie complex, 2 to 8 percent slopes	20						
	Vona soil	--	VIe-5	23	------	--	Sandyland	28
	Mobeetie soil	--	VIe-5	23	------	--	Mixedland Slopes	29

1/ Randall clay dominantly occurs in small areas, which are included in the range sites of the surrounding soils.

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