

SOIL SURVEY OF  
**Sherman County, Texas**



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

Major fieldwork for this survey was done in the period 1965-68. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1969. 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 Sherman County Soil and Water Conservation District.

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

**T**HIS 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 Sherman 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 identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

### Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetical order by map symbol and gives the capability unit and range site classifications of each. It shows the page where each soil is described and the page where each range site is described.

Individual colored maps that show 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 for 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 soil descriptions and from the discussions of range sites.

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

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

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

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

*Newcomers in Sherman County* may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in information about the county given at the beginning of this survey and in the section "Climate."

Cover: Cattle grazing on native range. The soil is Humbarger clay loam.

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# SOIL SURVEY OF SHERMAN COUNTY, TEXAS

BY BILLY R. STRINGER

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

**S**HERMAN COUNTY is located at the northern edge of the Texas Panhandle (fig. 1). It covers an area

of 916 square miles, or 586,240 acres. According to the 1960 U.S. Census, Sherman County had a population of 2,605.

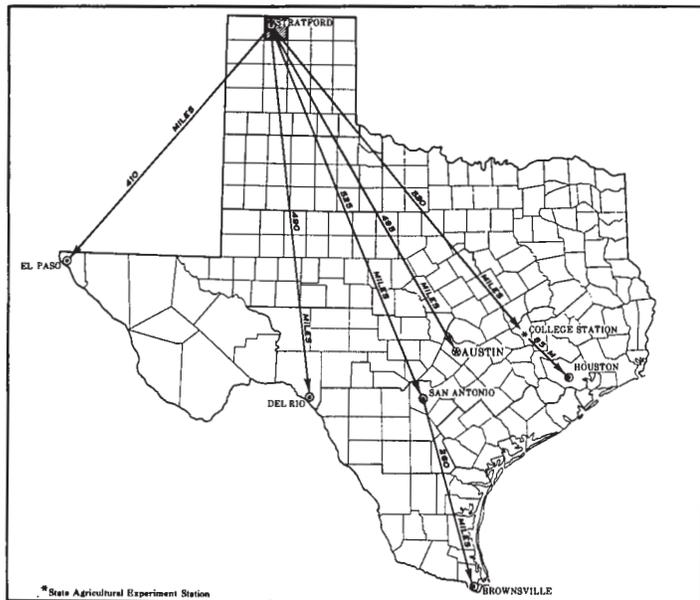


Figure 1.—Location of Sherman County in Texas.

of 916 square miles, or 586,240 acres. The county was organized in 1889. The average annual rainfall is about 16.5 inches, and the average annual temperature is about 56° F. Elevation ranges from about 3,300 to 3,800 feet above sea level.

Plains Indians were about the only inhabitants of what is now known as Sherman County until buffalo hunters arrived in the 1870's. Cattlemen soon followed to organize several cattle ranches. By 1910 much of the land had been settled and was being cultivated.

Sherman County is largely rural, and it produces wheat, sorghum, corn, and cattle. Corn production is increasing, and more than 250,000 acres is irrigated. Feedlot operations are large and are increasing. Gas and oil are produced in Sherman County.

Stratford, the county seat and largest town, is at the intersection of U.S. Highway No. 287 and U.S. Highway No. 54. It is the marketing center for Sherman County and is also a center for feedlot operations and businesses related to irrigation equipment and farm production.

## How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Sherman County, where they are located, and how they can be used. The soil scientists went into the county knowing that they would probably 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 compared these profiles with those in nearby and distant counties. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Dumas and Sunray, 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 the texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Sunray clay loam, 0 to 1 percent slopes, is one of several phases within the Sunray 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 soils of other kinds that have been seen within an area that is dominantly of a recognized soil phase.

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

A soil complex consists of areas of two or more soils, so intricately mixed 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. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen, but Pastura complex is an example of a complex made up of different phases of a single soil.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Cass and Humbarger soils, channeled, is an undifferentiated soil group in this county.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been 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 this county.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and of engineering tests. Laboratory data from the same kinds of soil in other places are also 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.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as building material, foundations, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil and relate this to the slow permeability of the soil or to a high water table. They see that streets, road pavements, and foundations for houses are cracked on

a named soil and relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of study and consultation. Thus, the groups that finally evolve reflect up-to-date knowledge of the soils and soil 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 Sherman 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 is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The soil associations in Sherman County are discussed in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 1, the word "loamy" refers to the texture of the surface layer.

### 1. Sherm-Gruver association

*Nearly level, loamy, noncalcareous soils on smooth upland plains*

This association consists of broad expanses of nearly level soils that extend across the county. There is no definite pattern of drainage except where the soils slope slightly into playas.

This association makes up about 47 percent of the county. Sherm soils make up about 62 percent of the association; Gruver soils about 26 percent; and Ness, Dumas, Spurlock, Dalhart, Sunray, and Conlen soils make up the remaining 12 percent (fig. 2).

Sherm soils are nearly level and are on large plains. They have a surface layer of brown clay loam about 5

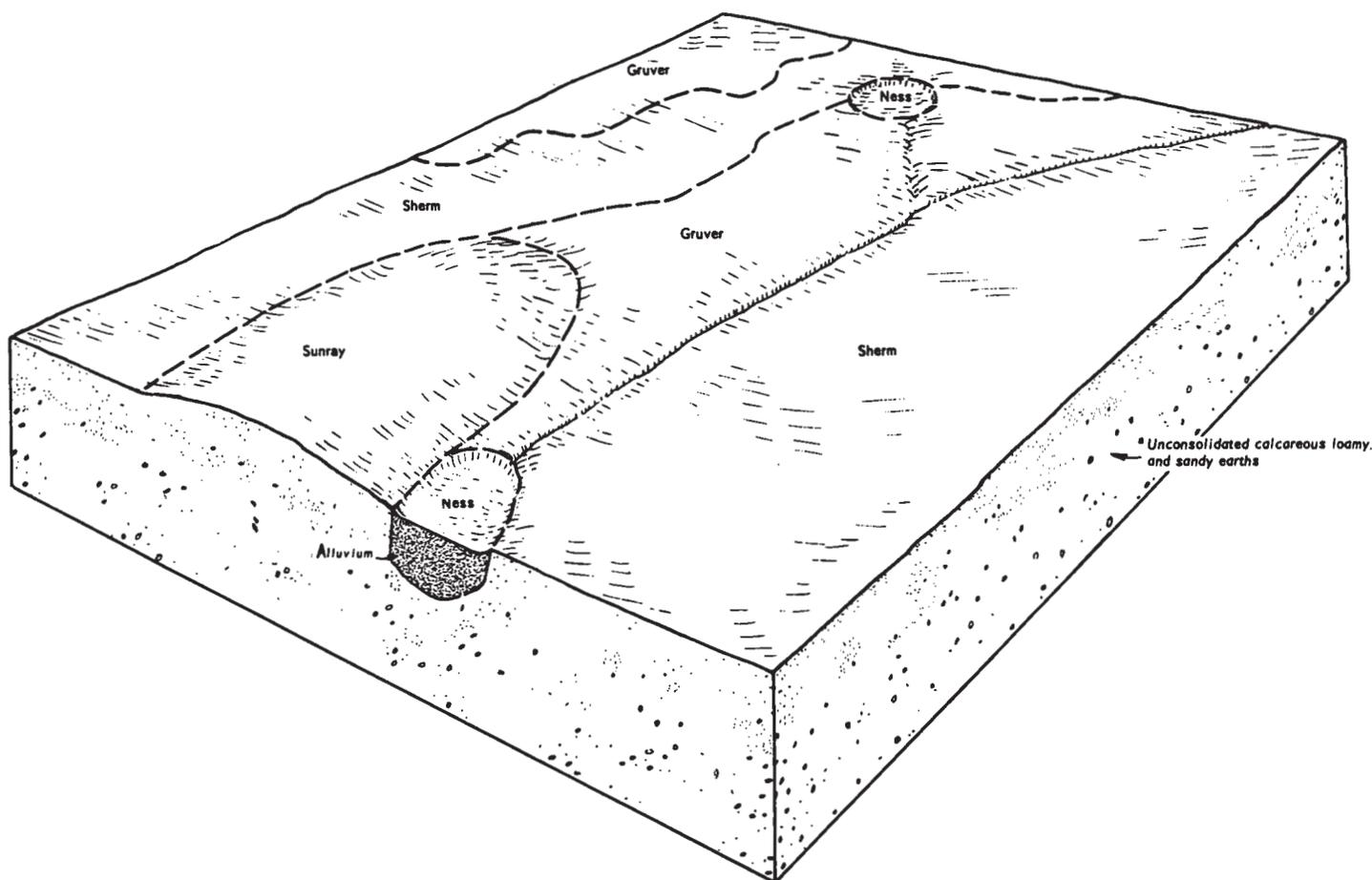


Figure 2.—Typical pattern of soils in the Sherm-Gruver association.

inches thick. The next layer is dark-brown clay about 6 inches thick, and below that is brown clay about 24 inches thick. Next is a layer of very pale brown and light-brown clay loam about 33 inches thick. It is underlain to a depth of 84 inches by reddish-yellow clay loam.

Gruver soils are in slightly higher areas than the Sherm soils. They have a surface layer of brown clay loam about 24 inches thick. The next layer is reddish-yellow clay loam about 28 inches thick. Below this is a layer of pink clay loam about 16 inches thick. It is underlain to a depth of 84 inches by reddish-yellow clay loam.

Most of this association is used for dryland and irrigated crops. These soils are well suited to surface irrigation because they are smooth and nearly level. Small areas are used for range.

## 2. Sunray-Conlen association

*Nearly level to gently sloping, loamy, calcareous soils on smooth upland plains*

This association consists of deep soils on uplands. There is no definite pattern of drainage except where the soils slope slightly into playas or heads of drains.

This association makes up about 27 percent of the county. Sunray soils make up about 75 percent of the association; Conlen soils 12 percent; and Dumas, Sherm, Gruver, Spurlock, Dalhart, and Ness soils make up the remaining 13 percent (fig. 3).

Sunray soils are nearly level to gently sloping and are on broad plains. They have a surface layer of dark grayish-brown clay loam about 10 inches thick. The next layer is light-brown clay loam about 12 inches thick. Below this is a layer of pink clay loam about 23 inches thick. The next layer is reddish-yellow clay loam about 25 inches thick. It is underlain to a depth of 84 inches by yellowish-red clay loam.

Conlen soils are nearly level and are in slightly higher areas than the Sunray soils. They have a surface layer of brown loam about 10 inches thick. The next layer is brown clay loam about 7 inches thick. Below this is a layer of white clay loam, about 25 inches thick, that is underlain by a layer of pink clay loam about 25 inches thick. Below the pink clay is reddish-yellow clay loam that reaches to a depth of 84 inches.

Most of this association is cultivated. The dryland acreage is about equal to the irrigated acreage. A few small areas are used for range.

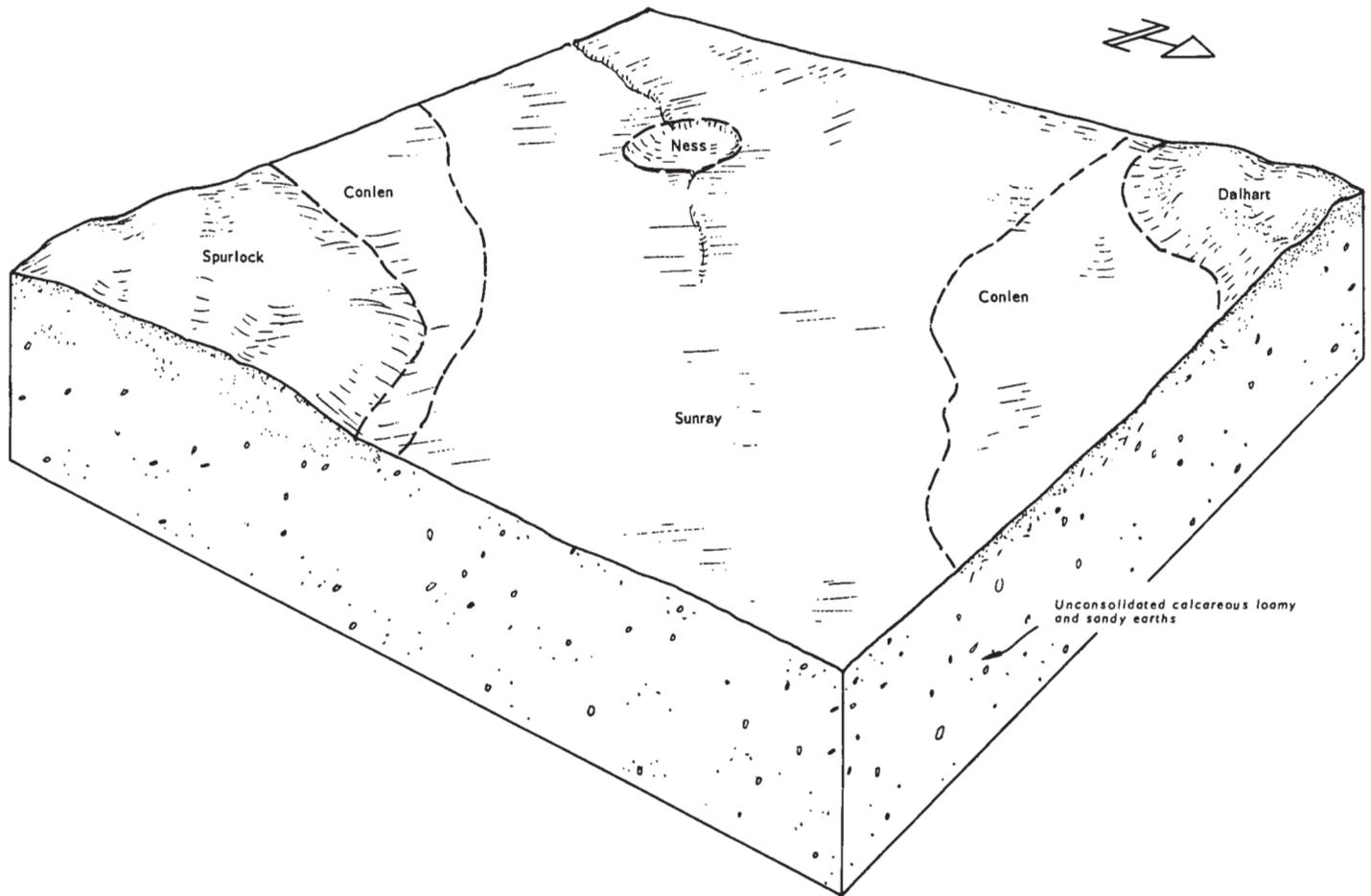


Figure 3.—Typical pattern of soils in the Sunray-Conlen association.

### 3. Spurlock-Dalhart association

*Nearly level to gently sloping, loamy, calcareous and noncalcareous soils on upland plains*

This association consists of deep, well-drained soils. Some of these soils are calcareous and shallow to caliche, and others are noncalcareous.

This association makes up about 14 percent of the county. Spurlock soils make up about 45 percent of the association; Dalhart soils 42 percent; and Dumas, Sherm, Gruver, Sunray, Conlen, Karde, and Ness soils make up the remaining 13 percent.

Spurlock soils are gently sloping and are in areas below the Dalhart soils. They have a surface layer of brown loam about 7 inches thick. The next layer is pale-brown clay loam about 9 inches thick. Below this is white clay loam about 16 inches thick. The next layer is pink clay loam about 28 inches thick. It is underlain to a depth of 84 inches by light-brown clay loam.

Dalhart soils are nearly level to gently sloping and are in areas above the Spurlock soils. They have a surface layer of brown fine sandy loam about 9 inches thick. The next layer is brown sandy clay loam about 27 inches thick. Below this is light-brown sandy clay

loam about 16 inches thick. The next layer is light reddish-brown sandy clay loam about 16 inches thick. It is underlain to a depth of about 84 inches by pink sandy clay loam.

This association is used for crops and range. The dryland acreage is about equal to the irrigated acreage.

### 4. Mobeetie-Pastura-Berthoud association

*Gently sloping to steep, loamy, calcareous soils on side slopes and foot slopes*

This association consists of deep fine sandy loams, loams, and loams that are very shallow to caliche. These soils occupy the erosional valleys and drainage-ways of the county.

This association makes up about 12 percent of the county. Mobeetie soils make up about 29 percent of the association; Pastura soils 29 percent; Berthoud soils 19 percent; and Cass, Humbarger, Spurlock, Likes, Manzano, and Tivoli soils and areas of Rough broken land make up the remaining 23 percent.

Mobeetie soils are below Pastura soils and above the valley floors and flood plains. They have a surface layer of grayish-brown fine sandy loam about 8 inches thick. The next layer is light brownish-gray fine sandy loam about 18 inches thick. It is underlain to a depth

of 80 inches by pale-brown and light yellowish-brown fine sandy loam.

Pastura soils are on side slopes of valleys and in areas that border escarpments. They have a surface layer of a grayish-brown loam about 6 inches thick. It is underlain to a depth of 34 inches by pinkish-white gravelly loam.

Berthoud soils are below areas of Pastura soils. They have a surface layer of brown loam about 9 inches thick. The next layer is pale-brown loam about 12 inches thick. Below this is a layer of light yellowish-brown loam about 14 inches thick. It is underlain to a depth of 80 inches by very pale brown loam.

Most of this association is used for range. Vegetation is sparse on the Pastura soils but grows well on the others.

### Descriptions of the Soils

This section describes the soil series and mapping units in Sherman County. The approximate acreage and proportionate extent of each mapping unit are given in table 1. Each soil series is described in detail and then, briefly, each mapping unit in that series. Unless otherwise indicated, it is to be assumed that statements about the soil series hold true for the mapping units in that series. Thus, to get full information about a mapping unit, it is necessary to read the description of the mapping unit and the description of the soil series to which it belongs. The description of each mapping unit contains suggestions on how the soil can be managed under programs of dryland farming and irrigation.

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

Soil	Area		Extent
	Acres	Percent	
Berthoud loam, 3 to 5 percent slopes .....	7,752	1.3	
Berthoud loam, 5 to 12 percent slopes .....	6,403	1.1	
Cass and Humbarger soils, channeled .....	4,736	.8	
Conlen loam, 0 to 1 percent slopes .....	19,876	3.4	
Dalhart fine sandy loam, 0 to 1 percent slopes ..	22,369	3.8	
Dalhart fine sandy loam, 1 to 3 percent slopes ..	13,579	2.2	
Dumas loam, 0 to 1 percent slopes .....	27,475	4.7	
Gruver clay loam, 0 to 1 percent slopes .....	75,863	13.0	
Karde soils, 3 to 8 percent slopes .....	1,807	.3	
Likes loamy fine sand .....	5,287	.8	
Manzano clay loam .....	2,942	.5	
Mobeetie fine sandy loam, 3 to 5 percent slopes ..	8,421	1.4	
Mobeetie fine sandy loam, 5 to 12 percent slopes ..	12,843	2.2	
Ness clay .....	4,414	.7	
Pastura complex .....	21,252	3.6	
Rough broken land .....	1,957	.3	
Sherm clay loam, 0 to 1 percent slopes .....	182,565	31.0	
Spurlock loam, 1 to 3 percent slopes .....	37,322	6.6	
Spurlock loam, 3 to 5 percent slopes .....	3,021	.5	
Sunray clay loam, 0 to 1 percent slopes .....	104,023	18.0	
Sunray clay loam, 1 to 3 percent slopes .....	21,302	3.6	
Tivoli fine sand, hummocky .....	1,031	.2	
Total .....	586,240	100.0	

An important part of the description of each soil series is the soil profile; that is, the sequence of layers from the surface down to the rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in the description of the mapping unit, or are differences that are apparent in the name of the mapping unit. Color terms are for dry soil unless otherwise stated.

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

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

Many of the terms used in describing soils can be found in the Glossary. More detailed information about the terminology and methods of soil mapping can be obtained from the *Soil Survey Manual* (6).<sup>1</sup>

### Berthoud Series

The Berthoud series consists of deep, friable, calcareous, loamy soils that are gently sloping to strongly sloping. These soils are on foot slopes and alluvial fans in valleys.

In a representative profile the surface layer is brown, calcareous loam about 9 inches thick. The next layer is pale-brown, friable loam about 12 inches thick. Below this layer is light yellowish-brown loam about 14 inches thick. The underlying material, to a depth of about 80 inches, is very pale brown loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is medium to rapid.

These soils are used mainly for range, but a few areas are farmed.

Representative profile of Berthoud loam, 5 to 12 percent slopes, in a pasture, 0.45 mile south and 60 feet west of the northeast corner of sec. 80, block 1C, GH&H Railroad Survey, about 1 mile east and 5.5 miles south of Texhoma on Farm Road 1290:

A1—0 to 9 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate, coarse, prismatic structure parting to fine and very fine, granular; hard, friable; common worm casts; few pores; few fine and very fine caliche pebbles; calcareous; moderately alkaline; gradual, smooth boundary.

<sup>1</sup> Italic numbers in parentheses refer to Literature Cited, p. 39.

B2—9 to 21 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; moderate, coarse, prismatic structure parting to weak, fine and very fine, subangular blocky; hard, friable; few very fine pores; common worm casts; few threads and films of calcium carbonate; few very fine to medium caliche pebbles; calcareous; moderately alkaline; gradual, smooth boundary.

B3ca—21 to 35 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; few fine and very fine pores; few worm casts; few threads and films, very fine soft masses, and fine and very fine concretions of visible calcium carbonate (10 percent of horizon, by volume); calcareous; moderately alkaline; diffuse, smooth boundary.

C—35 to 80 inches, very pale brown (10YR 7/4) loam, yellowish brown (10YR 5/4) moist; massive (structureless); hard, friable; few fine and very fine pores; few, fine and very fine, soft masses and concretions of visible calcium carbonate (3 percent of horizon, by volume); calcareous; moderately alkaline.

The solum ranges from 32 inches to 50 inches in thickness. The A horizon ranges from grayish brown to pale brown in color and from 6 to 10 inches in thickness. The B2 horizon is grayish brown to pale brown and 12 to 23 inches thick. It is loam to clay loam and has a clay content of about 20 to 30 percent. The B3ca horizon ranges from very pale brown and light yellowish brown to light brown. Calcium carbonate content is 5 to 10 percent, by volume. The C horizon ranges from very pale brown to light brown and is 1 to 4 percent calcium carbonate.

**Berthoud loam, 3 to 5 percent slopes (BeC).**—This soil is in valleys. Slopes are dominantly about 4 percent. Areas are much longer than they are wide, and they range from about 20 acres to 650 acres in size.

The surface layer is grayish-brown loam about 10 inches thick. The next layer is pale-brown loam about 12 inches thick. Below this layer is light yellowish-brown loam about 14 inches thick. The underlying material, to a depth of 80 inches, is very pale brown loam.

Included with this soil in mapping are small areas of Mobeetie and Spurlock soils and some areas of soils that have slopes of more than 5 percent. A few rills and gullies as much as 3 feet deep are in some areas.

The hazard of erosion is moderate. This soil is used mainly for range.

Good management practices are leaving crop residue on the surface, limited tillage, contour farming, and terracing. Diversion terraces and grassed waterways are needed in some areas. Terraces are needed for growing cultivated crops if crop residue is not managed on the surface throughout the year. A sprinkler system of irrigation is well suited to this soil. In places irrigated crops need fertilizer. If this soil is used for pasture, it needs proper management that includes fertilization, frequent irrigation, and rotation grazing. Capability units IVE-6, dryland, and IVE-3, irrigated; Hardland Slopes range site.

**Berthoud loam, 5 to 12 percent slopes (BeD).**—This soil is in valleys. Slopes are dominantly about 7 percent. Areas are much longer than they are wide, and they range from about 25 acres to 675 acres in size. The profile of this soil is the one described as representative for the Berthoud series.

Included with this soil in mapping are areas of Mobeetie and Spurlock soils and some areas of soils that have slopes of less than 5 percent. Areas of Pastura soils on caps and small knolls also are included. Also, a few rills or gullies are as much as 4 feet deep.

This soil is used for range. It is not suitable for crops. Capability unit VIe-1, dryland; Hardland Slopes range site.

### Cass Series

The Cass series consists of deep, very friable, calcareous, loamy soils that are nearly level. These soils are on broad flood plains.

In a representative profile the surface layer is dark grayish-brown, calcareous fine sandy loam about 14 inches thick. The next layer is brown, very friable, stratified, calcareous fine sandy loam about 8 inches thick. Below this is pale-brown fine sandy loam about 20 inches thick. The underlying material, to a depth of about 60 inches, is pale-brown, calcareous loamy fine sand.

Permeability is moderately rapid. Available water capacity is moderate. These soils are well drained, and runoff is slow.

These soils are used mainly for range, but a few areas are farmed.

The Cass soils in Sherman County are mapped only in an undifferentiated group with the Humbarger soils.

Representative profile of a Cass fine sandy loam in an area of Cass and Humbarger soils, channeled, 0.5 mile west and 0.4 mile south of the northeast corner of sec. 1, block 1C, GH&H Railroad Survey, about 23 miles east and 3 miles south of Stratford:

A1—0 to 14 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very fine, subangular blocky structure; slightly hard, very friable; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.

B21—14 to 22 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; moderate, medium to coarse, prismatic structure; slightly hard, very friable; common roots; few worm casts; thin strata of loamy sand, silt, and clay loam; calcareous; moderately alkaline; clear, smooth boundary.

B22—22 to 32 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive (structureless); hard, friable; common pores; few films and threads of calcium carbonate; thin strata of loamy and silty materials; calcareous; moderately alkaline; clear, smooth boundary.

C1—32 to 42 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive (structureless); slightly hard, very friable; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C2—42 to 60 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; massive (structureless); soft, very friable; calcareous; moderately alkaline.

The solum ranges from 30 to 44 inches in thickness. The A horizon ranges from dark grayish brown to grayish brown in color and from 10 to 16 inches in thickness. The B2 horizon is pale brown to brown and 15 to 28 inches thick. The C1 horizon is very pale brown to brown and 8 to 14 inches thick. The C2 horizon ranges from very pale brown to light brown in color.

The soils named for this series in Sherman County are outside of the range defined for the series, because they are calcareous throughout and their solum is thicker. These differences do not affect their use and management.

**Cass and Humbarger soils, channeled (Ch).**—This mapping unit consists of nearly level soils on flood plains and in channels. About 51 percent of it is a Cass fine sandy loam, and about 43 percent is a Humbarger clay loam. The remaining 6 percent is Mobeetie and Berthoud soils. Some areas are all Cass soils, and some are all Humbarger soils. Cass soils generally occupy the higher elevations, and Humbarger soils the lower. Some areas have several secondary flood channels. There are a few small, steep-sided, lateral gullies where runoff from higher lying soils flows into a main channel.

The Cass and Humbarger soils have the profiles described as representative for their respective series. Bedding planes and stratification are evident in both soils, and there is evidence of continual sedimentation from floodwater (fig. 4).

Floodwater covers these soils following heavy rains, but little damage is done because the soils are flooded for only short periods. Meandering stream channels erode some areas. The hazard of soil blowing is slight.

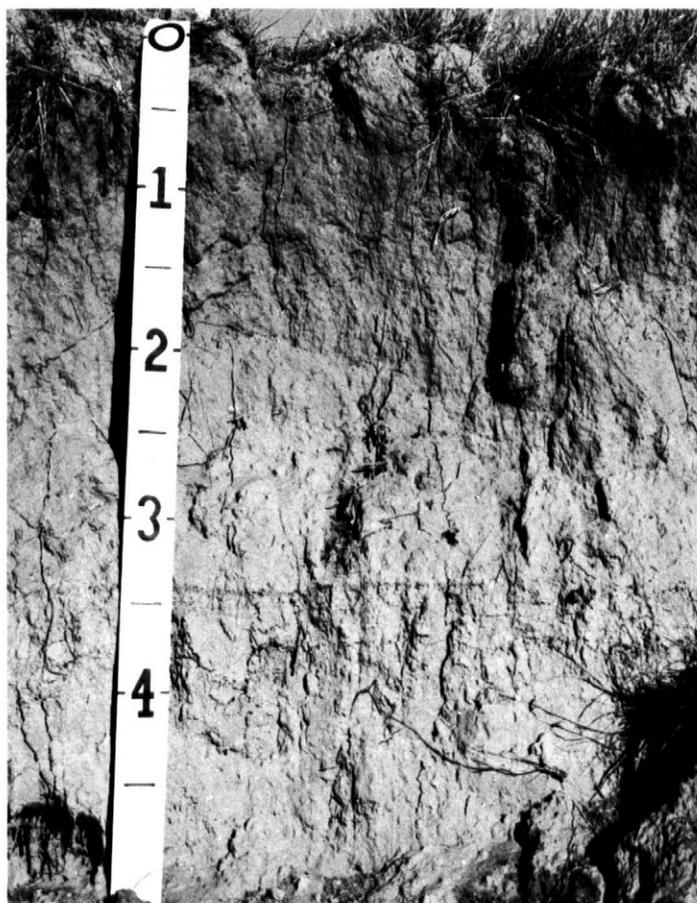


Figure 4.—Profile of a Cass fine sandy loam showing stratification.

These soils are mainly used for range, but a small acreage is farmed. Forage sorghum and wheat are the main crops. Moisture is a limitation to dryland farming, and flooding is a hazard if these soils are cultivated. These soils respond to crop rotation, a protective covering of crop residue, and timely but limited tillage. Capability unit Iie-1, dryland; Loamy Bottomland range site.

### Conlen Series

The Conlen series consists of deep, friable, calcareous, loamy soils that are nearly level. These soils are on uplands.

In a representative profile the surface layer is brown, calcareous loam about 10 inches thick. The next layer is brown, calcareous clay loam about 7 inches thick. Below this is white, calcareous clay loam 21 inches thick. The next layer is pink, calcareous clay loam about 25 inches thick. It is underlain to a depth of 84 inches by reddish-yellow clay loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and surface runoff is medium to rapid.

These soils are used for crops and range.

Representative profile of Conlen loam, 0 to 1 percent slopes, 0.4 mile south and 100 feet west of the northeast corner of sec. 54, block 1C, GH&H Railroad Survey, about 18 miles east of Stratford on Texas Highway 15, and 4.4 miles south:

- A1—0 to 10 inches, dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate, fine, subangular blocky structure; hard, friable; many fine pores; many worm casts; few fine films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.
- B21ca—10 to 17 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, fine, subangular blocky structure; hard, friable; many fine pores; many worm casts; common fine films and threads and fine concretions of visible calcium carbonate (6 percent of horizon, by volume); calcareous; moderately alkaline; clear, smooth boundary.
- B22ca—17 to 38 inches, white (10YR 8/2) clay loam, light brownish gray (10YR 6/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; few fine pores; many films and threads, soft masses and concretions of visible calcium carbonate (55 percent of horizon, by volume); calcareous; moderately alkaline; diffuse, wavy boundary.
- B23tca—38 to 63 inches, pink (7.5YR 7/4) clay loam, strong brown (7.5YR 5/6) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; few fine pores; few clay films; common films and threads and concretions of visible calcium carbonate (7 percent of horizon, by volume); calcareous; moderately alkaline; clear, smooth boundary.
- B24t—63 to 84 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; few clay films; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The solum is more than 80 inches thick. The A horizon ranges from dark grayish brown to brown. Depth to the B2ca horizon is 10 to 20 inches. The B21ca horizon is light brown to brown in color and 6 to 9 inches thick. The visible content of carbonates is 5 to 10 percent, by volume.

The B22ca horizon is white to pinkish gray in color and 16 to 25 inches thick. It is 25 to 60 percent calcium carbonate. The content of calcium carbonate in the B23tea horizon ranges from 8 to 15 percent. The B24t horizon is reddish yellow to yellowish red.

**Conlen loam, 0 to 1 percent slopes (CoA).**—This soil is nearly level to slightly convex. Areas are mostly elongated. Some are on rounded knolls. The areas are typically about 100 acres in size but range from 10 acres to more than 400 acres.

Included with this soil in mapping are small areas of Dalhart, Dumas, Sunray, and Spurlock soils.

The hazard of soil blowing is moderate. This soil is used for crops and range. Dryland and irrigated crops are wheat, forage sorghum, and grain sorghum.

If this soil is dryfarmed, a lack of moisture and high calcium carbonate content limit crop growth. Intensive use of small grain and sorghum in the cropping system and leaving crop residue on the surface help to control soil blowing and to maintain soil structure. Diversion terraces and grassed waterways are needed in some areas. If this soil is irrigated, fertilizer is needed. To help control erosion, the inherent soil limitations need to be considered when irrigation systems are designed and installed. Capability units IIVe-2, dryland, and IIIe-6, irrigated; Hardland Slopes range site.

### Dalhart Series

The Dalhart series consists of deep, very friable, noncalcareous, loamy soils that are nearly level to gently sloping. These soils are on uplands.

In a representative profile the surface layer is brown, neutral fine sandy loam about 9 inches thick. The next layer is brown sandy clay loam about 27 inches thick. Below this is light-brown sandy clay loam about 16 inches thick. The next layer is light reddish-brown sandy clay loam about 16 inches thick. It is underlain to a depth of about 84 inches by pink sandy clay loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is slow.

These soils are used for crops and range.

Representative profile of Dalhart fine sandy loam, 0 to 1 percent slopes, in a cultivated field, 300 feet west and 40 feet north of the southeast corner of sec. 409, block 1T, T&NO Railroad Survey, 14 miles south of Stratford on U.S. Highway 287 and 5 miles east on Farm Road 1573:

Ap—0 to 9 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, granular structure; slightly hard, very friable; neutral; abrupt, smooth boundary.

B21t—9 to 22 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, very coarse, prismatic structure parting to fine subangular blocky; very hard, very friable; common fine pores; few worm casts; few clay films; mildly alkaline; gradual, smooth boundary.

B22t—22 to 36 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak, very coarse, prismatic structure parting to fine subangular blocky; very hard, friable; few fine pores; few worm casts; few clay films; calcareous; moderately alkaline; diffuse, smooth boundary.

B3ca—36 to 52 inches, light-brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak subangular blocky structure; hard, friable; few films and threads, soft masses, and fine concretions of visible calcium carbonate (5 percent of horizon, by volume); calcareous; moderately alkaline; diffuse, smooth boundary.

C1—52 to 68 inches, light reddish-brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; massive (structureless); hard, friable; few films and threads of calcium carbonate; mildly alkaline; clear, smooth boundary.

C2—68 to 84 inches, pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) moist; massive (structureless); hard, friable; common fine pores; few films and threads of visible calcium carbonate (2 percent of horizon, by volume); calcareous; moderately alkaline.

The solum ranges from 40 inches to 60 inches in thickness. The A horizon ranges from dark grayish brown to brown in color and from 7 to 10 inches in thickness. The B21t horizon is grayish brown to brown and 11 to 16 inches thick. The B22t horizon is pale brown to brown and 8 to 14 inches thick. The B3ca horizon is very pale brown to brown and 12 to 24 inches thick. The C1 horizon is light reddish brown to dark brown, and the C2 horizon is pink to brown.

The soils named for this series in Sherman County are outside of the range defined for the series, because they have a thicker solum. This difference does not affect their use and management.

**Dalhart fine sandy loam, 0 to 1 percent slopes (DaA).**—Areas of this soil range from about 30 acres to about 500 acres in size. The profile of this soil is the one described as representative for the Dalhart series.

Included with this soil in mapping are small areas of Dumas, Spurlock, and Sunray soils, and some areas of soils that have slopes of more than 1 percent.

The hazard of soil blowing is moderate. This soil is used for crops and range. Dryland and irrigated crops are wheat, grain sorghum, and forage sorghum.

Good management practices that help to control soil blowing and maintain tilth are leaving crop residue on the surface when crops are not grown, timely but limited tillage, and crop rotation. Diversion terraces and grassed waterways are needed in some areas. If this soil is irrigated, fertilizer is needed. Water should be supplied in an irrigation system designed to meet crop needs, overcome soil limitations, and conserve water. Capability units IIIe-3, dryland, and IIe-3, irrigated; Sandy Loam range site.

**Dalhart fine sandy loam, 1 to 3 percent slopes (DaB).**—This soil is on convex ridges. Slopes are commonly about 2 percent. Areas range from 15 acres to about 250 acres in size.

The surface layer is brown fine sandy loam about 8 inches thick. The next layer is brown sandy clay loam about 28 inches thick. Below this is light-brown sandy clay loam about 16 inches thick. The next layer is light reddish-brown sandy clay loam about 14 inches thick. It is underlain to a depth of about 80 inches by pink sandy clay loam.

Included with this soil in mapping are areas of Dumas, Spurlock, and Sunray soils and soils that have slopes of less than 1 percent.

The hazards of soil blowing and water erosion are moderate. This soil is used for crops and range. Dryland and irrigated crops are wheat, grain sorghum, and forage sorghum.

Good management practices are leaving crop residue on the surface when crops are not growing, timely but limited tillage, and crop rotation. Contour farming and terraces are needed for erosion control unless crops are drilled and stubble-mulched. Diversion terraces and grassed waterways are needed in some areas. If this soil is irrigated, fertilizer is needed and irrigation water must be managed in an irrigation system planned to control erosion. Capability units IIIe-3, dryland, and IIIe-3, irrigated; Sandy Loam range site.

### Dumas Series

The Dumas series consists of deep, friable, noncalcareous loamy soils that are nearly level. These soils are on uplands.

In a representative profile the surface layer is brown, neutral loam about 7 inches thick. The next layer is brown clay loam about 15 inches thick. Under this is a layer of yellowish-red clay loam about 12 inches thick. Below this is reddish-yellow clay loam about 11 inches thick, and then light-brown clay loam about 22 inches thick. These are underlain to a depth of about 84 inches by reddish-yellow clay loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is slow to medium.

These soils are used for crops and range.

Representative profile of Dumas loam, 0 to 1 percent slopes, in a pasture, 0.7 mile south and 30 feet east of the northeast corner of sec. 75, block 1C, GH&H Railroad Survey, about 1 mile east and 2 miles south of Texhoma on Farm Road 1290:

- A1—0 to 7 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate, fine, granular structure; hard, friable; few very fine pores; neutral; abrupt, smooth boundary.
- B21t—7 to 15 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, coarse, prismatic structure parting to moderate, fine and very fine, subangular blocky; hard, friable; common and medium fine pores; few clay films on surface of peds; few worm casts; neutral; gradual, smooth boundary.
- B22t—15 to 22 inches, dark-brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; very hard, firm; few fine pores; few clay films; neutral; clear, wavy boundary.
- B23t—22 to 34 inches, yellowish-red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky; hard, friable; few clay films; few films, threads, very fine soft masses, and concretions of calcium carbonate; calcareous; moderately alkaline; clear, wavy boundary.
- B24tca—34 to 45 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 4/6) moist; moderate, coarse, prismatic structure parting to moderate, fine, subangular blocky; hard, friable; few clay films; common films; threads, soft masses and fine concretions of calcium carbonate (10 percent of horizon, by volume); calcareous; moderately alkaline; gradual, wavy boundary.
- B25tca—45 to 67 inches, light-brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; moderate, fine, subangular blocky structure; hard, friable; common fine pores; many soft masses and concretions of calcium carbonate (30 percent of horizon,

by volume); calcareous; moderately alkaline; gradual, wavy boundary.

B26tca—67 to 84 inches, reddish-yellow (7.5YR 7/6) clay loam, strong brown (7.5YR 5/6) moist; weak, medium, subangular blocky structure; hard, friable; many medium and fine pores; common soft masses and concretions of calcium carbonate (about 15 percent of horizon, by volume); calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. The A horizon ranges from dark grayish brown to brown in color and from 6 to 10 inches in thickness.

The B21t horizon is dark grayish brown to brown and 5 to 10 inches thick. The B22t horizon is grayish brown to brown and 6 to 10 inches thick. The B23t horizon is grayish brown to brown and 6 to 10 inches thick. The B24tca horizon is yellowish red to reddish yellow and 10 to 20 inches thick. The B24tca horizon is 5 to 25 percent calcium carbonate, by volume. The B25t horizon ranges from reddish yellow to light brown in color and from 18 to 25 inches in thickness.

**Dumas loam, 0 to 1 percent slopes (DuA).**—This soil has weakly convex to concave slopes. Areas range from 20 acres to 500 acres in size.

Included with this soil in mapping are small areas of Dalhart, Gruver, Sherm, and Sunray soils.

The hazard of soil blowing is slight. This soil is used for crops and range. Dryland and irrigated crops are wheat, corn, grain sorghum, and forage sorghum. Some alfalfa and vegetables are also grown in irrigated areas.

Good management practices are leaving crop residue on the surface as long as possible, crop rotation, and timely but limited tillage. Terraces, diversions, and grassed waterways are also needed. If this soil is irrigated, fertilizer is needed. Water needs to be supplied in an irrigation system designed to overcome soil limitations and meet crop needs. Capability units IIIc-2, dryland, and IIe-1, irrigated; Deep Hardland range site.

### Gruver Series

The Gruver series consists of deep, friable, noncalcareous, loamy soils that are nearly level. These soils are on uplands.

In a representative profile the surface layer is brown, noncalcareous clay loam about 6 inches thick. The next layer is brown clay loam about 18 inches thick. Below this is reddish-yellow clay loam about 28 inches thick, and then pink clay loam about 16 inches thick. The underlying material, to a depth of 84 inches, is reddish-yellow clay loam.

Permeability is moderately slow. Available water capacity is high. These soils are well drained, and runoff is slow.

These soils are used for crops and range.

Representative profile of Gruver clay loam, 0 to 1 percent slopes, in a field, 0.5 mile south and 100 feet northwest of the northeast corner of sec. 64, block 3B, GH&N Railroad Survey, 14 miles south of Stratford on U.S. Highway 287 and 13 miles east on Farm Road 1573:

- Ap—0 to 6 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; hard, friable; mildly alkaline; abrupt, smooth boundary.

- B21t—6 to 14 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate, fine, subangular blocky structure; hard, friable; few fine pores; few worm casts; few clay films; mildly alkaline; gradual, smooth boundary.
- B22t—14 to 24 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, blocky structure; very hard, firm; few very fine pores; few clay films; mildly alkaline; gradual, smooth boundary.
- B23t—24 to 52 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; weak, fine, subangular blocky structure; hard, friable; few very fine pores; few clay films; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.
- B24tca—52 to 68 inches, pink (7.5YR 7/4) clay loam, reddish yellow (7.5YR 6/6) moist; weak, fine, subangular blocky structure; hard, friable; few clay films on ped faces; common films and threads, soft masses, and concretions of calcium carbonate (15 to 20 percent of horizon, by volume); calcareous; moderately alkaline; clear, smooth boundary.
- B25t—68 to 84 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak, fine, subangular blocky structure; hard, friable; few clay films on ped faces; few films, threads and soft masses of visible calcium carbonate (1 to 3 percent of horizon, by volume); calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. Secondary soft lime is at a depth of 22 to 28 inches. The B2ca horizon is at a depth of 34 to 60 inches. The A horizon ranges from dark grayish brown to brown in color and from 6 to 7 inches in thickness. The B21t horizon is 7 to 12 inches thick. The B22t horizon is brown to dark brown. The B23t horizon is 18 to 28 inches thick. The B24tca horizon is pink to light brown. The B24tca horizon is 20 to 35 percent calcium carbonate, by volume.

**Gruver clay loam, 0 to 1 percent slopes (GrA).**—This soil is in broad areas. Included with it in mapping are small areas of Conlen, Ness, and Sherm soils.

The hazard of soil blowing is slight. This soil is used mainly for crops. Small areas are used for range. Dryland and irrigated crops are wheat, corn, grain sorghum, and forage sorghum. Some alfalfa and vegetables are grown in irrigated areas.

A good management practice is leaving crop residue on the surface as long as possible. Timely but limited tillage and the use of terraces, diversions, and grassed waterways are important conservation measures. If this soil is irrigated, fertilizer is needed. Water needs to be supplied in an irrigation system designed to meet crop needs and overcome soil limitations. Capability units IIIc-2, dryland, and IIe-2, irrigated; Deep Hardland range site.

### Humbarger Series

The Humbarger series consists of deep, firm, calcareous, loamy soils that are nearly level. These soils are on flood plains.

In a representative profile the surface layer is dark grayish-brown, calcareous clay loam about 16 inches thick. The next layer is brown, firm, stratified, calcareous clay loam about 12 inches thick. Below this is grayish-brown clay loam about 16 inches thick. The underlying material, to a depth of about 60 inches, is light brownish-gray loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is slow.

These soils are used mainly for range, but a small acreage is farmed.

The Humbarger soils in Sherman County are mapped only in an undifferentiated group with the Cass soils.

Representative profile of a Humbarger clay loam in an area of Cass and Humbarger soils, channeled, 0.25 mile west and 700 feet south of the northeast corner of sec. 83, block 1C, GH&H Railroad Survey, 18 miles east of Stratford and 4 miles north on Farm Road 1290:

- A1—0 to 16 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, very fine, subangular blocky structure; hard, firm; common roots; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.
- B21—16 to 28 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; hard, firm; thin strata of sandy material; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.
- B22—28 to 44 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, fine, subangular blocky structure; hard, firm; thin strata of sandy material; few worm casts; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.
- C—44 to 60 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive (structureless); slightly hard, friable; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 39 inches to 54 inches in thickness. The A horizon is brown to dark grayish brown and 11 to 17 inches thick. The B21 horizon is brown to dark grayish brown and 11 to 14 inches thick. The B22 horizon is pale brown to grayish brown. The C horizon is very pale brown to light brownish gray.

### Karde Series

The Karde series consists of deep, friable, calcareous, loamy soils that are gently sloping to sloping. These soils are on ridges or dunes.

In a representative profile the surface layer is grayish-brown, calcareous loam about 7 inches thick. The next layer is light brownish-gray, calcareous loam about 8 inches thick. It is underlain to a depth of about 80 inches by white loam that is limy but has no segregation of calcium carbonate.

Permeability is moderate. Available water capacity is moderate. Runoff is slow. The hazards of soil blowing and water erosion are severe.

These soils are used for crops and range.

Representative profile of Karde loam, in an area of Karde soils, 3 to 8 percent slopes, 0.3 mile west, 100 feet north of the southeast corner of sec. 407, block 1T, T&NO Railroad Survey, 14 miles south of Stratford on U.S. Highway 287 and 2.6 miles east on Farm Road 1573:

- Ap—0 to 7 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard, friable; common worm casts; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—7 to 15 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive (structureless); slightly hard, friable; many worm casts; common films and threads of calcium carbonate (10 percent of horizon by volume); calcareous; moderately alkaline; gradual, smooth boundary.

C2—15 to 80 inches, white (10YR 8/2) loam, light gray (10YR 7/2) moist; massive (structureless); slightly hard, friable; many worm casts; limy, but no segregation of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 5 to 9 inches in thickness, from light gray to grayish brown in color, and from fine sandy loam to clay loam in texture. The C1 horizon ranges from 7 to 10 inches in thickness, from light gray to light brownish gray in color, and from loam to clay loam in texture. The C2 horizon is white to light gray and loam to clay loam.

**Karde soils, 3 to 8 percent slopes (KaC).**—These soils are on ridges and dunes, mostly on the east and southeast sides of playas. Slopes are dominantly about 5 percent. Severely eroded spots are in some areas. Most areas are crescent shaped.

Included with this soil in mapping are Dalhart, Spurlock, and Sunray soils.

This soil is used for crops and range. Wheat, forage sorghum, and grain sorghum are the main crops.

A lack of moisture and a high content of lime in these soils limit crop growth under dryland management. Diversion terraces and grassed waterways are needed in places. Leaving crop residue on the surface, limited tillage, and contour farming are practices that help to control erosion and to maintain soil structure. If these soils are irrigated, fertilizer is needed in some areas. Sprinkler irrigation is better suited to these soils than are other systems. If pasture is grown, proper management, fertilizer, frequent irrigation, and rotation grazing are necessary for best results. Capability units VIe-3, dryland, and IIIe-4, irrigated; High Lime range site.

### Likes Series

The Likes series consists of deep, very friable, calcareous, sandy soils that are gently sloping to sloping. These soils are in valleys.

In a representative profile the surface layer is brown, calcareous loamy fine sand about 6 inches thick. The next layer is pale-brown, calcareous loamy fine sand about 24 inches thick. It is underlain, to a depth of about 80 inches, by very pale brown loamy fine sand.

Permeability is moderately rapid. Available water capacity is low. These soils are excessively drained, and surface runoff is slow. The hazard of soil blowing is severe.

These soils are used for range.

Representative profile of Likes loamy fine sand, 0.6 mile south and 0.3 mile west of the northeast corner of sec. 14; block 1C; GH&H Railroad Survey, 24 miles east and 2 miles south of Stratford:

A1—0 to 6 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak, fine, granular structure; loose, very friable; calcareous; moderately alkaline; clear, smooth boundary.

C1—6 to 30 inches, pale-brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grain (structureless); loose; calcareous; moderately alkaline; gradual, smooth boundary.

C2—30 to 80 inches, very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; single grain (structureless); loose; calcareous; moderately alkaline.

The A horizon ranges from 6 to 14 inches in thickness and from light brownish gray to brown in color. The C1 horizon is light yellowish brown to pale brown and 17 to 27 inches thick. The C2 horizon ranges from pink to very pale brown.

The soils named for this series in Sherman County are outside of the range defined for the series, because soil temperature is about 58° or 59° F. This difference does not affect their use and management.

**Likes loamy fine sand (Lk).**—This gently sloping to sloping soil is in valleys of the larger drainageways. Slopes are dominantly about 5 percent but range from 1 to 8 percent. Areas are typically about 100 acres in size but range from 20 acres to more than 500 acres.

Included with this soil in mapping are areas of Mo-beetie, Pastura, and Tivoli soils.

This soil is used mostly for range. If it is irrigated, crops that produce adequate cover and residue are needed to protect and condition the soil. Good management requires the use of fertilizers and a properly designed sprinkler irrigation system. In places grassed waterways and diversion terraces are needed to control runoff. Capability units VIe-1, dryland, and IVE-2, irrigated; Sandyland range site.

### Manzano Series

The Manzano series consists of deep, friable, noncalcareous, loamy soils that are nearly level. These soils are on broad flood plains and in concave areas on alluvial fans.

In a representative profile the surface layer is dark grayish-brown, noncalcareous clay loam about 20 inches thick. Below this is pale-brown, friable, calcareous clay loam about 42 inches thick. The underlying material, to a depth of 84 inches, is dark grayish-brown silty clay loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is slow.

These soils are used mainly for range, but a small acreage is farmed.

Representative profile of Manzano clay loam, 750 feet north and 60 feet east of the southwest corner of sec. 69, block 1C, GH&H Railroad Survey, on Farm Road 1290, about 1 mile east and 8 miles south of Texhoma:

A11—0 to 12 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, very fine, subangular blocky; hard, friable; few fine and medium pores; few worm casts; mildly alkaline; clear, smooth boundary.

A12—12 to 20 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, fine, subangular blocky; hard, friable; few fine and medium pores; few worm casts; mildly alkaline; gradual, smooth boundary.

B2—20 to 36 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to fine, subangular blocky; hard, friable; few fine pores; few worm casts; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—36 to 48 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; massive (structureless); hard, friable; few fine pores; few worm casts; few films and threads, soft masses, and fine concretions of visible calcium carbonate (3 percent of horizon, by volume); calcareous; moderately alkaline; gradual, smooth boundary.

C—48 to 62 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; massive (structureless); hard, friable; few fine pores; few films, threads, and very fine concretions of visible calcium carbonate (1 percent of horizon, by volume); calcareous; moderately alkaline; clear, smooth boundary.

B2b—62 to 84 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish-brown (10YR 3/2) moist; moderate, fine, subangular blocky structure; hard, firm; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The A11 horizon ranges from very dark grayish brown to grayish brown in color and from 7 to 12 inches in thickness. The A12 horizon is very dark grayish brown to grayish brown and 4 to 8 inches thick. The B2 horizon is pale brown to brown. The B2b horizon, where it occurs, is dark grayish brown to brown and ranges from silty clay loam to clay loam in texture. The C horizon is pale brown to grayish brown. It is 1 to 6 percent calcium carbonate.

**Manzano clay loam (Ma).**—This nearly level soil is on flood plains. Slopes are less than 1 percent. Areas are long and range from 150 to 1,000 feet in width. They traverse the valleys.

Included with this soil in mapping are areas of Berthoud, Cass, Humbarger, and Mobeetie soils. Also included are soils that have slopes of more than 1 percent.

This soil is used for crops and range. Wheat, forage sorghum, and grain sorghum are the main crops. Good management practices are crop rotation and leaving crop residue on the surface. Timely but limited tillage and the use of terraces, diversions, and grassed waterways are important conservation measures. If this soil is irrigated, fertilizer is needed. Water needs to be supplied in an irrigation system planned to meet crop needs and maintain soil tilth. Capability units IIIc-2, dryland, and IIe-1, irrigated; Deep Hardland range site.

### Mobeetie Series

The Mobeetie series consists of deep, very friable, calcareous loamy soils that are gently to strongly sloping. These soils are on foot slopes and on alluvial fans in valleys.

In a representative profile the surface layer is grayish-brown, calcareous fine sandy loam about 8 inches thick. The next layer is light brownish-gray fine sandy loam about 18 inches thick. It is underlain to a depth of 80 inches by pale-brown and light yellowish-brown fine sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. These soils are well drained, and runoff is medium.

These soils are used mainly for range, but a few areas are dryfarmed.

Representative profile of Mobeetie fine sandy loam, 5 to 12 percent slopes, 0.3 mile south and 100 feet east of the northwest corner of sec. 2, block 2B, GH&H Railroad Survey, 13 miles east of Stratford and 5.3 miles south on Farm Road 119:

A1—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, prismatic structure parting to weak, fine, subangular blocky; slightly hard, very friable; few very fine calcium carbonate concretions; calcareous; moderately alkaline; gradual, smooth boundary.

B2—8 to 26 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak, coarse, prismatic structure parting to weak, medium and fine, subangular blocky; slightly hard, very friable; few worm casts; few films, threads, and fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—26 to 35 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak, coarse, prismatic structure parting to weak, subangular blocky; slightly hard, friable; common films and threads, soft masses, and concretions of visible calcium carbonate (4 percent of horizon, by volume); calcareous; moderately alkaline; diffuse, smooth boundary.

C—35 to 80 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive (structureless); slightly hard, very friable; few medium to very fine concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 24 to 48 inches in thickness. The A horizon is grayish brown to light brown and 6 to 10 inches thick. The B2 horizon is grayish brown to pale brown and 12 to 22 inches thick. The Cca horizon is very pale brown to pale brown and 8 to 16 inches thick. It has a calcium carbonate content of 3 to 6 percent, by volume. The C horizon ranges from pink to pale brown.

The soils named for this series in Sherman County are outside of the range defined for the series, because the soil temperature is about 58° or 59° F. This difference does not affect their use or management.

**Mobeetie fine sandy loam, 3 to 5 percent slopes (MoC).**—This soil is in valleys. Slopes are dominantly about 4 percent. Areas are much longer than they are wide. They range from about 30 acres to about 700 acres in size.

The surface layer is grayish-brown fine sandy loam 6 inches thick. The next layer is a pale-brown fine sandy loam about 18 inches thick. It is underlain, to a depth of 80 inches, by pale-brown fine sandy loam that has an accumulation of calcium carbonate in the upper part.

Included with this soil in mapping are areas of Berthoud, Likes, and Spurlock soils and some areas of soils that have slopes of more than 5 percent. Also included in some areas are Pastura soils on caps and small knolls. A few rills or gullies as much as 5 feet deep are in some areas.

This soil is subject to erosion if it is left unprotected. It is used mainly for range.

If this soil is dryfarmed, good management practices include planting drilled crops and stubble-mulching crops or leaving crop residue on the surface. Diversion terraces and grassed waterways are needed to help control erosion in some places. If this soil is irrigated, fertilizer is needed. Irrigation water needs to be applied in an irrigation system planned to

control erosion. Contour farming and terraces are also needed to protect the soil. Capability units IVE-3, dryland, and IVE-1, irrigated; Mixedland Slopes range site.

**Mobeetic fine sandy loam, 5 to 12 percent slopes (MoD).**—This soil is in valleys. Slopes are dominantly about 7 percent. Areas of this soil have greater length than width and range from about 25 acres to 700 acres in size. The profile of this soil is the one described as representative for the Mobeetic series.

Included with this soil in mapping are areas of Berthoud, Likes, and Pastura soils and some areas of soils that have slopes of less than 5 percent.

This soil is used for range. Capability unit VIe-2, dryland; Mixedland Slopes range site.

### Ness Series

The Ness series consists of deep, extremely firm, neutral, clayey soils that are nearly level. The soils are on the floors of intermittent playa lakebeds and are under water for a few weeks to several months each year.

In a representative profile the surface layer is gray, neutral clay about 11 inches thick. The next layer is gray, noncalcareous clay about 30 inches thick. It is underlain, to a depth of 80 inches, by pale-brown silty clay loam.

Permeability is very slow. Available water capacity is high. These soils are poorly drained, and runoff is ponded.

These soils are used mainly for grazing. In places where runoff is controlled, a few small areas are cultivated.

Representative profile of Ness clay, in a playa, 0.4 mile east and 60 feet north of the southwest corner of sec. 9, block 2B, GH&H Railroad Survey; 14 miles south of Stratford and 11.4 miles east on Farm Road 1573:

- A11—0 to 11 inches, gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure; extremely hard, extremely firm; neutral; gradual, smooth boundary.
- A12—11 to 41 inches, gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; weak, coarse, blocky structure; extremely hard, extremely firm; few small black concretions, probably iron and manganese; mildly alkaline; diffuse, smooth boundary.
- C—41 to 80 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) moist; weak, fine, blocky structure; very hard, firm; few, faint, strong-brown mottles; mildly alkaline.

The A11 horizon ranges from dark gray to gray in color and from 11 to 15 inches in thickness. The A12 horizon is gray to light gray in color and 13 to 30 inches thick. The C horizon ranges from grayish brown to pale brown.

**Ness clay (Ne).**—This soil is on the floors of intermittent lakes, or playas, that are from 1 foot to 30 feet below the level of the surrounding plain. Most areas are oval and range from a few acres to a few hundred acres in size.

Included with this soil in mapping are some narrow areas of sloping Sherm and Sunray soils.

In places periodic flooding precludes the use of this soil for crops unless it is drained. Water collects in depressions and remains until it evaporates. Small areas

of this soil are grazed along with areas of surrounding soils. Pits dug in the soil provide water for livestock (fig. 5). A few areas of this soil are drained. If this soil is drained and dryfarmed, suitable management practices include smoothing or leveling the areas, controlling runoff received from higher areas, maintaining crop residue on the surface, and limiting tillage. Capability units VIw-1, dryland; included in adjoining range site.

### Pastura Series

The Pastura series consists of very shallow, friable, sloping to steep, calcareous, loamy soils over indurated caliche. These soils are along sides of valleys and in areas of caprock escarpments.

In a representative profile the surface layer is grayish-brown, calcareous loam about 6 inches thick. The underlying material, to a depth of 34 inches, is pinkish-white indurated caliche in the upper 14 inches and weakly cemented gravelly loam below a depth of 20 inches.

Permeability is moderate. Available water capacity is low. These soils are well drained, and surface runoff is medium to slow.

These soils are used as range. They support sparse stands of grasses. In some areas the underlying caliche is quarried and used as base material for roadbeds.

Representative profile of Pastura loam in an area of Pastura complex, in a pasture, 300 feet north and 30 feet west of the southeast corner of sec. 78, block 1C, GH&H Railroad Survey, on Farm Road 1290, about 1 mile east and 4 miles south of Texhoma:

- A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, very fine, subangular blocky structure; hard, friable; many worm casts; common indurated caliche pebbles as much as 4 inches in diameter; calcareous; moderately alkaline; clear, wavy boundary.
- Ccam—6 to 34 inches, pinkish-white (7.5YR 8/2) indurated caliche, pinkish gray (7.5YR 7/2) moist; becomes weakly cemented gravelly loam below a depth of about 20 inches.

The A horizon ranges from 4 to 6 inches in thickness, from pale brown to dark grayish brown in color, and from clay loam to gravelly loam in texture. It is 15 to 20 percent calcium carbonate, by volume. The Ccam horizon is 40 to 90 percent calcium carbonate, by volume. Depth to the Cam horizon is 4 to 10 inches.

**Pastura complex (Pa).**—This complex consists of sloping to steep soils. Most areas are narrow and long and are along the rims of valleys. Slopes are predominantly about 10 percent but range from 5 to 45 percent. Escarpments of caprock occur in some areas, and where more than one caprock crops out, the areas have a steplike appearance.

About 60 percent of this complex is Pastura loam, clay loam, or gravelly loam. About 30 percent is a soil that has fractured caliche or soft caliche. Included soils make up the remaining 10 percent.

Included with this complex in mapping are areas of soils in the Berthoud, Mobeetic, and Spurlock series and areas of Rough broken land.

These soils are used for range and wildlife habitat.



Figure 5.—A pit dug in an area of Ness clay provides water for livestock.

Capability unit VIIs-1, dryland; Very Shallow range site.

### Rough Broken Land

Rough broken land (Ro) consists of steep soils on foot slopes, very steep soils on upper slopes, and nearly vertical walls and bluffs, mainly along rivers and creeks. Slope ranges from 25 to 60 percent and local relief from 75 to 350 feet (fig. 6).

Areas of Rough broken land are dissected by numerous drainage channels. Runoff is very rapid. One or more layers of hardened caliche caprock occur in most areas. Little or no soil is in the steeper areas, but the loamy calcareous soils support a thin cover of native grasses and some brush.

Included with Rough broken land in mapping are small areas of Likes, Mobeetie, and Pastura soils. A few areas of Conlen and Spurlock soils are also included.

The areas of Rough broken land are used for range and wildlife habitat. Capability unit VIIs-1, dryland; Rough Breaks range site.

### Sherm Series

The Sherm series consists of deep, friable, noncalcareous, loamy soils that are nearly level (fig. 7).

In a representative profile the surface layer is brown, noncalcareous clay loam about 5 inches thick. The next layer is dark-brown clay about 6 inches thick. Below this is brown clay about 24 inches thick. The next layer is very pale brown and light-brown clay loam about 33 inches thick. It is underlain to a depth of about 84 inches by reddish-yellow clay loam.

Permeability is very slow. Available water capacity is high. These soils are well drained, and runoff is slow.

These soils are used mainly for crops, but a few areas remain in native range.

Representative profile of Sherm clay loam, 0 to 1 percent slopes, in a field, 200 feet east and 40 feet south of the northwest corner of sec. 97, block 1T, T&NO Railroad Survey, on Farm Road 2677, 5 miles north of its intersection with U.S. Highway No. 54 in Stratford:

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

B21t—5 to 11 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate, medium and fine, blocky structure; very hard, firm; few very fine pores; few worm casts; common clay films; mildly alkaline; clear, smooth boundary.



Figure 6.—An area of Rough broken land.

B22t—11 to 20 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate, medium, blocky structure; very hard, very firm; few very fine pores; common clay films; moderately alkaline; clear, smooth boundary.

B23t—20 to 35 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak, medium and fine, blocky structure; hard, friable; few fine and very fine pores; few clay films; few threads and films of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B24tca—35 to 50 inches, very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak, medium and fine, subangular blocky structure; hard, friable; many medium to fine pores; common films and threads and a few soft masses of visible calcium carbonate (5 percent of horizon, by volume); calcareous; moderately alkaline; gradual, smooth boundary.

B25t—50 to 68 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; weak, medium and fine, subangular blocky structure; hard, friable; few fine pores; few worm casts; few films and threads, soft masses, and concretions of calcium carbonate (1 to 3 percent, by volume); calcareous; moderately alkaline; gradual, smooth boundary.

B26t—68 to 84 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; weak, medium, subangular blocky structure; hard, friable; few fine pores; few films and threads of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. Secondary soft lime is at a depth of 15 to 25 inches. The A horizon ranges from very dark grayish brown to brown in color and from 4 to 9 inches in thickness. A distinct B2ca horizon is at a depth of 30 to 60 inches. The B21t horizon is dark grayish brown to brown and 5 to 8 inches thick. The upper 20 inches of the Bt horizon is 40 to 45 percent clay. The lower part of the Bt horizon is reddish yellow to brown.

**Sherm clay loam, 0 to 1 percent slopes (ShA).—**This soil is the most extensive soil on the broad, nearly level plain that extends across the county.

Included with this soil in mapping are areas of Dumas, Gruver, Ness, and Sunray soils.

The hazard of soil blowing is slight. This soil is used mainly for crops, but small areas are used for range. Dryland and irrigated crops are wheat, corn,

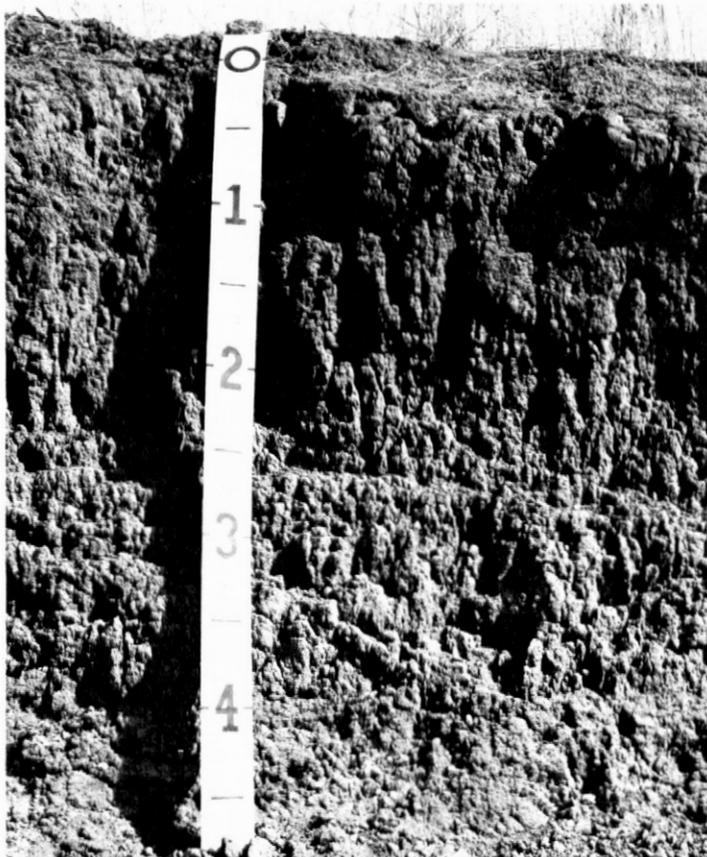


Figure 7.—Profile of Sherm clay loam, 0 to 1 percent slopes.

grain sorghum, and forage sorghum. Some alfalfa and vegetables are grown in irrigated areas (fig. 8).

Good management practices are the use of crop residue to protect the soil from blowing, timely but limited tillage, and the use of diversion terraces and grassed waterways to control excess runoff. If this soil is irrigated, fertilizer is needed. Irrigation water should be applied in a system planned to prevent undue water loss (fig. 9). In many places recovery systems for runoff irrigation water are useful. Capability units IIIc-1, dryland, and IIs-1, irrigated; Deep Hardland range site.

### Spurlock Series

The Spurlock series consists of deep, friable, calcareous, loamy soils that are gently sloping. These soils are on uplands and are shallow to caliche (fig. 10).

In a representative profile the surface layer is brown, calcareous loam about 7 inches thick. The next layer is pale-brown, calcareous clay loam about 9 inches thick. Below this is white clay loam about 16 inches thick. The next layer is pink clay loam about 28 inches thick. It is underlain to a depth of about 84 inches by light-brown clay loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is medium.

These soils are used for crops and range.

Representative profile of Spurlock loam, 1 to 3 percent slopes, 0.5 mile west and 100 feet north of the southeast corner of sec. 52, block 2B, GH&H Railroad Survey, about 8.5 miles east and 7 miles south of Stratford:

- A1—0 to 7 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate, fine and very fine, subangular blocky structure; hard, friable; many fine pores; many worm casts; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.
- B2—7 to 16 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate, fine and very fine, subangular blocky structure; hard, friable; many fine pores; few films, threads and, fine concretions of calcium carbonate (2 to 4 percent of horizon, by volume); calcareous; moderately alkaline; clear, smooth boundary.
- C1ca—16 to 32 inches, white (10YR 8/2) clay loam, light brownish gray (10YR 6/2) moist; massive (structureless); hard, friable; few fine pores; many films, threads, soft masses, and concretions of calcium carbonate (50 percent of horizon, by volume); calcareous; moderately alkaline; diffuse, smooth boundary.
- C2ca—32 to 60 inches, pink (7.5YR 7/4) clay loam, strong brown (7.5YR 5/6) moist; massive (structureless); hard, friable; few fine pores; common films, threads, and concretions of calcium carbonate (10 to 15 percent of horizon, by volume); calcareous; moderately alkaline; clear, smooth boundary.
- C3—60 to 84 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive (structureless); hard, friable; few fine pores; few films, threads and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 13 inches to 18 inches in thickness. The A horizon is pale brown to grayish brown and brown and 5 to 8 inches thick. The B2 horizon is pale brown to grayish brown and 8 to 11 inches thick. This horizon contains a trace to an estimated 5 percent of films, threads, and weakly cemented concretions of calcium carbonate. The C1ca horizon is white to light gray and 8 to 23 inches thick. It is 40 to 55 percent calcium carbonate. The C2ca horizon is pink to light brown and from 11 to 38 inches thick. The content of calcium carbonate is of 4 to 12 percent. The C3 horizon ranges from pink to brown. It contains 1 to 2 percent films, threads, and weakly cemented concretions of calcium carbonate.

**Spurlock loam, 1 to 3 percent slopes (SpB).**—This soil is on convex ridges. Slopes are dominantly about 2 percent. Areas range from about 20 acres to 200 acres in size. The profile of this soil is the one described as representative for the Spurlock series.

Included with this soil in mapping are areas of Berthoud, Dalhart, Dumas, Pastura, Spurlock, and Sunray soils. Also included are areas of soils that have slopes of more than 3 percent.

The hazard of soil blowing is moderate. This soil is used for crops and range. Dryland and irrigated crops are wheat, grain sorghum, and forage sorghum. Alfalfa is grown in some areas.

Good management practices are limiting tillage and growing such crops as small grain and sorghum that produce large amounts of residue to maintain tilth and to help control soil blowing. Diversion terraces and grassed waterways to carry off excess water and control erosion are also helpful. If this soil is irrigated, fertilizer is needed, along with an irrigation system designed with the inherent limitations of the



Figure 8.—Harvesting irrigated wheat on Sperm clay loam, 0 to 1 percent slopes.

soil in mind. Capability units IVE-2, dryland, and IIIe-6, irrigated; Hardland Slopes range site.

**Spurlock loam, 3 to 5 percent slopes (SpC).**—This soil is on convex ridges and side slopes. Slopes are dominantly about 4 percent. Areas range from about 15 acres to 100 acres in size.

The surface layer is grayish-brown loam about 5 inches thick. The next layer is pale-brown clay loam about 10 inches thick. Below this is light-gray clay loam about 20 inches thick. To a depth of 80 inches is pink clay loam.

Included with this soil in mapping are areas of Berthoud, Dalhart, Karde, Pastura, and Spurlock soils. Also included are areas of soils that have slopes of less than 3 percent.

The hazard of soil blowing is moderate. This soil is used mostly for range, but small areas are farmed. Dryland and irrigated crops are wheat, grain sorghum, and forage sorghum.

Good management practices for control of soil blowing are growing such crops as small grain and sorghum that produce large amounts of residue, limited tillage, contour farming, terracing, and rotation

grazing. If this soil is irrigated, fertilizer is needed. Capability units IVE-6, dryland, and IVE-3, irrigated; Hardland Slopes range site.

### Sunray Series

The Sunray series consists of deep, friable, calcareous, loamy soils that are nearly level to gently sloping. These soils are on uplands.

In a representative profile the surface layer is dark grayish-brown, calcareous clay loam about 10 inches thick. The next layer is about 12 inches of light-brown clay loam underlain by about 23 inches of pink clay loam. Below this is reddish-yellow clay loam about 25 inches thick. It is underlain to a depth of about 84 inches by yellowish-red clay loam.

Permeability is moderate. Available water capacity is high. These soils are well drained, and runoff is slow to medium.

These soils are used for crops and range.

Representative profile of Sunray clay loam, 0 to 1 percent slopes, 400 feet east and 25 feet south of the northwest corner of sec. 185, block 1C, GH&H Rail-

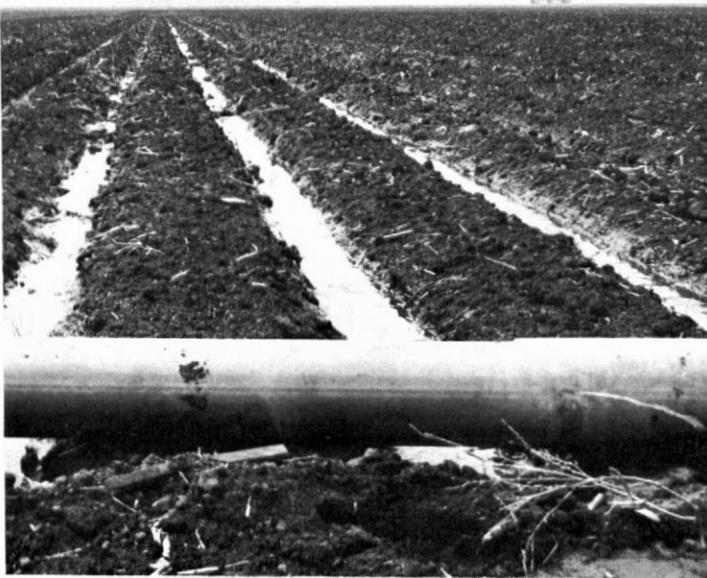


Figure 9.—Gated pipe used to conserve irrigation water on Sperm clay loam, 0 to 1 percent slopes.

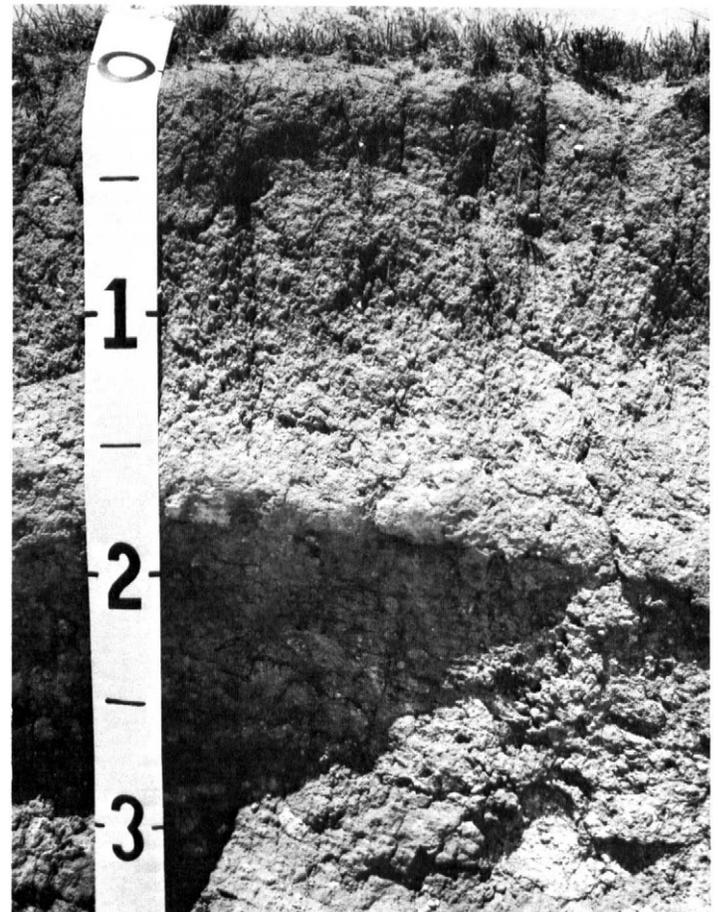


Figure 10.—Profile of Spurlock loam, 1 to 3 percent slopes.

road Survey, about 10 miles east of Stratford on Texas Highway 15:

- A1—0 to 10 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, very fine, subangular blocky structure parting to moderate, coarse prismatic; hard, friable; many fine roots; common worm casts; calcareous; moderately alkaline; clear, smooth boundary.
- B21t—10 to 22 inches, light-brown (7.5YR 6/4) clay loam, strong brown (7.5YR 5/6) moist; moderate, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; few clay films; common worm casts; common threads and films of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.
- B22tca—22 to 45 inches, pink (7.5YR 7/4) clay loam, brown (7.5YR 5/4) moist; weak, coarse, prismatic structure parting to weak, fine, subangular blocky; hard, friable; few fine pores; few clay films; few roots; few worm casts; common, fine and very fine, soft masses and concretions of visible calcium carbonate (10 to 14 percent of horizon, by volume); calcareous; moderately alkaline; diffuse, smooth boundary.
- B23tca—45 to 52 inches, reddish-yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; weak, fine, subangular blocky structure; hard, friable; common fine pores; few clay films; few films and threads of visible calcium carbonate (3 to 4 percent of horizon, by volume); calcareous; moderately alkaline; gradual, smooth boundary.
- B24t—52 to 70 inches, reddish-yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; moderate, fine, subangular blocky structure; hard, friable; few clay films; few films and threads of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.
- B25t—70 to 84 inches, yellowish-red (5YR 5/8) clay loam, yellowish red (5YR 4/8) moist; moderate, medium, subangular blocky structure; hard, firm; few clay films; calcareous, moderately alkaline.

The solum ranges from 60 inches to more than 80 inches in thickness. The A horizon ranges from grayish brown to brown in color and from 10 to 14 inches in thickness. The B21t horizon is light brown to brown and 10 to 15 inches thick. The B22t horizon is pink to light brown and 12 to 24 inches thick. The B23tca horizon is pink to strong brown and 5 to 10 inches thick. The B24t horizon is reddish yellow to yellowish red and 12 to 20 inches thick. The B25t horizon ranges from reddish yellow to yellowish red.

**Sunray clay loam, 0 to 1 percent slopes (SuA).—**This soil is on low, convex ridges. Areas range from about 20 acres to about 1,400 acres in size. The profile of this soil is the one described as representative for the Sunray series.

Included with this soil in mapping are areas of Conlen, Dumas, Gruver, Ness, and Sperm soils.

The hazard of soil blowing is slight. This soil is used for crops and range. Dryland and irrigated crops commonly grown are wheat, corn, grain sorghum, and forage sorghum. Some alfalfa and vegetables are also grown in irrigated areas.

A good management practice is to leave crop residue on the surface to help control soil blowing and erosion and to maintain soil tilth. Diversion terraces and grassed waterways are needed in some areas. If this soil is irrigated, fertilizer is needed. Water needs to be supplied in an irrigation system planned to meet crop

needs and overcome soil limitations. Capability units IIIc-2, dryland, and IIe-1, irrigated; Deep Hardland range site.

**Sunray clay loam, 1 to 3 percent slopes (SuB).**—This soil has convex slopes. Slopes are dominantly about 2 percent. Areas range from about 15 acres to 300 acres in size.

The surface layer is dark grayish-brown clay loam about 11 inches thick. The next 10 inches is brown clay loam. Below this is pink clay loam about 20 inches thick. The next layer, to a depth of 80 inches, is reddish-yellow clay loam.

Included with this soil in mapping are areas of Daltart and Spurlock soils and some areas of soils that have slopes of less than 1 percent.

The hazard of soil blowing is moderate. This soil is used for crops and range. Dryland and irrigated crops are wheat, grain sorghum, and forage sorghum.

Good management practices are leaving crop residue on the soil surface when crops are not growing, timely but limited tillage, and crop rotation. Contour farming, together with use of terraces, is needed for erosion control, except where crops are drilled and stubble mulched. Diversion terraces and grassed waterways are needed in some areas. If this soil is irrigated, fertilizer is needed. Water needs to be supplied in an irrigation system planned to control erosion, conserve water, and meet crop needs. Capability units III-e-1, dryland, and IIIe-2, irrigated; Deep Hardland range site.

### Tivoli Series

The Tivoli series consists of deep, loose, neutral sandy soils that are sloping to undulating. These soils are in areas that are marked by dunes and hummocks.

In a representative profile the surface layer is brown, loose fine sand about 5 inches thick. The next layer is about 27 inches of pale-brown, loose fine sand. Below this is about 18 inches of light yellowish-brown, loose fine sand. It is underlain to a depth of 80 inches by light-brown, loose fine sand.

Permeability is rapid. Available water capacity is low. These soils are excessively drained, and runoff is very slow.

These soils are used for range.

Representative profile of Tivoli fine sand, hummocky, in a pasture, 0.45 mile south and 0.65 mile west of the northeast corner of sec. 10, block 1T, T&NO Railroad Survey, about 10 miles north and 1.5 miles west of Stratford:

- A1—0 to 5 inches, brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grain (structureless); loose, neutral; gradual, smooth boundary.
- C1—5 to 32 inches, pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain (structureless); loose, mildly alkaline; gradual, smooth boundary.
- C2—32 to 50 inches, light yellowish-brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grain (structureless); loose, mildly alkaline; clear, smooth boundary.
- C3—50 to 80 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain (structureless); loose; mildly alkaline.

The A horizon ranges from 4 to 6 inches in thickness and from pale brown to brown in color. The C horizon is very pale brown to light yellowish brown.

The soils named for this series in Sherman County are outside of the range defined for the series, because the soil temperature is about 58° or 59° F. This difference does not affect their use and management.

**Tivoli fine sand, hummocky (TfC).**—This sloping to undulating soil is on uplands. Slopes are dominantly 7 percent but range from 5 to 10 percent. Areas have greater length than width and are subrounded. Areas are typically about 40 acres in size but range from about 10 acres to more than 80 acres.

Included with this soil in mapping are areas of Likes and Mobeetie soils. Small blowout areas are in a few places.

The hazard of soil blowing is severe. This soil is used for range. Capability unit VIIe-1, dryland; Deep Sand range site.

### Use and Management of the Soils

The first part of this section is concerned with use of the soils for crops. It briefly explains the system of capability classification used by the Soil Conservation Service and describes the capability units in Sherman County. Those who wish to know the capability classification of a given soil can refer to the "Guide to Mapping Units" at the back of this survey. Those who want detailed information about management of a soil can refer to the section "Descriptions of the Soils." Predicted yields are given for both dryland and irrigated crops for the major farming soils of the county.

This section also discusses use of the soils for range, for wildlife, and for engineering purposes.

### Capability Grouping

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

The grouping is based on permanent limitations of soils when used for field crops, the risk of damage when they are farmed, and the way the soils 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 that require 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 for range, for forest trees, or for engineering.

In the capability system, all kinds of soil are grouped at three levels: the class, the subclass, and the

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

The subclass specifies major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil interferes with plant growth or cultivation (in some soils 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* indicates that the chief limitation is a climate that is too cold or too dry.

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

Within the subclasses are capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and response to management. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-3.

Following is a descriptive outline of the system as it applies in Sherman County, Texas. To find the names of all the soils in a given capability unit, see the "Guide to Mapping Units" at the back of this survey, or refer to the notation at the end of the description of each mapping unit.

The capability units are not numbered consecutively in this county, because not all of the capability units used in a multicounty area of Texas are present in Sherman County.

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

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

Subclass IIe. Soils subject to moderate erosion if they are not protected.

Capability unit IIe-1, dryland.—Deep, nearly level, moderately permeable and moderately rapidly permeable fine sandy loam and clay loam.

Capability unit IIe-1, irrigated.—Deep, nearly level, moderately permeable loam to clay loam.

Capability unit IIe-2, irrigated.—Deep, nearly level, moderately slowly permeable clay loam.

Capability unit IIe-3, irrigated.—Deep, nearly level, moderately permeable fine sandy loam.

Subclass IIs. Soils that have moderate limitations of moisture capacity or tilth.

Capability unit IIs-1, irrigated.—Deep, nearly level, very slowly permeable clay loam.

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

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

Capability unit IIIe-1, dryland.—Deep, gently sloping, moderately permeable clay loam.

Capability unit IIIe-2, irrigated.—Deep, gently sloping, moderately permeable clay loam.

Capability unit IIIe-3, dryland.—Deep, nearly level to gently sloping, moderately permeable fine sandy loam.

Capability unit IIIe-3, irrigated.—Deep, gently sloping, moderately permeable fine sandy loam.

Capability unit IIIe-4, irrigated.—Deep, gently sloping to sloping, moderately permeable loam to clay loam.

Capability unit IIIe-6, irrigated.—Deep, nearly level to gently sloping, moderately permeable loam.

Subclass IIIc. Soils that are severely limited by climate.

Capability unit IIIc-1, dryland.—Deep, nearly level, very slowly permeable clay loam.

Capability unit IIIc-2, dryland.—Deep, nearly level, moderately permeable to moderately slowly permeable loam to clay loam.

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

Subclass IVe. Soils that are subject to severe erosion if they are not protected.

Capability unit IVe-1, irrigated. Deep, gently sloping, moderately rapidly permeable fine sandy loam.

Capability unit IVe-2, dryland.—Deep, nearly level to gently sloping, moderately permeable loam.

Capability unit IVe-2, irrigated.—Deep, gently sloping to sloping, moderately rapidly permeable fine sandy loam.

Capability unit IVe-3, dryland.—Deep, gently sloping, moderately rapidly permeable fine sandy loam.

Capability unit IVe-3, irrigated.—Deep, gently sloping, moderately permeable loam.

Capability unit IVe-6, dryland.—Deep, gently sloping, moderately permeable loam.

Class V. Soils that are not likely to erode but have other limitations, impractical to remove without major reclamation, that limit their use largely to

pasture, range, or wildlife habitat. (None in Sherman County.)

**Class VI.** Soils that have severe limitations that make them unsuitable for cultivation and that limit their use largely to range or wildlife food and cover.

**Subclass VIe.** Soils that are severely limited, chiefly by risk of erosion, if protective cover is not maintained; some of these soils can be cultivated under irrigation.

Capability unit VIe-1, dryland.—Deep, gently sloping to strongly sloping, moderately permeable to moderately rapidly permeable loam and loamy fine sand.

Capability unit VIe-2, dryland.—Deep, sloping to strongly sloping, moderately rapidly permeable fine sandy loam.

Capability unit VIe-3, dryland.—Deep, gently sloping to sloping, moderately permeable loam to clay loam.

**Subclass VIw.** Soils where water in or on the soil interferes with plant growth or cultivation.

Capability unit VIw-1, dryland.—Deep, nearly level, very slowly permeable clay.

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

**Subclass VIIe.** Soils that are very severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIIe-1, dryland.—Deep, sloping, rapidly permeable fine sand.

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

Capability unit VIIs-1, dryland.—Very shallow to caliche, gently sloping to steep, moderately permeable loamy soils and Rough broken land.

**Class VIII.** Soils and landforms that have limitations that preclude their use, without major reclamation,

for commercial production of plants and restrict their use to recreation, wildlife habitat, or esthetic purposes. (None in Sherman County.)

**Estimated Yields**

Crop yields in Sherman County depend on how well the soils have been managed. Consistent high yields can be obtained if the soils are used within their capabilities and are managed according to their needs.

Table 2 gives for each soil in the county that is commonly used for crops the predicted average yields per acre under a high level of management. These predictions are for dryland and irrigated crops. Wheat and grain sorghum are the principal crops. The predictions are based on information obtained from farmers and others familiar with the soils.

A high level of management for dryland soils in the county consists of—

1. Managing crop residue to control erosion and to protect the soil.
2. Using a cropping sequence that maintains an adequate supply of organic matter.
3. Conserving rainwater.
4. Applying fertilizer and growing soil-improving crops to maintain fertility.
5. Controlling insects, diseases, and weeds.
6. Keeping tillage to a minimum and tilling only when the moisture content is such that compaction is minimized.
7. Planting improved crop varieties.
8. Maintaining terraces and other mechanical aids.
9. Applying water to satisfy the needs of crops and soils.
10. Coordinating tillage with irrigation.
11. Using properly designed irrigation systems and land treatments to reduce erosion.

TABLE 2.—Estimated yields per acre of principal crops grown on selected soils under a high level of management

[Absence of an entry indicates the crop is not grown on the soil specified]

Soil	Dryland crops		Irrigated crops	
	Wheat	Grain sorghum	Wheat	Grain sorghum
	Bu	Lb	Bu	Lb
Conlen loam, 0 to 1 percent slopes.....	10	750	40	4,500
Dalhart fine sandy loam, 0 to 1 percent slopes.....	16	1,200	60	6,300
Dalhart fine sandy loam, 1 to 3 percent slopes.....	16	1,200	55	5,700
Dumas loam, 0 to 1 percent slopes.....	15	1,000	75	7,800
Gruver clay loam, 0 to 1 percent slopes.....	15	1,000	75	7,800
Manzano clay loam.....	15	900	65	7,500
Sherm clay loam, 0 to 1 percent slopes.....	14	800	70	7,500
Spurlock loam, 1 to 3 percent slopes.....	8	700	35	4,000
Spurlock loam, 3 to 5 percent slopes.....	8	700		
Sunray clay loam, 0 to 1 percent slopes.....	11	900	65	6,600
Sunray clay loam, 1 to 3 percent slopes.....	10	800	50	5,500

## Use and Management of Range <sup>2</sup>

Ranching is important in Sherman County. There are about 32 ranching units that range from 750 acres to 38,000 acres in size. The average size is 7,000 acres. Native grasses cover approximately 43 percent of the county. Most of the range is in the northeastern part of the county and along drainageways scattered throughout the county. An average annual rainfall of about 16.5 inches permits good grass production, except in years of below-average rainfall.

Livestock operations are primarily cow-calf on all bona fide ranching units. Some ranchers include stocker cattle with their cow-calf operation. Most ranches have a small acreage of cropland that is used to produce wheat, sudangrass, or forage sorghum for grazing. Several thousand head of stockers are brought in annually to graze wheatfields. These cattle are shipped into the county in September and in October and are sent to market in May. Some ranchers bring in stockers the first part of June and take them to feedlots in October. In recent years some stockmen have purchased irrigated wheat crops for grazing stocker cattle. Although the cost per acre appears to be high, as many as five stockers per acre can be safely grazed during April and May. Another recent trend is the establishment of feedlots that have a capacity to feed 10,000 to 25,000 head of cattle. More than 100,000 animals are fed each year in Sherman County. Most of these operations feed locally produced corn ensilage and corn and milo grain.

Cold winters hamper cattle operations and force ranchers to break ice frequently to make water available to cattle. Supplemental feeding begins early in winter and extends well into spring. Only protein concentrates are fed, except during severe snows, when hay is also used.

Soils on the ranches are primarily clay loam, fine sandy loam, or loamy fine sand. Gently sloping to steep soils and rough, broken areas are prevalent. These are dissected by district drainage patterns. Creeks and rivers drain toward the east and northeast.

The native grassland has been heavily grazed for several generations. As a result the more desirable grasses and forbs have been grazed out and there is a wide variety of less desirable grasses. Although these grasslands have been abused in the past, they are still a source of seed for the better species.

The only areas of native grassland that require re-seeding are those that have been mechanically disturbed by the installation of pipelines, electrical highlines, and natural gas industrial works. Grassland management, rather than grassland restoration, is the key to improvement. Sand sagebrush and yucca are the chief undesirable plants.

### Range sites and condition classes

Range sites are classified according to their capacity to produce native vegetation. Range sites differ in ability to produce significantly different kinds or proportions of plant species. They also differ in total an-

nual yield. This requires some variation in management, such as a different rate of stocking. Kind, proportion, and production of plants vary because of differences in environmental factors such as topography and climate. Each range site has its own soils and environmental conditions. These produce the distinctive climax vegetation, or potential plant community, that characterizes a specific site.

Most of the native grassland of Sherman County has been heavily grazed for several generations, and its original plant cover has been materially altered. Range condition is the present state of vegetation on a range site in relation to the potential plant cover for that site. Range condition classes measure the degree to which the present plant composition, expressed as a percentage, resembles that of the potential plant community for that site.

Four range classes are recognized—excellent, good, fair, and poor. A range is in *excellent* condition if 76 to 100 percent of the vegetation is the same kind as that in the original stand; it is in *good* condition if the percentage is between 51 and 75; in *fair* condition if the percentage is between 26 and 50; and in *poor* condition if the percentage is 25 or less.

In determining the range condition on a given range site, plants are grouped in accordance with their response to the kind of grazing use on the site. These plant groups are referred to as decreaseers, increaseers, and invaders.

*Decreaser plants* are members of the potential plant community that decrease in relative abundance when the community is subject to continued moderately heavy to heavy grazing. Most of these plants have a high grazing preference and decrease with excessive use. The total of all such species is counted in determining the range condition class.

*Increaseer plants* are members of the potential plant community that increase in relative abundance when the community is subject to continued moderately heavy to heavy grazing. Some increaseers with a moderately high grazing preference may initially increase, and then decrease as grazing pressure continues. Those of lower grazing preference may continue to increase in plant number or in relative proportions. Only the percentages of increaseer plants normally expected to be in the potential plant community are counted in determining range condition.

*Invader plants* are not members of the potential plant community. They invade the community as a result of various kinds of disturbance. They may be annuals or perennials, and they may be grasses, weeds, or woody plants. Some have relatively high grazing value; many are worthless because they provide very little grazing and compete with the more desirable plants for sunlight, moisture, and nutrients. Invader plants are not counted in determining range condition.

For most range sites and most range livestock operations, the higher the range condition class, the greater the quality and amount of available forage.

### Descriptions of the range sites

The range sites in Sherman County are described on the pages that follow. Climax plants and principal in-

<sup>2</sup> By JOHN A. WRIGHT, range conservationist, Soil Conservation Service.

vaders are named. In each description are estimates of the potential annual production of air-dry herbage for each site in excellent condition. The "Guide to Mapping Units" shows the range site into which each soil in the county has been placed.

#### DEEP HARDLAND RANGE SITE

This site is accessible to livestock and is favored for grazing. It consists of deep, loamy, nearly level to gently sloping soils. These soils are moderately permeable to very slowly permeable and have high available water capacity. In places they contain a compacted layer, or hoofpan, caused by trampling livestock.

Approximately 40 percent, by weight, of the climax plant community is blue grama, 10 percent is western wheatgrass, 10 percent is buffalograss, 5 percent is vine-mesquite, 5 percent is side-oats grama, 5 percent is wild alfalfa, 5 percent is silver bluestem, 5 percent is plains bristlegrass, 3 percent is gray coldenia, 2 percent is skeletonplant, 7 percent is annual forbs, and 3 percent is annual grasses.

Under continued heavy grazing, blue grama, vine-mesquite, and western wheatgrass become thinner in the plant community. Plants such as buffalograss become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 1,300 to 2,100 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### DEEP SAND RANGE SITE

This site consists of deep, sandy, sloping and undulating to hummocky soils on uplands. Many areas have the appearance of stabilized dunes. These soils are rapidly permeable and have low available water capacity. The hazard of soil blowing is severe. This site deteriorates rapidly under continued heavy grazing, but it responds to good management.

Approximately 10 percent, by weight, of the climax plant community is little bluestem, 10 percent is sand bluestem, 8 percent is switchgrass, 5 percent is indian-grass, 5 percent is sand lovegrass, 5 percent is side-oats grama, 5 percent is silver bluestem, 5 percent is sand dropseed, 5 percent is big sandreed, 5 percent is skunkbush 4 percent is three-awns, 3 percent is giant dropseed, 3 percent is wild alfalfa, 3 percent is prairie-clover, 3 percent is hairy grama, 3 percent is annual grasses, 2 percent is Canada wildrye, 2 percent is leadplant, 2 percent is catclaw sensitivebrier, 2 percent is blue grama, 2 percent is sand plum, 2 percent is annual forbs, and 1 percent is Texas bluegrass.

Under continued heavy grazing, sand bluestem, little bluestem, indiangrass, and switchgrass become thinner in the plant community. Plants such as sand lovegrass and Canada wild-rye become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 1,200 to 3,200 pounds per acre. About 95 percent of this yield can be considered suitable forage for cattle.

#### HARDLAND SLOPES RANGE SITE

This site consists of deep, loamy, nearly level to strongly sloping soils. These soils are moderately

permeable and have high available water capacity. The hazards of soil blowing and water erosion are moderate.

Approximately 40 percent, by weight, of the climax plant community is side-oats grama, 15 percent is blue grama, 10 percent is little bluestem, 8 percent is annual forbs, 5 percent is buffalograss, 5 percent is three-awns, 5 percent is sand dropseed, 5 percent is plains blackfoot, 3 percent is prairie-clover, 2 percent is dotted gayfeather, and 2 percent is annual grasses.

Under continued heavy grazing, side-oats grama, little bluestem, and prairie-clover become thinner in the plant community. Plants such as blue grama and buffalograss become thicker.

If this site is in excellent condition, total annual production of air-dry herbage ranges from 1,300 to 2,100 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### HIGH LIME RANGE SITE

This site consists of deep, loamy, gently sloping to sloping soils. It is generally 30 to 50 feet higher than surrounding sites. These soils are moderately permeable and have moderate available water capacity. The hazards of soil blowing and water erosion are severe.

Approximately 30 percent, by weight, of the climax plant community is side-oats grama, 20 percent is blue grama, 10 percent is vine-mesquite, 10 percent is alkali sacaton, 5 percent is plains bristlegrass, 5 percent is buffalograss, 5 percent is sand dropseed, 5 percent is inland saltgrass, 5 percent is broom snakeweed, and 5 percent is annuals.

Under continued heavy grazing, blue grama, vine-mesquite, side-oats grama, and plains bristlegrass become thinner in the plant community. Plants such as buffalograss become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 1,100 to 1,800 pounds per acre. About 80 percent of this production can be considered suitable forage for cattle.

#### LOAMY BOTTOMLAND RANGE SITE

This site consists of deep, loamy, nearly level soils on flood plains along streambeds and in draws. These soils are moderately permeable to moderately rapidly permeable and have moderate to high available water capacity. They receive runoff from adjacent areas. They are under water for only short periods, and any damage to vegetation is from sedimentation rather than from wetness.

Approximately 15 percent, by weight, of the climax plant community is switchgrass, 10 percent is indian-grass, 5 percent is little bluestem, 5 percent is Canada wildrye, 5 percent is prairie cordgrass, 5 percent is eastern gamagrass, 5 percent is western wheatgrass, 5 percent is alkali sacaton, 5 percent is tall dropseed, 5 percent is silver bluestem, 5 percent is sedges, 5 percent is inland saltgrass, 5 percent is annual forbs, 5 percent is woody plants, 3 percent is side-oats grama, 3 percent is heath aster, 3 percent is vine-mesquite, 2 percent is sand bluestem, 2 percent is Texas bluegrass, and 2 percent is blue grama.

Under continued heavy grazing, switchgrass, indiangrass, sand bluestem, little bluestem, and side-oats

grama become thinner in the plant community. Plants such as Canada wildrye and prairie cordgrass become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 2,100 to 3,800 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### MIXEDLAND SLOPES

This site consists of deep, loamy, gently sloping to strongly sloping soils along drainageways. These soils are moderately rapidly permeable and have moderate available water capacity. In most places erosion is slight, but a few gullies have been cut in old cattle trails and roads.

Approximately 25 percent, by weight, of the climax plant community is little bluestem, 15 percent is side-oats grama, 15 percent is blue grama, 10 percent is sand bluestem, 5 percent is buffalograss, 5 percent is sand dropseed, 5 percent is sand sagebrush, 5 percent is yucca, 5 percent is annual grasses, 5 percent is annual forbs, 2 percent is dotted gayfeather, 2 percent is hairy grama, and 1 percent is prairie-clover.

Under continued heavy grazing, side-oats grama, little bluestem, and sand bluestem become thinner in the plant community. Plants such as blue grama and buffalograss become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 1,200 to 2,500 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### ROUGH BREAKS RANGE SITE

This site consists only of Rough broken land. Areas of this site consist of limestone, caliche, and dolomite outcrops; spots of shallow soils on mesas; and shallow soils on foot slopes. Areas of this site are mostly very steep, and the hazard of erosion is severe. Some areas of this site are not accessible to livestock.

Approximately 25 percent, by weight, of the climax plant community is little bluestem, 10 percent is sand bluestem, 10 percent is switchgrass, 10 percent is side-oats grama, 10 percent is annual forbs, 8 percent is skunkbush, 5 percent is indiangrass, 5 percent is hairy grama, 5 percent is rough tridens, 5 percent is annual grasses, 2 percent is black samson, 2 percent is dotted gayfeather, 2 percent is sand dropseed, and 1 percent is catclaw sensitivebrier.

Under continued heavy grazing, sand bluestem, little bluestem, indiangrass, and switchgrass become thinner in the plant community. Plants such as side-oats grama and hairy grama become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 550 to 950 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### SANDYLAND RANGE SITE

This site consists of deep, sandy, gently sloping to sloping soils in valleys. These soils are moderately rapidly permeable and have low available water capacity. The hazard of soil blowing is severe. Overgrazing causes rapid deterioration, but the site responds well to good management.

Approximately 10 percent, by weight, of the climax plant community is little bluestem, 10 percent is sand bluestem, 5 percent is indiangrass, 8 percent is switchgrass, 3 percent is Canada wildrye, 2 percent is needle-and-thread, 3 percent is sand lovegrass, 2 percent is leadplant, 2 percent is bigtop dalea, 3 percent is roundhead lespedeza, 2 percent is prairie-clover, 5 percent is blue grama, 5 percent is side-oats grama, 5 percent is three-awn, 5 percent is sand dropseed, 6 percent is sand sagebrush, 5 percent is sand plum, 5 percent is skunkbush, 2 percent is longleaf wild-buckwheat, 3 percent is mentzelia, 5 percent is annual grasses, and 5 percent is annual forbs.

Under continued heavy grazing, sand bluestem, little bluestem, indiangrass, and switchgrass become thinner in the plant community. Plants such as Canada wildrye, needle-and-thread, and sand dropseed become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 1,800 to 3,350 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### SANDY LOAM RANGE SITE

This site consists of deep, loamy, nearly level to gently sloping soils. They are moderately permeable and have high available water capacity. The hazards of soil blowing and water erosion are moderate. Overgrazed areas may become infested with yucca (fig. 11).

Approximately 10 percent, by weight, of the climax plant community is side-oats grama, 5 percent is needle-and-thread, 10 percent is little bluestem, 5 percent is sand bluestem, 10 percent is indiangrass, 5 percent is switchgrass, 5 percent is Canada wildrye, 5 percent is Texas bluegrass, 2 percent is leadplant, 3 percent is prairie-clover, 10 percent is blue grama, 5 percent is buffalograss, 5 percent is sand dropseed, 5 percent is sand sagebrush, 5 percent is longleaf wild-buckwheat, 5 percent is annual grasses, and 5 percent is annual forbs.

Under continued heavy grazing, side-oats grama becomes thinner in the plant community. Plants such as needle-and-thread become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 1,600 to 2,500 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

#### VERY SHALLOW RANGE SITE

This site consists of loamy, sloping to steep soils that are very shallow to caliche. The site is characterized by outcrops of caliche. (fig. 12). Some narrow, steep escarpments and gullies are included with this site. Vegetation is commonly sparse.

Approximately 10 percent, by weight, of the climax plant community is little bluestem, 5 percent is sand bluestem, 5 percent is indiangrass, 10 percent is switchgrass, 3 percent is bigtop dalea, 5 percent is dotted gayfeather, 5 percent is black samson, 15 percent is side-oats grama, 5 percent is hairy grama, 10 percent is blue grama, 5 percent is three-awn, 5 percent is sand dropseed, 5 percent is rough tridens, 2 percent



**Figure 11.**—Area of Sandy Loam range site infested with yucca. The soil is Dalhart fine sandy loam.

is plains blackfoot, 2 percent is annual grasses, and 8 percent is annual forbs.

Under continued heavy grazing, sand bluestem, little bluestem, indiagrass, and switchgrass become thinner in the plant community. Plants such as blue grama and hairy grama become thicker.

If this site is in excellent condition, the total annual production of air-dry herbage ranges from 850 to 1,750 pounds per acre. About 95 percent of this production can be considered suitable forage for cattle.

### Use of the Soils for Wildlife

The principal kinds of wildlife in Sherman County are pheasant, bobwhite quail, scaled (blue) quail, dove, cottontail rabbit, jackrabbit, prairie dogs, hawks, and numerous songbirds. The county also has pronghorn antelope, badger, porcupine, fox, skunk, opossum, and other furbearers. Common predators are bobcat and coyote. Playa lakes, ponds, and grainfields attract ducks and geese during migration, and most farm and ranch ponds are stocked with fish.

Successful management of wildlife on any tract of land requires, among other things, that food, cover, and water be available in a suitable combination. A lack of any one of these necessities, unfavorable balance between them, or inadequate distribution of them can severely limit desired wildlife species. Information about soils is a valuable tool for creating, improving, or maintaining suitable food, cover, and water for wildlife.

Most wildlife habitats are managed by planting suitable vegetation; by manipulating existing vegetation to bring about the natural establishment, increase, or improvement of desired plants; or by combinations of such measures. The ways in which soil influences growth are known for many plants. Unknown influences are suggested by characteristics and behavior of the soil. Soil information is useful in planning new water areas for wildlife or in improving natural ones.

Soil interpretations for wildlife habitat aid in selecting suitable sites for wildlife management, they indicate the intensity of management needed to achieve



Figure 12.—Area of Very Shallow range site in Pastura complex.

satisfactory results, and they show why it may not be feasible to manage a particular area for a given kind of wildlife. Soil interpretations are also useful in acquiring wildlife lands and in broad-scale planning of wildlife management areas, parks, and nature areas.

Soil properties that affect development of wildlife habitat are thickness of soil useful to crops, surface texture, available water capacity to a depth of 40 inches, wetness, surface stoniness or rockiness, hazard of flooding, and slope.

Soil areas shown on the soil survey maps are rated without regard to positional relationships with adjoining mapped areas. The size, shape, or location of the outlined area does not affect the rating. Certain influences on habitat, such as elevation and aspect, must be appraised on the site.

In table 3 the soils of Sherman County are rated according to their suitability for developing, improving, or maintaining each of six elements of wildlife habitat and three kinds of wildlife. These ratings are based upon limitations imposed by the characteristics or behavior of the soil. A rating of *well suited* indicates that habitat generally is easily created, improved, or maintained, that the soil has few or no limitations

that affect management, and that satisfactory results can be expected. *Suited* indicates that habitat can be created, improved, or maintained in most places, that the soil has moderate limitations that affect management, and that moderate intensity of management and fairly frequent attention may be required for satisfactory results. *Poorly suited* indicates that habitat can be created, improved, or maintained in most places, that the soil has rather severe limitations, that habitat management is difficult and expensive and requires intensive effort, and that results are not always satisfactory. For short-term use, however, soils rated poorly suited may provide easy establishment and temporary values. *Unsuited* indicates that the soil limitation is so extreme that it is impractical, if not impossible, to manage the designated habitat element, and unsatisfactory results are probable.

The six elements of wildlife habitat rated in table 3 are defined in the following paragraphs.

*Grain and seed crops.*—Agricultural grains or seed-producing annuals planted to produce food for wildlife. Examples are corn, sorghums, millets, soybeans, wheat, oats, and sunflower.

*Grasses and legumes.*—Domestic perennial grasses and legumes planted to furnish food and cover for wildlife. Examples are western wheatgrass, ryegrass, fescue, and panicgrasses. Legumes include such species as clovers, lespedezas, and alfalfa.

*Wild herbaceous plants.*—Perennial grasses, forbs, and weeds that provide food and cover for wildlife. Examples are beggarweed, perennial lespedezas, wild bean, indiagrass, wild ryegrass, and bluestems.

*Hardwood trees and shrubs.*—Nonconiferous trees, shrubs, and woody vines that commonly become established through natural processes but can be planted. These plants produce fruits, nuts, buds, catkins, or foliage (browse) and are used extensively for food by wildlife. Examples are mountain mahogany, black dalea, skunkbush, catclaw hackberry, redberry juniper, sandbrush, and sand plum.

*Wetland food and cover plants.*—Annual and perennial wild herbaceous plants in moist to wet sites, exclusive of submerged or floating aquatics, that produce food or cover that is extensively and dominantly used by wetland wildlife. Examples are smartweed, wild millet, bulrush, spikeseed, rushes, sedges, burweeds, dock, and cattails.

*Shallow-water developments.*—Low dikes and water-control structures established to create habitat, principally for water fowl. They can be designed to allow draining, planting, and flooding or they can be used as permanent impoundments for growing submerged aquatics. Fresh water and brackish water situations are included.

The three general kinds of wildlife rated in table 3 are defined in the following paragraphs.

*Openland wildlife.*—Birds and mammals that generally frequent cropland, pastures, and areas overgrown with grapes, herbs, and shrubby growth. Examples are pheasant, antelope, quail, cottontail rabbit, jack rabbit, prairie dogs, meadow lark, and lark sparrow.

*Brushland wildlife.*—Birds and mammals that generally frequent areas of hardwood trees and shrubs. Examples are badger, fox, and porcupine.

*Wetland wildlife.*—Birds and mammals that generally frequent ponds, streams, ditches, marshes, and swamps. Examples are ducks, geese, rails, shorebirds, and snipe.

### Engineering Uses of the Soils <sup>3</sup>

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. 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 are treated in this section. Among the soil properties most important in engineering are permeability, compressibility, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties are furnished in tables 4 and 5. The estimates and interpretations of soil properties in these tables can be used in:

1. Planning 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 sand, gravel, or rock suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational areas.

The engineering interpretations reported in this section 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 shown in the tables. Even in these situations, the soil map is useful for planning more detailed field investigations and for indicating the kinds of problems that can be expected. The estimated values for traffic-supporting capacity expressed in words should not be assigned specific values. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soils that have strongly contrasting properties and different suitabilities and limitations for engineering use.

Some terms used by soil scientists may be unfamiliar to engineers, and some terms may have different meanings in soil science than they have in engineering. Among the terms that have special meanings in soil science are gravel, sand, silt, clay, and horizon. These terms are defined in the Glossary at the back of this survey.

#### Engineering classification systems

The two systems most commonly used by engineers to classify soil are the AASHTO system, adopted by the American Association of State Highway Officials, (1) and the Unified system, used by SCS engineers, the Department of Defense, and others (8). Both systems are explained in the PCA Soil Primer (3).

The AASHTO system is used to classify soils according to those properties that affect use in highway construction. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, which are the best soils for subgrade. At the other extreme are clay soils that have low strength when wet. The best soils for subgrade are therefore 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; and A-7-5, 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 num-

<sup>3</sup> By JOHN W. JACKSON, area engineer, Soil Conservation Service.

TABLE 3.—*Suitability of the soils for elements*

Soil series and map symbols	Elements of wildlife habitat		
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants
Berthoud: BeC, BeD	Suited	Well suited	Well suited
Cass: Ch	Suited	Well suited	Well suited
Conlen: CoA	Suited	Well suited	Well suited
Dalhart: DaA, DaB	Well suited	Well suited	Well suited
Dumas: DuA	Well suited	Well suited	Well suited
Gruver: GrA	Well suited	Well suited	Well suited
Humbarger	Suited	Well suited	Well suited
Karde: KaC	Suited	Well suited	Well suited
Likes: Lk	Poorly suited	Well suited	Well suited
Manzano: Ma	Well suited	Well suited	Well suited
Mobeetie: MoC, MoD	Suited	Well suited	Well suited
Ness: Ne	Suited	Suited	Suited
Pastura: Pa	Poorly suited	Poorly suited	Poorly suited
Rough broken land: Ro	Poorly suited	Poorly suited	Poorly suited
Sherm: ShA	Well suited	Well suited	Well suited
Spurlock: SpB, SpC	Well suited	Well suited	Well suited
Sunray: SuA, SuB	Well suited	Well suited	Well suited
Tivoli: TfC	Poorly suited	Poorly suited	Poorly suited

ber. Group indexes range from 0 for the best material to 20 for the poorest. The estimated classification for all soils mapped in the survey area is given in table 4.

In the Unified system, soils are classified according to grain-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 of two classes are designated by symbols for both classes; for example, ML-CL.

#### **Estimated properties significant to engineering**

Table 4 provides estimates of soil properties important to engineering. These estimates are based on field classification and descriptions, physical and chemical tests of selected representative samples, test data from comparable soils in adjacent areas, and detailed experience in working with the individual kind of soil in the survey area. Following are explanations of some of the columns in table 4.

Hydrologic soil groups give information about the runoff potential of soil as affected by rainfall. Four major soil groups are used. These soils are classified on the basis of water intake at the end of a long-lasting storm occurring after prior wetting and opportunity for swelling, and without the protection of vegetation.

The major soil groups are:

- A. (Low runoff potential). These soils have high infiltration rates, even when thoroughly wetted. They consist chiefly of deep, well-drained to excessively drained sand or gravel. These soils have a high rate of water transmission.
- B. These soils have moderate infiltration rates when thoroughly wetted. They consist chiefly

of moderately deep to deep, moderately well drained to well-drained soils that are moderately fine to moderately coarse in texture. These soils have a moderate rate of water transmission.

- C. These soils have slow infiltration rates when thoroughly wetted. They have a layer that impedes downward movement of water. They are well-drained soils that are moderately fine to medium coarse in texture. These soils have a slow rate of water transmission.
- D. (High runoff potential). These soils have very slow infiltration rates when thoroughly wetted. They consist chiefly of clay soils that have a high swelling potential, soils that have a permanent high water table, soils that have a claypan or clay layer on or near the surface, and shallow soils that overlay nearly impervious material. These soils have a very slow rate of water transmission.

Texture is determined by the relative proportions of sand, silt, and clay in the soil. "Sand," "silt," "clay," and some of the other terms that have special meaning in soil science are used in the USDA textural classification and defined in the Glossary at the end of this survey.

Permeability is the quality of a soil that enables water or air to move through it. It relates only to movement, in the case of water, downward through undisturbed and uncompacted soil. It does not include lateral seepage. Estimates are based on structure and porosity of a soil. Plowpans, surface crusts, and other properties resulting from use of soil are not considered. Permeability is described as very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Available water capacity is the amount of water a soil can hold and make available to plants. It is the

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Continued			Kinds of wildlife		
Hardwood trees and shrubs	Wetland food and cover plants	Shallow-water developments	Openland	Brushland	Wetland
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Suited	Poorly suited	Poorly suited	Well suited	Poorly suited	Poorly suited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Suited	Poorly suited	Poorly suited	Well suited	Poorly suited	Poorly suited.
Unsuited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Suited	Suited	Suited	Suited	Poorly suited	Suited.
Poorly suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Unsuited.

numerical difference between the percentage of water at field capacity and the percentage of water at the time plants wilt. The rate is expressed as inches of water per inch of soil.

Reaction is the degree of acidity or alkalinity of a soil expressed as a pH value. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is an indication of the volume change to be expected in soil material as changes occur in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential is a hazard to the maintenance of structures constructed in, on, or with materials having this rating.

Soil salinity is not a concern in Sherman County, because the soils are not naturally saline. In Sherman County depth to bedrock is generally well below the depths to which the soils were investigated in field mapping. The depth to indurated caliche is 4 to 10 inches in the Pastura soils.

The water table in the soils of this county is many feet below the surface. The Cass, Humbarger, and Ness soils are temporarily flooded after heavy rains.

**Engineering interpretations of the soils**

Table 5 contains selected information that is useful to engineers and others who plan to use soil material in the construction of highways, farm facilities, buildings, and sewage disposal systems. Detrimental features are emphasized. Ratings and other interpretations in this table are based on estimated physical and chemical properties of the soils provided in table 4, on available test data, and on field experience. Although the information strictly applies only to soil depths indicated in table 4, it is reasonably reliable to a depth of about 6 feet for most soils, and several more for some.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties generally are favorable for the rated use or that limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation and special designs are needed.

Soil suitability is rated *good*, *fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 5.

Topsoil refers to fertile soil or soil material, ordinarily rich in organic matter, that is used as a top-dressing for lawns, gardens, roadbanks, and the like.

Road subgrade is soil material on which a subbase is laid and the pavement is built. Suitability ratings are based on performance of the soil material as a subgrade if excavated and compacted or if compacted and used in place.

The rating of a soil for highway location is influenced by features of the undisturbed soil that affect geographic location, construction, and maintenance of highways. Among these features are wetness and susceptibility to flooding, slope, and content of stones and rocks.

Soil features considered in the ratings for foundations for low buildings are chiefly those of the undisturbed soil that determine its capacity to support low buildings that have normal foundation loads. Among these features are slope, wetness, plasticity, density, and shrink-swell potential.

Soil features that affect septic tank filter fields are mainly permeability, location of water table, and susceptibility to flooding.

Suitability ratings of a soil considered for use as

TABLE 4.—*Estimated soil prop*

[An asterisk in the first column indicates that the mapping unit is made up of  
It is therefore necessary to follow carefully the instructions for referring to

Soil series and map symbols	Hydro-logic soil group	Depth from surface	Classification		
			USDA texture	Unified	AASHO
Berthoud: BeC, BeD.....	B	<i>Inches</i> 0-80	Loam.....	ML, CL	A-4, A-6
* Cass: Ch..... For Humbarger part, see Humbarger series.	A	0-60	Fine sandy loam.....	SM or SM-SC	A-2-4 or A-4
Conlen: CoA.....	B	0-10	Loam.....	SM, ML, CL, SC	A-6, A-4
Dalhart: DaA, DaB.....	B	10-84	Clay loam.....	CL, ML	A-6
		0-9	Fine sandy loam.....	SM	A-2, A-4
		9-36	Sandy clay loam.....	CL, SC	A-2, A-6
Dumas: DuA.....	B	36-84	Sandy clay loam.....	SC, CL	A-6
		0-7	Loam.....	CL, CL-ML	A-4
		7-34	Clay loam.....	CL	A-6
Gruver: GrA.....	C	34-84	Clay loam.....	CL	A-6, A-4
		0-6	Clay loam.....	CL	A-6
		6-24	Clay loam.....	CH, CL	A-7-6
Humbarger: Mapped only in an undifferentiated group with Cass soils.	B	24-84	Clay loam.....	CL, CH	A-7, A-6
		0-44	Clay loam.....	CL, ML	A-6, A-4
		44-60	Loam.....	CL, ML	A-6, A-4
Karde: KaC.....	B	0-80	Loam.....	SC, CL	A-4, A-6
Likes: Lk.....	A	0-80	Loamy fine sand	SM-SC or SP-SM	A-2-4
Manzano: Ma.....	B	0-84	Clay loam and silty clay loam.	CL	A-6
Mobeetie: MoC, MoD.....	B	0-80	Fine sandy loam.....	SM-SC	A-4
Ness: Ne.....	D	0-41	Clay.....	CH	A-7
		41-80	Silty clay loam.....	CH	A-7
Pastura: Pa.....	C	0-6	Loam.....	ML, CL, ML-CL	A-6, A-4
		6-34	Indurated caliche.		
Rough broken land: Ro..... Properties too variable to rate.					
Sherm: ShA.....	D	0-5	Clay loam.....	CL	A-6, A-7-6
		5-35	Clay.....	CH, CL	A-7-6
		35-84	Clay loam.....	CL	A-6, A-7-6
Spurlock: SpB, SpC.....	B	0-7	Loam.....	CL-ML, CL	A-4, A-6
		7-84	Clay loam.....	ML, CL	A-6, A-4
Sunray: SuA, SuB.....	B	0-84	Clay loam.....	CL	A-6, A-7-6
Tivoli: TfC.....	A	0-80	Fine sand.....	SP-SM	A-3

sites for sewage lagoons are influenced chiefly by soil features such as permeability, depth of water table, and slope.

Features considered in rating a soil for farm pond reservoir areas are mainly those that affect loss of water through seepage.

Farm pond embankments serve as dams. Properties of both the subsoil and the substratum are important to the use of soils for constructing embankments.

Camp areas, intended for extensive camping, need to be on soils that do not require hard surfaces for parking, and that have no hard layers to interfere with setting tent pegs. Bearing strength of the natural soil, as influenced by soil texture and soil moisture, is a particularly important criterion in rating a soil for this purpose. Susceptibility to flooding and dust or muddiness, slope, and stoniness are other criteria used in rating a soil as prospective camping areas. Grassy, tree-shaded grounds are most desirable for campsites.

Picnic areas are tree-shaded, park-type sites that have tables and cooking grills and that are readily accessible by automobile. It is assumed that vehicular traffic will be confined to access roads. Susceptibility to flooding, slope, texture of the surface, and amount of coarse fragments on the surface are properties considered in evaluating the suitability of the soils for picnic areas.

Playgrounds are natural soil areas used as playing grounds for organized sports and games. These areas are subject to intensive foot traffic and need to be nearly level, have good drainage, and have a firm surface free of rock outcrop and stones.

Paths and trails are footpaths, hiking trails, or bridle paths along which the seeker of recreation has the opportunity to enjoy the beauties of nature. In rating the suitability of a soil for this purpose, it is assumed that only enough natural vegetation will be removed to provide a pathway, and that few excavations or fills

*erties significant to engineering*

two or more kinds of soil that may have different properties and limitations. other series that appear in the first column. The symbol < means less than.]

Percentage less than 3 inches 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)				
		100	55-85	<i>Inches per hour</i> 0.63-2.00	<i>Inches per inch of soil</i> 0.12-0.16	<i>pH</i> 7.9-8.4	Low.
95-100	95-100	75-85	30-45	2.0-6.30	0.10-0.13	7.9-8.4	Low.
95-100	95-98	85-95	35-70	0.63-2.0	0.15-0.18	7.9-8.4	Low.
90-100	85-98	85-95	50-80	0.63-2.0	0.12-0.16	7.9-8.4	Low.
	100	95-100	25-50	2.0-6.30	0.11-0.15	6.6-7.3	Low.
95-100	95-100	95-100	30-65	0.63-2.0	0.13-0.17	7.4-8.4	Low.
75-100	70-100	65-95	45-75	0.63-2.0	0.09-0.13	7.4-8.4	Low.
	100	95-100	50-75	0.63-2.0	0.12-0.16	6.6-7.3	Low.
	100	95-100	70-80	0.63-2.0	0.14-0.18	6.6-8.4	Moderate.
100	95-100	80-95	65-70	0.63-2.0	0.12-0.18	7.9-8.4	Low.
99-100	95-100	85-100	55-85	0.63-2.0	0.15-0.18	7.4-7.8	Low.
	100	100	94-98	0.20-0.63	0.16-0.20	7.4-7.8	Moderate.
95-100	90-100	85-98	85-98	0.20-0.63	0.13-0.16	7.4-8.4	Moderate.
	100	95-98	65-80	0.63-2.0	0.10-0.14	7.9-8.4	Low.
		100	50-80	0.63-2.0	0.12-0.16	7.9-8.4	Low.
	100	70-80	40-60	0.63-2.0	0.10-0.15	7.9-8.4	Low.
92-98	92-98	75-95	12-30	2.0-6.3	0.06-0.10	7.9-8.4	Low.
100	95-100	90-100	80-90	0.63-2.0	0.15-0.18	7.4-8.4	Low.
100	95-100	90-95	40-50	2.0-6.3	0.10-0.13	7.9-8.4	Low.
	100	96-100	75-95	<0.06	0.14-0.18	6.6-7.8	High.
	100	96-100	75-95	<0.06	0.14-0.18	7.4-7.8	High.
80-95	70-90	60-85	50-70	0.63-2.0	0.12-0.16	7.9-8.4	Low.
		100	85-96	0.06-0.20	0.16-0.20	7.4-7.8	Moderate.
		100	80-99	<0.06	0.15-0.19	7.4-8.4	High.
97-100	95-100	94-99	75-92	0.2-0.63	0.13-0.17	7.9-8.4	Moderate.
93-100	90-100	85-99	55-70	0.63-2.0	0.13-0.16	7.9-8.4	Low.
94-100	85-97	84-90	50-70	0.63-2.0	0.12-0.14	7.9-8.4	Low.
95-100	95-100	85-100	50-95	0.63-2.0	0.13-0.17	7.9-8.4	Low.
98	95-98	90-95	5-12	6.3-20.0	0.04-0.06	7.4-7.8	Low.

will be along the pathway. Soil features that affect muddiness and dust are important considerations in rating a soil for this purpose because a grass cover cannot be maintained on a path. Other important soil features are stoniness, slope, susceptibility to flooding, and hazard of erosion.

Irrigation of the soil is affected by such soil features as slope, permeability, thickness of the solum, and susceptibility to flooding.

Features that affect the use of a soil for terraces and diversions are susceptibility to erosion, thickness of the soil, and slope. Terraces and diversions are not generally needed on some of the soils in the county.

Grassed waterways are natural or shaped watercourses covered with close-growing grass. They are used to carry off excess water from terraces. Among the soil features that affect waterways are slope, available water capacity, structure, thickness, and erodibility.

In table 5 the soils are given ratings on their potential for inducing corrosion of uncoated steel. Soil properties to a depth of 4 feet are considered. Among the properties affecting corrosion of uncoated steel pipes are drainage, texture, acidity, resistivity, and conductivity. Properties that affect the potential of a soil to induce corrosion of concrete are texture and reaction, and amounts of sodium, magnesium sulfate, or sodium chloride in the soil. All the soils of Sherman County have low potential for corrosivity of concrete.

The substratum of the Pastura soils is a source of indurated caliche. This indurated caliche is generally in layers 2 to 4 feet thick.

**Formation and Classification of Soils**

This section has two parts. First, the five major factors of soil formation and the process involved in soil

TABLE 5.—*Interpretations of*

[An asterisk in the first column indicates that the mapping unit is and limitations. It is therefore necessary to follow carefully the in-

Soil series and map symbols	Suitability as source of—		Degree and kind of limitation for—				
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Farm ponds Reservoir areas
Berthoud: BeC, BeD.....	Good where slope is 3 to 8 percent. Fair where slope is 8 to 12 percent.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Moderate where slope is 3 to 7 percent: moderate permeability. Severe where slope is 7 to 12 percent.	Moderate: moderate permeability.
* Cass: Ch..... For Humbarger part, see Humbarger series.	Good.....	Fair: fair traffic-supporting capacity.	Severe: subject to flooding.	Severe: flooding.	Severe: flooding.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Conlen: CoA.....	Fair: 10 to 20 inches of loam	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.....	Slight.....	Moderate: moderate permeability.	Moderate: moderate permeability.
Dalhart: DaA, DaB.....	Fair: 7 to 10 inches of fine sandy loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.....	Slight.....	Moderate: moderate permeability.	Moderate: moderate permeability.
Dumas: DuA.....	Fair: 6 to 10 inches of loam.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.
Gruver: GrA.....	Fair: clay loam texture.	Fair: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: fair traffic-supporting capacity; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Slight.....	Moderate: moderately slow permeability.
Humbarger:..... Mapped only in an undifferentiated group with Cass soils.	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: moderate permeability.	Moderate: moderate permeability.
Karde: KaC.....	Poor where 5 to 6 inches of loam. Fair where 6 to 9 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.....	Slight.....	Moderate where slope is 3 to 7 percent. Severe where slope is 7 to 8 percent.	Moderate: moderate permeability.

*engineering properties of the soils*

made up of two or more kinds of soil that may have different properties  
 structions for referring to other series that appear in the first column]

Degree and kind of limitation for—Continued					Soil features affecting—			Corrosivity of uncoated steel
Farm ponds— Cont.	Recreation				Irrigation	Terraces and diversions	Grassed waterways	
Embankments	Camp areas	Picnic areas	Playgrounds	Paths and trails				
Moderate: fair slope stability; poor resistance to piping and erosion.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Moderate where slope is 3 to 6 percent. Severe where slope is 6 to 12 percent.	Slight.....	Slope: erodibility.	Slope: erodibility.	Slope: erodibility.	Low.
Moderate: poor resistance to piping and erosion	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Slight.....	Flooding; moderately rapid permeability.	Flooding....	Flooding; moderately rapid permeability.	High: conductivity'
Moderate: fair resistance to piping and erosion.	Slight.....	Slight.....	Slight.....	Slight.....	Erodible; 10 to 20 inches to limey loam.	Erodible; 10 to 20 inches to limey loam.	Erodible; 10 to 20 inches to limey loam.	Moderate: clay loam
Moderate: poor resistance to piping and erosion.	Slight.....	Slight.....	Slight where slope is 0 to 2 percent. Moderate where slope is 2 to 3 percent.	Slight.....	Erodibility...	Erodibility...	Erodibility...	High: conductivity.
Moderate: fair resistance to piping and erosion.	Slight.....	Slight.....	Slight.....	Slight.....	No limiting features.	No limiting features.	No limiting features.	Moderate: resistivity.
Moderate: fair resistance to piping and erosion.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	No limiting features.	No limiting features.	No limiting features.	High: resistivity.
Moderate: poor resistance to piping and piping and erosion.	Moderate: clay loam texture; flooding.	Moderate: clay loam texture; flooding.	Moderate: clay loam texture; flooding.	Moderate: clay loam texture; flooding.	Flooding....	Flooding....	Flooding....	High: conductivity.
Moderate: fair resistance to piping and erosion.	Slight.....	Slight.....	Moderate where slope is 3 to 6 percent. Severe where slope is 6 to 8 percent.	Slight.....	Slope; erodibility.	Slope; erodibility.	Slope; erodibility.	High: conductivity.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Degree and kind of limitation for—				
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Farm ponds
							Reservoir areas
Likes: Lk.....	Poor: loamy fine sand texture.	Good.....	Slight.....	Slight.....	Slight.....	Severe: moderate permeability.	Severe: moderate permeability.
Manzano: Ma.....	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight.....	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.
Mobeetie: MoC, MoD.....	Good where slope is 3 to 8 percent. Fair where slope is 8 to 12 percent.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Severe: moderately rapid permeability.	Severe: moderately rapid permeability.
Ness: Ne.....	Poor: clay texture.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: flooding; high shrink-swell potential.	Severe: very slow permeability; flooding.	Slight.....	Slight.....
Pastura: Pa.....	Poor: 4 to 6 inches of loam; fragments.	Fair: fair traffic-supporting capacity.	Severe: indurated caliche at a depth of 4 to 10 inches.	Severe: indurated caliche at a depth of 4 to 10 inches.	Severe: indurated caliche at a depth of 4 to 10 inches.	Severe: indurated caliche at a depth of 4 to 10 inches.	Severe: indurated caliche at a depth of 4 to 10 inches.
Rough broken land: Ro Properties too variable to rate.							
Sherm: ShA.....	Poor where 4 to 6 inches of clay loam. Fair where 6 to 9 inches of clay loam.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight.....	Slight.....

properties of the soils—Continued

Degree and kind of limitation for—Continued					Soil features affecting—			Corrosivity of uncoated steel
Farm ponds—Continued	Reaction				Irrigation	Terraces and diversions	Grassed waterways	
Embankments	Camp areas	Picnic areas	Playgrounds	Paths and trails				
Moderate: poor resistance to piping and erosion.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture; slopes of 3 to 6 percent. Severe: slopes of 6 to 8 percent.	Moderate: loamy fine sand texture.	Erodibility; moderately rapid permeability.	Erodibility	Erodibility	Low.
Moderate: poor resistance to piping and erosion.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay; loam texture.	No limiting features.	No limiting features.	No limiting features.	High: conductivity.
Moderate: fair slope stability; poor resistance to piping and erosion.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Slight where slope is 3 to 8 percent. Moderate where slope is 8 to 12 percent.	Moderate where slope is 3 to 6 percent. Severe where slope is 6 to 12 percent.	Slight	Slope; moderately rapid permeability.	Slope; erodibility.	Slope; erodibility.	High: conductivity.
Moderate: fair slope stability.	Severe: poorly drained; flooding; clay texture.	Severe: poorly drained; flooding; clay texture.	Severe: poorly drained; flooding; very slow permeability; clay texture.	Severe: poorly drained; flooding; clay texture.	Very slow permeability; flood hazard.	Flood hazard.	Flood hazard.	High: clay and silty clay loam texture.
Severe: indurated caliche at a depth of 4 to 10 inches	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is 15 to 45 percent.	Slight where slope is 5 to 8 percent. Moderate where slope is 8 to 15 percent. Severe where slope is 15 to 45 percent.	Moderate where slope is 5 to 6 percent. Severe where slope is 6 to 45 percent.	Slight where slope is 5 to 15 percent. Moderate where slope is 15 to 25 percent. Severe where slope is 25 to 45 percent.	Indurated caliche at a depth of 4 to 10 inches.	Indurated caliche at a depth of 4 to 10 inches.	Indurated caliche at a depth of 4 to 10 inches.	High: conductivity.
Moderate: fair resistance to piping and erosion.	Severe: very slow permeability.	Moderate: clay loam surface layer.	Severe: very slow permeability.	Moderate: clay loam surface layer.	Very slow permeability.	No limiting features.	No limiting features.	High: conductivity.

TABLE 5.—*Interpretations of engineering*

Soil series and map symbols	Suitability as source of—		Degree and kind of limitation for—				
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Farm ponds
							Reservoir areas
Spurlock: SpB, SpC-----	Fair where 6 to 8 inches of loam. Poor where 5 to 6 inches of loam.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight-----	Slight-----	Moderate: moderate permeability.	Moderate: moderate permeability.
Sunray: SuA, SuB-----	Fair: clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	Slight-----	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: moderate permeability.
Tivoli: TfC-----	Poor: fine sand texture.	Good-----	Slight-----	Slight-----	Severe: inadequate filtration.	Severe: rapid permeability.	Severe: rapid permeability.

horizon differentiation are discussed briefly in terms of their effect on the soils of Sherman County. Second, the system of classifying soils is discussed and the soils are placed in some of the categories of the system.

**Factors of Soil Formation**

Soil is the product of the interaction of five major factors of soil formation. They are parent material, climate, living organisms, relief, and time.

The factors of soil genesis are so closely interrelated in their effects on soils that few generalizations can be made regarding the effect of any one unless conditions are specified for the other four.

**Parent material**

Parent material is the unconsolidated mass from which a soil is formed. It determines the limits of chemical and mineralogical composition of the soil. In Sherman County the parent materials are of mixed origin and are mostly calcareous, unconsolidated, and loamy or sandy.

Soils, like those in the Gruver, Sherm, and Sunray series, that formed in loamy parent materials generally have developed to a greater degree than soils, such as those in the Likes and Tivoli series, that formed in sandy parent materials.

Loamy material or finer sized particles contain more mineral that weather. These are made available to plants and animals during the process of soil formation. Particle size also influences the rate at which water enters and percolates through soil material. Water infiltrates rapidly through sands but slowly through clays.

**Climate**

Sherman County has a dry steppe climate with mild winters and dry summers. Climate is uniform throughout the county, although its effect is modified locally by runoff and slope.

Some of the more nearly mature soils, such as Gruver and Sherm, apparently formed thick, blocky layers during an earlier period of wetter climate. The present-day winds are laden with calcium carbonate dust, much of which settles to earth and is leached down into the soil by rainwater, where it forms prominent layers of calcium carbonate.

Climate, both past and present, has played an important part in soil formation in Sherman County.

**Living organisms**

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

Vegetation, predominantly grasses, has affected soil formation in Sherman County. Soils that formed under grass generally have a medium to high content of organic matter and generally have a dark surface layer.

**Relief**

Relief affects the formation of soils by its local influence on drainage and runoff, rate of erosion, plant cover, and exposure to sun and wind. The degree of development of the soil profile depends on the average amount of moisture in the soil. Moisture, in turn, affects the kinds and amounts of plant and animal life

*properties of the soils—Continued*

Degree and kind of limitation for—Continued					Soil features affecting—			Corrosivity of uncoated steel
Farm ponds—Continued	Reaction				Irrigation	Terraces and diversions	Grassed waterways	
Embankments	Camp areas	Picnic areas	Playgrounds	Paths and trails				
Moderate: fair slope stability.	Slight.....	Slight.....	Slight where slope is 1 to 2 percent. Moderate where slope is 2 to 5 percent.	Slight.....	Erodibility; shallow to limey loam.	Erodibility; shallow to limey loam.	Erodibility; shallow to limey loam.	Moderate: clay loam texture.
Moderate: fair slope stability.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	Moderate: clay loam texture.	No limiting features.	No limiting features.	No limiting features.	Moderate: clay loam texture.
Severe: poor resistance to piping and erosion.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Severe: fine sand texture.	Erodibility: rapid permeability.	Erodibility..	Erodibility..	Low.

on and in the soil. Steeper soils absorb less moisture and have less well-developed profiles than nearly level and gently sloping soils. In Mobeetie soils, for example, the soil-forming processes have been retarded by continuous or geologic erosion. Soils, such as those in the Manzano series, that occupy foot slopes or concave areas receive additional water and sediment from other soils.

**Time**

Generally a long time is required for the formation of soils that have distinct horizons. The length of time that parent materials have been in place is commonly reflected in the degree of development of the soil profile.

Soils of Sherman County range from young to old. Young soils have little profile development, but the older soils have well-developed soil horizons.

Mobeetie soils are an example of young soils that have little development. Except for darkening of the surface layer, some Mobeetie soils have retained most of the characteristics of their calcareous fine sandy loam parent materials. The parent material of Gruver soils was more clayey than that of Mobeetie soils. They developed a blocky clay loam subsoil that bears little resemblance to their parent material.

**Classification of Soils**

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils

are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (2) and revised later (5). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (4) and was adopted in 1965 (7). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 6 shows the classification of each soil series of Sherman County by family, subgroup, and order, according to the current system. Most of the classes within the current system are briefly defined in the following paragraphs.

**ORDERS:** Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic

TABLE 6.—*Classification of soil series*

Soil series	Family	Subgroup	Order
Berthoud	Fine-loamy, mixed, mesic	Aridic Ustochrepts	Inceptisols.
Cass <sup>1</sup>	Coarse-loamy, mixed, mesic	Fluventic Haplustolls	Mollisols.
Conlen	Fine-loamy, mixed, mesic	Aridic Calcistolls	Mollisols.
Dalhart <sup>1</sup>	Fine-loamy, mixed, mesic	Aridic Haplustalfs	Alfisols.
Dumas	Fine-loamy, mixed, mesic	Aridic Paleustolls	Mollisols.
Gruver	Fine, mixed, mesic	Aridic Paleustolls	Mollisols.
Humbarger	Fine-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols.
Karde	Fine-silty, carbonatic, mesic	Ustic Torriorthents	Entisols.
Likes <sup>1</sup>	Mixed, thermic	Typic Ustipsamments	Entisols.
Manzano	Fine-loamy, mixed, mesic	Cumulic Haplustolls	Mollisols.
Mobeetie <sup>1</sup>	Coarse-loamy, mixed, thermic	Aridic Ustochrepts	Inceptisols.
Ness	Fine, montmorillonitic, mesic	Udic Pellusterts	Vertisols.
Pastura	Loamy, mixed, mesic, shallow	Ustollic Paleorthids	Aridisols.
Sherm	Fine, mixed, mesic	Aridic Paleustolls	Mollisols.
Spurlock	Coarse-loamy, carbonatic, mesic	Aridic Ustochrepts	Inceptisols.
Sunray	Fine-loamy, carbonatic, mesic	Calciorthidic Paleustolls	Mollisols.
Tivoli	Mixed, thermic	Typic Ustipsamments	Entisols.

<sup>1</sup> The soils of Sherman County named in these series are taxadjuncts. They are outside the defined range of the series in ways that do not affect their use or management. These differences are as follows:

Soils in the Cass series are calcareous throughout and have a thicker solum.

Soils in the Dalhart series have a thicker solum.

Soils in the Likes, Mobeetie, and Tivoli series have soil temperatures of about 58° or 59°F.

groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates.

Six of these orders are represented in Sherman County. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, and Alfisols.

Entisols are recent soils that do not have genetic horizons or that have only the beginnings of such horizons. In Sherman County, Entisols include the soils previously classified as Regosols.

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

Inceptisols are generally on young but not recent land surfaces; hence, their name is derived from the Latin *inceptum*, for beginning. In this county Inceptisols include some of the soils formerly called Calcisols and Regosols.

Aridisols are primarily soils of dry places. In Sherman County, Aridisols include soils formerly called Lithosols.

Mollisols have a high base supply and a dark-colored A horizon that is friable or soft and has a high content of organic matter. This order consists of soils that were formerly called Alluvial soils, Calcisols, and Chestnut soils.

Alfisols have a clay-enriched B horizon and are high in base saturation. In Sherman County this order includes soils previously called Lithosols.

**SUBORDERS:** Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. Suborders narrow the broad climatic range permitted in orders. Soil properties used to separate suborders commonly reflect the present or absence of waterlogging or soil differences resulting from climate or vegetation.

**GREAT GROUPS:** Suborders are separated into great groups on the basis of uniformity in kind and sequence of major soil horizons and features. The horizons used to differentiate great groups are those in which clay, iron, or humus have accumulated or those that have pans that interfere with growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately because it is the last word in the name of the subgroup.

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

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

**SERIES:** As explained in the section "How This Survey Was Made," the series is a group of soils with major horizons that, except for texture of the surface layer, are similar in important characteristics and arrangements. Soil series are given the names of geographic locations near the place where they were first observed and mapped.

## Climate <sup>4</sup>

Sherman County has a dry, steppe climate that is characterized by mild winters and arid summers. Average total annual precipitation is 16.55 inches, four-fifths of which falls during the warm season from May through October. Most rainfall occurs during thunderstorms and monthly and annual amounts are extremely variable. Annual extremes since 1929 range from 30.67 inches in 1941 to only 8.68 inches in 1956.

The prevailing winds are southwesterly from November through April and southerly from May through October. Average annual relative humidity is estimated at 72 percent at 6 a.m., 42 percent at noon, and 41 percent at 6 p.m., Central Standard Time. Sherman County receives approximately 74 percent of the amount of possible annual sunshine. Seasonal variations in both relative humidity and sunshine are small. Average annual lake evaporation is estimated at 62 inches. Meteorological conditions most common in the Sherman County area favor the rapid transport and dilution of any pollutants that may be emitted. The probability of the occurrence of high air pollution is among the lowest in Texas.

Frequent surges of cold polar Canadian air bring strong northerly winds and rapid drops in temperature during winter. Cold spells, however, are rather short and rarely last longer than 48 hours before sunshine and southwesterly winds bring rapid warming. Freezes occur almost every night, but days are usually sunny, and daily maximum temperature averages 50.7° F. The lowest temperature on record in Sherman County is -20°, which occurred on several days in February, 1933. Winters are dry. Precipitation falls most often in the form of light snow. Heavy snows, though rare, bias the snowfall statistics so that the arithmetic average is not a good estimate of expected snowfall.

Spring is a season of frequent weather changes. Warm and cold spells follow each other in rapid succession throughout March and April, the windiest months of the year. Frequent, strong, persistent, southwesterly to northwesterly winds produce dust-storms in the area. Thunderstorm activity, which rarely occurs in winter, increases late in spring.

Summer is one of the most pleasant seasons on the High Plains. Afternoons are sometimes hot, but nights are pleasantly cool. In summer the minimum temperature averages 62.6°. Evaporative-type home air conditioners operate efficiently in this relatively dry climate. The highest temperature on record in Sherman County is 108°, which occurred on June 15 and June 24, 1953. Thundershowers occur every three to four days in an average season. One-half of the average annual precipitation falls during this 3-month summer period. Damaging winds and hail accompany the few thunderstorms that appear late in spring and early in summer.

In fall the weather is pleasant. As cold fronts push southward into Texas, the variety of weather becomes

greater than in summer. Rainfall decreases progressively from September through November. Mild, sunny days and crisp, cool nights characterize the fall season.

The warm season (freeze-free period) in Sherman County averages 182 days. The average dates of the last occurrence of 32° or below in spring and the first occurrence of 32° or below in fall are April 23 and October 22, respectively.

Temperature and precipitation data for Sherman County, gathered at Stratford, are shown in table 7.

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## Glossary

- Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.
- 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.
- Climax vegetation.** The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.
- 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.

<sup>4</sup> By ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

TABLE 7.—Summary of temp

[Data recorded at Stratford, eleva

Month	Temperature						
	Average daily maximum	Average daily minimum	Average monthly	Average number of days when maximum temperature is—		Average number of days when minimum temperature is—	
				90° F and above	32° F and below	32° F and below	0° F and below
	°F	°F	°F				
January	49.6	17.9	33.8	( <sup>1</sup> )	5	30	3
February	51.6	21.4	36.5	0	3	27	( <sup>1</sup> )
March	58.9	26.8	42.9	( <sup>1</sup> )	2	23	0
April	70.2	37.7	54.0	1	( <sup>1</sup> )	6	0
May	79.4	48.0	63.7	7	0	1	0
June	89.2	59.1	74.2	14	0	0	0
July	92.8	63.3	78.1	21	0	0	0
August	91.4	61.7	78.4	19	0	0	0
September	83.7	53.1	68.4	8	0	0	0
October	74.1	41.1	57.6	2	0	3	0
November	58.9	28.0	43.5	0	1	20	( <sup>1</sup> )
December	51.0	20.4	35.7	0	4	29	( <sup>1</sup> )
Year	70.9	39.9	55.6	72	15	139	3

<sup>1</sup> Less than one-half day.

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

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

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

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

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

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

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

**Drainage class (natural).** Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

**Deferred grazing.** The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

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

**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.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of

depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

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

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

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

**B horizon.**—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying distinctive characteristics caused (1) by accumulation of A to the underlying C horizon. The B horizon also has 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.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are—

**Border.**—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

**Basin.**—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

erature and precipitation data

tion 3,699 feet, for period 1952-68]

Precipitation					
Average monthly total	Greatest daily total	Average number of days when precipitation is 0.10 or more	Snow and sleet		
			Monthly average	Monthly maximum	Greatest accumulated depth
Inches	Inches		Inches	Inches	Inches
0.23	0.51	1	1.0	6.0	2
.36	.60	1	2.5	10.0	10
.77	1.64	2	2.9	14.0	5
1.06	2.00	2	.1	1.3	1
2.39	3.00	5	0	0	0
2.34	1.72	6	0	0	0
3.42	2.90	6	0	0	0
2.49	2.40	4	0	0	0
1.44	2.12	3	0	0	0
1.13	1.88	2	0	0	0
.55	1.03	1	1.3	6.0	3
.37	1.00	1	2.2	10.0	5
16.55	3.00	34	10.0	14.0	10

**Controlled flooding.**—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

**Corrugation.**—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

**Furrow.**—Water is applied in small ditches made by cultivation implements used for tree and row crops.

**Sprinkler.**—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

**Subirrigation.**—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

**Wild flooding.**—Irrigation water, released at high points, flows onto the field without controlled distribution.

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

**Munsell notation.** A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

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

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from a semisolid to a plastic state.

**Plowpan.** A compacted layer formed in the soil immediately below the plowed layer.

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

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

reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

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

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

**Sand.** Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

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

**Solum.** The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

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

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

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

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

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

**Texture, soil.** The relative proportions of sand, silt, and clay

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

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

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. The suitability of the soils for crops is discussed in the soil descriptions. Other information is given in tables as follows:

Acreage and extent, table 1, page 5.  
 Predicted yields, table 2, page 21.

Wildlife, table 3, page 28.  
 Engineering uses of the soils, tables 4 and 5, pages 30 through 37.

Map symbol	Mapping unit	Page	Capability unit		Range site	Page
			Dryland	Irrigated		
			Symbol	Symbol	Name	
BeC	Berthoud loam, 3 to 5 percent slopes-----	6	IVe-6	IVe-3	Hardland Slopes	23
BeD	Berthoud loam, 5 to 12 percent slopes----	6	VIe-1	-----	Hardland Slopes	23
Ch	Cass and Humbarger soils, channeled-----	7	IIe-1	-----	Loamy Bottomland	23
CoA	Conlen loam, 0 to 1 percent slopes-----	8	IVe-2	IIIe-6	Hardland Slopes	23
DaA	Dalhart fine sandy loam, 0 to 1 percent slopes-----	8	IIIe-3	IIe-3	Sandy Loam	24
DaB	Dalhart fine sandy loam, 1 to 3 percent slopes-----	8	IIIe-3	IIIe-3	Sandy Loam	24
DuA	Dumas loam, 0 to 1 percent slopes-----	9	IIIc-2	IIe-1	Deep Hardland	23
GrA	Gruver clay loam, 0 to 1 percent slopes--	10	IIIc-2	IIe-2	Deep Hardland	23
KaC	Karde soils, 3 to 8 percent slopes-----	11	VIe-3	IIIe-4	High Lime	23
Lk	Likes loamy fine sand-----	11	VIe-1	IVe-2	Sandyland	24
Ma	Manzano clay loam-----	12	IIIc-2	IIe-1	Deep Hardland	23
MoC	Mobeetie fine sandy loam, 3 to 5 percent slopes-----	12	IVe-3	IVe-1	Mixedland Slopes	24
MoD	Mobeetie fine sandy loam, 5 to 12 percent slopes-----	13	VIe-2	-----	Mixedland Slopes	24
Ne	Ness clay-----	13	VIw-1	-----	(1/)	--
Pa	Pastura complex-----	13	VIIIs-1	-----	Very Shallow	24
Ro	Rough broken land-----	14	VIIIs-1	-----	Rough Breaks	24
ShA	Sherm clay loam, 0 to 1 percent slopes---	15	IIIc-1	IIIs-1	Deep Hardland	23
SpB	Spurlock loam, 1 to 3 percent slopes-----	16	IVe-2	IIIe-6	Hardland Slopes	23
SpC	Spurlock loam, 3 to 5 percent slopes-----	17	IVe-6	IVe-3	Hardland Slopes	23
SuA	Sunray clay loam, 0 to 1 percent slopes--	18	IIIc-2	IIe-1	Deep Hardland	23
SuB	Sunray clay loam, 1 to 3 percent slopes--	19	IIIe-1	IIIe-2	Deep Hardland	23
TfC	Tivoli fine sand, hummocky-----	19	VIIe-1	-----	Deep Sand	23

<sup>1/</sup> Included in adjoining range site.



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