Series 1960, No. 5

Issued July 1963

SOIL SURVEY
Childress County, Texas

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
in cooperation with the
TEXAS AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Childress County, Tex., will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; and add to our knowledge of soil science.

Locating the soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map is found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units, Capability Units, and Range Sites" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the capability unit and range site and the page where each of these is described.

Engineers will want to refer to the section "Engineering Applications." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Formation and Classification of Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

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

* * * * *

Fieldwork for this survey was completed in 1960. Unless otherwise indicated, all statements in the report refer to conditions in the county at that time. Childress County is in the Hall County Soil Conservation District, and the soil survey was made as part of the technical assistance furnished by the Soil Conservation Service to that district.

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SOIL SURVEY OF CHILDRESS COUNTY, TEXAS

BY EARL R. BLAKLEY AND PAUL H. MOHLE, SOIL CONSERVATION SERVICE

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

CHILDRESS COUNTY is in the southeastern corner of the Texas Panhandle (fig. 1). The Red River flows through the county from west to east, just north of the center of the county. The area of the county is 455,040 acres. The 1960 population was 8,421. Childress is the county seat.

Agriculture is the main occupation in the county. About 224,327 acres are used for range, 203,213 acres for dryland farming, and 7,500 acres for irrigation. There are 20,000 acres of miscellaneous land, such as river channels and townsites. Wheat, cotton, and grain sorghum are the main cash crops. Cattle are the principal livestock.

Most of the cultivated soils are susceptible to water and wind erosion. Droughts are common. In years of high rainfall yields of crops are good, and in drought years they are low.

The Fort Worth and Denver Railroad shops, as well as cotton gins, grain elevators, and other processing plants related to agriculture, provide full- or part-time employment for many of the people in the county.

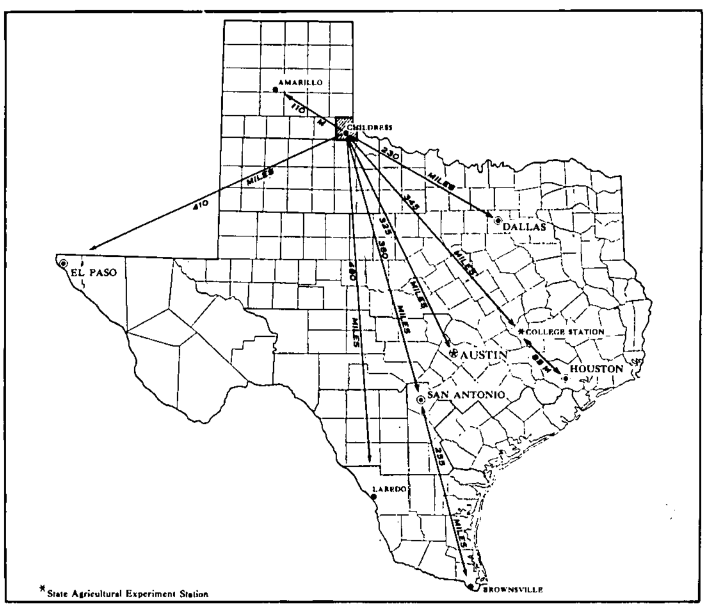


Figure 1.—Location of Childress County in Texas.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in Childress County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rocks; and many facts about the soils. They dug or bored 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 to the rock material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Enterprise and Carey, 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 natural characteristics.

Many soil series contain soils that differ in the texture of their surface layer. According to such difference, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Enterprise fine sandy loam and Enterprise very fine sandy loam are two soil types in the Enterprise series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases.

The name of a soil phase indicates a feature that affects management. For example, Enterprise fine sandy loam, 1 to 3 percent slopes, is one of three phases of Enterprise fine sandy loam, a soil type that ranges from nearly level to gently sloping.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because these show woodlands, buildings, field borders, trees, and similar details that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed or occur in such small individual tracts that it is not practical to show them separately on the map. Therefore, he shows this mixture of soils as one mapping unit and calls it a soil complex. Ordinarily, a soil complex is named for the major soil series in it, for example, Abilene-Cottonwood complex, 0 to 1 percent slopes. Also, in most mapping, there are areas to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they cannot be called soils. These areas are shown on a soil map, but they are given descriptive names, such as Gravelly broken land or Rough broken land, and are called land types rather than soils.

After the soil scientist had named and described the soil series and mapping units and had shown the location of the mapping units on the soil map, there was additional work to be done. He still had to present the mass of detailed information he had recorded in different ways for different groups of users, among them farmers, managers of rangeland, and engineers.

To do this efficiently, he had to consult with persons in other fields of work and jointly prepare with them groupings that would be of practical value to the different users. Such groupings are the capability classes, subclasses, and units, designed primarily for those interested in producing the short-lived crops and tame pasture; range sites, for those using large tracts of native grass; and the classifications used by engineers who build highways or structures to conserve soil and water.

General Soil Map

After studying the soils in a locality and the way they are arranged, it is possible to make a general map that shows the main patterns of soils. Such a map is the colored general soil map in the back of this report. The general soil areas are also called soil associations. Each kind of association, as a rule, contains a few major soils and several minor soils in a pattern that is characteristic, although not strictly uniform.

The soils within any one association are likely to differ greatly among themselves in some properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general map does not show the kind of soil at any particular place, but main patterns of soils. Each pattern may contain several different kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soil series of one association may also be present in other areas, but in a different pattern.

The general map that shows patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of a county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

1. *Miles-Abilene association: Loamy soils*

This soil association consists of loamy, nearly level to gently sloping soils. It occupies about 18 percent of the county. The largest area is in the northeastern part of the county in the Arlie and Loco communities. Another large area occurs in the eastern part of the county near Community Center School.

The main soils in the association are the Miles, Abilene, Tipton, and Norwood. The Miles soils are dominant. They have developed in moderately sandy outwash material. Some have a surface layer of fine sandy loam, and some have a surface layer of loam. The Miles soils with a loam surface layer are dark in color and usually occur in lower areas than those soils with a fine sandy loam surface layer. The Abilene soils have a clay loam surface layer and a clayey subsoil. They occur mostly in low, nearly level areas and are dark in color. The areas of Tipton soils are small and usually occur along drains in lower areas than the Miles and Abilene soils. The Norwood soils occur along the flood plains of small streams in lower areas than the associated soils.

Areas of this association are among the most productive in the county. About 90 percent of the association is cultivated. Because the soils are level to gently sloping, they are very suitable for crop production. Most of them are only slightly susceptible to wind and water erosion. All crops suited to this area can be grown on these soils. Wheat and cotton are the main crops. All the soils are high in natural fertility. Because of their heavier texture and compact subsoil, the Abilene soils are more droughty than the other soils for summer crops. The average size of the farms in this association is about 400 acres.

2. *Springer-Miles association: Sandy soils*

This association consists mainly of the sandy, severely eroded soils in the Garden Valley community. It occupies about 7 percent of the county. The areas are nearly level to sloping.

The main soils in this association are the Springer, Miles, and Nobscot. These soils have developed from outwash material. This material was worked by water and reworked by wind into a complex, rolling topography (fig. 2). All of these soils are deep and sandy. The Springer and Nobscot soils have moderately rapid permeability and are sandy throughout their profiles. The Miles soils have a sandy clay loam layer within 10 to 20 inches of the surface.

Because of their high susceptibility to wind erosion, the Springer and Nobscot soils are unsuitable for cultivation. A large part of these soils was cultivated at one time, but most of this area has been seeded to grass and returned to range. Many areas are severely eroded. The nearly level to gently sloping Miles soils are suitable for cultivation, but careful management is needed to control erosion.

The present vegetation consists mostly of bluestem, Indiangrass, switchgrass, and other tall grasses. Invaders, such as shinnery oak and sand sagebrush, are common on most of these soils. The average size of the farms in this association is about 600 acres.

3. *Carey-Woodward association: Mixedland*

This association consists of the mixedland hills, ridges, and flats in the southwestern and northwestern parts of the county. It occupies about 25 percent of the county. The towns in this association are Childress, Carey, and Tell.

The soils of this association are mainly the Carey, Woodward, St. Paul, and Quinlan. The Carey are deep soils that occur mostly in the gently sloping areas. The Woodward and Quinlan are shallow soils that occupy the steeper slopes on the ridges and hills above the Carey and St. Paul soils. The deep, dark, silty St. Paul soils are in the nearly level areas below the more sloping associated soils. All of the soils of this association have developed in soft sandstone (fig. 3). Severely eroded and gullied areas occur in all parts.

Because of the steep slope, shallowness, and high susceptibility to water erosion, the Quinlan soils are poor for crops. The Woodward soils are more productive, but the steeper slopes are highly susceptible to water erosion. The Carey and St. Paul soils are very productive.

About 75 percent of this association is in cultivation. Because of the large proportion of Carey and St. Paul soils, areas of this association are among the most productive in the county. A large part of the acreage of steep, shallow soils that was formerly cultivated is now seeded to grass. Cotton is the main cash crop in this association. Other crops are grain sorghum and small grain. The average size of farms in this association is about 400 acres.

4. *Tillman-Vernon association: Hardland*

This association consists of moderately fine textured soils in the southeastern part of the county. It occupies about 10 percent of the county. The areas are nearly level to gently sloping and rolling. The small community of Kirkland is in this association.

The soils of this association are mainly the Tillman, Vernon, Tipton, and Norwood. The Tillman soils are deep and nearly level to gently sloping. The shallow Vernon soils occur on the steeper slopes and on ridges. The Tillman and Vernon soils are underlain by red and gray shaly clays (fig. 4). The deep, dark, silty Tipton soils are in nearly level areas above streams. The Norwood soils occur on bottom lands along the larger streams.

About 90 percent of this association is in cultivation. Wheat is the main crop grown. Some cotton and grain sorghum are also grown. Because of their shallowness and high susceptibility to water erosion and droughtiness, the Vernon soils are not so productive. The Tillman soils are more productive but are droughty, have low water-intake rate, and are susceptible to water erosion. The average size of farms in this area is about 500 acres.

5. *La Casa-Harmon association: Deep and stony hardland*

This association occupies a large part of the rangeland in the northeastern and north-central parts of the county between the Red River and Buck Creek. It is characterized by broad, gently sloping areas of La Casa soils and

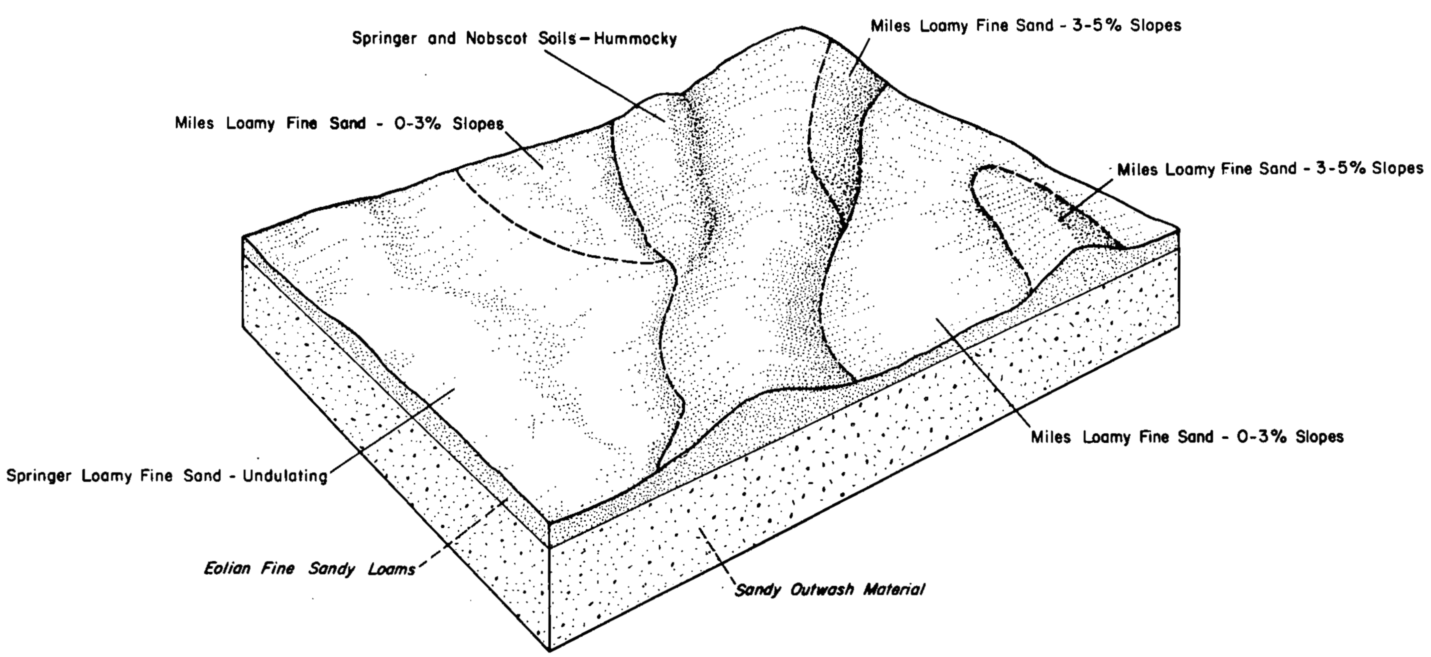


Figure 2.—**Soils developed in sandy outwash material.**

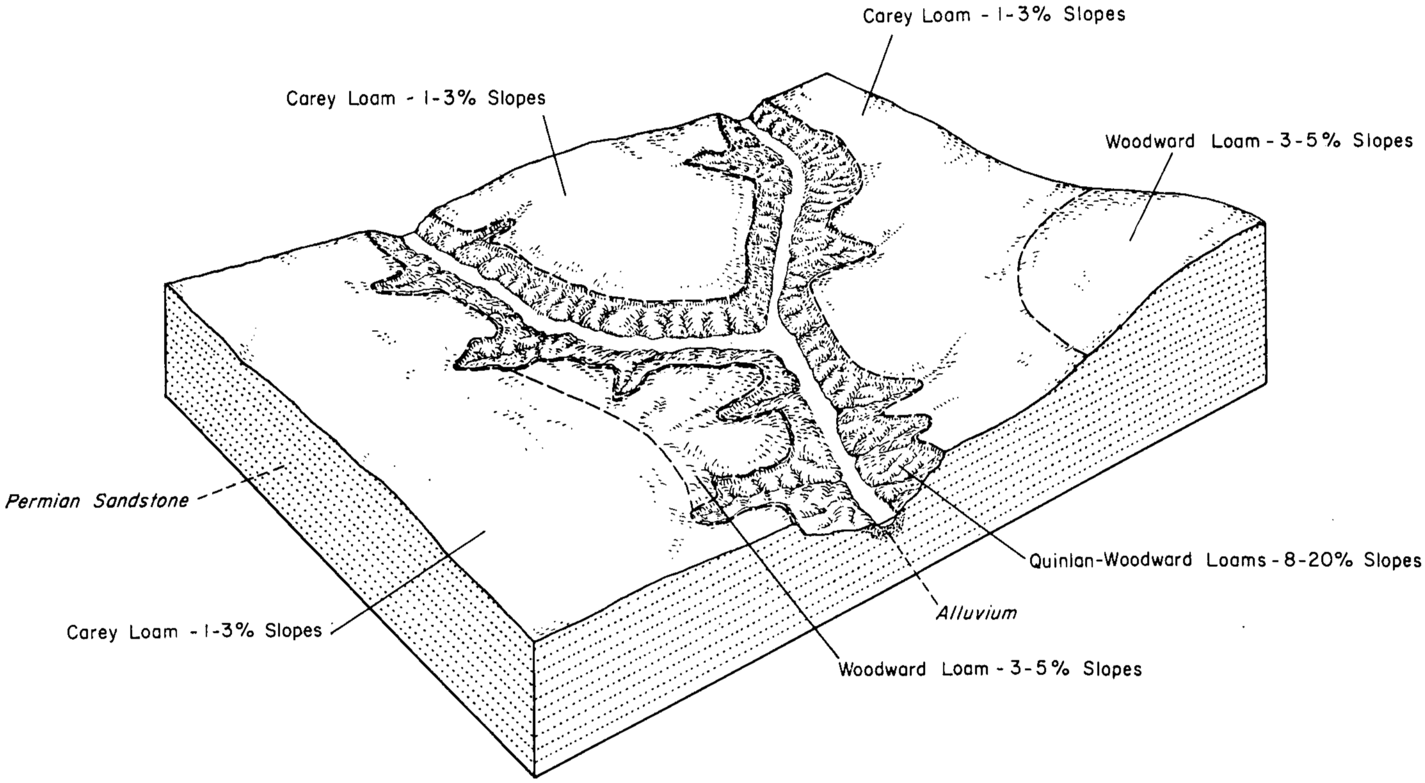


Figure 3.—**Soils developed in sandstone material.**

frequent outcrops of Harmon soils. This association makes up about 20 percent of the county.

The soils of this association are mainly the La Casa, Harmon, Cottonwood, and Vernon. The La Casa are deep, dark, silty soils that occupy gently sloping, convex areas. The Harmon soils are very shallow and occur as limestone outcrops and ridges and knobs above the La Casa soils (fig. 5). The Cottonwood and Vernon soils occur along ridges and drains. The shallow Cottonwood soils have developed from gypsum, and the shallow Vernon soils have developed from Permian clay.

About 75 percent of this association is in range. The Harmon, Vernon, and Cottonwood soils are unsuitable for crop production because of their shallowness. The La Casa soils are fairly productive. They are suitable for small grain, grain sorghum, and cotton.

A large part of this association that was formerly cultivated is now reseeded to native grass. The soils in it are best suited to livestock production. The average size of farms is about 1,000 acres. There are several large ranches in this association.

6. *Vernon-Quinlan association: Very shallow soils*

This association consists mostly of the rough, broken, cedar-break country in the south-central part of the county and the rough, broken, shaly gypsum soils in the northwestern part. It occupies about 7 percent of the county.

The main soils in this association are the Vernon, Quinlan, Cottonwood, and Harmon. Many hills and ridges—broken by a complex drainage pattern of deep, severely eroded gullies—are characteristic of this association. Many of the soils are thin or very shallow. The steeper soils consist mostly of raw materials from shale, sandstone, gypsum, and limestone. A few areas of Norwood soils occur along the larger drains.

This association is used entirely for range. Most of the area is occupied by large ranches. The soils are suitable only for limited grazing and for wildlife. They are very susceptible to erosion. On many of the soils, the vegetation has been nearly all removed by heavy grazing, and there is very little grass. Most of the area has a cover of redberry juniper (cedar).

7. *Enterprise-Tivoli association: Deep, loamy, and sandy soils*

This association consists of the wind-deposited, medium to moderately coarse and coarse textured soils along both sides of the Red River. It occupies about 13 percent of the county.

The main soils are the Enterprise and Tivoli. They have developed from materials that have been blown from the riverbed (fig. 6).

The Tivoli soils consist of coarse-textured dune sand along the bank of the river. The areas of Tivoli soils are generally no more than 1 mile wide and are parallel to the river. The Enterprise soils are less sandy than the Tivoli soils and occupy undulating to rolling areas. They range from nearly level to steep but are mostly gently to moderately sloping.

Along both sides of the Red River, there are many areas of sandy alluvial soils. They are salty, have a high water table, and are generally only 2 to 3 feet above the river channel.

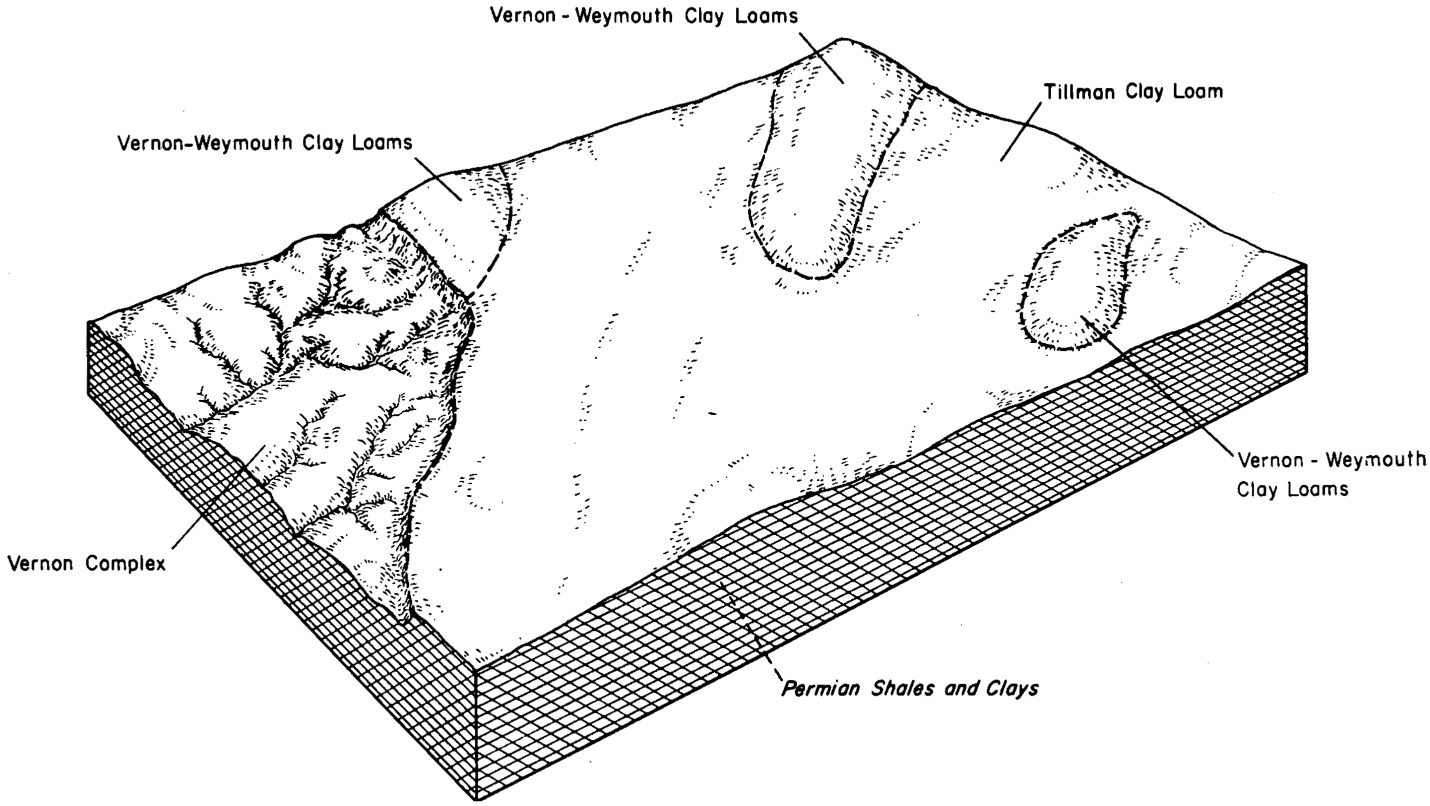


Figure 4.—Soils developed in Permian shales and clays.

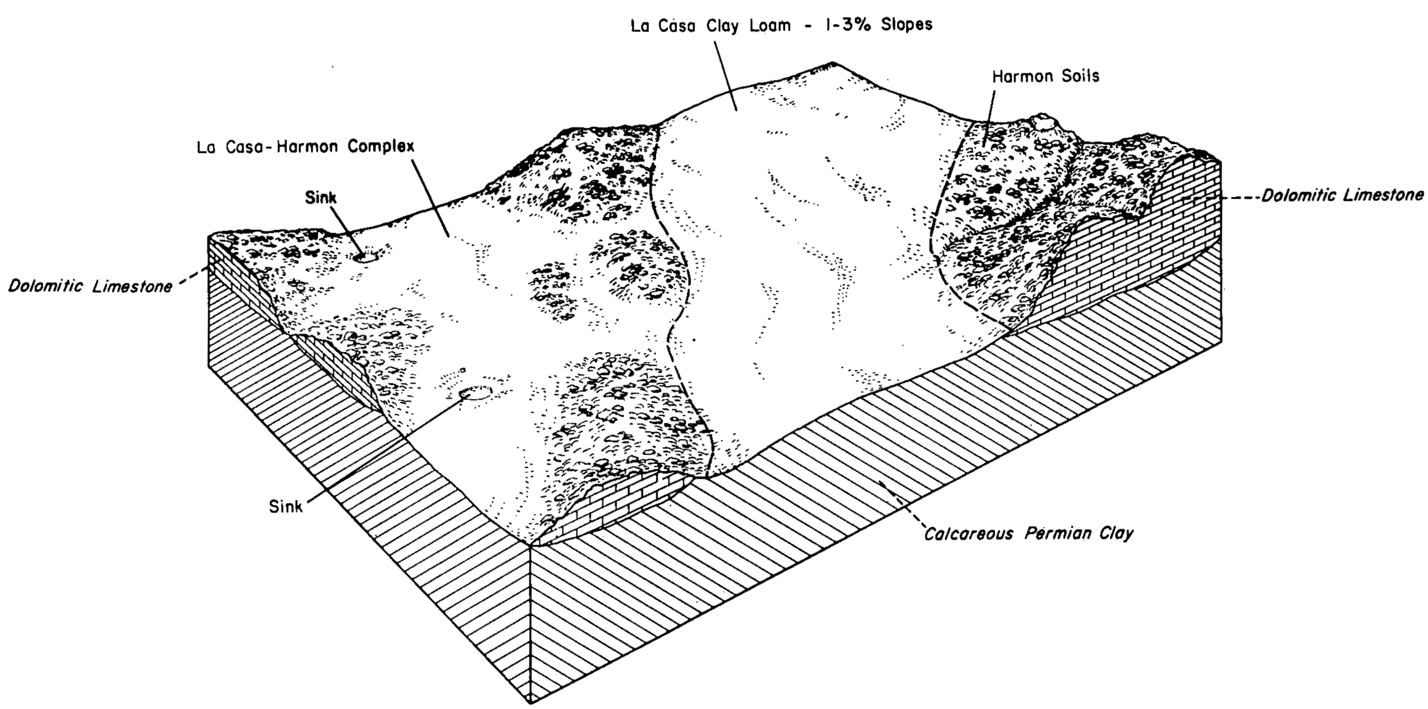


Figure 5.—La Casa-Harmon association.

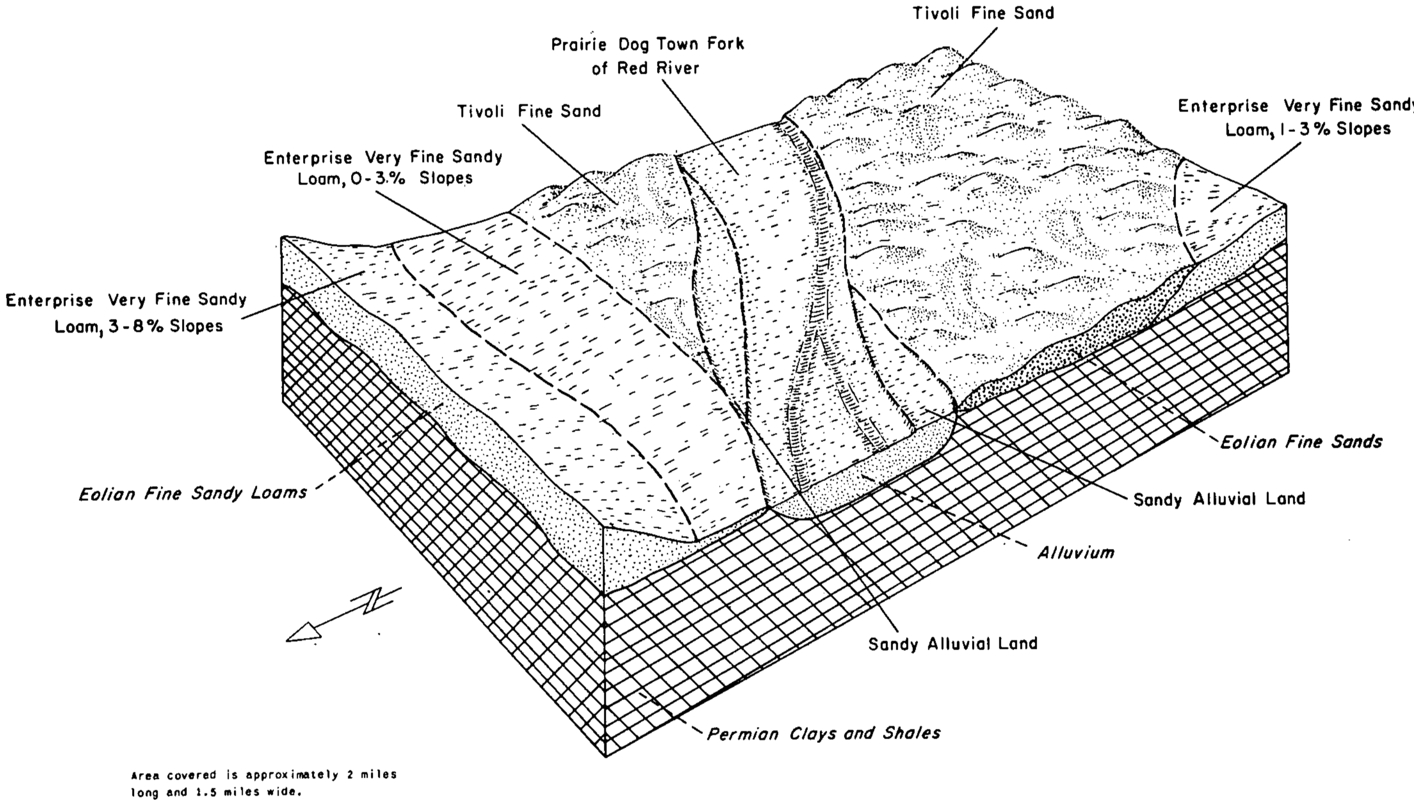


Figure 6.—**Soils developed in eolian materials.**

The Tivoli soils are unsuitable for cultivation, because they are too sandy and have too many dunes. The native vegetation is mostly tall grasses and sagebrush. Most areas of the Enterprise soils are in cultivation. They are well suited to cotton and small grain and are very productive. The steeper slopes, however, are susceptible to water erosion. The hazard of wind erosion is slight to moderate. The average size of farms in this association is about 400 acres.

Descriptions of the Soils

The soil scientists who prepared this survey went over the area at appropriate intervals and dug holes with a spade, auger, or power soil sampler. They examined the different layers, or horizons, in each boring, and they compared the different borings. By such comparison, they determined the different kinds of soils in the area.

Then, they described the various soils and drew boundaries on aerial photographs to separate them. The soils are described in the following pages. Their approximate acreage and proportionate extent are shown in table 1, and their location can be seen on the detailed soil map at the back of this report.

In this report, the soil series are described in alphabetic order. After each series, the soils of that series that were mapped in the county are described. An important part of each soil description is the soil profile, a record of what the soil scientist saw and learned when he dug into the ground. Since all the soils in one series have essentially the same profile, except for possible differences in texture of the surface layer, it is not necessary to describe the profile of every soil. The profile is therefore described for a typical soil in each series. The reader can assume that all the other soils in a series have essentially the same kind of profile. To illustrate, a detailed profile is described for Abilene clay loam, and the reader is to conclude that all the Abilene soils mapped have essentially the same kind of profile. The differences, if any, are indicated in the soil name or mentioned in describing the particular soil.

TABLE 1.—*Approximate acreage and proportionate extent of the soils, lakes, and river channels*

Soil	Acres	Percent
Abilene clay loam, 0 to 1 percent slopes	6, 473	1. 4
Abilene clay loam, 1 to 3 percent slopes	2, 185	. 5
Abilene-Cottonwood complex, 0 to 1 percent slopes	792	. 2
Abilene-Cottonwood complex, 1 to 3 percent slopes	549	. 1
Carey loam, 1 to 3 percent slopes	42, 364	9. 3
Carey loam, 3 to 5 percent slopes	8, 632	1. 9
Enterprise very fine sandy loam, 0 to 1 percent slopes	1, 137	. 2
Enterprise very fine sandy loam, 1 to 3 percent slopes	3, 051	. 7
Enterprise very fine sandy loam, 3 to 5 percent slopes	1, 806	. 4
Enterprise very fine sandy loam, 5 to 8 percent slopes	470	. 1
Enterprise fine sandy loam, 0 to 1 percent slopes	309	. 1

TABLE 1.—*Approximate acreage and proportionate extent of the soils, lakes, and river channels*—Continued

Soil	Acres	Percent
Enterprise fine sandy loam, 1 to 3 percent slopes	1, 449	. 3
Enterprise fine sandy loam, 3 to 5 percent slopes	278	. 1
Gravelly broken land	3, 280	. 7
Harmon soils	7, 097	1. 6
La Casa clay loam, 1 to 3 percent slopes	17, 430	3. 8
La Casa-Harmon complex	44, 567	9. 8
Loamy alluvial land	1, 802	. 4
Miles loam, 0 to 1 percent slopes	7, 282	1. 6
Miles loam, 1 to 2 percent slopes	19, 448	4. 3
Miles fine sandy loam, 0 to 1 percent slopes	2, 669	. 6
Miles fine sandy loam, 1 to 3 percent slopes	11, 128	2. 4
Miles fine sandy loam, 3 to 5 percent slopes	5, 043	1. 1
Miles fine sandy loam, 3 to 5 percent slopes, eroded	699	. 2
Miles fine sandy loam, 5 to 8 percent slopes, eroded	2, 592	. 6
Miles loamy fine sand, 0 to 3 percent slopes	3, 530	. 8
Miles loamy fine sand, 3 to 5 percent slopes	1, 399	. 3
Norwood clay loam	2, 651	. 6
Norwood silt loam	5, 844	1. 3
Quinlan-Woodward loams, 8 to 20 percent slopes	22, 554	5. 0
Roscoe clay	118	(1)
Rough broken land	18, 131	4. 0
Sandy alluvial land	4, 779	1. 0
Springer loamy fine sand, undulating	9, 348	2. 1
Springer and Nobscot soils, hummocky	6, 286	1. 4
Springer and Nobscot soils, severely eroded	7, 520	1. 7
St. Paul silt loam, 0 to 1 percent slopes	11, 984	2. 6
St. Paul silt loam, 1 to 2 percent slopes	1, 011	. 2
Tillman clay loam, 0 to 1 percent slopes	1, 837	4
Tillman clay loam, 1 to 3 percent slopes	22, 740	5. 0
Tillman clay loam, 1 to 3 percent slopes, eroded	812	. 2
Tipton clay loam, 0 to 1 percent slopes	10, 537	2. 3
Tipton clay loam, 1 to 3 percent slopes	1, 269	. 3
Tivoli fine sand	12, 371	2. 7
Vernon-Weymouth clay loams, 1 to 3 percent slopes	12, 508	2. 7
Vernon-Weymouth clay loams, 3 to 5 percent slopes	884	. 2
Vernon complex	49, 367	10. 8
Vernon-Quinlan complex	10, 566	2. 3
Woodward loam, 1 to 3 percent slopes	2, 574	. 6
Woodward loam, 3 to 5 percent slopes	18, 811	4. 1
Woodward-Quinlan loams, 5 to 12 percent slopes	9, 182	2. 0
Lakes	567	. 1
River channels	13, 328	2. 9
Total	455, 040	100. 0

[1] Less than 0.1 percent.

In describing the soils, the scientist frequently assigns a letter symbol, for example, "A_1," to the various layers. These letter symbols have special meanings that concern scientists and others who desire to make a special study of soils. Most readers need to remember only that all letter symbols beginning with "A" are surface soil and subsurface soil; those beginning with "B" are subsoil; and those beginning with "C" are substratum or parent material. It may also be helpful to remember that the small letter "p" indicates a plowed layer, and that the small letters "ca" indicate an accumulation of calcium carbonate. Some soils do not have a B horizon, and the A horizon may be directly underlain by the C horizon or a transitional AC horizon. Where the B horizon is thin or lacking, the upper C horizon may be called subsoil.

Layers, or horizons, in soils are measured from the top of the mineral soil material downward. The distance from the top to the bottom of each layer is indicated in inches. In soils, one layer is seldom followed immediately by another layer in such a way that they can be divided by a straight line. Boundaries between horizons have thickness and shape. The terms for thickness are (1) *abrupt*, if less than 1 inch thick; (2) *clear*, if about 1 to 2½ inches thick; (3) *gradual*, if 2½ to 5 inches thick; and (4) *diffuse*, if more than 5 inches thick. The shape of the boundary is described as *smooth*, *wavy*, *irregular*, or *broken*.

Soil scientists use Munsell notations to indicate the color of a soil precisely, and they provide the equivalent in words for those not familiar with the system. They compare a sample of the soil with a standard color chart. The Munsell notation, and its less exact approximation in words, are read from the chart; for example, "brown (10YR 5/3 dry)." In the example given, "10YR" is the hue, and "5/3" expresses value and chroma. The notation "10YR 5/3" is in the range equivalent to the word "brown;" the color was observed when the soil was dry. In this report the first Munsell notation is for dry soil, and the word "dry" is omitted.

The texture of the soil refers to the content of sand, silt, and clay. It is determined by the way the soil feels when rubbed between the fingers, and it is checked from time to time by laboratory analyses. Each mapping unit is identified by a textural name, such as "clay loam." This refers to the texture of the surface layer.

The general terms for describing texture in this soil survey are as follows:

- Sandy soils:
  - Coarse-textured soils
    - Sand
    - Loamy sand
- Loamy soils:
  - Moderately coarse textured soils
    - Sandy loam
    - Fine sandy loam
  - Medium-textured soils
    - Very fine sandy loam
    - Loam
    - Silt loam
    - Silt
  - Moderately fine textured soils
    - Clay loam
    - Sandy clay loam
    - Silty clay loam
- Clayey soils:
  - Fine-textured soils
    - Sandy clay
    - Silty clay
    - Clay

The permeability of each soil is estimated. This is an estimate of how fast water and air moves through the soil. It depends mainly on the texture, structure, and porosity of each soil. The permeability rating of a soil is based on the movement of water in the layer that is the least permeable. Following is a list of the different permeability classes and the rates of flow of water through a saturated soil under controlled conditions:

	Permeability rates in inches per hour
Slow:	
1. Very slow	Less than 0.05
2. Slow	0.05 to 0.20
Moderate:	
3. Moderately slow	0.20 to 0.80
4. Moderate	0.80 to 2.50
5. Moderately rapid	2.50 to 5.0
Rapid:	
6. Rapid	5.0 to 10.0
7. Very rapid	More than 10.0

Structure is indicated by the way the individual soil particles are arranged in larger grains, or aggregates, and the amount of pore space between the grains. The structure of soil is determined by the strength or grade, the size, and the shape of the aggregates. For example, a horizon may have "weak, fine, blocky structure."

Consistence refers to the feel of the soil when wet, moist, or dry. Calcareousness refers to the presence of free lime in each horizon. Other technical terms are explained in the Glossary in the back of this report and in the "Soil Survey Manual" (*8*).[1]

Abilene Series

The Abilene series consists of deep, dark, loamy soils. These soils are well drained and have moderately slow permeability. They occur mostly in nearly level to gently sloping areas on high terraces or in valleys in the northeastern and southeastern parts of the county. They developed in old clayey alluvial deposits. The present vegetation consists mostly of buffalograss, blue grama, mesquite trees, and prickly pear.

The surface layer is brown to dark grayish-brown clay loam to a depth of 5 to 12 inches. It has a weak, granular or subangular blocky structure. It is friable when moist but becomes hard and cloddy when dry. If worked when too wet, it becomes compacted in places. During rains of high intensity, it crusts readily where there is no cover.

The clayey subsoil extends to an average depth of 40 to 48 inches. It has a blocky structure. The upper part is noncalcareous, but the lower part contains films and threads of calcium carbonate. The upper 8 to 14 inches of the subsoil is friable when moist and has some pores and evidence of biological activity. Below this depth the subsoil is very firm when moist and very hard when dry.

The substratum is calcareous, clayey, alluvial material. The upper part contains large accumulations of calcium carbonate, but the quantity decreases with depth. In some areas this layer contains some soft gypsum.

Abilene soils are associated with the Tipton soils but are less friable and have more distinctly blocky structure in the B horizon. They are less sandy and darker than the Miles soils and less friable and less permeable than the St. Paul soils.

Abilene soils are high in fertility. Because of their heavy texture, they are droughty in years of low rainfall. In years of above-average rainfall they are very productive.

Some areas of Abilene soils are mapped as a complex with Cottonwood soils.

[1] Italic numbers in parentheses refer to Literature Cited, p. 73.

Typical profile of Abilene clay loam (0.8 mile east and 100 feet south of the northwest corner of section 505, W. and N.W. RR. Co. Survey, about 6 miles southeast of Childress):

A_{1p} 0 to 5 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt boundary; pH 7.0–7.5.

A_{12} 5 to 8 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; weak to moderate, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; gradual boundary; pH 7.0–7.5.

B_1 8 to 14 inches, dark grayish-brown (10YR 4/2) heavy clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; clear boundary; pH 7.0–7.5.

B_{21} 14 to 21 inches, dark-brown (7.5YR 4/2) light clay, dark brown (7.5YR 3/2) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; noncalcareous; clear boundary; pH 7.5–8.0.

B_{22} 21 to 44 inches, brown (7.5YR 5/2) light clay, dark brown (7.5YR 4/2) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; many threads and films of calcium carbonate; strongly calcareous; diffuse boundary; pH 8.0–8.5.

C_{ca} 44 to 80 inches +, yellowish-red (5YR 5/6) heavy clay loam, yellowish red (5YR 4/6) when moist; very strongly calcareous but becomes less calcareous in the lower part; pH 8.0–8.5.

The dry color of the A horizon ranges from brown to dark grayish brown. The thickness ranges from 6 to 12 inches. The dry color of the B horizon ranges from reddish brown to dark grayish brown. The depth of the C horizon ranges from 36 to 60 inches. Red-bed materials occur at a depth of 3 to 6 feet in a few scattered areas, particularly those that are more sloping.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This nearly level soil is easily tilled. It is well suited to wheat and cotton. Most areas are in cultivation. Under irrigation this is one of the most productive soils in the county. Included within this soil are a few small areas of Miles loam and Cottonwood clay loam. (Capability unit IIce–3; Hardland range site.)

Abilene clay loam, 1 to 3 percent slopes (AbB).—This soil is similar to Abilene clay loam, 0 to 1 percent slopes, but it is gently sloping. In many areas the A and B horizons are somewhat less thick and lighter in color than in the profile described for the series. This soil is best suited to small grain. It is slightly susceptible to water erosion. Small rills are often caused by rains but are removed by cultivation.

Included with this soil are a few moderately eroded areas along drainageways in cultivated fields. (Capability unit IIIe–2; Hardland range site.)

Abilene-Cottonwood complex, 0 to 1 percent slopes (AcA).—This complex consists of areas of Abilene clay loam, Cottonwood clay loam, and Acme clay loam that were too intricately mixed to be mapped separately (fig. 7). The Abilene soils comprise 40 to 50 percent of the complex; Cottonwood soils, 30 to 40 percent; and Acme soils, 15 to 20 percent. The Cottonwood and Acme soils occur within broad areas of the Abilene soils. The areas of Cottonwood soils are generally less than 3 or 4 acres in size. The Acme soils are mostly around the edges of the

Figure 7.—**Abilene-Cottonwood complex. The light areas are Cottonwood soils; the darker areas are Abilene soils.**

Cottonwood soils in a transitional area between the deep Abilene soils and the very shallow Cottonwood soils.

This complex occurs mostly west of Community Center School. The areas are nearly level to gently sloping. The soils are well drained and absorb water readily. Very little runoff occurs, except on the steeper slopes.

A typical profile of Abilene clay loam is described under the Abilene series.

Following is a profile of Cottonwood clay loam in a typical area of the Abilene-Cottonwood complex (0.2 mile south of Farm Road 268 and 2 miles west of Community Center School):

A_{1p} 0 to 4 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, granular structure; soft when dry, very friable when moist; strongly calcareous; abrupt boundary; pH 7.5–8.0.

A_{12} 4 to 8 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; strongly calcareous; abrupt boundary; pH 7.5–8.0.

C 8 to 20 inches +, white (10YR 8/2), calcareous, soft, chalky gypsum that becomes hard at 20 inches.

The dry color of the A horizon is mostly grayish brown and brown. The depth to the C horizon ranges from 4 to 12 inches.

The Acme soils are shallow to moderately deep and have developed over white gypsum. They are weakly calcareous and very friable. They are less deep and more friable than the Abilene soils. The Acme soils are brown to grayish-brown clay loam to an average depth of 8 to 10 inches. Their subsoil is brown to grayish-brown or reddish-gray clay loam to an average depth of 22 to 24 inches. This subsoil is weakly to strongly calcareous and friable. It has a weak, subangular blocky structure. The substratum of the Acme soils consists mainly of calcareous, white or grayish beds of soft, massive gypsum.

A profile of Acme clay loam in a typical area of the Abilene-Cottonwood complex (0.2 mile south of Farm Road 268 and 2 miles west of Community Center School):

A_{1p} 0 to 5 inches, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; weakly calcareous; abrupt boundary; pH 7.5–8.0.

A_{12} 5 to 9 inches, dark-brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; weakly calcareous; clear boundary; pH 7.5–8.0.

AC 9 to 22 inches, reddish-gray (5YR 5/2) clay loam, dark reddish gray (5YR 4/2) when moist; weak to moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist; strongly calcareous; abrupt boundary; pH 8.0.

C 22 to 36 inches +, pinkish-white (5YR 8/2), strongly calcareous gypsum.

The depth to the C horizon ranges from 15 to 28 inches.

The soils in this complex are nearly level to gently sloping and are easily tilled. Most areas are in cultivation. Small grain is best suited, but some cotton is also grown. Since these soils are nearly level, water erosion is significant only in a few areas where runoff concentrates. Because of the shallowness of the Cottonwood soils, areas of this complex are only moderately productive. (Both soils of complex, capability unit IIIsc-1; Abilene clay loam, Hardland range site; Cottonwood clay loam, Gypland range site.)

Abilene-Cottonwood complex, 1 to 3 percent slopes (AcB).—This complex is closely associated with Abilene-Cottonwood complex, 0 to 1 percent slopes. It is similar to that complex in characteristics and occurrence. It is more sloping, however, and has a slightly lower percentage of Abilene and a higher percentage of Cottonwood soils.

This complex occurs mostly along drains in the area west of Community Center School. In some areas it is slightly eroded, especially on the steeper slopes. Small grain is the main crop grown in cultivated areas. (Both soils of complex, capability unit IVes-1; Abilene clay loam, Hardland range site; Cottonwood clay loam, Gypland range site.)

Carey Series

The Carey series consists of reddish-brown, deep, moderately permeable soils. These soils have a very fine sandy loam or loam surface layer and a sandy clay loam or loam subsoil. They occur in gently sloping to moderately sloping areas of the uplands in the southwestern and northwestern parts of the county. The present vegetation is mainly buffalograss, blue grama, and mesquite trees.

The surface layer is reddish brown in color and averages about 8 inches in thickness. It is noncalcareous and has a weak, granular or subangular blocky structure. Under proper management it is friable and well suited to plant growth. If tilled when too wet, it becomes compacted, and a plowpan is formed. After hard rains, the surface layer crusts readily. Because of this, it is often necessary to replant cotton several times.

The subsoil is red to reddish-brown sandy clay loam or loam. It is noncalcareous and averages about 38 inches in thickness. The structure is subangular blocky. Plant roots and water move freely through the subsoil, and the water in it is readily available to plants.

The parent material is soft sandstone. The upper part has a layer of lime accumulation, averaging about 20 inches in thickness (fig. 8). Below this accumulation, the material is soft sandstone or packsand.

The Carey soils are similar to the St. Paul soils but are lighter colored and have a thinner solum. They are closely associated with the Woodward soils, which are thinner and lack a B horizon.

The Carey soils are well drained and are very fertile.

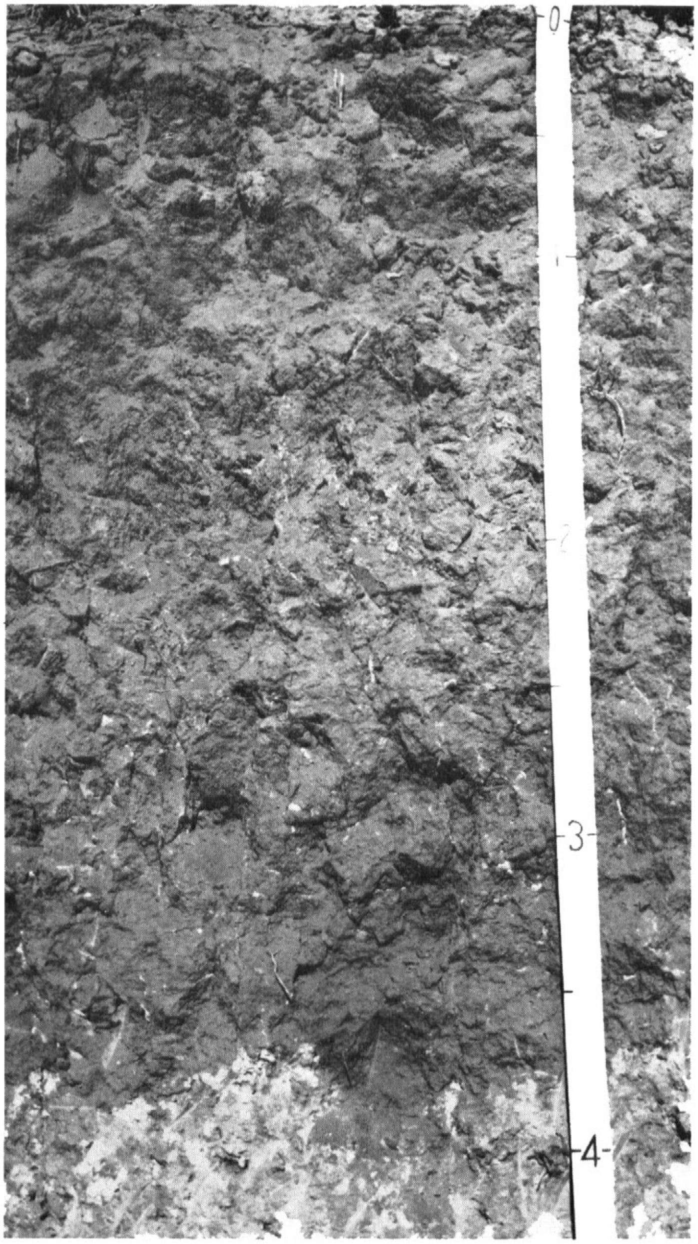


Figure 8.—**Profile of Carey loam. C_{ca} horizon is at a depth of 4 feet.**

They wash easily where water concentrates and are slightly susceptible to wind erosion.

Typical profile of Carey loam (about 1 mile southeast of Carey; northeast corner, section 727, Block H, W. and N. W. RR. Co. Survey):

A_{1p} 0 to 8 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; weak, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt boundary; pH 7.5–8.0.

B_1 8 to 12 inches, reddish-brown (5YR 4/3) light sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak to moderate, fine, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; clear boundary; pH 7.5–8.0.

B_2 12 to 25 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; very hard when dry, firm when moist; noncalcareous; gradual boundary; pH 7.5–8.0.

B_3 25 to 38 inches, red (2.5YR 5/6) light sandy clay loam, dark red (2.5YR 3/6) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; gradual boundary; pH 7.5–8.0.

C_{ca} 38 to 58 inches, red (2.5YR 5/8) heavy very fine sandy loam, red (2.5YR 4/8) when moist; slightly hard when dry, very friable when moist; strongly calcareous; few concretions of calcium carbonate; gradual boundary; pH 8.0–8.5.

C 58 to 82 inches +, red (2.5YR 5/6), weakly calcareous, soft Permian sandstone.

The dry color of the A horizon ranges in hue from 5YR to 7.5YR, in value from 3 to 6, and in chroma from 2 to 4. The thickness ranges from 5 to 12 inches.

The dry color of the B_2 horizon ranges in hue from 2.5YR to 5YR, in value from 4 to 5, and in chroma from 3 to 6. The texture of the B_2 horizon ranges from light sandy clay loam to clay loam. The thickness ranges from 10 to 24 inches. The depth to the C_{ca} horizon ranges from 30 to 50 inches. The reaction of the C_{ca} horizon is weakly to strongly calcareous.

Representative samples of the surface soil were taken at two locations for mechanical analysis by the Soil Survey Laboratory at Lincoln, Nebr. Sample 13383 was sampled about 0.5 miles east of the Carey School in the southeast corner of section 729 in a cultivated field. Sample 13384 was sampled about 3 miles southeast of Tell, 0.3 mile east of the northeast corner of section 772 in a cultivated field. The results are given in table 2.

Carey loam, 1 to 3 percent slopes (CaB).—This soil is gently sloping. A large part is cultivated. It is one of the most desirable soils in the county for dryland farming. Cotton and grain sorghum are well suited. Wind and water erosion are slight hazards. In a few cultivated areas along drainageways, small areas of eroded soils occur. Included with this soil are areas of Woodward loam that were too small to be mapped at the scale used. These included areas make up about 5 percent of the acreage. (Capability unit IIe–1; Mixed Land range site.)

Carey loam, 3 to 5 percent slopes (CaC).—This moderately sloping soil occurs mostly along ridges above the gently sloping Carey soils. A large part of this soil is cultivated. In most areas the A horizon is thinner than the one in the profile described.

This soil is moderately susceptible to water erosion. Small gullies occur in places where runoff concentrates. Included with this soil are areas of Woodward loam that were too small to be mapped at the scale used. These included areas make up about 10 percent of the acreage. (Capability unit IIIe–4; Mixed Land range site.)

Cottonwood Series

The Cottonwood series consists of very shallow, calcareous, well-drained soils developed over soft, whitish gypsum. The surface soil, to a depth of about 8 inches, is brown or grayish-brown loam or clay loam. It is underlain by a substratum of gypsum.

In this county Cottonwood soils are mapped only in complex with the Abilene soils. A typical profile of a Cottonwood soil is described in the Abilene-Cottonwood complex, 0 to 1 percent slopes (fig. 9).

TABLE 2.—*Mechanical analysis of two samples of surface soil of Carey loam, analyzed July 1960*

Sample number	Horizon	Depth	pH	Organic carbon	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.1 mm.)	Very fine sand (0.1–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)	(0.02–0.002 mm.)	(0.2–0.02 mm.)
		Inches		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
13383	A_{1p}	0–7	7. 7	0. 36	0. 1	0. 4	0. 8	22. 9	37. 8	24. 7	13. 4	5. 5	78. 2
13384	A_{1p}	0–6	7. 8	. 32	. 1	. 3	. 4	19. 4	39. 3	28. 0	12. 5	5. 8	79. 2

Enterprise Series

The Enterprise series consists of reddish-brown, calcareous soils of the upland. These soils are well drained and very friable. They occur on nearly level to sloping areas adjacent to the Red River and other large streams. The parent material is eolian sandy loam blown from the riverbeds and deposited as a mantle along the riverbanks. The present vegetation consists of buffalograss, sand dropseed, blue grama, bluestem, mesquite trees, and sagebrush.

The surface layer is reddish-brown very fine sandy loam or fine sandy loam to an average depth of 16 inches. This weakly calcareous layer is favorable for plant growth. It is very friable when moist and soft when dry.

The subsoil is light reddish brown to reddish yellow. It has the same texture as the surface layer. The structure is prismatic to weak, subangular blocky. The subsoil is strongly to very strongly calcareous. Roots and moisture can easily move through the profile. A profile of Enterprise very fine sandy loam is shown in figure 10.

The Enterprise soils are similar to the Tivoli but are much less sandy throughout and lack the duned topography.

The Enterprise soils are easily tilled. They are well drained and have moderately rapid permeability. Their natural fertility is moderate to low. They are slightly to moderately susceptible to wind erosion. Fence rows that adjoin cultivated fields generally have soil accumulations that are 1 to 3 feet high and 5 to 10 feet across.

Typical profile of Enterprise very fine sandy loam (200 feet east of U.S. Highway No. 83, 0.3 mile north of Red River Bridge, about 10 miles north of Childress):

A_{1p} 0 to 6 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) when moist; weak, granular structure; soft when dry, very friable when moist; weakly calcareous; abrupt boundary; pH 7.5–8.5.

A_{12} 6 to 16 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; strongly calcareous; clear boundary; pH 7.5–8.5.

AC 16 to 60 inches +, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; strongly calcareous; pH 7.5–8.5.

The color of the A horizon ranges from light reddish brown to brown. The texture is mainly very fine sandy loam or fine sandy loam. The thickness ranges from 8 to 20 inches. The color of the AC horizon ranges from light reddish brown to yellowish red. The texture ranges from fine sandy loam to very fine sandy loam. The AC horizon ranges from weakly to strongly calcareous. Limestone or gypsum occurs at a depth of 4 to 6 feet in places, especially in the more sloping areas.

Enterprise fine sandy loam, 0 to 1 percent slopes (EfA).—This soil has a profile similar to that described for the series. It is fine sandy loam throughout, however, and is slightly darker in color. In some areas the A horizon is noncalcareous.

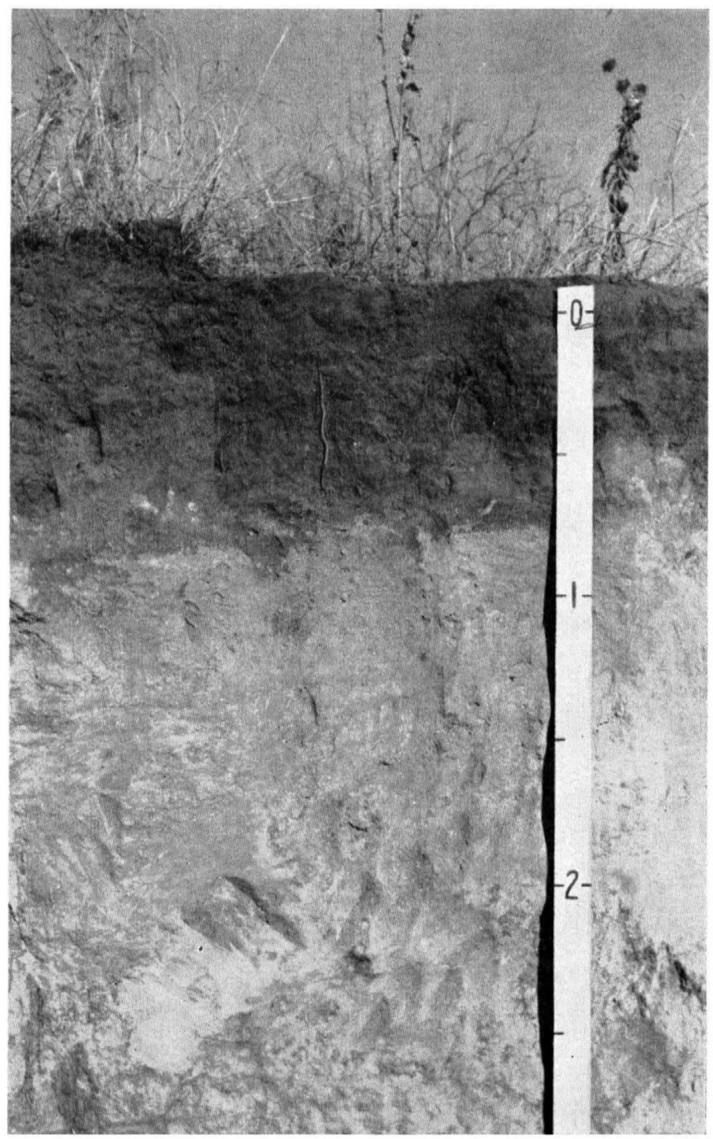


Figure 9.—**Profile of Cottonwood clay loam. The whitish gypsum beds are at a depth of 8 inches.**

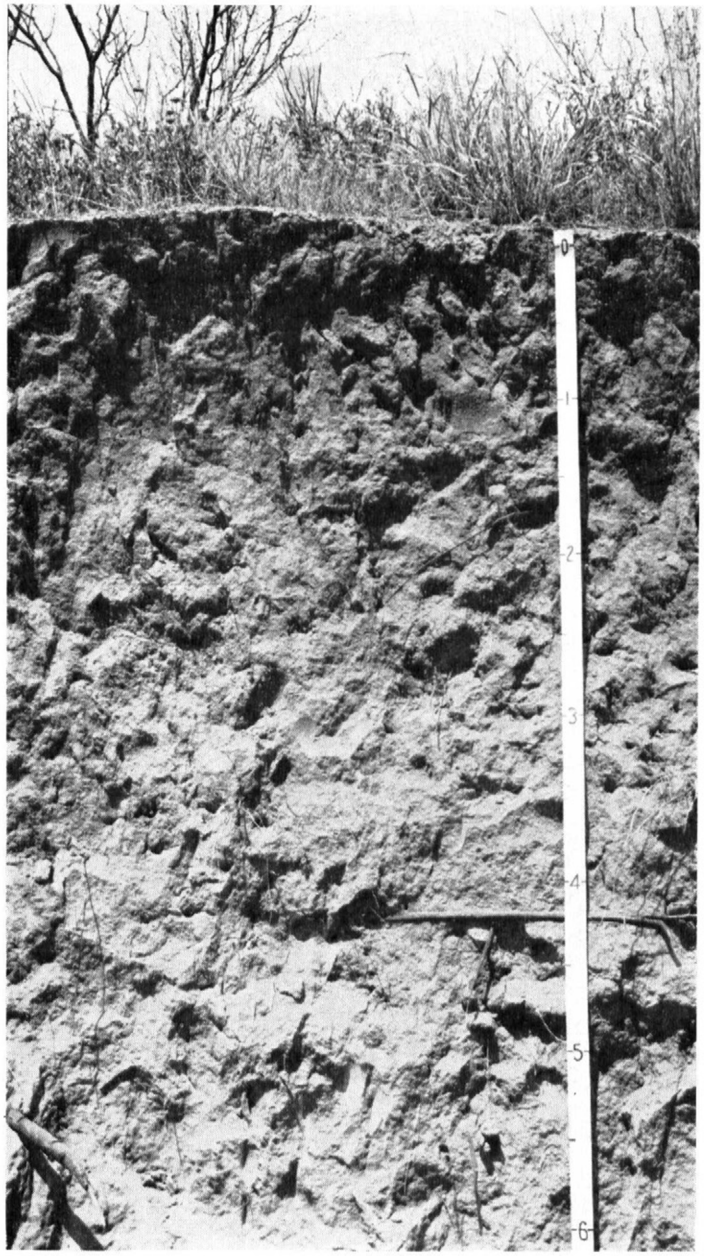


Figure 10.—**Profile of Enterprise very fine sandy loam showing roots in the lower subsoil.**

This soil has a minor acreage in Childress County. Most areas are cultivated. Cotton and grain sorghum are the main crops grown. The cultivated areas are moderately susceptible to wind erosion. In the first few inches, the surface layer is generally winnowed. Fence rows bordering cultivated fields have soil accumulations that are 2 to 5 feet high and 5 to 15 feet across. (Capability unit IIIe–6; Sandy Loam range site.)

Enterprise fine sandy loam, 1 to 3 percent slopes (EfB).—This soil is similar to Enterprise fine sandy loam, 0 to 1 percent slopes, but it is gently sloping. The A horizon is slightly thinner than that of the profile described.

Most of this soil is in cultivation. The cultivated areas are moderately susceptible to wind erosion. In most areas the upper few inches of the surface layer have been winnowed. Included with this soil are small areas of Enterprise very fine sandy loam on slopes of 0 to 1 and 1 to 3 percent. Also included in places on steeper slopes along drainageways are small, water-eroded areas. (Capability unit IIIe–6; Sandy Loam range site.)

Enterprise fine sandy loam, 3 to 5 percent slopes (EfC).—This soil is moderately sloping. The A horizon is lighter in color and thinner than that of the profile described. Also, the texture is fine sandy loam throughout.

Most of this soil is in cultivation. It is moderately susceptible to water and wind erosion. Small gullies are common where runoff concentrates. In most areas the surface layer is winnowed and the upper few inches are sandier than normal. (Capability unit IVe–2; Sandy Loam range site.)

Enterprise very fine sandy loam, 0 to 1 percent slopes (EmA).—This soil has a profile similar to that described for the series. It is nearly level to undulating. Most of these areas are in cultivation. This soil occurs mostly as small areas within larger areas of the more sloping Enterprise soils. This soil is very well suited to crops, but it is slightly susceptible to wind erosion. (Capability unit IIce–2; Mixed Land range site.)

Enterprise very fine sandy loam, 1 to 3 percent slopes (EmB).—This soil is gently sloping to undulating. Most areas are in cultivation. The main crops are cotton and grain sorghum. The hazard of erosion is slight in cultivated areas. Some small, eroded areas occur on the steeper slopes where runoff concentrates. Small areas of Enterprise very fine sandy loam on slopes of 0 to 1 and 3 to 5 percent are included with this soil. (Capability unit IIIe–4; Mixed Land range site.)

Enterprise very fine sandy loam, 3 to 5 percent slopes (EmC).—This soil has moderate slopes. It is moderately susceptible to water erosion. Small, eroded areas are common where runoff concentrates. In most areas the A horizon is slightly thinner than that of the profile described. Most of the acreage of this soil is cultivated. Included are small areas of Enterprise very fine sandy loam on slopes of 1 to 3 and 5 to 8 percent. (Capability unit IIIe–4; Mixed Land range site.)

Enterprise very fine sandy loam, 5 to 8 percent slopes (EmD).—This soil occurs mostly in small bands along ridges. It is associated with the less sloping Enterprise very fine sandy loams.

Some areas of this soil are in cultivation, but they are highly susceptible to water erosion. For this reason this soil is best suited to native vegetation. In most cultivated areas, the A horizon has been thinned considerably and ranges from 8 to 12 inches in thickness. (Capability unit IVe–5; Mixed Land range site.)

Gravelly Broken Land

Gravelly broken land (Gr).—This miscellaneous land type consists of gravelly areas. These areas are outwash deposits that have been dissected. The surface is rough, and slopes are moderate to steep. Many narrow ridges or divides with steep side slopes and narrow valleys are characteristic of the topography. About 60 percent of the area consists of the more steeply sloping side slopes and valleys. Most areas are stabilized by vegetation, and little erosion occurs.

This land type is mostly associated with the soils of the Miles series. The largest area occurs about 5 miles northeast of Community Center School, near the county line. Another large area occurs about 3 miles northeast of Carey on the Crews Ranch. There are several smaller areas in the county. This land type is suitable only for range and wildlife. Most areas have enough gravel and sand for commercial use (fig. 11). (Capability unit VIe-2; Gravelly range site.)

***Figure 11.*—Gravelly broken land. Gravel pit is in background.**

Harmon Series

The Harmon series is comprised of brown, calcareous, very shallow, stony soils of the upland. These soils have developed from dolomitic limestone. They are distributed widely in the northern part of the county between the Red River and Buck Creek. Small areas also occur in the southeastern part of the county. The present vegetation consists of side-oats grama, blue grama, and buffalograss.

The surface soil is stony loam to an average depth of 8 inches. In most areas it is partly covered with limestone fragments. Under natural conditions, it is very granular and friable and is favorable for plant growth.

The substratum consists of limestone (fig. 12). The upper part is somewhat altered by weathering, and plant roots can penetrate it for several inches. It hardens with depth.

The soils of this series are associated mostly with the La Casa soils, which are deep, dark soils with gentle slopes.

Harmon soils are well drained and moderately permeable. Because of stones and shallowness, they are unsuitable for cultivation. They are good producers of grass, however.

A large part of the areas of Harmon soils is mapped as a complex with La Casa soils.

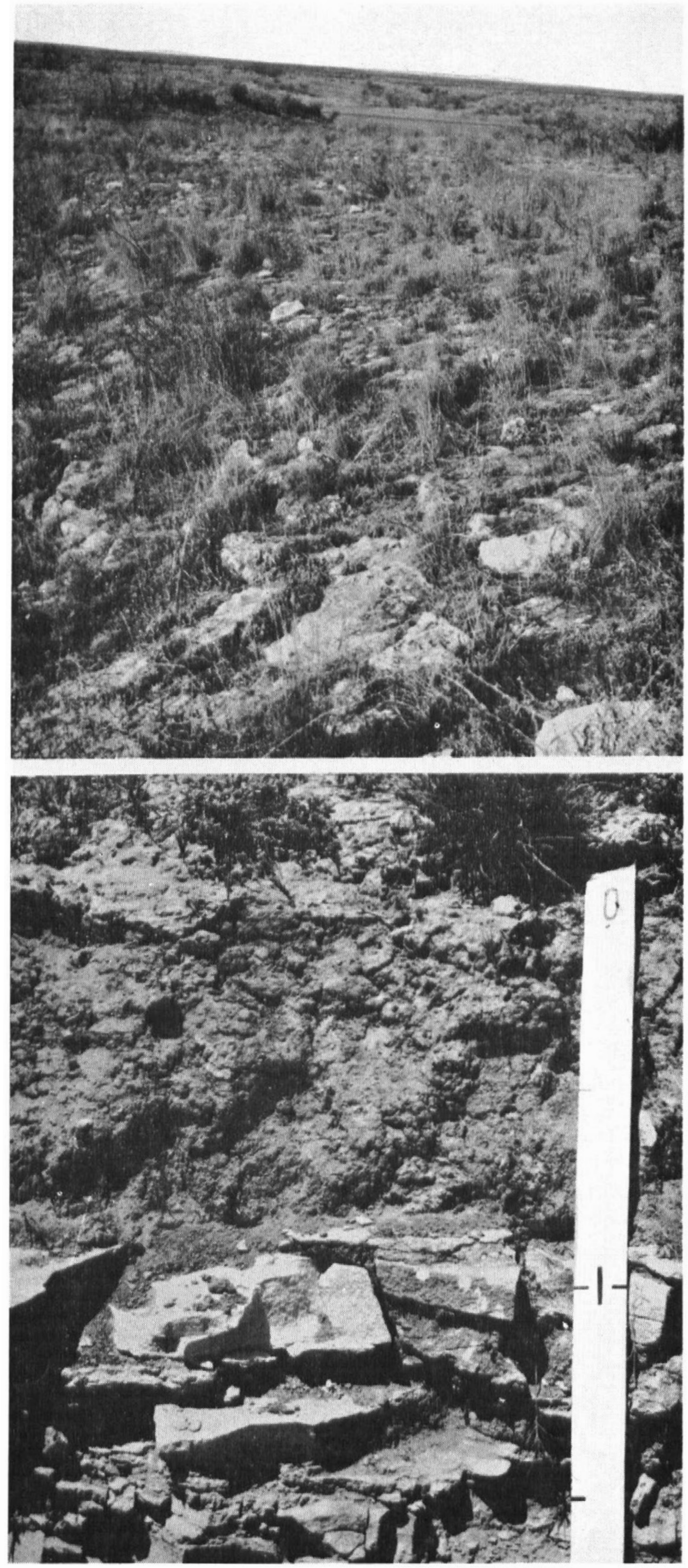


***Figure 12.*—*Top:* Harmon soils showing limestone fragments on the surface. *Bottom:* Profile of Harmon stony loam (dolomitic limestone is at a depth of 10 inches).**

Typical profile of Harmon soils (300 feet west of U.S. Highway No. 83, 12.9 miles north of Childress):

A_1 0 to 8 inches, brown (7.5YR 5/2) stony loam, brown (7.5YR 4/2) when moist; weak, granular and subangular blocky structure; soft when dry, friable when moist; few limestone fragments on surface and throughout horizon; strongly calcareous; abrupt boundary; pH 7.5–8.5.

D_r 8 to 10 inches +, partly weathered dolomitic limestone; some soil intermixed with limestone in upper few inches.

The dry color of the A horizon ranges from brown to reddish brown. The depth to the limestone ranges from 1 to 12 inches.

Harmon soils (Ha).—These soils have convex, gentle to strong slopes. In most places they occur as small outcrops within large areas of La Casa soils, but a few large areas occur along drainageways. Some areas of La Casa soils are included with this soil. The included areas occur along drainageways and in low areas below Harmon soils. They make up about 10 percent of the total acreage. Small areas of Vernon soils are also included. (Capability unit VIIs-3, Very Shallow range site.)

La Casa Series

The La Casa series consists of deep, friable, moderately permeable, calcareous soils. These soils occur on gently sloping areas of the upland in the northeastern part of the county. The parent material is strongly calcareous, loamy to clayey material, probably of the Permian age. The present vegetation consists of buffalograss, blue grama, vine-mesquite, and mesquite trees.

The surface layer is brown or reddish-brown clay loam to an average depth of 9 inches. It has a granular or weak, subangular blocky structure. If properly managed, it is suitable for plant growth. If worked when wet, however, it becomes compacted. In native grassland, roots are plentiful throughout this layer.

The subsoil, a brown to reddish-brown clay loam, becomes slightly lighter in color with depth. It extends to an average depth of 36 to 40 inches and has a weak to moderate, subangular blocky structure. The lower part of the subsoil has a higher concentration of lime than the upper part. Cultivated areas are much more compact than areas in pasture.

Strongly calcareous, loamy to clayey parent material underlies the subsoil. The upper part has an accumulation of soft lime.

The La Casa soils are associated with the Harmon soils, which are very shallow and were developed over dolomitic limestone. In color and texture, they are similar to the Tipton soils. They occur on higher areas, however, and have a higher content of lime.

The La Casa soils are well drained. They are droughty during years of low rainfall. They are slightly susceptible to water erosion, and during rains of high intensity, some erosion occurs. A profile of a La Casa soil is shown in figure 13.

Some areas of La Casa soils are mapped as a complex with Harmon soils.

Typical profile of La Casa clay loam (4 miles east and

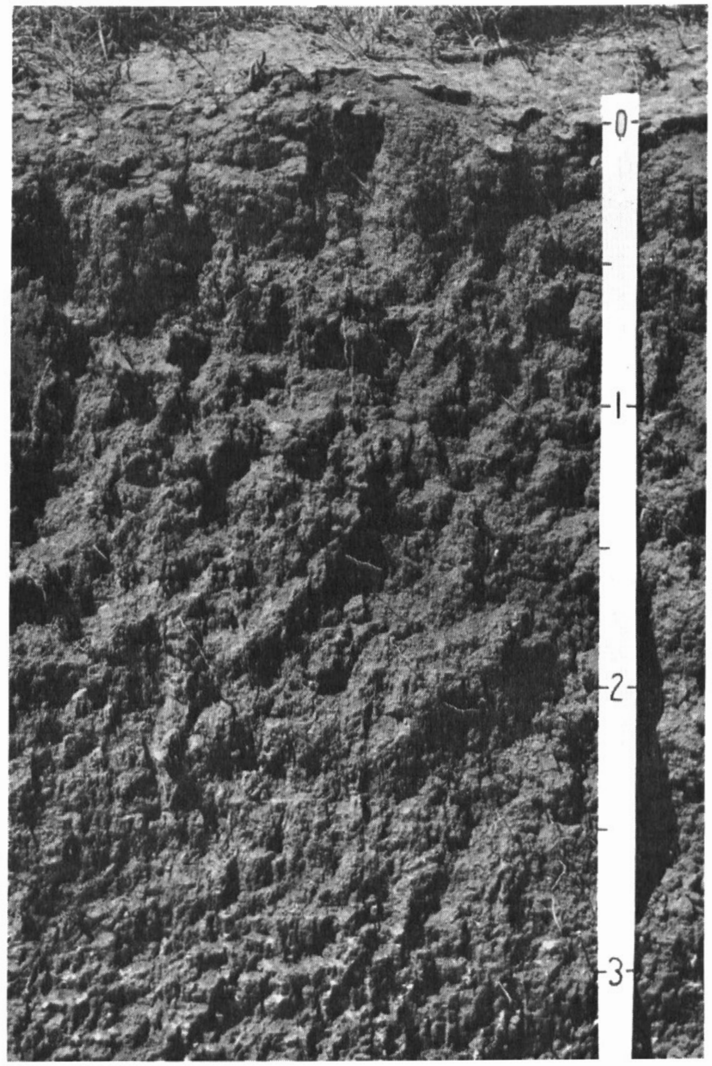


***Figure 13.*—Profile of La Casa clay loam showing blocky structure in lower subsoil.**

0.2 mile north of U.S. Highway No. 83, 11 miles north of Childress):

A_{1p} 0 to 8 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; weak, subangular blocky and granular structure; hard when dry, friable when moist; weakly calcareous; abrupt boundary; pH 7.5–8.0.

B_2 8 to 24 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; weakly calcareous; gradual boundary; pH 7.5–8.0.

B_{ca} 24 to 40 inches, reddish-brown (5YR 5/4) heavy clay loam, reddish brown (5YR 4/4) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; strongly calcareous; diffuse boundary; pH 7.5–8.5.

C_{ca} 40 to 72 inches +, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; hard when dry, firm when moist; many films, threads, and soft deposits of calcium carbonate; very strongly calcareous; pH 7.5–8.5.

In cultivated areas the A horizon ranges from 6 to 10 inches in thickness. In rangeland it ranges from 7 to

14 inches. The color ranges from brown to reddish brown. The depth to the C_{ca} horizon ranges from 26 to 44 inches. In a few areas limestone bedrock occurs at a depth of 2 to 3 feet.

La Casa clay loam, 1 to 3 percent slopes (LaB).—A large area of this soil is in native range. Some cotton is also grown. In cultivated areas this soil is best suited to small grain. Some small cultivated areas have been damaged by runoff. These areas occur mostly as small gullies. Included with this soil are a few small areas with a slope of less than 1 percent. These included areas are generally along drains and are darker in color than this soil. Also included are a few areas along ridges that have steeper slopes. These inclusions are small and do not affect use and management. (Capability unit IIIe-3; Hardland range site.)

La Casa-Harmon complex (Lh).—This complex consists of areas of La Casa clay loam and Harmon stony loam that were too intricately mixed to be mapped separately at the scale used. It varies widely in composition. In some areas La Casa soils comprise as much as 80 percent of the complex. In other areas Harmon soils comprise up to 75 percent of the complex. In a few areas Cottonwood soils comprise up to 25 percent of the complex. A typical composition is 60 percent La Casa soils, 30 percent Harmon soils, and 10 percent Cottonwood and Vernon soils.

This complex occurs extensively on nearly level to sloping areas in the northern part of the county between the Red River and Buck Creek. Broad, smooth, gently sloping areas of La Casa soils, intermixed with knobs and ridges of Harmon soils, are characteristic of this complex.

At present all of this complex is used for range. It produces grasses very well. Because of the shallowness of the Harmon soils, this complex is best suited to range and wildlife. Erosion has not affected it, because of the grass cover.

Typical Harmon soils are described under the Harmon series. (Both soils of complex are in capability unit VIes-1; La Casa clay loam, Hardland range site; Harmon stony loam, Very Shallow range site.)

Loamy Alluvial Land

Loamy alluvial land (Lo).—This miscellaneous land type consists of nearly level, bottom-land areas that are mostly adjacent to small streams and large drains. It is subject to damaging floods several times each year. The texture of the surface layer is not consistent and ranges from clay loam to sandy loam. In most areas the profile does not have any salt accumulations.

This land type is closely associated with soils of the Norwood series but occurs in lower positions. Because of the frequent floods, it is unsuitable for crops. It is well suited to grazing and wildlife, however. (Capability unit Vw-2; Bottom Land (Loamy) range site.)

Miles Series

The Miles series is comprised of brown to reddish-brown, deep, loamy, friable soils. These soils are nearly level to sloping. They are extensive in the northeastern and eastern parts of the county. The parent material is sandy outwash or old alluvial material. The present vegetation consists of buffalograss, blue grama, bluestem, Indiangrass, switchgrass, and mesquite trees. On the sandier soils, shin oak and sand sagebrush are common invaders.

The surface layer ranges from loam to loamy fine sand to an average depth of about 10 inches. It is noncalcareous and has a granular structure.

The subsoil is reddish-brown to brown sandy clay loam. It is noncalcareous and has moderate, subangular blocky structure. Moisture and plant roots penetrate the subsoil readily.

The substratum consists of sandy outwash material that is calcareous in places.

The Miles soils are redder in color and sandier throughout than the Abilene soils. They are redder in color and less silty than the Tipton soils. They are less sandy than the Springer and Nobscot soils.

The Miles soils are moderately permeable and are well drained. They absorb water readily and have a moderately high moisture-holding capacity. Natural fertility is fairly high on the loamy soils but is low on the sandier soils. A profile of Miles fine sandy loam is shown in figure 14.

Typical profile of Miles fine sandy loam (0.6 mile east and 300 feet south of the northwest corner of section 398, W. and N. W. RR. Co. Survey, about 6 miles northeast of Community Center School):

A_{1p} 0 to 10 inches, reddish-brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) when moist; weak, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt boundary; pH 7.0-7.5.

B_1 10 to 16 inches, reddish-brown (5YR 4/3) light sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; gradual boundary; pH 7.5-8.0.

B_2 16 to 30 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; clear boundary; pH 7.5-8.0.

B_3 30 to 42 inches, yellowish-red (5YR 5/6) light sandy clay loam, yellowish red (5YR 4/6) when moist; slightly hard when dry, friable when moist; noncalcareous; gradual boundary; pH 7.5-8.0.

C 42 to 60 inches +, red (2.5YR 4/6), weakly calcareous, outwash material; pH 7.5-8.0.

The texture of the surface layer is mostly loam, fine sandy loam, or loamy fine sand. The thickness of the A horizon ranges from 4 to 20 inches. The color ranges from dark reddish brown to brown, hue 5YR to 7.5 YR. In some areas a B_1 horizon is lacking in the sandier soils. The texture of the B horizon ranges from light sandy clay loam to clay loam. The color of the B horizon ranges from red to reddish brown in the Miles loamy fine sands and Miles fine sandy loams. It ranges from reddish brown to brown in the Miles loams. In places a C_{ca} horizon is present. The depth to the C horizon ranges from 36 to 60 inches. The underlying shale and sandstone on which the alluvial materials were deposited are at a depth of 4 to 8 feet in many areas.

Miles fine sandy loam, 0 to 1 percent slopes (MfA).—This soil is nearly level. It is darker than the soil described for the series. The A horizon ranges from brown to dark brown. In some areas, it is thicker than that of the profile described for the series.

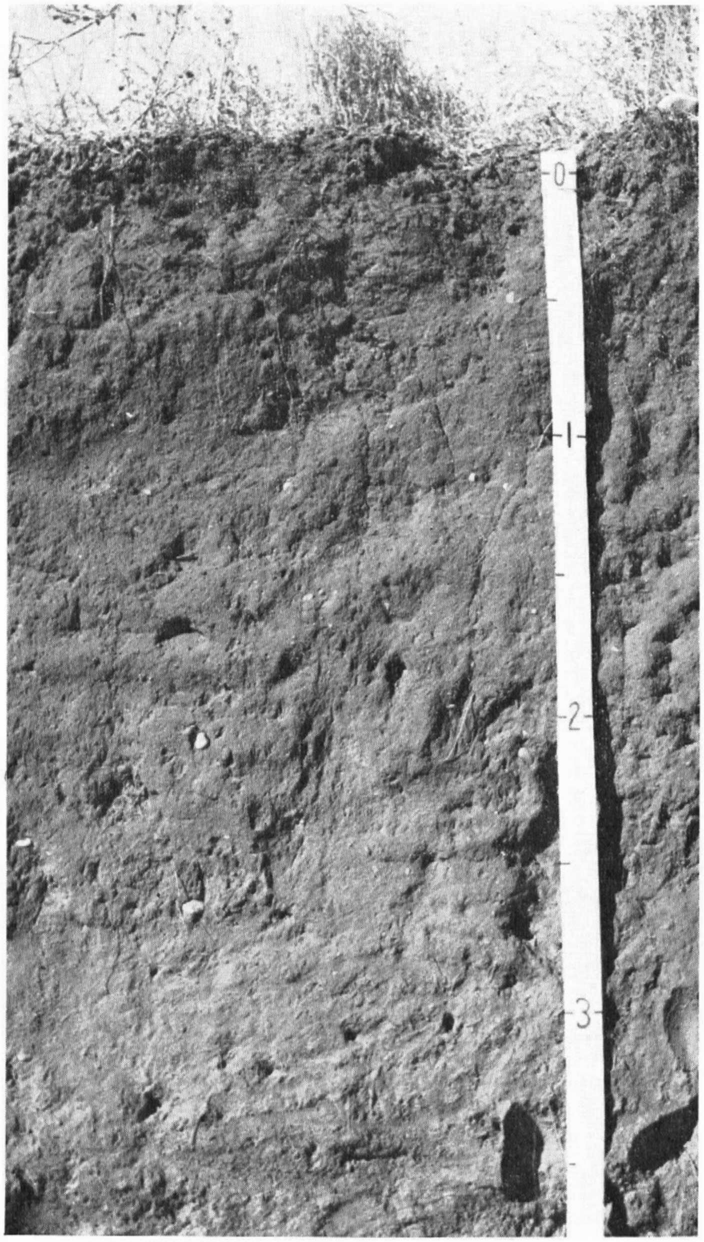


Figure 14.—**Profile of Miles fine sandy loam showing waterworn gravel throughout.**

Most areas of this soil are in cultivation. The soil is easily tilled and very suitable for crops. It is moderately susceptible to wind erosion. In some areas the surface layer is winnowed in the upper few inches. (Capability unit IIIe–5; Sandy Loam range site.)

Miles fine sandy loam, 1 to 3 percent slopes (MfB).—This soil is gently sloping. It is the most extensive of the Miles fine sandy loams. Most of it is in cultivation. The main crops grown are cotton and grain sorghum. Cultivated areas are moderately susceptible to wind erosion and slightly susceptible to water erosion. Most of the areas are winnowed in the upper few inches. Included with this soil are a few areas having moderate wind erosion (fig. 15). A few small areas having moderate water erosion also are included. These areas are along drainageways. (Capability unit IIIe–5; Sandy Loam range site.)

Miles fine sandy loam, 3 to 5 percent slopes (MfC).—This soil is moderately sloping. It occurs on convex areas. The A and B horizons are generally thinner than those of the profile described for the series. As this soil is moderately susceptible to water and wind erosion, cultivated areas need careful management. Most of these areas are winnowed in the upper few inches of topsoil. This soil is best suited to permanent grasses. Included with this soil are a few, small gullied areas where runoff concentrates. Also included are a few outcrops of Woodward soils. These inclusions are small and do not affect use and management. (Capability unit IVe–2; Sandy Loam range site.)

Miles fine sandy loam, 3 to 5 percent slopes, eroded (MfC2).—This soil is similar to Miles fine sandy loam, 3 to 5 percent slopes. It has been moderately eroded by water, however. It occurs mostly along drainageways. The surface layer has been removed, and the B horizon is exposed in at least 25 percent of the area. In all areas the A horizon has been thinned. Gullies are common. Production of crops is very hazardous on this soil. Native grass is better suited. (Capability unit IVe–2; Sandy Loam range site.)

Miles fine sandy loam, 5 to 8 percent slopes, eroded (MfD2).—The profile of this soil is thinner than the one described for the series. The soil is strongly sloping to steep. Most areas occur along drainageways and ridges in association with the less sloping phases of Miles fine sandy loam.

As a result of water erosion, most areas have gullies. The B horizon is exposed in 25 to 50 percent of the areas. This soil is too susceptible to erosion to be used for crops. It is best used for native grass for grazing. (Capability unit VIe–3; Sandy Loam range site.)

Miles loam, 0 to 1 percent slopes (MmA).—This soil is level or nearly level. It occupies broad areas in the northeastern part of the county. It is darker in color than the

Figure 15.—**Wind erosion on Miles fine sandy loam.**

Miles fine sandy loams and is less sandy throughout the solum. The dark color was probably caused by poor drainage and excess water at one time. In many areas drainage is slow from the surface. Permeability is moderate.

Typical profile of a Miles loam in a cultivated field (1 mile east of Loco, 0.25 mile south and 100 feet east):

A_{1p} 0 to 5 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; weak, granular structure; slightly hard when dry; friable when moist; noncalcareous; abrupt boundary; pH 7.5–8.0.

A_{12} 5 to 12 inches, dark-brown (7.5YR 3/2) loam, very dark brown (7.5YR 2/2) when moist; weak, granular and subangular blocky structure; slightly hard when dry, friable when moist; gradual boundary; pH 7.5–8.0.

B_1 12 to 20 inches, dark-brown (7.5YR 3/2) sandy clay loam, very dark brown (7.5YR 2/2) when moist; weak to moderate, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; gradual boundary; pH 7.5–8.0.

B_2 20 to 32 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; gradual boundary; pH 7.5–8.0.

B_3 32 to 40 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; gradual boundary; pH 7.5–8.0.

C_{ca} 40 to 50 inches, yellowish-red (5YR 5/6) light sandy clay loam, yellowish red (5YR 4/6) when moist; slightly hard when dry, friable when moist; strongly calcareous; diffuse boundary; pH 8.0–8.5.

C 50 to 60 inches +, this horizon is similar in texture and consistence to the one above; yellowish red (5YR 5/6); weakly calcareous; pH 8.0–8.5.

The A horizon ranges from 10 to 16 inches in thickness. The dry color of the A and B_1 horizons ranges from dark reddish brown to brown, hue 5YR to 7.5YR, value 3 to 4, and chroma 2 to 3. The dry color of the B_2 horizon ranges from reddish brown to brown, hue 2.5YR to 7.5YR, value from 3 to 5, and chroma from 2 to 4. The texture of the B_2 horizon ranges from light sandy clay loam to clay loam. The depth to the C_{ca} horizon ranges from 36 to 60 inches. The C_{ca} horizon ranges from weak to distinct.

Most of this soil is in cultivation and is very productive. It is only slightly susceptible to wind erosion. Cotton, wheat, and grain sorghum are grown extensively. Included with this soil are a few, small areas of the Enterprise fine sandy loams. (Capability unit IIce–2; Hardland range site.)

Miles loam, 1 to 2 percent slopes (MmB).—This soil is gently sloping. It occurs in association with Miles loam, 0 to 1 percent slopes. It is generally not so dark at the surface, however. Surface drainage and permeability are moderate. Most of this soil is in cultivation. It is slightly susceptible to water and wind erosion.

Included with this soil are a few, small areas with fine sandy loam surfaces that occur mostly along ridges. Also included are a few areas where runoff concentrates and has caused moderate erosion. These inclusions are small and do not affect use and management. (Capability unit IIIe–3; Hardland range site.)

Miles loamy fine sand, 0 to 3 percent slopes (MsB).—This soil has a sandier A horizon than the Miles fine sandy loams. It is nearly level to gently sloping.

This soil is highly susceptible to wind erosion. Careful management is needed to protect cultivated areas from erosion. At one time most areas were in cultivation, but they are gradually being returned to grass. This soil is best suited to permanent grasses.

Many areas have been deep plowed to increase the clay content in the surface layer. Also, many areas are winnowed in the upper few inches of the A horizon. In some eroded areas, the surface layer has been removed, and the B horizon is exposed. In others, small dunes occur over the surface in places. In most areas fence rows bordering this soil have accumulations of sand, 2 to 6 feet high and 8 to 20 feet across. Included within this soil are areas having moderate wind and water erosion. Also included are small areas of Springer and Nobscot soils. (Capability unit IVe–3; Sandy Land range site.)

Miles loamy fine sand, 3 to 5 percent slopes (MsC).—This soil is redder than the one described for the series.

It is moderately sloping to steep and occurs in convex areas in association with Miles loamy fine sand, 0 to 3 percent slopes. In many areas the B horizon is absent.

Because of the steep slopes and high susceptibility to wind erosion, this soil is unsuitable for cultivation. Many areas are moderately eroded by wind and water. Some are gullied by water erosion. Other areas have sand dunes on the surface. Included with this soil are small areas of Springer and Nobscot soils. (Capability unit VIe–5; Sandy Land range site.)

Nobscot Series

The Nobscot series consists of light-colored, very sandy, well-drained soils. The parent material is eolian sand.

The surface layer is light-colored fine sand to an average depth of 22 inches. It is structureless and single grained.

The subsoil, to an average depth of 54 inches, is yellowish-red fine sandy loam. It has a weak, subangular blocky or prismatic structure. It is noncalcareous. It is very permeable to moisture and plant roots. The substratum consists of deposits of eolian sand.

The Nobscot soils are freely permeable. They have a very low moisture-holding capacity. They also have a very low capacity to hold plant nutrients. Fertility is low. These soils are highly susceptible to wind erosion.

The Nobscot soils differ from the Springer soils in having an A_2 horizon and a lighter color throughout. They are less sandy than the Tivoli series.

In this county the Nobscot soils are mapped only with the Springer soils as undifferentiated mapping units. A typical profile of a Nobscot soil is described in Springer and Nobscot soils, hummocky.

Norwood Series

The Norwood series consists of reddish-brown, calcareous, loamy soils of the bottom land. These are young soils that occur along large drains and small streams in this county. The parent material consists of calcareous sediment deposited by floodwaters along streams.

Most of these soils are occasionally flooded, but they are successfully cultivated. Because these soils are young, they lack a B horizon. The present vegetation consists mostly of mid and tall grasses and mesquite trees. In some areas a few chinaberry trees occur along drains.

The surface layer is reddish-brown silt loam or clay loam to an average depth of 16 inches. It is calcareous and has a granular or weak, blocky structure. It is very porous and friable.

The subsoil is reddish brown and is calcareous in most places. It has a weak to moderate, subangular blocky or granular structure. The texture ranges from silt loam to silty clay loam. In many areas there are layers throughout the subsoil that are more clayey and sandy than normal. These layers give the subsoil a stratified appearance.

The Norwood soils occur in slightly lower areas than the Tipton soils. They differ from the Tipton soils in lacking a B horizon. They are associated with Loamy alluvial land but are less frequently flooded and are more uniform in texture. A profile of Norwood silt loam is shown in figure 16.

***Figure 16.*—Profile of Norwood silt loam.**

Typical area of Norwood clay loam (0.3 mile east and 100 feet north of the southwest corner of section 487, W. and N.W. RR. Co. Survey, about 6 miles southeast of Childress):

A_{1p} 0 to 5 inches, reddish-brown (5YR 4/3) clay loam; dark reddish brown (5YR 3/3) when moist; weak, granular structure; slightly hard when dry, friable when moist; weakly calcareous; abrupt boundary.

A_{12} 5 to 16 inches, reddish-brown (5YR 4/3) clay loam; dark reddish brown (5YR 3/3) when moist; weak to moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; weakly calcareous; diffuse boundary.

AC 16 to 60 inches, reddish-brown (5YR 5/4) clay loam; reddish brown (5YR 4/4) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; strongly calcareous.

The thickness of the A horizon ranges from 10 to 22 inches. In most areas the texture is clay loam and silt loam, but in some areas it is fine sandy loam and silty clay loam. The color ranges from light reddish brown to dark reddish brown, hue 5YR. The texture of the AC horizon ranges from clay loam to sandy clay loam. In many areas the AC horizon is stratified with alternate layers of sandier material.

Norwood clay loam (Nc).—This soil occurs mostly along large drains and small streams that drain the moderately fine textured soils. Most areas are narrow and occur parallel to the streams. This soil is nearly level and easily tilled. It is very high in natural fertility and is very well suited to crops. The main crops grown are small grain, cotton, and wheat. Drainage is slow on the surface, and permeability is moderate. Inclusions of Norwood silt loam make up about 10 percent of the acreage of this soil. (Capability unit IIce-1; Bottom Land (Loamy) range site.)

Norwood silt loam (No).—This soil is similar to Norwood clay loam but is less clayey throughout. The surface layer is mostly silt loam to very fine sandy loam. The subsoil is mostly silt loam to light silty clay loam or light clay loam. This soil occurs mainly along small streams that drain the medium- to coarse-textured soils. It is nearly level. Drainage is slow on the surface. Permeability is moderate. Most of this soil is in cultivation. The main crops are cotton and grain sorghum. The hazard of wind erosion is slight.

Inclusions of Norwood clay loam make up about 10 percent of the acreage of this soil. Also included are a few, small areas having a fine sandy loam surface layer. (Capability unit IIce-2; Bottom Land (Loamy) range site.)

Quinlan Series

The Quinlan series consists of very shallow, calcareous soils that have developed in soft sandstone of Permian age. These soils occur mainly in association with the Woodward, Carey, and St. Paul soils.

The surface layer, to a depth of about 10 inches, is reddish-brown to reddish-yellow loam. It has a weak, granular or subangular blocky structure. It is underlain by a substratum of soft, weakly calcareous sandstone or packsand. Strata of hard gypsum rock are common in the upper part of the substratum.

The Quinlan soils, in depth, are similar to the Vernon soils, but they are lighter in texture and are less compact. They differ from the Woodward soils in that they are less deeply developed and have no distinct C_{ca} horizon.

In this county the Quinlan soils are mapped only in complex with the Woodward and the Vernon soils. A profile of the Quinlan soils is described in the Vernon-Quinlan complex.

Quinlan-Woodward loams, 8 to 20 percent slopes (QuE).—This complex consists of areas of Quinlan loam and Woodward loam that were too intricately mixed to be mapped separately. It is made up mainly of gullied areas that were caused by geologic erosion that cut into the sandstone material of the Permian age. The pattern consists of a continuous main gully having many secondary fingerlike gullies that project back from the main one. In most areas the gullies are stabilized by vegetation. In some areas where excess water concentrates, however, the gullies remain active and continue to erode.

The Quinlan soils may comprise 20 to 40 percent of the complex. They occur mostly along the rims of the gullies. The Woodward soils may comprise 10 to 30 percent of the complex and occur mostly above the rims of the gullies in areas with less slope. Alluvial soils occupy the flat bottoms of the gullies and may comprise 5 to 25 percent of the complex. Sloughed areas and escarpments along the gullies (Rough broken land) make up 10 to 50 percent. Cottonwood soils that occur in association with the Quinlan soils are included with the complex. They may make up as much as 5 to 10 percent of the acreage.

A typical profile of the Quinlan soils is described in the Vernon-Quinlan complex. A typical profile of the Woodward soils is described under the Woodward series.

Associated with areas of this complex are the Woodward soils, the Woodward-Quinlan loams, the Carey soils, and the St. Paul soils. All of these soils occur above this complex.

The soils of this complex are suitable only for range and wildlife. The present vegetation consists mostly of bluestem, Indiangrass, switchgrass, side-oats grama, buffalograss, blue grama, and mesquite trees. Proper management is needed so that the vegetation is not too heavily grazed to maintain good cover. If good cover is not maintained, these soils erode very easily. (Capability unit VIe-4; Mixed Land range site. Inclusions of Rough broken land are in the Rough Broken (Loamy) range site; those of alluvial soils, in the Bottom Land (Loamy) range site.)

Roscoe Series

The Roscoe series consists of dark, clayey, noncalcareous soils. These soils occur in slowly drained depressions in the southeastern part of the county. The parent material is calcareous, clayey, old alluvium.

The surface layer extends to an average depth of 18 inches. It is dark grayish-brown, light clay. It is noncalcareous and has a strong blocky structure. The soil is very hard when dry and very sticky when wet. When it dries, it shows large shrinkage cracks. It is difficult to till.

The subsoil is dark-gray clay. It has a blocky structure and is noncalcareous. The subsoil has a few brown mottles throughout.

The substratum is strongly calcareous clay at a depth of 4 to 5 feet. The Roscoe soils are darker and grayer than the Abilene soils. They are also more poorly drained. They are less red and more clayey than the Tillman soils.

Typical profile of Roscoe clay (0.1 mile east and 100 feet south of the northwest corner of sec. 385, W. and N.W., RR. Co. Survey, about 5 miles southeast of Kirkland):

A_{1p} 0 to 5 inches, dark grayish-brown (10YR 4/2) light clay, very dark brown (10YR 2/2) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; abrupt boundary; pH 7.5-8.5.

A_{12} 5 to 18 inches, dark-gray (10YR 4/1) clay, black (10YR 2/1) when moist; moderate to strong, fine and medium, blocky structure; extremely hard when dry, extremely firm when moist; noncalcareous; diffuse boundary; pH 7.5-8.5.

AC 18 to 45 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) when moist; strong, fine and medium, blocky structure; extremely hard when dry, extremely firm when moist; few shiny surfaces on peds; noncalcareous; gradual boundary; pH 7.5-8.5.

C_{ca} 45 to 84 inches +, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; extremely hard when dry, extremely firm when moist; few deposits of calcium carbonate; strongly calcareous; pH 7.5-8.5.

The dry color of the A horizon ranges from dark brown to dark grayish brown. The color of the AC horizon ranges from brown to dark gray.

Roscoe clay (Rc).—This soil occurs in poorly drained depressions. It is very productive, and all areas are in cultivation. Wheat is the main crop. During dry years this soil is very droughty. Some areas that receive large amounts of water have been drained. Some areas that are not drained are covered with water for long periods during years of very high rainfall. (Capability unit IIIw-1; Hardland range site.)

Rough Broken Land

Rough broken land (Rf).—This miscellaneous land type consists of the steep, rough, broken areas in the northwestern and southern parts of the county.

Rough broken land in the northwestern part of the county occurs along the salt creeks and is moderately sloping to steep. The soil material in this part of the county is mostly gypsum, or clay and limestone intermixed with gypsum. Where the material is mostly gypsum, it is much like that of the Cottonwood soils. There are only a few inches of soil material over white gypsum. Small tracts of Harmon soils are common throughout this area of Rough broken land.

Most of Rough broken land in the southern part of the county is in the Pease River breaks. This area is generally steeper and less productive than that in the northwestern part of the county. It is characterized mostly by deep gullies, ridges, and bluffs of Permian sandstone and clay. Because of geologic erosion, gullies have formed in the highly erosive clay and sandstone. The sides and bottoms of the gullies are a mixture of sandy and clayey materials interbedded with seams of gypsum (satin spar). The material above the rims of the gullies is mostly soft sandstone. In some areas limestone occurs along the rims of the gullies.

This land type supports only limited amounts of vegetation. The native vegetation consists of little bluestem, side-oats grama, blue grama, black grama, and buffalograss. Redberry juniper (cedar) also occurs in most areas. The areas with a high content of gypsum support 25 to 50 percent more vegetation than those without gypsum. (Capability unit VIIs–1; the areas high in gypsum, Gypland range site; the other areas, mostly in the Pease River breaks, Rough broken (Loamy) range site.)

Sandy Alluvial Land

Sandy alluvial land (Sa).—This miscellaneous land type consists of bottom-land soils along the Red River and Buck Creek. It occurs from 1 to 3 feet above the river channel and is subject to recurrent flooding. These areas have a water table 1 to 3 feet below the surface.

The texture of the surface layer is not consistent. It ranges from sand to clay. The subsoil is sandy in most places. Most areas are salty and have a white surface crust of calcium salts. They support only salt-tolerant vegetation, such as saltcedar, inland saltgrass, and alkali sacaton. This land type is suitable only for pasture. (Capability unit Vw–1; Bottom Land (Sandy) range site.)

Springer Series

The Springer series consists of reddish-brown to brown, deep, sandy soils. These soils have moderately rapid permeability. They occur in nearly level to sloping areas in the uplands, mostly along the south side of the Red River. A band of these sandy soils, about 1 to 5 miles wide, extends from Garden Valley to about 4 miles west of the River Camp School. The parent materials of the Springer soils are old outwash or old alluvial materials that were reworked by wind. The present vegetation consists of bluestem, Indiangrass, switchgrass, and sand lovegrass. Shin oak and sand sagebrush are the two woody invaders most common on these soils.

The A horizon is reddish-brown to brown loamy fine sand. It is single grained. It is noncalcareous and extends to an average depth of about 12 inches.

The subsoil, to an average depth of about 42 inches, is reddish-brown fine sandy loam. It is noncalcareous and has a weak, granular or subangular blocky structure. Plant roots and moisture can penetrate it. The substratum consists of sandy outwash material.

The Springer soils are similar to the Miles soils but have a more sandy B horizon. They are less sandy than the Nobscot and Tivoli soils.

The Springer soils are permeable and well drained. They absorb water readily but have a low moisture-holding capacity. Natural fertility is low. These soils are very susceptible to wind erosion. Where runoff concentrates, they erode very easily. Deep gullies with vertical banks usually result (fig. 17). A large area of the Springer soils was cultivated at one time, but, because of the risk of erosion, most of it has been returned to native grass.

Some areas of Springer soils have been mapped with the Nobscot soils in an undifferentiated unit.

Figure 17.—**Deep, steep-sided gully in Springer soils.**

Typical profile of Springer loamy fine sand (0.4 mile east and 200 feet north of the southwest corner of section 429, W. and N.W. RR. Co. Survey, about 4 miles north of Community Center School):

A_{1p} 0 to 12 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; structureless; loose when dry and moist; noncalcareous; abrupt boundary; pH 7.0–7.5.

B_2 12 to 30 inches, reddish-brown (2.5YR 5/4) fine sandy loam; reddish brown (2.5YR 4/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; gradual boundary; pH 7.0–7.5.

B_3 30 to 42 inches, reddish-yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; diffuse boundary; pH 7.5–8.0.

C 42 to 48 inches +, yellowish-red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) when moist; structureless; loose when dry and moist; noncalcareous; pH 7.5–8.0.

The thickness of the A horizon ranges from 6 to 18 inches. The dry color ranges from reddish brown to brown. The texture of the B horizon ranges from heavy fine sandy loam to loamy fine sand. The dry color of the B horizon ranges in hue from 2.5YR to 5YR, value from 4 to 5, chroma from 2 to 6. A C_{ca} horizon occurs in a few areas. The depth to the C horizon ranges from 32 to 54 inches.

Springer loamy fine sand, undulating (SfB).—This is a nearly level to gently sloping soil of the upland (fig. 18). The dominant slope is about 2 percent. Erosion ranges from none to moderate. Most areas in native vegetation are not eroded. Most cultivated areas are slightly to moderately eroded.

This soil is highly susceptible to wind erosion. Accumulations of sand, 3 to 8 feet high and 8 to 25 feet across at the base, generally occur in fence rows bordering cultivated fields. Most areas that were cultivated have been

Figure 18.—**Profile of Springer loamy fine sand.**

returned to native vegetation. The areas in native vegetation have a cover of sand sagebrush and shin oak in most places. This soil is best suited to range and wildlife unless it is irrigated. It can be cultivated, but careful management is needed to control erosion. (Capability unit IVe-3; Sandy Land range site.)

Springer and Nobscot soils, hummocky (SnD).—This undifferentiated unit consists of Springer and Nobscot soils. These soils are moderately sloping to steep. The dominant slope is about 5 percent.

About 3,000 acres of this undifferentiated unit is in virgin pasture. Most of this land is not eroded. The rest of the unit consists of areas that have been cultivated and are mostly slightly to moderately eroded. A few severely eroded areas are included.

A typical profile of the Springer soils is described under the Springer series.

Typical profile of Nobscot fine sand (100 feet east of Farm Road 268, 2.4 miles north of Community Center School):

A_1 0 to 5 inches, brown (7.5YR 5/2) fine sand, brown (7.5YR 4/2) when moist; single grain (structureless); loose when dry and moist; noncalcareous; clear boundary; pH 7.0–7.5.

A_2 5 to 22 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; single grain (structureless); loose when dry and moist; noncalcareous; abrupt boundary; pH 6.5–7.5.

B_2 22 to 42 inches, yellowish-red (5YR 5/6) heavy fine sandy loam, yellowish red (5YR 4/6) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; gradual boundary; pH 6.5–7.5.

B_3 42 to 54 inches, yellowish-red (5YR 5/6) light fine sandy loam, yellowish red (5YR 4/6) when moist; soft when dry, very friable when moist; noncalcareous; gradual boundary; pH 6.5–7.5.

C 54 to 66 inches +, reddish-yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) when moist; single grain (structureless); loose when dry and moist; noncalcareous; pH 6.5–7.5.

The thickness of the A_1 horizon ranges from 4 to 8 inches. The texture of the B_2 horizon ranges from light to heavy fine sandy loam. Thin lenses of sandy clay loam are common in the B_2 horizon.

At one time a large area of these soils was in cultivation. Because of their high susceptibility to water and wind erosion, however, they are not suitable for cultivation. Consequently, most areas have been returned to native grass. A cover of shin oak and sand sagebrush is characteristic of those areas in range. (Both soils of this mapping unit are in capability unit VIIe-1; Springer soils, Sandy Land range site and Nobscot soils, Deep Sand range site.)

Springer and Nobscot soils, severely eroded (Sn3).—This undifferentiated unit consists of gently sloping to steep soils that were once cultivated and were severely eroded. About 2,500 acres of these soils have gentle slopes; the rest of the acreage has moderate to steep slopes.

Most areas were severely eroded by wind, and a few were severely eroded by water. The B horizon is exposed in 60 to 75 percent of the areas of these soils (fig. 19). These blowout areas are as much as 200 feet in diameter and 2 to 5 feet deep. Sand dunes have accumulated on the areas not blown out. Deep gullies occur in a few places where there is runoff. Fence rows surrounding areas of these soils have accumulations of sand, 5 to 12 feet high and 15 to 40 feet wide at the base. These soils are unsuitable for cultivation. (Both soils of this mapping unit are in capability unit VIIe-1; Springer soils, Sandy Land range site; Nobscot soils, Deep Sand range site.)

St. Paul Series

The St. Paul series comprises deep, dark, silty soils in the southwestern part of the county (fig. 20). Most areas are level to nearly level, but a few are gently sloping. The present vegetation consists mainly of buffalograss, blue grama, and mesquite trees.

***Figure 19.*—Typical blowout area on Springer and Nobscot soils, severely eroded.**

The surface layer is brown to dark-brown silt loam to an average depth of 8 inches. It is noncalcareous and has granular structure. If this layer is well managed, its physical condition is good. If it is tilled when too wet, it becomes compacted and crusts and clods.

The subsoil ranges from dark brown to reddish brown. In most areas, it is lighter in color with depth. It extends to an average depth of 40 to 50 inches and has subangular blocky or blocky structure. The texture is mostly sandy clay loam to clay loam. In some areas the lower part of the subsoil has some lime accumulation and is calcareous. The upper 8 to 18 inches has many pores and evidence of much biological activity.

The underlying parent material consists of calcareous old alluvial or sandy red-bed material. The upper part has an accumulation of calcium carbonate.

The St. Paul soils are less red and less friable than the associated Carey soils. They have a less clayey and more friable and permeable subsoil than the Abilene soils.

The St. Paul soils have moderate to moderately slow permeability. They absorb water readily. Very little runoff occurs except on the steeper slopes. The soils are fairly well drained in most areas. In a few concave areas, however, drainage is poor. These soils are high in fertility and are favorable for crop production.

Typical profile of St. Paul silt loam (0.3 mile east and 100 feet south of the northwest corner of section 631, W. and N.W. RR. Co. Survey, about 2 miles west of Childress):

A_{1p} 0 to 8 inches, brown (7.5YR 5/2) silt loam, brown (7.5YR 4/2) when moist; weak, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt boundary; pH 7.5–8.0.

B_1 8 to 18 inches, brown (7.5YR 4/2) silty clay loam, very dark brown (7.5YR 2/2) when moist; weak to

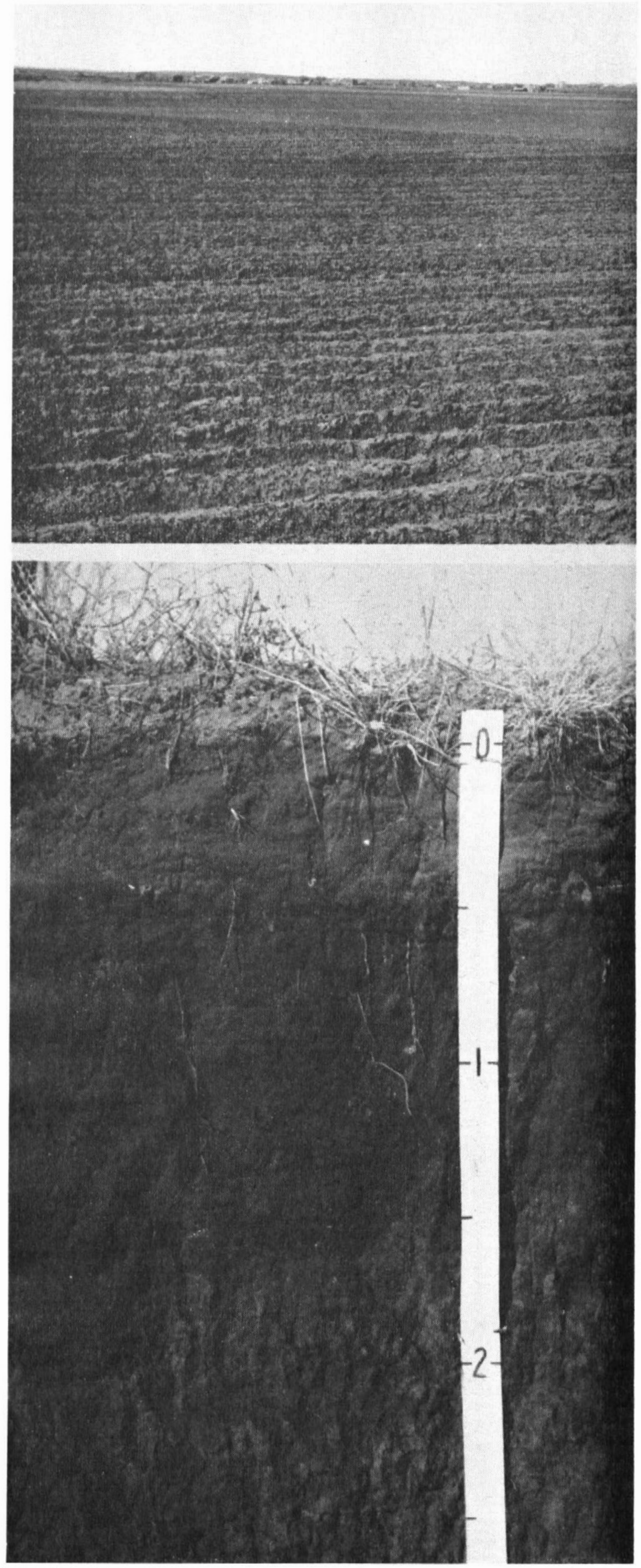


***Figure 20.*—*Top:* Broad, flat areas of St. Paul silt loam east of Tell. *Bottom:* Profile of St. Paul silt loam.** →

moderate, medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; diffuse boundary; pH 7.5–8.0.

B_2 18 to 38 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; moderate to strong, medium, subangular blocky and blocky structure; very hard when dry, firm when moist; noncalcareous; gradual boundary; pH 7.5–8.0.

B_3 38 to 48 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; hard when dry, friable when moist; noncalcareous; clear boundary; pH 8.0–8.5.

C_{ca} 48 to 80 inches, reddish-yellow (5YR 6/6) heavy very fine sandy loam, yellowish red (5YR 5/6) when moist; soft when dry, very friable when moist; strongly calcareous in the upper part but less calcareous with depth; pH 8.0–8.5.

The surface layer ranges from 6 to 14 inches in thickness. The dry color of the B horizon ranges from reddish brown to dark grayish brown. The texture ranges from sandy clay loam to clay loam. The B_3 horizon ranges from noncalcareous to strongly calcareous. The depth to the C horizon ranges from 36 to 60 inches. In a few depressed areas, buried horizons of clayey material occur at a depth of 30 to 50 inches.

St. Paul silt loam, 0 to 1 percent slopes (SpA).—This soil occurs in concave to weakly convex areas in association with the Carey soils. Some areas that receive extra water from surrounding soils are very productive. Most of this soil is in cultivation. Cotton, small grain, and grain sorghum are the main crops. If proper cover is not maintained, this soil is slightly susceptible to wind erosion. Water erosion is not a problem. (Capability unit IIce–2; Hardland range site.)

St. Paul silt loam, 1 to 2 percent slopes (SpB).—This soil occurs in gently sloping, convex areas in association with St. Paul silt loam, 0 to 1 percent slopes. Most areas are small. In some places the surface layer is not as thick as that of the profile described for the series.

This soil is slightly susceptible to wind and water erosion. In places the surface layer has been thinned by water erosion. A few gullies occur where water concentrates. Most of the soil is cultivated. (Capability unit II–1; Hardland range site.)

Tillman Series

The Tillman series comprises reddish-brown, deep, moderately fine textured, slowly permeable soils. The parent material is calcareous, Permian red-bed clay and shale. These soils are nearly level to gently sloping. They occur in the upland in the southeastern part of the county. The present vegetation consists mostly of tobosagrass, buffalograss, pricklypear, and mesquite trees.

The surface soil averages about 7 inches in thickness. It has a granular or subangular blocky structure and a clay loam texture. It ranges from noncalcareous to weakly calcareous. It is hard when dry. Areas that have no cover puddle easily when wet. Such areas crust on the surface when they dry and are then difficult to handle. Areas in range have many grass roots in the surface layer.

The subsoil is a heavy clay loam or light clay. It extends to an average depth of 32 inches and has a blocky structure (fig. 21). Clay films are common on the peds. The upper 7 to 12 inches is not so compact as the lower part of the layer. Range areas have grass roots in the upper part of this layer, but the quantity decreases rapidly with depth. The subsoil is strongly calcareous in the lower part. It is noncalcareous to weakly calcareous in the upper part.

The substratum consists of calcareous, red and gray, shaly clays. It is very hard and massive. The upper part has a high accumulation of calcium carbonate that gradually decreases with depth.

The Tillman soils are associated with Vernon-Weymouth clay loams, which are similar in color and texture but lack B horizons and have thinner solums. They are redder in color and generally occur in higher positions than the Abilene soils, which have formed from outwash material.

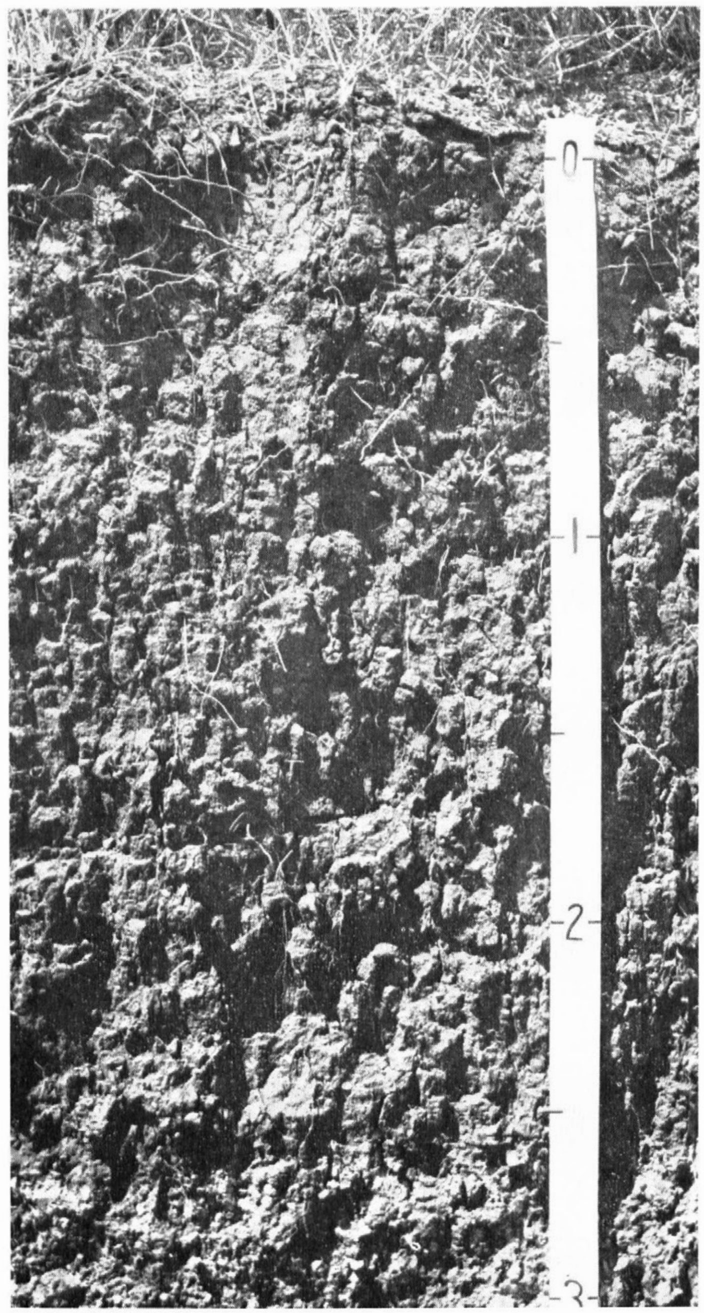


Figure 21.—**Profile of Tillman clay loam showing blocky subsoil.**

The Tillman soils are well drained. They absorb water slowly because of the clayey subsoil. They are very droughty. On the steeper slopes, rapid runoff causes erosion. Except for small grain and other cool-season crops, these soils are only fair for crop production. Natural fertility is moderately high.

Typical profile of Tillman clay loam (about 0.5 mile south of the northwest corner of section 451, W. and N. W. RR. Co. Survey, about 3 miles southwest of Kirkland):

A_{1p} 0 to 7 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) when moist; weak to moderate, fine, subangular blocky structure; hard when dry, firm when moist; weakly calcareous; abrupt boundary; pH 7.5–8.0.

B_1 7 to 12 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist; weak to moderate, fine, subangular blocky structure; very hard when dry, firm when moist; weakly calcareous; gradual boundary; pH 7.5–8.0.

B_2 12 to 32 inches, reddish-brown (5YR 4/4) heavy clay loam or light clay, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; strongly calcareous; gradual boundary; pH 7.5–8.5.

C_{ca} 32 to 44 inches, reddish-brown (5YR 5/4) light clay, reddish brown (5YR 4/4) when moist; very hard when dry, very firm when moist; many soft concretions of calcium carbonate; very strongly calcareous; clear boundary; pH 8.0–8.5.

C 44 to 60 inches +, reddish-brown (5YR 4/4), calcareous, red and gray, shaly clay; pH 8.0–8.5.

The A horizon ranges from 4 to 10 inches in thickness. It ranges from reddish brown to brown in color. This horizon is mostly weakly calcareous, but in a few areas it is noncalcareous. A B_1 horizon is lacking in a few areas. The B_2 horizon ranges from heavy clay loam to light clay. It is mostly calcareous, but in a few areas it is noncalcareous. The depth to the C_{ca} horizon ranges from 24 to 48 inches.

Tillman clay loam, 0 to 1 percent slopes (TcA).—This soil is level to nearly level. The dominant slope is about 0.5 percent. The solum is slightly thicker and the surface soil is darker than in the profile described for the series.

Most of this soil is cultivated. The main crops are wheat and cotton. Except for a few areas where runoff concentrates and small gullies occur, water erosion is of minor importance. Included with this soil are a few small outcrops of Vernon-Weymouth clay loams. (Capability unit IIIs–1; Hardland range site.)

Tillman clay loam, 1 to 3 percent slopes (TcB).—This soil occurs on gentle slopes that are dominantly about 2 percent. Except for about 2,300 acres, all of this soil is calcareous throughout the solum. A large part is in cultivation. Small outcrops of Vernon-Weymouth clay loams make up about 6 percent of the acreage. These areas occur along ridges and knobs. (Capability unit IIIe–1; Hardland range site.)

Tillman clay loam, 1 to 3 percent slopes, eroded (TcB2).—This soil has a profile similar to that of Tillman clay loam, 1 to 3 percent slopes, but it is moderately eroded. The soil is in gullied areas along drainageways. Most of the eroded areas are narrow and are parallel to the drains. Gullies, 1 to 2 feet deep and 6 to 30 feet wide, are common but can be crossed by farm equipment. In most eroded areas the A horizon has been thinned by sheet erosion, and in many, the B horizon is exposed. Inclusions of Vernon-Weymouth loams make up about 10 percent of the acreage. (Capability unit IVe–1; Hardland range site.)

Tipton Series

The Tipton series consists of deep, dark, moderately permeable, loamy soils. These soils occur mostly in the northern and eastern parts of the county. The parent materials are silty or clayey outwash or old alluvial materials deposited on terraces along drains. The present vegetation consists mostly of buffalograss, blue grama, side-oats grama, and mesquite trees.

The surface layer is brown to dark-brown clay loam or silty clay loam to an average depth of 10 inches. It is weakly calcareous to noncalcareous and has a granular to weak, subangular blocky structure. This layer is very friable and is highly suitable for cultivation.

The subsoil is brown to dark-brown clay loam to silty clay loam to a depth of 36 to 48 inches. It is noncalcareous to weakly calcareous. The structure is subangular blocky. The upper part of the subsoil is highly porous and shows evidence of much biological activity. The lower part is more compact.

The substratum consists of calcareous outwash material. The upper part has a high accumulation of calcium carbonate.

The Tipton soils are similar to the La Casa soils but are slightly darker, are less calcareous, and occur on alluvial terraces. They are darker than the Miles soils and have a less distinctly blocky structure in the B horizon than the Abilene soils.

Typical profile of Tipton clay loam (0.2 mile west of U.S. Highway 83, 10.5 miles north of Childress):

A_{1p} 0 to 6 inches, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; weakly calcareous; abrupt boundary; pH 7.5–8.0.

A_{12} 6 to 10 inches, brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) when moist; weak to moderate, medium, subangular blocky structure; slightly hard when dry, friable when moist; weakly calcareous; clear boundary; pH 7.5–8.0.

B_1 10 to 30 inches, dark-brown (7.5YR 3/2) clay loam, very dark brown (7.5YR 2/2) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; weakly calcareous; gradual boundary; pH 7.5–8.0.

B_2 30 to 45 inches, reddish-brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) when moist; moderate to strong, medium, subangular blocky structure; very hard when dry, firm when moist; strongly calcareous; gradual boundary; pH 8.0–8.5.

C_{ca} 45 to 76 inches +, reddish-brown (5YR 5/4) heavy clay loam, reddish brown (5YR 4/4) when moist; very hard when dry, firm when moist; very strongly calcareous; pH 8.0–8.5.

The A horizon ranges from brown to reddish brown in color. It ranges from 6 to 14 inches in thickness. The texture of the surface layer ranges from clay loam to silty clay loam. In a few areas the A_1 and B_1 horizons are noncalcareous. The B horizon ranges from dark brown to reddish brown in color, and from silty clay loam to heavy clay loam in texture. The depth to the C_{ca} horizon ranges from 36 to 54 inches.

Tipton clay loam, 0 to 1 percent slopes (TpA).—This soil occurs on level to nearly level, broad terraces in association with fine-textured soils.

Except for a few areas where runoff concentrates, this soil is not eroded. There are a few gullies in places. Most of this soil is cultivated. It is easily tilled. The main crops are cotton, wheat, and grain sorghum. Included with this soil are a few, small areas of Norwood soils, which occur along drains. Also included are a few areas of Abilene soils. These inclusions are small and do not affect use and management. (Capability unit IIce–1; Hardland range site.)

Tipton clay loam, 1 to 3 percent slopes (TpB).—In most areas the surface layer of this soil is not quite so thick as that of the profile described for the series. This soil is gently sloping. It occurs in association with Tipton clay loam, 0 to 1 percent slopes. It is usually on the slopes of drains within larger areas of the less sloping soil. It is not extensive.

A few areas of this soil are slightly eroded. A few gullies occur where water concentrates. Most areas are cultivated and are well suited to small grain and cotton. (Capability unit IIIe–3; Hardland range site.)

Tivoli Series

The Tivoli series comprises light-colored, freely permeable soils with a duned topography (fig. 22). These soils occur in a narrow band along the banks of the Red River and Buck Creek. The parent material consists of recent eolian sands blown from the riverbeds. The profile has a uniform texture throughout. The present vegetation consists of bluestem, Indiangrass, switchgrass, and sand sagebrush.

The surface layer, to an average depth of 8 inches, is reddish-brown fine sand. It is noncalcareous to weakly calcareous. It has no structure but is slightly darkened by organic matter.

The layers below the surface layer have no structure or development. They consist of light reddish-brown, weakly calcareous to noncalcareous fine sand that has been deposited by wind. There are very few grass roots in this fine sand.

The Tivoli soils are associated with the Enterprise soils but are sandier throughout. The Enterprise soils in this area do not have a duned topography.

The Tivoli soils are excessively drained. They have a low water-holding capacity. Fertility is also very low. These soils have no runoff, but they are highly susceptible to wind erosion.

Typical profile of Tivoli fine sand (in a pasture 0.1 mile south of Red River Bridge on U.S. Highway No. 83, and 200 feet east, about 9 miles north of Childress):

A_1 0 to 8 inches, reddish-brown (5YR 5/4) fine sand, slightly darker reddish brown (5YR 4/4) when moist; single grain (structureless); loose when dry and moist; weakly calcareous; clear boundary; pH 7.5–8.0.

AC 8 to 60 inches +, light reddish-brown (5YR 6/4) fine sand, reddish brown (5YR 5/4) when moist; single grain (structureless); loose when dry and moist; weakly calcareous; pH 7.5–8.0.

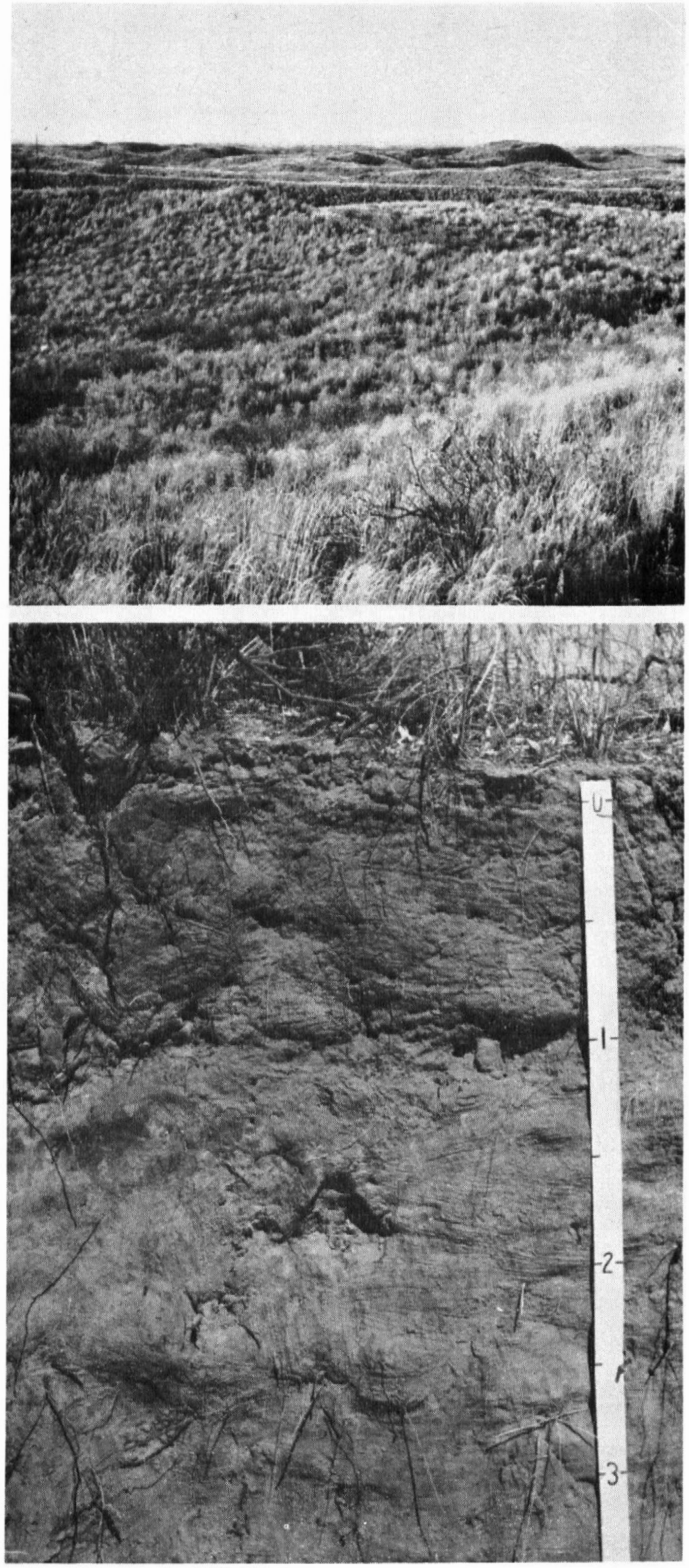


Figure 22.—Top: **Tivoli sand dunes along the Red River.** ***Bottom:*** **Profile of Tivoli fine sand.**

The thickness of the A horizon ranges from 5 to 10 inches. The profile ranges from noncalcareous to weakly calcareous.

Tivoli fine sand (Tv).—This soil is suitable only for grazing and wildlife. Included within areas of this soil are finer textured soils that make up about 5 percent of the acreage. These included soils occur in low areas between dunes and generally are less than 5 acres in size. Also included with this soil are a few small areas of Enterprise soils. These areas occur along the outer edge of the Tivoli soil. Two areas of dunes not stabilized by vegetation, each covering about 100 acres, are also included. One area occurs on the Crews Ranch near Red River. The other is north of Garden Valley near Red River. (Capability unit VIIe-1; Deep Sand range site.)

Vernon Series

The Vernon series consists of shallow to very shallow, calcareous, reddish-brown, compact soils. The parent material is shaly clay of Permian age. The present vegetation consists of buffalograss, blue grama, and mesquite trees.

The surface soil, to an average depth of 5 to 6 inches, is reddish-brown clay loam. It is calcareous and has a granular to subangular blocky structure. When wet, the surface soil tends to run together. When dry, it is hard and cloddy.

The subsoil ranges from red to reddish brown in color and from heavy clay loam to light clay in texture. It extends to an average depth of 12 to 15 inches. It has blocky structure and is very compact. Plant roots and moisture cannot freely penetrate it. The substratum consists of red and blue shaly clay that is almost impermeable to plant roots.

In this county the Vernon soils are mapped only in complex with the Weymouth soils and the Quinlan soils. They do not have the layer of calcium carbonate accumulation in the upper part of the substratum that is characteristic of the Weymouth soils. In depth, they are similar to the Quinlan soils, but they have developed from clayey red beds and are heavier in texture and more compact. A typical profile of a Vernon soil is described under Vernon-Weymouth clay loams, 1 to 3 percent slopes (fig. 23).

Vernon-Weymouth clay loams, 1 to 3 percent slopes (VcB).—This complex consists of areas of Vernon soils and Weymouth soils that were too intricately mixed to be mapped separately. Vernon clay loam comprises 70 to 85 percent of the complex and Weymouth clay loam, 15 to 30 percent. The percentage of each depends on the particular area.

This complex occurs in convex areas along ridges and knobs, mostly in the southeastern part of the county. It is within larger areas of Tillman clay loam. These soils are mostly gently sloping but are moderately sloping in a few areas. The dominant slope is about 2 percent.

These soils are associated with the Tillman soils and the Vernon complex. They have a thinner, less developed subsoil than the Tillman soils. They are more deeply developed and less eroded than the soils of the Vernon complex. All of these soils have developed from similar parent materials.

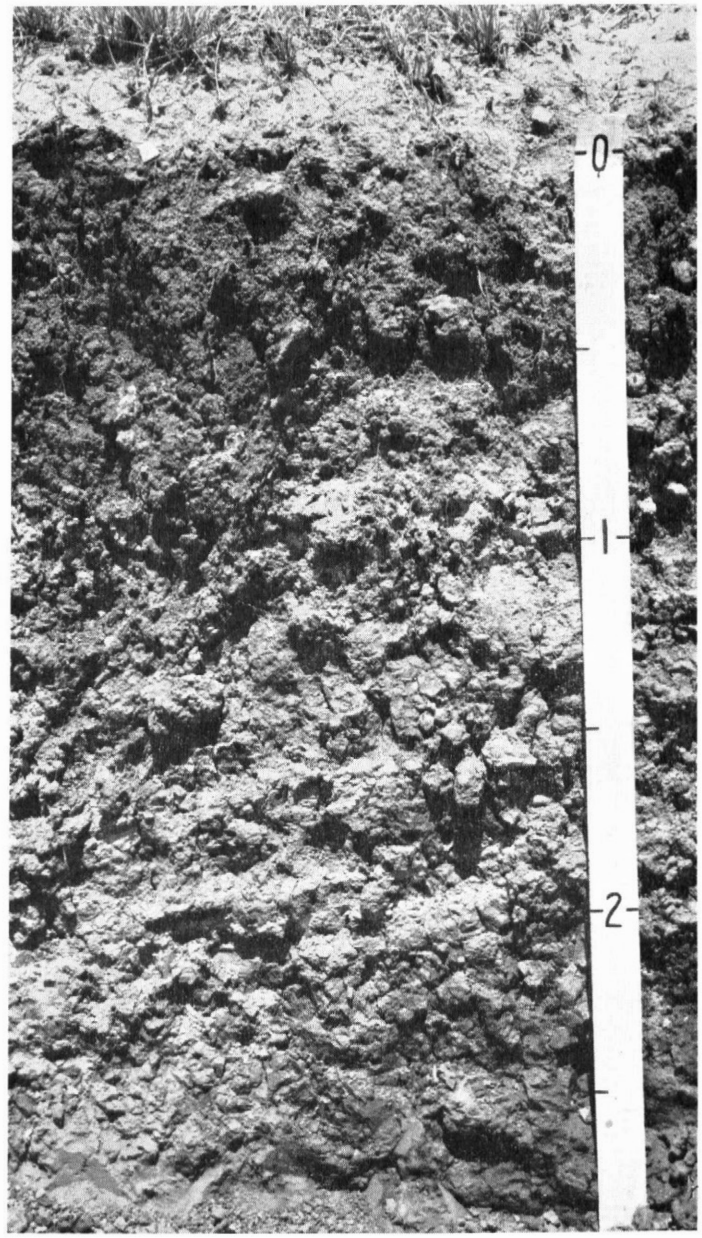


Figure 23.—**Profile of Vernon clay loam. Red and gray shales are at a depth of 12 inches.**

A profile of Vernon clay loam in a typical area of the Vernon-Weymouth clay loams complex (0.1 mile east of the southwest corner of section 383, Block H, W. and N. W. RR. Co. Survey, about 5 miles southeast of Kirkland):

A_1 0 to 5 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, granular or subangular blocky structure; hard when dry, friable when moist; strongly calcareous; few, hard concretions of calcium carbonate on surface; clear boundary; pH 7.5–8.5.

AC 5 to 12 inches, reddish-brown (2.5YR 5/4) heavy clay loam or light clay, reddish brown (2.5YR 4/4) when moist; moderate, fine, blocky structure; very hard when dry, firm when moist; strongly calcareous; few, soft deposits of calcium carbonate; gradual boundary; pH 7.5–8.5.

C 12 to 36 inches +, reddish-brown to red and gray shaly clay; calcareous.

The A horizon ranges from 4 to 7 inches in thickness. In some areas the texture is light clay. The depth to the C horizon ranges from 8 to 18 inches but is mostly less than 15 inches.

A profile of Weymouth clay loam in a typical area of the Vernon-Weymouth clay loams complex (0.1 mile east of the southwest corner of section 383, Block H, W. and N. W. RR Co. Survey, about 5 miles southeast of Kirkland):

A_1 0 to 6 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; weak, granular to subangular blocky structure; hard when dry, friable when moist; weakly calcareous; clear boundary; pH 7.5–8.5.

AC 6 to 18 inches, reddish-brown (5YR 5/4) heavy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; strongly calcareous; gradual boundary; pH 7.5–8.5.

C_{ca} 18 to 30 inches, reddish-brown (2.5YR 5/4) light clay or heavy clay loam, reddish brown (2.5YR 4/4) when moist; moderate, fine and medium, blocky and subangular blocky structure; very hard when dry, firm when moist; very strongly calcareous; many hard and soft concretions of calcium carbonate; diffuse boundary; pH 7.5–8.5.

C 30 to 48 inches +, reddish-brown (2.5YR 4/4), calcareous shaly clay.

The A horizon ranges from 5 to 8 inches in thickness. The AC horizon ranges from 8 to 15 inches in thickness. The depth to the C_{ca} horizon ranges from 14 to 22 inches. In some areas the C_{ca} and C horizons contain gypsum.

A large part of this complex is in cultivation. Crop production is limited, however, because the soils are shallow and their subsoil is compact. Small grain is best suited to these soils. Careful management is needed to control water erosion. Areas with moderate water erosion are common. These eroded areas are small and do not affect use and management. (Capability unit IVe-4; Shallow Redland range site.)

Vernon-Weymouth clay loams, 3 to 5 percent slopes (VcC).—The soils of this complex are moderately sloping. They occur mainly in small areas in association with Vernon-Weymouth clay loams, 1 to 3 percent slopes. In most areas the solum is thinner than in the profiles described for the Vernon and Weymouth soils. Cultivation is hazardous because of the high risk of water erosion. These soils should be planted to native grass. (Capability unit VIe-6; Shallow Redland range site.)

Vernon complex (Ve).—This complex consists of areas of Vernon soils and eroded, clayey, red-bed material that were too intricately mixed to be mapped separately. The profile of most of the Vernon soils in this complex is thinner than the one described under Vernon-Weymouth clay loams, 1 to 3 percent slopes. The areas are gently sloping to sloping. The present vegetation is mostly tobosagrass, buffalograss, catclaw acacia, and scrubby mesquite trees.

These soils occur mostly along drains and in severely eroded areas throughout the county. On about half of the acreage of this complex, the A and AC horizons are lacking and shale and clay are exposed. These areas have only a sparse cover of vegetation and are constantly being eroded by rainfall (fig. 24). The areas that are seriously eroded have a cover of vegetation in most places.

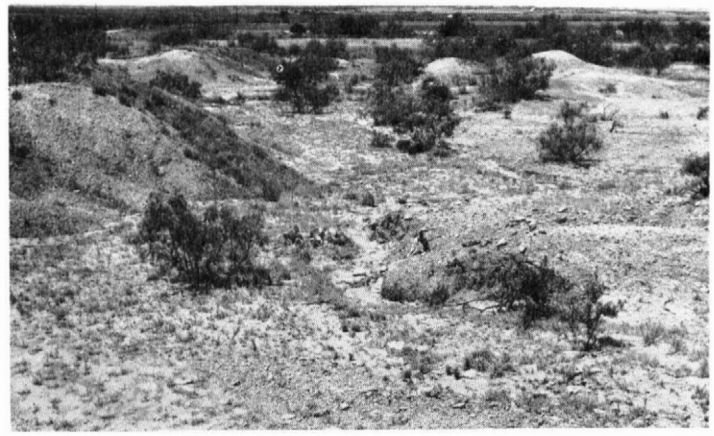


Figure 24.—**Vernon complex showing sparse cover of vegetation.**

Associated with these soils are the Tillman soils, which have developed from clayey red beds and occupy less sloping areas; and the Quinlan soils, which are similar in depth but have developed from sandy red beds and are sandier throughout.

The soils of the Vernon complex are low in fertility and are very droughty. Some areas of these soils are high in soft gypsum and are therefore more permeable and friable. These areas grow better grass. The soils of the Vernon complex are not suitable for cultivation; they are too shallow. (Capability unit VIIs-2; Shallow Redland range site.)

Vernon-Quinlan complex (Vx).—This complex consists mostly of areas of Vernon and Quinlan soils that were too intricately mixed to be mapped separately. It occurs mainly in the south-central part of the county in a transitional area between the soils developed from Permian clay and those developed from Permian sandstone. The areas range from nearly level to steep.

Characteristic of this complex are severely eroded escarpments and ridges of Quinlan soils and sandstone materials that spread out into gullied areas of Vernon soils below (fig. 25). In a few areas there are limestone caps over the Quinlan soils along the escarpments. Sandstone knobs are common throughout the Vernon soils.

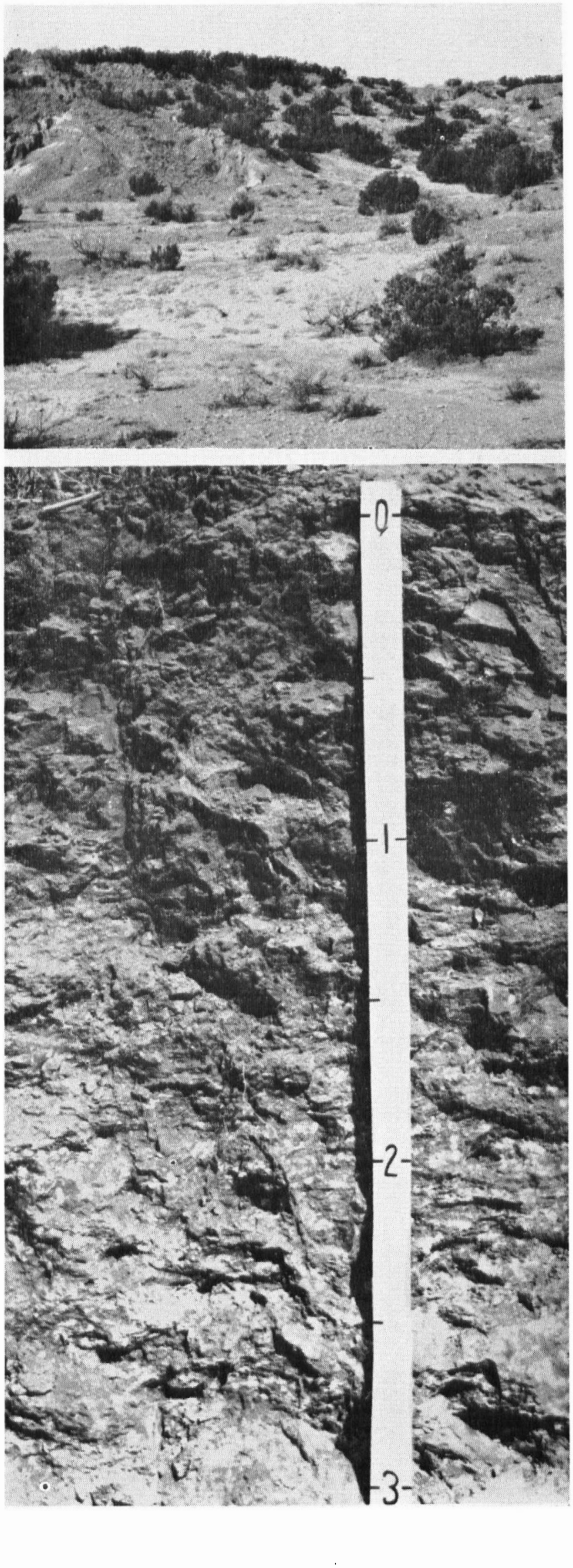
The Vernon soils comprise about 50 to 60 percent of the complex. The Quinlan soils comprise about 25 to 40 percent. About 20 percent of the area is composed of raw shaly clay and sandstone of the Permian age; this material has no soil development. The percentage of the component soils, however, varies from one area to another. Also included with this complex are a few areas of Carey, Woodward, and Tillman soils.

A typical profile of a Vernon soil is described under Vernon-Weymouth clay loams, 1 to 3 percent slopes.

Following is a typical profile of Quinlan loam (0.3 mile south and 200 feet east of the northwest corner of section 577, Block H, W. and N. W. RR. Co. Survey, about 1 mile north of Childress):

A_{1p} 0 to 5 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 5/6) when moist; weak, granular structure; soft when dry, very friable when moist; weakly calcareous; abrupt boundary; pH 7.5–8.0.

A_{12} 5 to 10 inches, light-red (2.5YR 6/6) loam, red (2.5YR 5/6) when moist; weak, subangular blocky struc-



ture; soft when dry, very friable when moist; weakly calcareous; clear boundary; pH 7.5–8.0.

C 10 to 36 inches +, red (2.5YR 5/6), calcareous, soft Permian sandstone; pH 7.5–8.5.

The A horizon ranges from 6 to 15 inches in thickness. The color ranges from light reddish brown to red and generally is redder with depth. The surface layer ranges from weakly to very strongly calcareous.

These soils are suitable only for pasture and wildlife. Vegetation is sparse on areas where the soil is thin. Vegetation should be carefully managed to control erosion. (Capability unit VIIs–2; Shallow Redland range site.)

Weymouth Series

The Weymouth series consists of dark, reddish-brown, shallow soils. The parent material is shaly clay of Permian age.

The surface soil, to an average depth of 5 to 6 inches, is reddish-brown clay loam. It is calcareous and has a granular to subangular blocky structure. When wet, the surface soil tends to run together. When dry, it is hard and cloddy.

The subsoil is reddish-brown heavy clay loam that has a subangular blocky structure. It is less compact and more friable than the subsoil of the Vernon soils. It extends to an average depth of 16 to 18 inches.

The substratum consists of red and blue shaly clay that is almost impermeable to plant roots. The upper part is less compact than that of the Vernon soils. It has a layer of calcium carbonate accumulation, 10 to 20 inches thick.

In color and depth, the Weymouth soils are similar to the Vernon soils, but they are more friable throughout. In this county they are mapped only in complex with the Vernon soils. This complex occurs in association with the Tillman soils. A typical profile of a Weymouth soil is described under Vernon-Weymouth clay loams, 1 to 3 percent slopes.

Woodward Series

The Woodward series consists of calcareous, shallow to moderately deep, well-drained soils of the upland. These soils are widely distributed in the southwestern and northwestern parts of the county. They occur in gently sloping to sloping, convex areas on ridges and knobs. The parent material is soft, calcareous sandstone. The present vegetation consists of buffalograss, blue grama, and mesquite trees.

The surface layer is a reddish-brown loam to a depth of 5 to 10 inches. It is weakly to strongly calcareous and has weak, granular structure. The surface crusts easily after hard rains and becomes compacted in places if tilled when too wet.

The subsoil ranges from reddish brown to reddish yellow in color. It ranges from heavy loam to sandy clay loam in texture. It is calcareous and extends to a depth of 15 to 30 inches. The structure is prismatic to subangular blocky, and the soil material is readily penetrated by water and plant roots. Threads and films of calcium carbonate are present.

Figure 25.—Top: **Area of Vernon-Quinlan complex.** ***Bottom:*** **← Profile of Quinlan loam (sandstone material is at a depth of 12 inches).**

The upper part of the parent material is the zone of maximum lime accumulation. The amount of lime decreases with depth. A profile of Woodward loam is shown in figure 26.

The Woodward soils differ from the Quinlan soils in being deeper and in having an accumulation of lime in the lower part of the solum. The Woodward soils have a thinner, less developed solum than the associated Carey soils, and they lack a B horizon.

Some areas of the Woodward soils are mapped as a complex with the Quinlan soils.

Typical profile of Woodward loam (0.4 mile east and 200 feet south of northwest corner of section 51, Block H, A. B. and M. Survey, about 2 miles north of Tell):

A_{1p} 0 to 7 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, subangular blocky and granular structure; soft when dry, very friable when moist; few, hard concretions of calcium carbonate on surface; strongly calcareous; abrupt boundary; pH 7.5–8.0.

AC 7 to 20 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; clear boundary; pH 7.5–8.0.

C_{ca} 20 to 36 inches, reddish-yellow (5YR 6/6) heavy loam, yellowish red (5YR 5/6) when moist; weak to moderate, medium, subangular blocky structure; soft when dry, very friable when moist; this horizon contains about 10 percent hard concretions of calcium carbonate; very strongly calcareous; gradual boundary; pH 7.5–8.5.

C 36 to 48 inches, red (2.5YR 5/6), calcareous, soft Permian sandstone.

The thickness of the A horizon ranges from 5 to 10 inches. The color of the AC horizon ranges in hue from 2.5YR to 5YR, in value from 3 to 6, and in chroma from 3 to 6. The texture ranges from loam to light clay loam. The depth to the C_{ca} horizon ranges from 15 to 30 inches. The C_{ca} horizon ranges from well defined to scarcely evident and is weakly to very strongly calcareous. The parent material is soft sandstone or packsand of Permian origin.

Woodward loam, 1 to 3 percent slopes (WoB).—This soil occurs in gently sloping, convex areas. It occurs in association with the Carey soils. Included Carey soils comprise about 10 percent of the acreage, but they do not affect use and management. Most of this soil is cultivated. Cotton and grain sorghum are the main crops grown.

This soil is slightly susceptible to water erosion. Included are a few small areas that are moderately eroded by runoff. (Capability unit IIe–1; Mixed Land range site.)

Woodward loam, 3 to 5 percent slopes (WoC).—This soil is moderately sloping. It occurs on ridges and knobs in the upland. It is closely associated with the Carey soils.

This soil is moderately susceptible to water erosion. In a few areas the surface soil has been thinned by erosion. Where runoff concentrates, a few gullies occur in places during heavy rains. A large part of this soil is cultivated, but it needs more careful management. The main crops are cotton and grain sorghum, but close-spaced crops or permanent grasses are better suited. Included with this soil are Carey and Quinlan soils. Each soil makes up about 5 percent of the area. Because these inclusions are usually small in size, they do not affect use and management. (Capability unit IIIe–4; Mixed Land range site.)

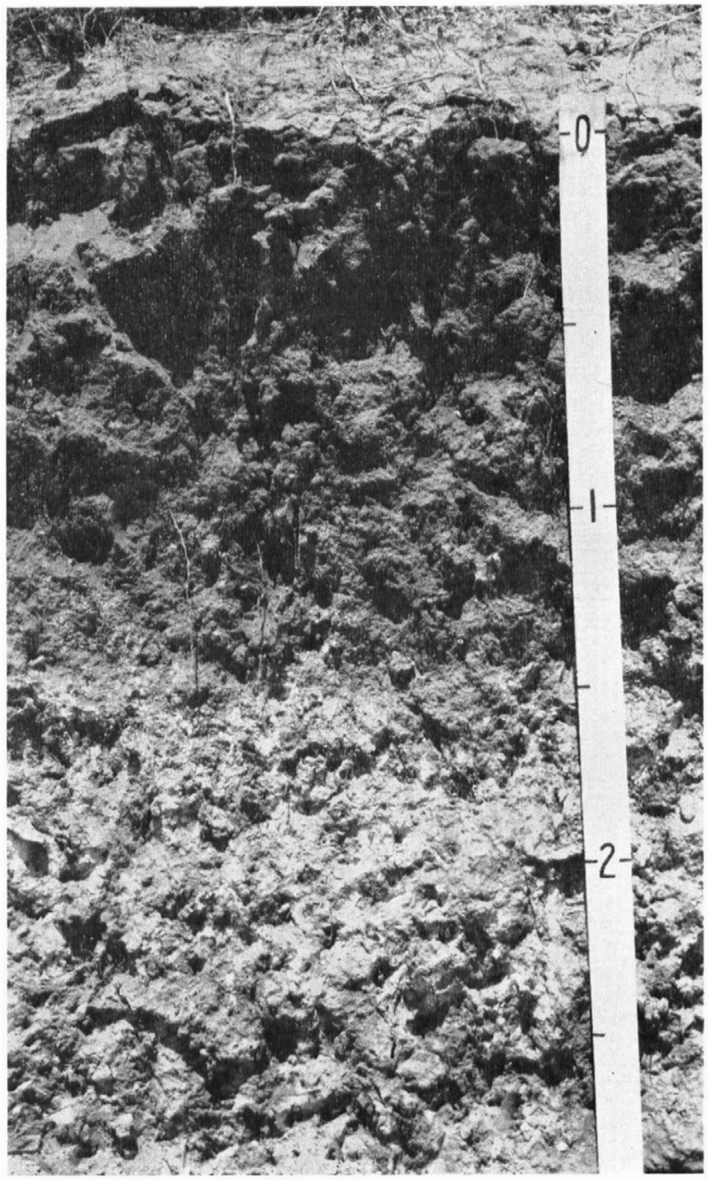


***Figure 26.*—Profile of Woodward loam; C_{ca} horizon is at a depth of 18 inches.**

Woodward-Quinlan loams, 5 to 12 percent slopes (WwD).—This complex consists of areas of Woodward soils and Quinlan soils that were too intricately mixed to be mapped separately.

Woodward loam is the dominant soil of this complex. It generally comprises 70 to 80 percent of the mapping unit. In most areas Quinlan loam comprises less than 30 percent, but in a few areas it comprises 50 percent, or more.

This complex occurs mostly along ridges and drainageways in moderately sloping to steep, convex areas. The Quinlan soils generally outcrop along the tops of ridges and knobs. The Woodward soils are deeper and occur mostly on side slopes below the Quinlan soils.

A typical profile of a Woodward soil is described under the Woodward series. A typical profile of a Quinlan soil is described under the Vernon-Quinlan complex.

Associated with this complex is Woodward loam, which is less sloping; Carey loam, which is a deep, noncalcarous, less sloping soil; and Quinlan-Woodward loams, which consist of gullied areas below this complex. All of these associated soils have developed in similar parent material.

This complex is used mostly for range. The present vegetation is blue grama, buffalograss, side-oats grama, sand dropseed, little bluestem, and mesquite trees. Once large areas were in cultivation, but many fields now have been retired to native vegetation. The steep slope and high susceptibility to water erosion make cultivation too hazardous on these soils. Most cultivated areas have slight to moderate sheet and gully erosion. In many areas erosion is severe. (Capability unit VIe-1; Mixed Land range site.)

Use and Management of the Soils

In this section the system of land capability classification used by the Soil Conservation Service is briefly explained. The soils are placed in capability groups, and the management for each group is discussed. Estimated yields of cultivated soils are given for two levels of management. Suggestions for the general management of cultivated soils and practices that are basic to good farming are also discussed. Separate sections on irrigation, range management, windbreaks, and wildlife are included.

The suggestions for soil use must be interpreted with judgment. A soil cannot always be managed by itself. Generally, there are several soils in one field and they have different features. These soils are often farmed together. For example, a steep soil is not suited to cultivation because of the erosion hazard. In places, nevertheless, a steep soil is farmed because it is in a small area and occurs within areas of soils that are suitable for cultivation.

Land use, kinds of crops, and control of erosion must be adjusted to each individual farm and ranch. The way the soil has been cropped in the past, its future potential, and the nature of the soil must be considered.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few 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. There are no class I and class VIII soils in Childress County.

The subclasses indicate 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 will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

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

Within the subclasses are the 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 other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The soils of Childress County have been placed in the following capability classes, subclasses, and units.

Class II.—Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe.—Soils that have moderate limitations because they are subject to erosion.
  - Capability unit IIe-1.—Deep to moderately deep, medium-textured, moderately to slowly permeable, gently sloping soils.
- Subclass IIce.—Soils that have some limitations because of climate and the risk of erosion.
  - Capability unit IIce-1.—Deep, dark, moderately fine textured, moderately permeable, nearly level soils.
  - Capability unit IIce-2.—Deep, dark, medium-textured, nearly level soils.
  - Capability unit IIce-3.—Deep, dark, moderately fine textured, slowly permeable, nearly level soils.

Class III.—Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.
- Subclass IIIe.—Soils that are subject to erosion when tilled and not protected.
  - Capability unit IIIe-1.—Deep, reddish-brown, moderately fine textured, slowly to very slowly permeable, gently sloping soils.

Capability unit IIIe-2.—Deep, dark, slowly permeable, moderately fine textured, gently sloping soils.

Capability unit IIIe-3.—Deep, dark, medium to moderately fine textured, moderately permeable, gently sloping soils.

Capability unit IIIe-4.—Deep, medium-textured, moderately to moderately rapidly permeable soils on gentle to moderate slopes.

Capability unit IIIe-5.—Deep, moderately coarse textured, moderately permeable, nearly level to gently sloping soils.

Capability unit IIIe-6.—Deep, light-colored, moderately coarse textured, moderately rapidly permeable, nearly level to gently sloping soils.

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

Capability unit IIIw-1.—Deep, dark, clayey soils in weakly depressed areas.

Subclass IIIs.—Soils that have severe limitations of moisture capacity or tilth.

Capability unit IIIs-1.—Deep, slowly or very slowly permeable, moderately fine textured, nearly level soils.

Subclass IIIsc.—Soils that are limited because they are droughty and have low fertility and low water-holding capacity.

Capability unit IIIsc-1.—A complex of deep and very shallow, moderately fine textured, nearly level soils.

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 very severely limited because of erosion hazards if tilled and not protected.

Capability unit IVe-1.—Deep, moderately fine textured, slowly permeable, eroded, gently sloping soils.

Capability unit IVe-2.—Deep, moderately coarse textured, moderately to moderately rapidly permeable, gently to moderately sloping soils that are subject to slight to moderate erosion.

Capability unit IVe-3.—Deep, moderately to moderately rapidly permeable, nearly level to gently sloping soils with a sandy surface layer.

Capability unit IVe-4.—A complex of shallow, slowly and moderately permeable, gently sloping soils with a clay loam surface layer.

Capability unit IVe-5.—Deep, medium-textured, strongly sloping soils.

Subclass IVes.—Soils that have severe limitations because of the risk of erosion, low fertility, and low water-holding capacity.

Capability unit IVes-1.—A complex of deep and very shallow, moderately fine textured, gently sloping soils.

Class V.—Soils that have little or no susceptibility to erosion but have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Subclass Vw.—Soils subject to flooding.

Capability unit Vw-1.—Deep, sandy soils along flood plains of rivers.

Capability unit Vw-2.—Loamy soils on flood plains of streams.

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

Subclass VIe.—Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIe-1.—Shallow to deep, medium-textured, steep soils.

Capability unit VIe-2.—Deep, gravelly soils.

Capability unit VIe-3.—Strongly sloping, moderately coarse textured, eroded soils.

Capability unit VIe-4.—Shallow to moderately deep, medium-textured, gullied soils.

Capability unit VIe-5.—Deep, sandy soils.

Capability unit VIe-6.—Shallow to moderately deep, moderately fine textured, moderately sloping soils.

Subclass VIes.—Soils that are shallow and are subject to moderate erosion hazard.

Capability unit VIes-1.—Complex of deep and very shallow, moderately fine textured soils.

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

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

Capability unit VIIe-1.—Deep, sandy soils.

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

Capability unit VIIs-1.—Very shallow, rough and broken, eroded soils.

Capability unit VIIs-2.—Very shallow or shallow, clayey soils.

Capability unit VIIs-3.—Very shallow, stony soils.

CAPABILITY UNIT IIe-1

This unit consists of deep to moderately deep, medium-textured, moderately to slowly permeable, gently sloping soils. The soils are—

Carey loam, 1 to 3 percent slopes.
St. Paul silt loam, 1 to 2 percent slopes.
Woodward loam, 1 to 3 percent slopes.

These soils are easily tilled. They have moderate to high natural fertility. Plant roots, moisture, and air readily penetrate these soils. The risk of wind erosion is slight, and the risk of water erosion is slight to moderate.

Cotton and grain sorghum are the main crops grown on these soils, but most crops grown in this area are suited. These soils also produce excellent grass.

The main conservation problems are moisture conservation and erosion control. These soils respond to commercial fertilizer only during the wetter years. Yields are best increased by holding as much rainfall in the soil as possible.

Under dryland farming a conservation cropping system on these soil should consist of growing high-residue crops or cover crops 1 year in 3, or mulching with cotton burs every third year. Residues should be kept on the surface to help conserve moisture and control erosion. Terracing and contour farming should be practiced to reduce runoff. When there are not enough residues, emergency tillage will be needed to roughen the surface and reduce wind erosion.

These soils are suitable for irrigation if water is available. For best results they should be leveled or irrigated with a sprinkler system. For sustained high yields, the soils should be fertilized in amounts determined by soil tests.

CAPABILITY UNIT IIce-1

This unit consists of deep, dark, moderately fine textured, moderately permeable, nearly level soils. The soils are—

Norwood clay loam.
Tipton clay loam, 0 to 1 percent slopes.

These soils are easily tilled. They are high in natural fertility. Moisture, roots, and air can penetrate these soils freely. Runoff is slow because the soils are nearly level. The risk of wind and water erosion is only slight in cultivated areas.

Most of the crops grown in the county are suited to these soils, but cotton and small grain are the main crops. Native grass is well suited.

Under dryland farming, soil fertility is not a problem. Practices that will conserve moisture and control erosion are the principal needs. Farmers have learned that it is necessary to save as much rainfall as possible in order to produce high yields. Crop residues should be kept on the surface as much of the time as possible as a means of reducing erosion and keeping the soil highly productive.

In a conservation cropping system on these soils, there should be a high-residue crop or a cover crop at least 1 year in 3; or a mulch of cotton burs should be applied every third year. The residues should be kept partly on the surface through stubble mulching. Residues managed in this way will help to control erosion and to improve the physical condition of the soil. They also prevent surface crusting and help maintain the content of organic matter. Emergency tillage should be used to roughen the surface, when needed, as a supplementary measure for control of wind erosion. Terracing and contour farming should be used to reduce water erosion where necessary.

These soils are very productive when irrigated. They are best suited to row irrigation. At least 1 year in 4, a high-residue crop or a cover crop should be grown, or the soils should be mulched with cotton burs. Applications of commercial fertilizer are needed in some areas for continuous high yields. Soil tests should be made to determine the amounts needed. Proper applications of irrigation water are necessary for maximum yields.

CAPABILITY UNIT IIce-2

This unit consists of deep, dark, medium-textured, nearly level soils. The soils are—

Enterprise very fine sandy loam, 0 to 1 percent slopes.
Miles loam, 0 to 1 percent slopes.
Norwood silt loam.
St. Paul silt loam, 0 to 1 percent slopes.

These soils have a high capacity to hold water and nutrients. They are readily permeable to moisture, air, and plant roots. They are slightly susceptible to wind and water erosion in cultivated areas.

Most crops suited to this area can be grown on these soils. Native grass is also well suited. Cotton, wheat, and grain sorghum are the main crops grown.

Farmers have found that the main problems on these soils under dryland farming are the conservation of rainfall and the control of erosion. Soil fertility is not a problem in most areas.

In a cropping system used for dryland farming, there should be a high-residue crop or a cover crop at least 1 year in 3; or a mulch of cotton burs should be applied every third year. The residues are more effective if they are used as a mulch and kept on the surface. Small-grain residues should be stubble mulched. Residues will conserve moisture by reducing runoff and by increasing the intake of water. As a result, yields will be increased. Residues also help to control erosion and to keep the soil in better physical condition. In some areas where there is runoff, terracing and contour farming should be used. If enough residues are not available for control of wind erosion, emergency tillage should be used, as needed, to roughen the surface.

If water is available, these soils are well suited to row irrigation. If irrigated, they need management in addition to that suggested for dryland farming. At least 1 in 3 years, a soil-improving crop, such as legumes, should be grown to keep the soil open and in good condition. Fertilizer is needed for continuous high yields and should be applied in amounts determined by soil tests. Proper use of irrigation water is needed for maximum yields.

CAPABILITY UNIT IIce-3

This unit consists of a deep, dark, slowly permeable, moderately fine textured, nearly level soil. The soil is—

Abilene clay loam, 0 to 1 percent slopes.

This soil has a compact subsoil and is not very permeable to moisture, air, and plant roots. It is high in natural fertility and has a high capacity to hold moisture and nutrients. This soil has slow runoff, but in years of low rainfall, it is droughty.

Small grain and cotton are the main crops grown, but most crops adapted to this area are suitable. Perennial grasses are also well suited.

Under dryland farming, the main conservation problems are conservation of moisture, control of erosion, and improvement of the physical condition of the soil.

The observation of local farmers has shown that stubble mulching, use of crop residues, and terracing and contour farming help to conserve moisture and to increase yields. These practices also help to control erosion. In a cropping system on these soils, a high-residue crop or cover crop should be grown at least half the time, or a mulch of cotton burs should be applied every other year. The residues should be managed as a mulch and kept on the surface. They will increase water intake, help to control wind and water erosion, prevent surface crusting, and maintain the organic-matter content of the soils. Terracing the longer slopes helps to reduce runoff and to control water erosion.

If water is available, this soil is highly suitable for irrigation farming. Row irrigation is best suited. Proper methods should be used in applying and distributing water. A cropping system on these soils should include a high-residue crop, or a cover crop, or a soil-improving crop at least 1 year in 4. The residues should be managed as under dryland farming. Commercial fertilizer is needed in some areas for continuous high yields.

CAPABILITY UNIT IIIe-1

This unit consists of a deep, reddish-brown, moderately fine textured, slowly to very slowly permeable, gently sloping soil. The soil is—

Tillman clay loam, 1 to 3 percent slopes.

This soil is not readily permeable to water, roots, and air. It is droughty. Natural fertility is high. The risk of water erosion is moderate, and that of wind erosion is only slight.

Cool-season crops are best suited to this soil. Consequently, wheat is the main crop grown. Native grass can also be grown.

Under dryland farming this soil normally will not respond to commercial fertilizer. The conservation problems are mainly controlling erosion and improving the physical condition of the soil so as to conserve more moisture.

In a cropping system, high-residue crops or a mulch of burs should be used at least 3 years in 5. The residues should be kept on the surface as much as possible. Farmers have learned that stubble mulching of crop residues will increase yields in this area. Residues on the surface reduce runoff and thus conserve moisture. They also help to prevent surface crusting, to control erosion, and to maintain the supply of organic matter. Terraces and farming on the contour are also needed to reduce runoff and to control water erosion.

This soil is suitable for row irrigation if water is available. It should be leveled for best results. Commercial fertilizer is needed in some areas for maximum yields. Proper methods should be used for applying and distributing the water. In irrigated areas high-residue crops and soil-improving crops should be grown at least 2 years in 3. The residues should be managed the same as for dryland farming.

CAPABILITY UNIT IIIe-2

This unit consists of a deep, dark, slowly permeable, moderately fine textured, gently sloping soil. The soil is—

Abilene clay loam, 1 to 3 percent slopes.

The capacity of this soil to hold moisture and fertility is high. The compact subsoil restricts the movement of air, moisture, and plant roots. In years of below-average rainfall, this soil is droughty. It is slightly susceptible to wind erosion and moderately susceptible to water erosion. Runoff is moderate.

Most crops grown in this area are suited to this soil, but wheat and cotton are the main crops. Perennial grasses also grow well.

Under dryland farming this soil is very fertile. The main conservation problems are controlling erosion, conserving moisture, and improving the physical condition of the soil.

In a cropping system, high-residue crops or a mulch of burs should be used at least half of the time. Soil-depleting crops, such as cotton, can be grown the other half. As much residue should be left on the surface as possible. Local observations show that crop residues help to increase yields by increasing the water intake of the soil. They also reduce erosion, prevent surface crusting, and maintain the organic matter content. This soil should be terraced and farmed on the contour to help reduce runoff and to control erosion. Emergency tillage should be used, as needed, if no residues are on the surface to control wind erosion.

If water is available, this soil is suitable for irrigation. In a cropping system, there should be a high-residue crop, a cover crop, or mulching at least 2 years in 5. The residues should be managed as under dryland farming. In some areas commercial fertilizer is needed for continuous high yields. Soil tests should be made to determine the proper applications. Row irrigation is best for this soil, but sprinkler irrigation can also be used. Proper application and distribution of water are needed for maximum yields.

CAPABILITY UNIT IIIe-3

This unit consists of deep, dark, medium to moderately fine textured, moderately permeable, gently sloping soils. The soils are—

La Casa clay loam, 1 to 3 percent slopes.
Miles loam, 1 to 2 percent slopes.
Tipton clay loam, 1 to 3 percent slopes.

These soils have a high moisture-holding capacity. Their capacity to hold plant nutrients is high. They are high in natural fertility. The subsoil is permeable to moisture, roots, and air. The risk of wind erosion is slight, and the risk of water erosion is slight to moderate in cultivated areas.

Most crops produced in this area can be grown on these soils. Small grain is most suitable, but native grass grows well.

These soils are high in fertility and generally do not respond to commercial fertilizer. Local farmers have learned that increased yields are the result of conservation practices that conserve as much moisture as possible and control wind and water erosion.

Under dryland farming high-residue, soil-improving, or cover crops should be grown in the cropping system at least half of the time. Soil-depleting crops, such as cotton, can be grown the other half. A mulch of cotton burs will replace a high-residue crop. During years when high-residue crops are grown, the residues should be stubble mulched. Maintaining these residues on the surface helps to protect the soil from erosion and to increase the movement of water into the soil. It also helps to maintain the organic matter content and to prevent surface crusting. Terraces should be used to help control erosion. Emergency tillage should be used, as needed, to roughen the surface and to protect it from wind erosion.

If good-quality water is available, these soils are suitable for irrigation. In a cropping system, soil-improving or high-residue crops should be grown at least 2 years in 5. Some areas may need commercial fertilizer for sustained high yields. Soil tests should be made to determine the needed amounts of fertilizer. Irrigation water should be properly applied.

CAPABILITY UNIT IIIe-4

This unit consists of deep, medium-textured, moderately to moderately rapidly permeable soils on gentle to moderate slopes. The soils are—

Carey loam, 3 to 5 percent slopes.
Enterprise very fine sandy loam, 1 to 3 percent slopes.
Enterprise very fine sandy loam, 3 to 5 percent slopes.
Woodward loam, 3 to 5 percent slopes.

These soils are easily tilled. They are very permeable to air, roots, and moisture. Natural fertility is moderate to high. The risk of wind erosion is slight, and that of water erosion is moderate.

Most crops suited to this area are grown on these soils. The main crops are cotton, wheat, and grain sorghum. Native grass is also suitable.

Under dryland farming these soils normally do not respond to commercial fertilizer, except in years of above-average rainfall. Local farmers have learned that yields are best increased by moisture conservation and erosion control.

In a cropping system, high-residue crops, or cover crops should be grown 3 years in 5, or the soil should be mulched with cotton burs 3 years in 5. The residues should be so managed that they will conserve water and control erosion. Crop residues will also improve tilth, prevent surface crusting, and help to maintain the organic-matter content. If crop residues are not available during critical blowing, emergency tillage should be used to control wind erosion.

Terracing and contour farming also reduce runoff and erosion.

If water is available, these soils are all suitable for irrigation. They are suited to either row or sprinkler irrigation. In a cropping system, high-residue crops should be grown at least half of the time. Soil-improving crops should also be grown half of the time. Fertilizer is needed for highest yields in irrigated areas. Soil tests should be made to determine the proper rates. Proper methods of applying and distributing water should be used for maximum yields.

CAPABILITY UNIT IIIe-5

This unit consists of deep, moderately coarse textured, moderately permeable, nearly level to gently sloping soils. The soils are—

Miles fine sandy loam, 0 to 1 percent slopes.
Miles fine sandy loam, 1 to 3 percent slopes.

These soils are easily tilled and are readily permeable to moisture, roots, and air. They are slightly susceptible to water erosion on steeper slopes. The risk of wind erosion is moderate.

Most locally grown crops are suited to these soils. Because of the risk of wind erosion, the most suitable crops are those that produce a large amount of residues. Native grass is also well suited.

The main conservation problems are conserving moisture, controlling erosion, and improving the condition of the soil. These soils respond to commercial fertilizer in some years. Tests should be made to determine proper applications. Local observations show that terracing, contour farming, and the use of crop residues help to conserve moisture, to reduce erosion, and to increase crop yields.

A cropping system should not include soil-depleting crops, such as cotton, more than 1 year in 3. In the other 2 years, cover crops or high-residue crops should be grown, or mulching with cotton burs should be used. If small grain is grown, the residues should be stubble mulched. These residues help to increase water intake, to reduce wind and water erosion, and to reduce surface crusting. They also help to maintain the organic-matter content and to improve the physical condition of the soil. Terraces and contour farming are needed where there is water erosion. Emergency tillage is needed to roughen the surface during periods of critical wind erosion.

These soils are suitable for row or sprinkler irrigation if water is available. Proper methods of applying water should be used for best results.

In a cropping system, high-residue crops, soil-improving crops, cover crops, or mulching should be used at least half of the time. In some areas applications of commercial fertilizer are needed for highest yields. Soil tests should be made to determine proper amounts.

CAPABILITY UNIT IIIe-6

This unit consists of deep, light-colored, moderately coarse textured, moderately rapidly permeable, nearly level to gently sloping soils. The soils are—

Enterprise fine sandy loam, 0 to 1 percent slopes.
Enterprise fine sandy loam, 1 to 3 percent slopes.

These soils are easily tilled. The subsoil is readily permeable to moisture, roots, and air. The risk of wind erosion is moderate; that of water erosion is slight. Fertility is moderate.

Most crops produced in this area can be grown on these soils, but cotton and grain sorghum are the main crops. Native grass also grows well.

The main conservation problems are controlling erosion and maintaining fertility. In most years crops respond to commercial fertilizer.

In a cropping system for dryland farming on these soils, high-residue crops, cover crops, or mulching should be used at least 3 years in 4. Crop residues should be kept on the surface as much as possible. This practice will help to control erosion, to conserve moisture, and to improve the tilth of the soil. Emergency tillage is needed at times to help control wind erosion.

If water is available, these soils are suitable for sprinkler irrigation. Fertilizer should be applied, as needed, to maintain high yields. Proper methods of applying and distributing water should be used for best results.

CAPABILITY UNIT IIIw-1

This unit consists of a deep, dark, clayey soil in weakly depressed areas. The soil is—

Roscoe clay.

This soil has a slow water-intake rate. It is not easily penetrated by plant roots and air. Natural fertility is very high. The risk of water and wind erosion is insignificant. Most areas are small and receive extra water from surrounding soils. Because of excess water, crop failures are common in wet years.

Cool-season crops are best suited to this soil. Wheat is the main crop.

Improving the physical condition of the soil by use of crop residues is the main conservation problem. Small grain residues should be stubble mulched. This practice helps to prevent surface crusting and to increase water-intake rate. In a cropping system, high-residue crops should be grown at least 1 year in 2.

CAPABILITY UNIT IIIs-1

This unit consists of a deep, slowly or very slowly permeable, moderately fine textured soil. The soil is—

Tillman clay loam, 0 to 1 percent slopes.

This nearly level soil is easily tilled. It has a compact, clayey subsoil that restricts the movement of water, air, and plant roots. The risk of erosion is only slight. Fertility and water-holding capacity are high.

Most crops suited to this area are grown on this soil. Perennial grasses are also well suited.

Under dryland farming the soil is very fertile. Practices that will conserve moisture by increasing water-intake rate and by improving the physical condition of the soil are the principal needs.

A cropping system should include a high-residue crop or a mulch of cotton burs at least 3 years in 5. The residues should be kept on the surface as much as possible. They will reduce runoff, prevent surface crusting, increase intake rates, and help to maintain the organic-matter content. If there is water erosion, terraces should be used.

If water is available, this soil is highly suitable for irrigation farming. At least 2 years in 5, the cropping system used under irrigation should include high-residue crops, cover crops, or mulching. In some areas commercial fertilizer is needed for continuous high yields. Proper methods should be used in applying and distributing water.

CAPABILITY UNIT IIIsc-1

This unit consists of a complex of deep and very shallow, moderately fine textured, nearly level soils. This complex is—

Abilene-Cottonwood complex, 0 to 1 percent slopes.

These soils are easily tilled. The Abilene soils are high in fertility, but the Cottonwood soils are low. The risk of water and wind erosion is slight.

Small grain is the main crop grown on these soils. Native grass is also well suited.

The main conservation problems are controlling erosion, conserving moisture, and improving the physical condition of the soil. The Cottonwood soils are low in fertility. They respond to commercial fertilizer.

If small grain is grown, the residues should be kept on the surface by stubble mulching. These residues improve the soil and reduce the erosion hazard. In some areas terraces are needed to reduce runoff. Emergency tillage should be used, as needed, to control wind erosion.

If water is available, these soils are suitable for row irrigation. Fertilizer is needed on irrigated areas for maximum yields. The crop residues should be managed in the same way as for dryland farmed areas. Proper methods of application and distribution of water should be used.

CAPABILITY UNIT IVe-1

This unit consists of a deep, moderately fine textured, slowly permeable, eroded soil with gentle slopes. The soil is—

Tillman clay loam, 1 to 3 percent slopes, eroded.

This soil has been moderately eroded by water. It has a compact subsoil that tends to be impermeable to moisture, roots, and air. It is droughty. Natural fertility is high. The risk of water erosion is moderate.

The crops suited to this soil are limited because of the thin surface layer and the risk of erosion. Small grain is best suited. Native grass is also suited.

The main problems are conserving moisture and controlling erosion. Under dryland farming this soil normally does not respond to fertilizer.

Continuous high-residue crops, such as small grain, should be used in a cropping system. The residues should be stubble mulched. These residues increase water-intake rates, reduce water erosion, reduce surface crusting, and improve the physical condition of the soil. Terraces should also be used. Farmers in this area have found that proper use of residues and terraces will conserve moisture and increase yields.

If water is available, this soil is suitable for row irrigation. In some areas fertilizer is needed for the production of highest yields.

CAPABILITY UNIT IVe-2

This unit consists of deep, moderately coarse textured, moderately to moderately rapidly permeable, gently to moderately sloping soils subject to slight to moderate erosion. The soils are—

Enterprise fine sandy loam, 3 to 5 percent slopes.
Miles fine sandy loam, 3 to 5 percent slopes.
Miles fine sandy loam, 3 to 5 percent slopes, eroded.

These soils are moderate in fertility. The subsoil is permeable to roots, air, and moisture. The risk of water and wind erosion is moderate.

Erosion can be best controlled by growing only high-residue crops or perennial grasses. These soils are best suited to native grass.

The main conservation problems are controlling erosion and increasing water intake. Crops generally respond to fertilizer during years of above-average rainfall.

Under dryland farming high-residue crops should be grown continuously in the cropping system. Terraces and contour farming also should be used on the Miles soils. Practices that control erosion and conserve moisture will help increase yields. If cover is not available, emergency tillage should be used, as needed, to control wind erosion.

If water is available, a sprinkler irrigation system can be used on these soils. Commercial fertilizer is needed for highest yields.

CAPABILITY UNIT IVe-3

This unit consists of deep, moderately to moderately rapidly permeable, nearly level to gently sloping soils with a sandy surface layer. The soils are—

Miles loamy fine sand, 0 to 3 percent slopes.
Springer loamy fine sand, undulating.

Because these soils are highly susceptible to wind erosion, careful management is needed in cultivated areas. The risk of water erosion is slight on steeper slopes. The subsoil is readily permeable to roots, moisture, and air. The capacity of these soils to hold their fertility is low.

Cotton and sorghum are the main crops grown. High-residue or close-spaced crops are best for controlling wind erosion. These soils are best suited to native grass.

The main conservation problems on these soils are controlling erosion, conserving moisture, and improving fertility.

Under dryland farming the cropping system should include high-residue crops, cover crops, or mulching with cotton burs at least three-fourths of the time on the Miles soils, and continuously on the Springer soils. Enough residues should be worked into the soil to hold them for protection against wind erosion. The residues also help to maintain the organic matter. Commercial fertilizer is needed for highest yields. Emergency tillage should be used, as needed, to reduce erosion during critical periods of soil blowing. Deep plowing can be used to increase the clay content in the surface soil and further reduce the hazard of wind erosion.

If water is available, a sprinkler irrigation system can be used. Proper applications of water are needed for best results. Large amounts of commercial fertilizer are needed to maintain high yields. Soil tests should be made to determine proper rates of fertilization.

CAPABILITY UNIT IVe–4

This unit consists of a complex of shallow, slowly and moderately permeable, gently sloping soils with a clay loam surface layer. The complex is—

Vernon-Weymouth clay loams, 1 to 3 percent slopes.

These soils have a shallow root zone and a moderate moisture-holding capacity. The capacity to hold plant nutrients is also high. The risk of water erosion is slight to moderate. Natural fertility is moderate to low.

Small grain is the dominant crop grown on these soils. Native grass is best suited.

The main conservation problems on these soils are conserving as much moisture as possible, controlling erosion, and maintaining or improving fertility.

A cropping system should include continuous, close-spaced, high-residue crops, such as small grain. The residues should be stubble mulched to conserve moisture and to improve tilth. Terraces should be used to help conserve moisture and to reduce erosion. If fertilizer is needed, tests should be made to determine proper rates of application.

A cropping system used for irrigated areas should include high-residue crops at least two-thirds of the time. Fertilizer will be needed for continued production of high yields. Proper application of water is necessary for best results.

CAPABILITY UNIT IVe–5

This unit consists of a deep, medium-textured, strongly sloping soil. The soil is—

Enterprise very fine sandy loam, 5 to 8 percent slopes.

This soil is freely permeable to plant roots and moisture. It is highly susceptible to water erosion. Susceptibility to wind erosion is slight. Natural fertility is moderate.

Only high-residue or close-spaced crops should be grown on this soil. These crops will keep water erosion to a minimum. This soil is best suited to native grass.

The main conservation problems are controlling water erosion and conserving moisture.

Local observation has shown that high-residue crops, grown continuously, will control water erosion. For maximum effectiveness, residues should be held on the surface as much as possible. Terraces and contour farming should also be used to help conserve moisture and reduce erosion.

If water is available, these soils can be irrigated with a sprinkler system. Commercial fertilizer will be needed for best results.

CAPABILITY UNIT IVes–1

This unit consists of a complex of deep and very shallow, moderately fine textured, gently sloping soils. This complex is—

Abilene-Cottonwood complex, 1 to 3 percent slopes.

The soils of this complex are moderately susceptible to water erosion. The risk of wind erosion is slight. Fertility is high in the Abilene soils and low in the Cottonwood soils.

Small grain and native grass are best suited to these soils.

The main conservation problems are controlling erosion, conserving moisture, and improving the physical condition of the soil. Most areas of these soils under dryland farming respond to commercial fertilizer.

The residues from small grain should be used as a mulch. Residues left on the surface help to conserve moisture and to improve the tilth of the soil. Terraces should be used to reduce runoff and to help control erosion.

These soils can be irrigated if water is available. Fertilizer is needed for continued high yields. The same management practices should be used as for dryland farming. Proper application and distribution of irrigation water is necessary for maximum yields.

CAPABILITY UNIT Vw–1

The miscellaneous land type in this unit consists of deep, sandy soils along the flood plains of rivers. This land type is—

Sandy alluvial land.

This land type is subject to recurrent damaging floods. It is suitable only for pasture and wildlife. In most areas there is a large amount of salt in the profile and the vegetation consists mostly of salt-tolerant grasses and shrubs.

This land type is in the Bottom Land (Sandy) range site. Information on its management for range is given in the section "Range Management."

CAPABILITY UNIT Vw–2

The miscellaneous land type in this unit consists of loamy soils on flood plains of streams. This land type is—

Loamy alluvial land.

This land type is subject to recurrent floods and is suitable only for pasture and wildlife. Except for wetness, it has few limitations. Its natural fertility is high. It is an excellent producer of grass.

This land type is in the Bottom Land (Loamy) range site. Information on its management for range is given in the section "Range Management."

CAPABILITY UNIT VIe–1

This unit consists of a complex of shallow to deep, medium-textured, steep soils. The soils are—

Woodward-Quinlan loams, 5 to 12 percent slopes.

Because of the steep slopes, these soils are not suitable for crop production. They are highly susceptible to water erosion and are suitable only for grass and wildlife. The areas now in cultivation should be seeded to grass, and a good stand should be obtained before grazing.

The soils of this complex are in the Mixed Land range site. Information on management of these soils for range is in the section "Range Management."

CAPABILITY UNIT VIe-2

The miscellaneous land type in this unit consists of deep, gravelly soils in steep areas. This land type is—

Gravelly broken land.

Because of the large amount of gravel and steep slopes, this land type is unsuitable for cultivation. It is a good producer of grass.

This land type is in the Gravelly range site. This site is discussed in the section "Range Management."

CAPABILITY UNIT VIe-3

This unit consists of a deep, moderately coarse textured, strongly sloping, eroded soil. This soil is—

Miles fine sandy loam, 5 to 8 percent slopes, eroded.

Because of strongly sloping slopes, this soil is unsuitable for cultivation. It is highly susceptible to water erosion. In many areas it is severely eroded. It should be used only for grazing and for wildlife. The areas now in cultivation should be retired to native grass. A good stand of grass should be obtained before grazing.

This soil is in the Sandy Loam range site. Information on management of this soil for range is given in the section "Range Management."

CAPABILITY UNIT VIe-4

This unit consists of a complex of shallow or moderately deep, medium-textured soils. These soils occur in moderately sloping to steep, gullied areas. The complex is—

Quinlan-Woodward loams, 8 to 20 percent slopes.

These soils are too steep and gullied for cultivation, but they are suitable for use for grazing and wildlife. They are highly susceptible to water erosion. Careful management is needed to reduce erosion on these soils, and proper grazing is needed to keep a grass cover.

These soils are in the Mixed Land range site. Inclusions of Rough broken land are in the Rough Broken (Loamy) range site; those of alluvial soils, in the Bottom Land (Loamy) range site. The productivity of each soil in the complex varies from one area to another. Information on management of the soils in this complex for range is given in the section "Range Management."

CAPABILITY UNIT VIe-5

This unit consists of a deep, coarse-textured, moderately permeable, gently sloping soil. The soil is—

Miles loamy fine sand, 3 to 5 percent slopes.

At one time a large area of this soil was in cultivation. Most cultivated areas, however, have now been returned to grass. This soil should be in grass unless irrigated. It is low in fertility and highly susceptible to wind erosion. Wind erosion has damaged many cultivated fields.

Irrigated areas can be safely cultivated if carefully managed. The soil should be kept in close-spaced, high-residue crops.

This soil is in the Sandy Land range site. Information on management of this soil for range is given in the section "Range Management."

CAPABILITY UNIT VIe-6

This unit consists of a complex of shallow to moderately deep, moderately fine textured soils on moderate slopes. The complex is—

Vernon-Weymouth clay loams, 3 to 5 percent slopes.

Because of their shallowness and steep slopes, these soils are unsuitable for cultivation. They are highly susceptible to water erosion.

Areas of these soils now in cultivation should be seeded to permanent grass. A good stand should be obtained before grazing. These soils are in the Shallow Redland range site. Information on management of the soils of this complex for range is given in the section "Range Management."

CAPABILITY UNIT VIes-1

This unit consists of a complex of deep, moderately fine textured, and very shallow, stony soils. The complex is—

La Casa-Harmon complex.

The risk of erosion is slight on this complex of soils. Because of the shallowness of the Harmon soils, however, this complex is generally unsuitable for cultivation. It is an excellent producer of grass, and areas now in cultivation should be returned to permanent grass. A good stand should be obtained before grazing is permitted.

These soils are a mixture of Hardland and Very Shallow range sites. Information on management of the soils of this complex for range is given in the section "Range Management."

CAPABILITY UNIT VIIe-1

This unit consists of deep, sandy, freely permeable soils. The soils are—

Springer and Nobscot soils, hummocky.
Springer and Nobscot soils, severely eroded.
Tivoli fine sand.

These soils are too highly susceptible to wind erosion for cultivation. Most of the areas formerly in cultivation have been eroded. Many of these areas are now retired to grass. These soils are very low in fertility and in water-holding capacity.

The Springer and Nobscot soils were mapped as undifferentiated units. The Springer soils are in the Sandy Land range site, and the Nobscot soils are in the Deep Sand range site. Tivoli fine sand is also in the Deep Sand range site. Information on the management of these soils for range is given in the section "Range Management."

CAPABILITY UNIT VIIs-1

The miscellaneous land type in this unit consists of very shallow, rough and broken, eroded soils. This land type is—

Rough broken land.

This land type is suitable only for very limited grazing and for wildlife. It is highly susceptible to water erosion.

Control of grazing will help to maintain vegetation and to reduce erosion.

This land type is in the Gypland and the Rough Broken (Loamy) range sites. More information on these sites is in the section "Range Management."

CAPABILITY UNIT VIIs-2

This unit consists of very shallow or shallow, moderately fine textured, gently to strongly sloping soils. They are—

Vernon complex.
Vernon-Quinlan complex.

These soils are unsuitable for cultivation because of their shallowness and susceptibility to water erosion. They have a shallow root zone and are low in fertility.

All areas of these soils in cultivation should be seeded to permanent grasses. Careful management is needed to maintain a grass cover that will control erosion. A good stand should be obtained before grazing. These soils are in Shallow Redland range site. Information on management of these soils for range is given in the section "Range Management."

CAPABILITY UNIT VIIs-3

This unit consists of very shallow, stony soils. The soils are—

Harmon soils.

These soils are unsuitable for cultivation because of their shallowness. They are good producers of grass but have a low moisture-holding capacity. The risk of erosion is only slight.

These soils are in the Very Shallow range site. Information on management of these soils for range is given in the section "Range Management."

Estimated Crop Yields

Crop yields in Childress County under dryland farming depend largely on the available moisture supply at planting time and during the growing season. Generally, the higher the rainfall, the higher the crop yields. Some of the sandier soils may also be limited by fertility. Consistently high yields depend on good soil management, in addition to available moisture and fertility. The soil that is used within its capabilities and managed according to its needs will produce the best average yields. Such management includes the use, where needed, of contour farming, soil-improving crops, cover crops, and high-residue crops. Fertilizer is also used where needed.

When these conservation practices are not used, crop yields can be expected to be lower. This is mainly because of excess runoff, less moisture-holding capacity of the soils; and lower fertility. Low yields may also be caused by growing crops that are not suited to the soil. Management practices have little effect on losses by hail, insects, and disease.

In Childress County several levels of management are used by different farmers. Because some levels of management are better than others, crop yields vary. Table 3 lists estimated average yields on dryland for the three main crops—cotton, wheat, and grain sorghum. These yields were obtained at two different levels of management that are referred to as A and B. No yield estimates were

TABLE 3.—*Estimated average acre yields of principal crops grown on the main cultivated soils under two levels of management*

[Yields in columns A are obtained at a low level of management; those in columns B are obtained at a high level of management]

Soil	Cotton (lint)		Wheat		Grain sorghum	
	A	B	A	B	A	B
	Lb.	*Lb.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*
Abilene clay loam, 0 to 1 percent slopes	140	170	13	17	900	1,000
Abilene clay loam, 1 to 3 percent slopes	125	140	10	13	800	850
Abilene-Cottonwood complex, 0 to 1 percent slopes	(1)	(1)	9	12	(1)	(1)
Abilene-Cottonwood complex, 1 to 3 percent slopes	(1)	(1)	7	9	(1)	(1)
Carey loam, 1 to 3 percent slopes	175	225	12	15	1,300	1,500
Carey loam, 3 to 5 percent slopes	150	180	10	12	1,100	1,250
Enterprise very fine sandy loam, 0 to 1 percent slopes	225	275	15	19	1,500	1,800
Enterprise very fine sandy loam, 1 to 3 percent slopes	200	235	12	15	1,300	1,500
Enterprise very fine sandy loam, 3 to 5 percent slopes	175	200	9	11	1,200	1,350
Enterprise very fine sandy loam, 5 to 8 percent slopes	140	160	(1)	(1)	1,000	1,100
Enterprise fine sandy loam, 0 to 1 percent slopes	200	250	(1)	(1)	1,300	1,600
Enterprise fine sandy loam, 1 to 3 percent slopes	160	200	(1)	(1)	1,100	1,300
Enterprise fine sandy loam, 3 to 5 percent slopes	140	160	(1)	(1)	1,000	1,100
La Casa clay loam, 1 to 3 percent slopes	125	150	12	14	800	900
Miles loam, 0 to 1 percent slopes	225	275	16	20	1,400	1,700
Miles loam, 1 to 2 percent slopes	190	225	14	17	1,300	1,450
Miles fine sandy loam, 0 to 1 percent slopes	200	250	12	15	1,400	1,600
Miles fine sandy loam, 1 to 3 percent slopes	175	225	10	12	1,300	1,400
Miles fine sandy loam, 3 to 5 percent slopes	140	175	9	11	1,200	1,300
Miles fine sandy loam, 3 to 5 percent slopes, eroded	110	150	7	8	800	1,000
Miles loamy fine sand, 0 to 3 percent slopes	125	175	(1)	(1)	900	1,100
Norwood silt loam	225	275	15	18	1,300	1,600
Norwood clay loam	150	180	14	17	1,000	1,200
Roscoe clay	(1)	(1)	14	15	(1)	(1)
Springer loamy fine sand, undulating	100	140	(1)	(1)	800	1,000
St. Paul silt loam, 0 to 1 percent slopes	200	250	15	18	1,300	1,500
St. Paul silt loam, 1 to 2 percent slopes	160	190	12	14	1,100	1,250
Tillman clay loam, 0 to 1 percent slopes	115	140	13	17	800	900
Tillman clay loam, 1 to 3 percent slopes	100	115	12	14	750	800
Tillman clay loam, 1 to 3 percent slopes, eroded	(1)	(1)	10	12	(1)	(1)
Tipton clay loam, 0 to 1 percent slopes	160	200	15	18	1,000	1,100
Tipton clay loam, 1 to 3 percent slopes	140	160	12	14	950	1,000
Vernon-Weymouth clay loams, 1 to 3 percent slopes	(1)	(1)	7	9	(1)	(1)
Woodward loam, 1 to 3 percent slopes	175	210	11	13	1,200	1,400
Woodward loam, 3 to 5 percent slopes	150	180	10	12	1,000	1,150

[1] Crop is usually not grown on this soil.

made for soils under irrigation, but yields are considerably higher for such soils.

The practices used at a low level of management (A) are as follows:

1. Crop rotations are not used.
2. No soil-improving crops are grown.
3. Generally one crop is grown continuously on the same land.
4. Water conservation practices are not used.
5. Crop residues are not used on the surface to control wind erosion and to reduce runoff.

The practices used at a high level of management (B) are as follows:

1. All soil conservation practices are used as needed.
2. Crop residues are kept on the surface as much as possible for maximum erosion control and conservation of moisture.
3. Crop rotations are used.
4. Terracing and contour farming are used to conserve moisture.

The yields in table 3 are estimated average yields over 10 or 20 years and cannot be expected every year. In some years they will be higher; in others, they will be lower. These yields are based on records of experiment stations and on information from farmers and others familiar with the soils and agriculture of the county.

General Management of Cultivated Soils

There are two main management problems on cultivated soils in the county. One is the control of erosion, and the other is the conservation of moisture. Other problems are the maintenance and improvement of tilth and fertility. These problems, as well as the management practices needed to solve them, are interrelated. In this section the management practices commonly used for soil protection and moisture conservation and for soil improvement are discussed. These practices are referred to in the discussions of capability units.

Control of erosion

Water erosion starts whenever rain falls faster than it can be absorbed by the soil. The rate of absorption depends on the texture and structure of the soil, the length and steepness of the slope, and the vegetation present. Water may cause either sheet or gully erosion. Sheet erosion is the most common and the least noticed. Both rill and gully erosion occur when the water concentrates as it moves downhill.

The susceptibility of a soil to water erosion depends greatly on its slope and partly on its texture. In this county all nearly level to gently sloping soils and all moderately sloping soils of coarse texture (sands and loamy sands) are only slightly susceptible to water erosion. Other moderately sloping soils are moderately susceptible. The sloping to steep soils are highly susceptible.

The susceptibility of a soil to wind erosion depends largely on its texture. In this county all of the fine, moderately fine, and medium-textured soils are only slightly susceptible to wind erosion. The moderately coarse textured soils are moderately susceptible, and the coarse textured soils are highly susceptible.

Wind erosion is most easily noticed on the coarse and moderately coarse textured soils. It tends to remove the finer particles by sorting action and leaves the surface sandier than normal. On the medium- and fine-textured soils, wind erosion is less evident. On these soils it removes all the particles and is hard to distinguish from water erosion.

Some important practices needed for erosion control (fig. 27) are discussed in the following paragraphs. They are (1) stubble mulching, (2) use of crop residues, (3) use of cover crops, (4) stripcropping, (5) terracing and contour farming, and (6) emergency tillage.

Stubble mulching.—This practice consists of tilling, planting, and harvesting crops in such a manner that most of the crop residues will be kept on the surface of the soil throughout the year (see fig. 27, *A*). It provides cover to reduce wind and water erosion, conserves moisture by reducing evaporation and increasing water intake, improves the physical condition of the soil, and helps to maintain the organic-matter content.

Crop residues should never be burned. This practice destroys the organic materials that the soils in Childress County need. If the excess residues are burned, tillage operations may be made easier, but erosion is increased.

Yields may be temporarily decreased when much residue is returned to the soil. This is because the bacteria that decompose the residue draw large quantities of moisture and nitrogen from the soil. Once the residue is decomposed, however, it improves the soil. The decomposition of the residue can be hastened by applying nitrogen fertilizer.

The crops that are usually stubble mulched are small grain and sorghum.

Use of crop residues.—In this practice a protective cover of crop residues is left on the surface of the soil when the soil is most likely to erode—generally during fall, winter, and spring. It provides protection from damaging wind or rain and improves the physical condition of the soil.

Suitable for crop residue are small grain, grain sorghum (see fig. 27, *B*), sudangrass, winter peas, and vetch.

Use of cover crops.—This practice involves the use of close-growing grasses, legumes, and small grain (see fig. 27, *C*), primarily for soil protection and improvement. It provides a protective vegetative cover on areas subject to wind and water erosion during periods when major crops do not furnish adequate cover. Cover crops generally occupy the land for less than 1 year and help improve its physical condition.

Stripcropping.—This practice consists of growing erosion-resisting crops in alternate strips with row crops or fallow land. These strips serve as a vegetative barrier against wind and water erosion and thus protect cropland or growing crops. For control of water erosion, the strips should be arranged on the contour. For control of wind erosion, they should be arranged at angles to offset the effects of prevailing winds.

Some of the crops suitable for stripcropping are grain and forage sorghum and perennial grasses (see fig. 27, *D*.)

Terracing and contour farming.—These practices are designed to conserve moisture and control erosion by reducing runoff. Most tillage is done on the contour,

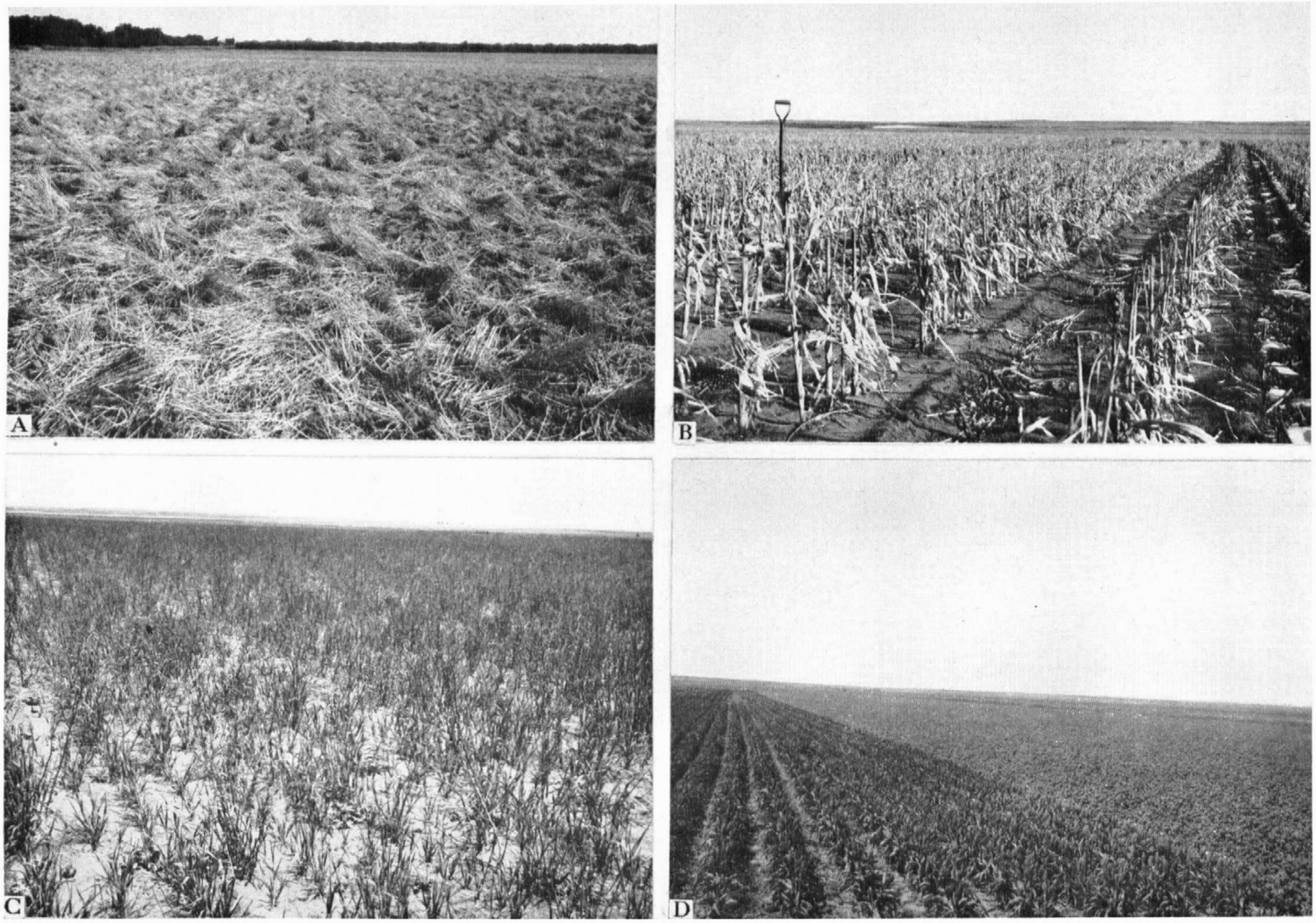


Figure 27.—**Control of erosion: *A*, Residues left on the surface by stubble mulching for control of erosion; *B*, sorghum stubble on Miles fine sandy loam for control of erosion; *C*, cover crop of rye drilled in cotton stalks to protect the soil from wind erosion; *D*, cotton stripcropped with grain sorghum.**

parallel to the terraces. As a result, the excess water is removed slowly and the soil absorbs more of it.

Emergency tillage.—Sometimes it is impossible to have a proper cover of crops or crop residues on the surface during critical periods of wind erosion. It is therefore necessary to roughen the soil surface by some type of tillage, normally by listing or chiseling or use of a stalk cutter. These practices should be done on the contour or at right angles to the prevailing winds.

This conservation measure is for emergency use only and does not provide long-term benefits.

Maintaining good soil structure and tilth

Many of the soils of the county are in poor physical condition; that is, they are low in organic matter. The statement is often made that "rains are not as effective as they used to be." This is because the soils are not able to absorb the water so readily.

Plants need water and air if they are going to grow. When a soil is cultivated for long periods, and not enough crop residues are left on the surface, the structure begins to break down. The organic-matter content decreases. The natural pores and channels in which water and air move into the soil are closed. When such a soil is wet, the surface layer runs together and forms a crust; when it is dry, large cementlike clods are formed. As a result, the soil is more susceptible to water erosion and the intake of water is reduced.

Plowpans—compacted layers just below the plow layer—are also a result of poor soil condition. They are generally caused by tilling the soil when it is too wet. They restrict the free movement of air, moisture, and plant roots through the soil.

Soils in good condition are granular, crumbly, and porous, and they break up easily. They hold their structure when wet. Air and rainfall move freely into such soils (*2*), and erosion is restricted.

Soil condition can be improved by the use of crop residues, stubble mulching, and such soil-improving crops as legumes. Cotton burs and gin trash are widely used for soil improvement. These materials should be used at the rate of about 3 tons per acre for proper protection of the soils.

Conservation cropping systems

Soil-improving practices are the basis of a good cropping system. Such a system helps to restore fertility and to improve the physical condition of the soil. In this way crop yields are increased.

Farmers and ranchers in Childress County do not have a wide choice of crops that can be used in a beneficial rotation. Because of the climate, mainly the lack of rainfall, only a few crops are suited to this area. All crops grown here must be relatively drought resistant. Many of the crops that are suited to this area are not profitable enough to justify extensive use.

The main cash crop is cotton, a soil-depleting crop. If grown continuously, it is hard on the soil. Therefore, a soil-improving crop should be grown in rotation with cotton to keep the soil as productive as possible. A crop is needed that will return residues to the soil. Such crops are called high-residue crops and soil-improving crops. The following crops commonly grown in the county are listed as soil-depleting, soil-improving, or high-residue crops:

Soil-depleting crops:
- Cotton

Soil-improving crops:
- All legumes
- Small grain
- Forage sorghum
- Grain sorghum
- Sudangrass
- Perennial grass

High-residue crops:
- Small grain
- Grain sorghum
- Forage sorghum
- Sudangrass
- Perennial grass
- Alfalfa
- Winter peas

Small grain, forage sorghum, grain sorghum, and sudangrass are soil-improving crops if (1) the crops are fertilized and the residues are returned to the soil; (2) the residues are fertilized and are returned to the soil; or (3) the residues are mixed with the soil as green-manure crops.

A cropping system for cropland should include enough high-residue crops and other protective crops, grown at the proper spacing and frequency, to control erosion effectively. At the same time, enough high-residue crops, legumes, or perennial grasses, or all of these crops, should be grown to keep the soil productive and reasonably fertile. Soils that are more sloping, shallower, coarser in texture, or lower in fertility require more intensive cropping systems than others.

Commercial fertilizers

The natural fertility of the soils of the county is fairly high. The soils have remained high in fertility because there is not enough rainfall to leach the nutrients from the soil. The use of commercial fertilizers on many soils in the county is of questionable value, because rainfall is the factor limiting yields.

Laboratory analyses, tests, and the experience of local farmers have shown that the fine-textured soils do not respond to fertilizers under dryland farming. Except in the wettest years, medium-textured soils do not respond. The moderately coarse and coarse textured soils readily respond to commercial fertilizers. The nutrients most lacking are nitrogen and phosphorus.

All the soils under irrigation will respond to fertilizers. Before fertilizer is applied, the rates and kinds of fertilizers needed for each particular soil should be determined by a soil-testing laboratory. The latest information on fertilizers can be obtained from the county agricultural extension agent or local representatives of the Soil Conservation Service who provide technical assistance for the Hall County Soil Conservation District.

Seeding grass on cultivated land

Because of unstable sand, steep slopes, or shallow soils, Childress County has many acres of cultivated land that is best suited to permanent grass. Such land is highly susceptible to erosion. The establishment of native grass is the most feasible means of control. Grasses also improve the physical condition and the fertility of the soils. Following is a list of the grasses best suited to different types of soils in the county:

Clayey soils:
- Buffalograss
- Blue grama
- Side-oats grama
- Western wheatgrass

Loamy soils:
- Side-oats grama
- Buffalograss
- Blue grama
- Western wheatgrass
- Canada wildrye
- King Ranch bluestem

Sandy soils:
- Switchgrass
- Side-oats grama
- Weeping lovegrass
- Sand lovegrass
- Indiangrass
- Bluestem

Care should be used in establishing native grass on the soils, since most grasses are very sensitive in the seedling stage. The year before seeding, a crop should be grown to provide litter in which to seed the grass. Sudangrass will provide adequate protection to the stand of seedling grass. A forage type of sorghum that has been drilled for close cover and mowed to a 6- or 8-inch stubble height before seed maturity will also provide adequate protection. The grass can then be seeded in this dead litter.

New strains of grass are constantly being developed. For the latest information on grasses, representatives of the Soil Conservation Service who serve the Hall County Soil Conservation District or the county agricultural extension agent should be consulted.

Irrigation

According to the 1954 Census of Agriculture, there were 30 irrigated farms in Childress County. A total of 2,193 acres was irrigated. At the time of the survey, there were about 80 wells in the county, and about 8,000 acres were irrigated.

Most of the irrigated areas are in the northeastern corner of the county in the Loco and Arlie communities and in the southeastern part around Community Center and Kirkland.

All water used for irrigation must come from deep wells. Most of them are 100 to 300 feet deep; a few are deeper. In many areas of the county where soils are suitable for irrigation, water is not available. In other areas the available water is of such low quality that, if used, it will harm the soil. The main harmful salts in the water of Childress County are sodium chloride (table salt), sodium sulfate (Glauber's salt), magnesium sulfate (Epsom salts), and sodium bicarbonate (baking soda). Other salts present in large amounts, but not harmful, are calcium sulphate (gypsum), calcium carbonate, and magnesium carbonate.

Two types of irrigation systems are used in the county—row and sprinkler. Row irrigation needs fairly level land, and land leveling is generally necessary before this system can be used. Sprinkler irrigation works satisfactorily on all slopes and is generally needed on the more sandy soils.

Yields under irrigation can be expected to be at least two or three times as large as those under dryland farming. The average yield of cotton is about 1 to 1.5 bales under irrigation. Sometimes, it is much higher. More information on irrigation can be obtained from representatives of the Soil Conservation Service who serve the Hall County Soil Conservation District.

Range Management [2]

Approximately 224,327 acres, or about 50 percent of the total land in Childress County, is in native grass.

The raising of livestock is a major enterprise in the county. It consists mainly of cow-calf operations, though some winter stockers or carryover calves also are grazed on winter wheat. Practically all ranches have some cropland that is used for supplemental grazing. Among the principal crops used for temporary grazing are small grain, sudangrass, and johnsongrass. Since the forage grown on rangeland is used to produce livestock and livestock products for market, the success of the livestock industry depends on the way ranchers manage their grassland.

The amount and distribution of rainfall and length of growing season have a marked effect on forage production in the county.

The largest part of the rainfall occurs during the four months of May, June, September, and October. Rains of high intensity normally occur within this period and result in excessive runoff. Droughts of 30 to 90 days are common in midsummer. They retard plant growth and prevent the spread of vegetation. Some rainfall occurs as ineffective showers. Because of high, hot winds, excessive evaporation and transpiration occur during part of the growing season.

The optimum growing season for the native vegetation is from April 15 into October. Recurring periods of drought within the growing season cause some plant dormancy almost every year in the months of July and August. When adequate moisture is available, regrowth occurs from about September 1 to October 15. At that time cool weather causes plants to become semidormant. Early development of plant growth is frequently retarded by lack of winter and early-spring moisture. The average frost-free period (215 days) in the county extends from April 3 to November 4.

Range sites and condition classes

Different kinds of range produce different kinds and amounts of grass. For proper range management, a rancher should know the different kinds of land or range sites in his holdings and the plants each site can grow. Management can then be used that will favor the growth of the best forage plants on each kind of land.

Range sites are kinds of rangeland that differ from one another in their ability to produce a significantly different kind or amount of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing use or management to maintain or to improve the present vegetation. Climax vegetation is the stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment remains unchanged. Throughout most of the prairie and the plains, the climax vegetation is the combination of plants that was growing there when the region was first settled. If cultivated crops are not to be grown, the most productive combination of forage plants on a range site is generally the climax type of vegetation.

In the descriptions of range sites, native plants are referred to as *increasers*, *decreasers*, and *invaders*. Increasers and decreasers are climax plants.

Decreasers are plants that are steadily reduced or killed out under continuous heavy grazing, since livestock generally prefer them. Increasers are plants that begin to spread as the more desirable vegetation declines. Eventually increasers carry the bulk of the grazing. Then the increasers begin to decrease in such amounts that they are eliminated by continuous heavy grazing.

As the climax plants are reduced, the invaders spread out and occupy the bare ground. These invaders did not occur in the original plant community. They may have existed on the site in disturbed areas, such as around animal burrows or waterholes. Some invaders are short-lived annuals, such as annual broomweed. Some are undesirable plants for livestock, such as woody species. Other invaders are poisonous.

When enough grazing pressure is relieved, nature tends to replace the climax species in their original proportions. The time required for range recovery depends on the soil, vegetation, adequacy of seed source, and rainfall.

On some relict areas, roadsides, and properly managed ranges, the original, or climax, vegetation is still largely intact. By analyzing the composition of plants in such areas, the climax vegetation can be determined for each site.

Range condition is classified by comparing the present vegetation with the climax vegetation on the site. Range condition is expressed as follows:

Condition class:	*Percentage of climax vegetation on the site*
Excellent	76–100
Good	51–75
Fair	26–50
Poor	0–25

Range in excellent or good condition generally provides effective soil and water conservation and good forage yields. Range in poor condition needs the most intensive conservation practices if desirable vegetation is to be restored.

The range in Childress County, at the time surveyed, rated as follows: Excellent, 10 percent; good, 20 percent; fair, 55 percent; and poor, 15 percent.

Other factors beside the percentage of climax vegetation influence range condition, but they are mainly useful in determining trends. These include plant density, plant vigor, soil tilth, degree of erosion, and plant litter.

[2] This section is by ODIS J. CURRY and JOE B. NORRIS, range conservationists, Soil Conservation Service.

Since forage production and livestock management largely depend on range sites, individual sites are identified and described as to soils, topography, kinds of grasses, and potential production (fig. 28). Descriptions of the twelve sites designated for Childress County follow.

BOTTOM LAND (LOAMY) RANGE SITE

This site consists of flat to gently sloping soil areas adjacent to rivers and intermittent streams. It also includes alluvial land along draws. The soils are silt loams and clay loams. They frequently receive water as overflow from watercourses and runoff from adjoining higher lying areas. These soils have a high fertility holding capacity. If unprotected by plant cover, they readily scour or gully in places. Debris and silt are commonly deposited on the site during heavy rains.

A typical area of this site is 0.1 mile west of north gate to W. N. and L. R. Reed Ranch, 7 miles southeast of Childress.

The following soils are in this range site—

Loamy alluvial land.
Norwood clay loam.
Norwood silt loam.

Areas of alluvial soils, which are inclusions in the mapping unit Quinlan-Woodward loams, 8 to 20 percent slopes, are also in this range site. In places areas of Tipton clay loam are present within mapping units of the soils of this site, normally those of Norwood clay loam.

Descriptions of the soils in this site are given in the section "Descriptions of the Soils."

The decreasers on this range site are Indiangrass, switchgrass, sand bluestem, little bluestem, side-oats grama, Canada wildrye, and meadow dropseed. Decreasers make up about 70 percent of the climax vegetation.

The increasers are vine-mesquite, Texas bluegrass, western wheatgrass, buffalograss, blue grama, white tridens, silver bluestem, and Texas wintergrass. In some saline areas, alkali sacaton is present.

As the range condition declines, sand dropseed, three-awns, western ragweed, cactus, mesquite, and annuals invade the site. A few tall trees—such as cottonwood, hackberry, and elm—are in the climax vegetation.

This site is often the most important site in a pasture because of its high productivity, accessibility, and wide variety of warm- and cool-season grasses. As it is readily accessible to livestock, overgrazing is common.

Basal herbage cover in climax condition ranges from 30 to 40 percent, depending on the position of the site and the amount of extra water received. Basal cover is the percentage of the total ground space occupied by the bases of the plants when range is in climax condition.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 1,100; good, 800; fair, 500; and poor, 300.

BOTTOM LAND (SANDY) RANGE SITE

This site consists of nearly level or undulating areas adjacent to large rivers and small streams. The areas are mainly sandy alluvial lands that receive extra water from high water tables, frequent floods, or runoff from higher, adjoining land. Wind and water erosion are hazards where vegetation is sparse. In many areas, particularly along the larger rivers, past geologic deposits of soil material have left mounds that are generally higher than the surrounding areas of the site. These duned areas do not receive the extra runoff that the rest of the site normally receives.

A typical area of this site occurs 10 miles north of Childress on U.S. Highway No. 83 and 0.2 mile east of the south end of Red River bridge.

The mapping unit in this site is—

Sandy alluvial land.

A description of this land type is in the section "Descriptions of the Soils."

Characteristic of this tall-grass site are such decreasers as sand bluestem and little bluestem. Switchgrass and Canada wildrye are also abundant decreasers in the climax vegetation; side-oats grama and meadow dropseed occur in smaller amounts. The decreasers make up about 75 percent of the climax vegetation.

The increasers include Texas bluegrass, Texas wintergrass, western wheatgrass, vine-mesquite, blue grama, silver bluestem, buffalograss, and, in saline areas, alkali sacaton.

After depletion of the climax vegetation, the invaders include sand dropseed, three-awns, western ragweed, mesquite, lotebush, and, in salty areas, inland saltgrass, saltcedar, and creeping muhly.

Deposits from floods occur in many places. In some areas these deposits cover the vegetation with bare soil.

Basal herbage cover in climax condition ranges from 30 to 40 percent.

Under proper use in average years, estimated production in pounds of usable air-dry forage varies according to range condition as follows: Excellent, 1,100; good, 800; fair, 500; and poor, 300.

SANDY LAND RANGE SITE

This range site consists of nearly level to gently undulating soils (see fig. 28, *A*). The soils are mainly loamy fine sands that have a coarse-textured surface layer. The water-holding capacity of the subsoil is distinctly higher than that of the surface soil. Susceptibility to wind erosion is high on these soils.

A typical area of this site occurs 2.3 miles north of Community Center School.

The following soils are in this site—

Miles loamy fine sand, 0 to 3 percent slopes.
Miles loamy fine sand, 3 to 5 percent slopes.
Springer loamy fine sand, undulating.
Springer soils, hummocky (in Springer and Nobscot soils, hummocky).
Springer soils, severely eroded (in Springer and Nobscot soils, severely eroded).

In places the soils mapped as Miles loamy fine sand include some areas where the surface soil is fine sandy loam.

Descriptions of the soils in this site are given in the section "Descriptions of the Soils."

The dominant decreasers in the climax vegetation in this tall-grass site are Indiangrass, sand bluestem, switchgrass, little bluestem, sand lovegrass, giant dropseed, and needle-and-thread grass. Decreasers make up approximately 70 percent of the climax vegetation.

The increasers consist of side-oats grama, blue grama, silver bluestem, hairy grama, sand dropseed, perennial

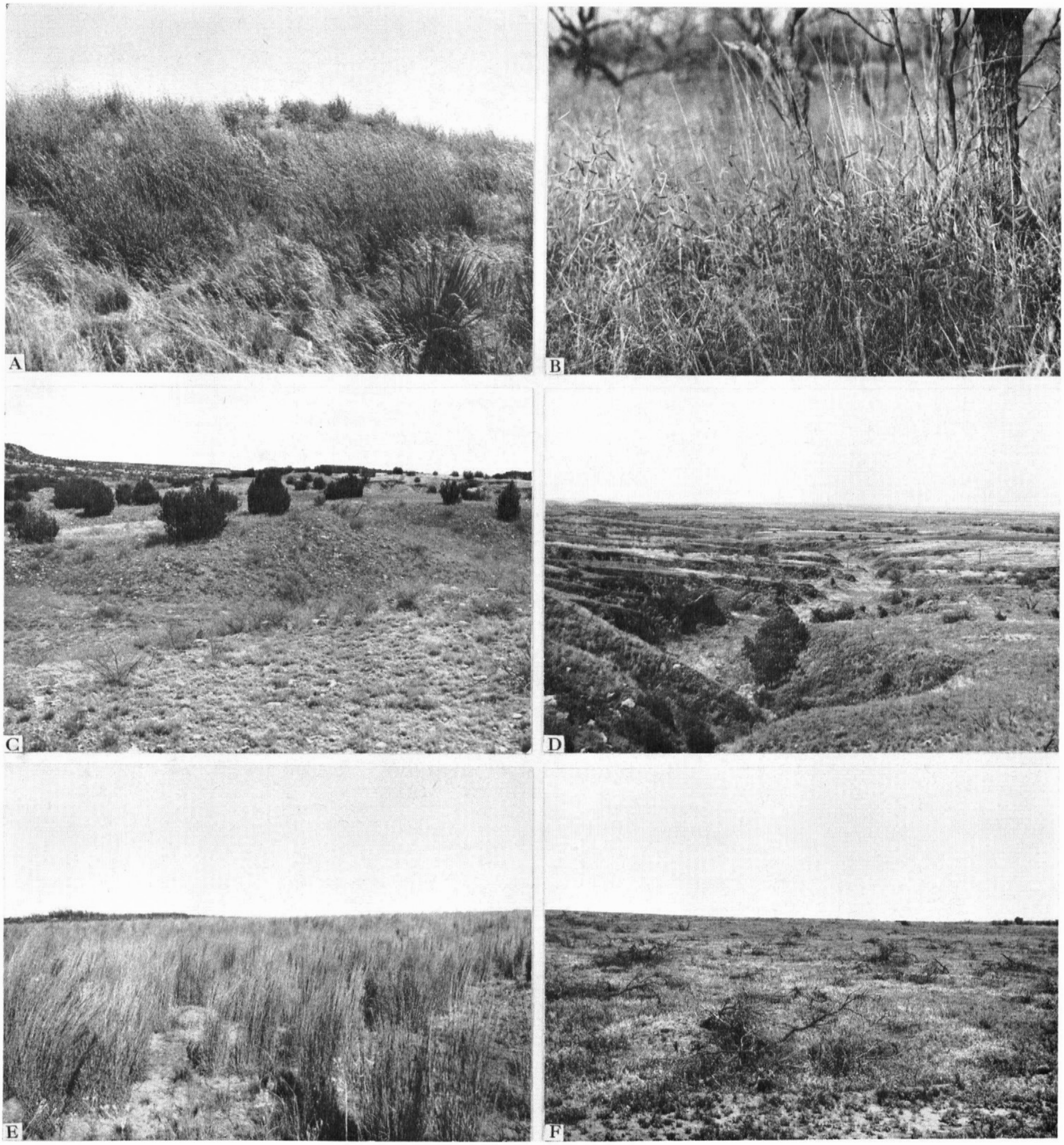


***Figure 28.**—**A**,* Sandy Land range site showing mainly sand bluestem; ***B**,* close view of blue grama (on left) and side-oats grama growing on Hardland range site; ***C**,* Shallow Redland range site showing typical rolling topography; ***D**,* typical view of Rough Broken (Loamy) range site; ***E**,* formerly cultivated field abandoned because of low fertility and erosion—the seeding of desirable native grasses has made the land useful and productive; ***F**,* area on which mesquite is controlled by bulldozing trees.

three-awn, sand paspalum, Texas bluegrass, hooded windmillgrass, and fall witchgrass. Sand sagebrush occurred in small amounts in the climax vegetation and spread to the deeper sands after range deterioration. Sand plum and skunkbush are other woody plants that occur in small amounts.

As the range condition declines, invading vegetation encroaches rapidly. Invaders include shin oak, yucca, queen's delight, gummy lovegrass, red lovegrass, tumble windmillgrass, tumble lovegrass, fringed signalgrass, and western ragweed and small amounts of mesquite. The more prevalent annual invaders are wild buckwheat, spectaclepod, Russian-thistle, tumble ringwing, purple sandgrass, and curlycup gumweed.

As the range deteriorates, shin oak increases correspondingly. In some areas this plant and yucca are serious problems. Mechanical or chemical control of oak and yucca generally is required before the site will respond to management.

Basal herbage cover in climax condition ranges from 5 to 15 percent.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 800; good, 650; fair, 475; poor, 300.

DEEP SAND RANGE SITE

This site occupies rolling to hilly land that includes stabilized dunes. The dunes are hummocky or undulating in places. The soils in this site are very deep, coarse-textured fine sands. They are nonarable and are highly susceptible to wind erosion. The soils have a high water-intake rate and are slightly susceptible to water erosion. They have a low capacity to hold water and fertility.

A typical area of this site occurs along the south side of the Red River, 10 miles north of Childress on U.S. Highway No. 83.

The following soils are in this site—

- Nobscot soils, hummocky (in Springer and Nobscot soils, hummocky).
- Nobscot soils, severely eroded (in Springer and Nobscot soils, severely eroded).
- Tivoli fine sand.

Enterprise fine sandy loam occurs in places as an inclusion in areas of Tivoli fine sand.

Descriptions of these soils are in the section "Descriptions of the Soils."

The climax vegetation in this tall-grass site includes sand bluestem, Indiangrass, switchgrass, little bluestem, needle-and-thread grass, sand lovegrass, giant dropseed, and in the duned areas, big sandreed and other decreasers. Decreasers make up about 70 percent of the climax vegetation.

Increasers include blue grama, side-oats grama, hairy grama, silver bluestem, hooded windmillgrass, sand paspalum, sand dropseed, perennial three-awn, and fall witchgrass. Clumps of shin oak appeared in the climax vegetation and spread readily as the range deteriorated. Skunkbush and sand plum occurred in small amounts in the climax vegetation.

Invaders include gummy lovegrass, tumblegrass, tumble lovegrass, red lovegrass, tumble windmillgrass, fringed signalgrass, yucca, sand sagebrush, groundsel, queen's delight, and western ragweed. More dominant annual invaders include spectaclepod, tumble ringwing, Russian-thistle, purple sandgrass, curlycup gumweed, and buckwheat.

This site responds favorably to range management, particularly if brush is controlled.

Basal herbage cover in climax condition ranges from 5 to 15 percent.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 775; good, 600; fair, 450; poor, 250.

HARDLAND RANGE SITE

The soils in this range site of the upland plains are level or gently sloping. The slope seldom exceeds 3 percent. The areas are readily accessible to livestock. Characteristic soils in this site are deep loams and clay loams. Their capacity to hold water and fertility is high. Surface crusting, however, reduces the slow moisture intake of these soils, particularly in areas unprotected by plant cover.

A typical area of this site occurs 1 mile south of the north entrance to W. N. and L. R. Reed Ranch, 7 miles southeast of Childress.

The following soils are in this site—

- Abilene clay loam, 0 to 1 percent slopes.
- Abilene clay loam, 1 to 3 percent slopes.
- La Casa clay loam, 1 to 3 percent slopes.
- Miles loam, 0 to 1 percent slopes.
- Miles loam, 1 to 2 percent slopes.
- Roscoe clay.
- St. Paul silt loam, 0 to 1 percent slopes.
- St. Paul silt loam, 1 to 2 percent slopes.
- Tillman clay loam, 0 to 1 percent slopes.
- Tillman clay loam, 1 to 3 percent slopes.
- Tillman clay loam, 1 to 3 percent slopes, eroded.
- Tipton clay loam, 0 to 1 percent slopes.
- Tipton clay loam, 1 to 3 percent slopes.

Vernon-Weymouth clay loams, in some places, are inclusions in areas of Tillman clay loams. Areas of Harmon soils are inclusions in La Casa clay loam.

Descriptions of these soils are given in the section "Descriptions of the Soils."

The dominant decreasers in good and excellent condition are blue grama and side-oats grama (see fig. 28, *B*). Smaller amounts of vine-mesquite and western wheatgrass occur in depressions. The decreasers make up about 65 percent of the climax vegetation.

As the range deteriorates, buffalograss and tobosagrass increase. Other increasers include Texas wintergrass, silver bluestem, and alkali sacaton (in saline areas). Meadow dropseed and white tridens are prevalent along small drains and depressions.

After further deterioration of the range, perennial three-awn, hairy tridens, sand dropseed, Texas grama, tumblegrass, pricklypear, mesquite, condalias, and annuals invade the climax vegetation.

Basal herbage cover in climax condition ranges from 30 to 40 percent.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 650; good, 450; fair, 375; and poor, 250.

MIXED LAND RANGE SITE

Soils of this site occupy gently sloping to steep uplands with rolling hills and a distinct drainage pattern. Most of the drains are nearly level and well grassed.

The soils in this site are very fine sandy loams and loams. If unprotected by plant cover, the surface layer crusts, and runoff and erosion are increased. Deep, V-shaped gullies appear where erosion has increased, generally at the lower ends of drainageways and in fringe areas.

A typical area of this site occurs 100 yards east of U.S. Highway No. 83, about 3 miles south of Childress.

The following soils are in this site—

Carey loam, 1 to 3 percent slopes.
Carey loam, 3 to 5 percent slopes.
Enterprise very fine sandy loam, 0 to 1 percent slopes.
Enterprise very fine sandy loam, 1 to 3 percent slopes.
Enterprise very fine sandy loam, 3 to 5 percent slopes.
Enterprise very fine sandy loam, 5 to 8 percent slopes.
Quinlan-Woodward loams, 8 to 20 percent slopes.
Woodward loam, 1 to 3 percent slopes.
Woodward loam, 3 to 5 percent slopes.
Woodward-Quinlan loams, 5 to 12 percent slopes.

St. Paul silt loam is included in some areas of Carey loam.

Descriptions of the soils in this site are given in the section "Descriptions of the Soils."

This short- to mid-grass site is characterized by side-oats grama and blue grama. Other decreasers are Arizona cottontop and plains bristlegrass. Western wheatgrass, meadow dropseed, vine-mesquite, and switchgrass are along the drains. In some areas where there is gypsum, little bluestem and sand bluestem occur. Decreasers comprise approximately 65 percent of the climax vegetation of this range site.

Included in a wide variety of increasers are hairy grama, buffalograss, Texas wintergrass, Texas bluegrass, silver bluestem, and perennial three-awns.

Invaders are hairy tridens, Texas grama, sand muhly, tumble windmillgrass, tumblegrass, gummy lovegrass, hooded windmillgrass, red grama, pricklypear, mesquite, tasajillo, lotebush, and numerous annuals.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 700; good, 525; fair, 350; poor, 250.

SANDY LOAM RANGE SITE

This site occurs on upland plains. Few of the gentle to moderately steep slopes are more than 10 percent. Some areas of this site are on ridges or on rolling terrain.

The soils of this site have a fine sandy loam surface layer and a moderately to moderately rapidly permeable subsoil. The water-holding and fertility-holding capacities are moderate. These soils are moderately to highly susceptible to wind and water erosion. Hoof pans form readily in areas unprotected by plant cover.

A typical area of this site occurs 4 miles northeast of Childress on Farm-to-Market Road 268 and about 5 miles northeast on a county road.

The soils of this site are—

Enterprise fine sandy loam, 0 to 1 percent slopes.
Enterprise fine sandy loam, 1 to 3 percent slopes.
Enterprise fine sandy loam, 3 to 5 percent slopes.
Miles fine sandy loam, 0 to 1 percent slopes.
Miles fine sandy loam, 1 to 3 percent slopes.
Miles fine sandy loam, 3 to 5 percent slopes.
Miles fine sandy loam, 3 to 5 percent slopes, eroded.
Miles fine sandy loam, 5 to 8 percent slopes, eroded.

Inclusions of Miles loamy fine sand and Miles loam occur in some of the areas of the Miles fine sandy loams.

Descriptions of the soils in this range site are in the section "Descriptions of the Soils."

This mid-grass site produces such decreasers as side-oats grama, little bluestem, Arizona cottontop, and plains bristlegrass. Small amounts of vine-mesquite, sand lovegrass, and needle-and-thread grass normally occur in areas that have more favorable moisture. Decreasers make up about 70 percent of the climax vegetation.

The principal increasers are buffalograss, blue grama, sand dropseed, perennial three-awn, hairy grama, and silver bluestem. Woody increasers that comprise 5 percent of the climax vegetation in some areas are sand sagebrush, agarito, skunkbush, and mimosa.

Invaders include tumble windmillgrass, gummy lovegrass, mesquite, pricklypear, yucca, and annuals.

Basal herbage cover in climax condition ranges from 30 to 40 percent.

Under proper use in average years, estimated production in pounds of usable air-dry forage varies according to range condition as follows: Excellent, 750; good, 575; fair, 400; poor, 275.

GRAVELLY RANGE SITE

This site occupies rolling hills, generally adjacent to major streams. It consists of a miscellaneous land type made up of reddish-brown to brown loamy soils that have a high content of waterworn gravel. The gravel is uniformally interspersed throughout the profile.

A typical area of this site occurs approximately 1.5 miles north and 1 mile northeast of a point on a ranch road, 2 miles north of Community Center School.

The following land type is in this site—

Gravelly broken land.

Inclusions of Miles fine sandy loam are present in the areas of Gravelly broken land.

The soil is described in the section "Descriptions of the Soils."

This is mainly a mid-grass site. It is characterized by side-oats grama, little bluestem, and black grama; sand bluestem is present in varying amounts. Other decreasers are blue grama, needle-and-thread grass, and Canada wildrye. Decreasers make up about 70 percent of the climax vegetation.

Increasers include hairy grama, silver bluestem, slim or rough tridens, perennial three-awns, and sand dropseed. Black or feather dalea, or both, and dotted gayfeather help characterize the site. Another increaser on this site is shin oak.

Invaders include pricklypear, mesquite, catclaw, Texas grama, hairy tridens, sand muhly, and numerous annuals.

Basal herbage cover in climax condition ranges from 10 to 15 percent.

Under proper use in average years, estimated production in pounds of usable air-dry forage varies according to range condition as follows: Excellent, 650; good, 450; fair, 375; and poor, 250.

VERY SHALLOW RANGE SITE

This site consists of rolling to hilly land. Some knolls or relatively steep escarpments are included. The soils in this site are characterized by many limestone rocks on the surface and in the profile, or by small rocks, gravel, or caliche. If unprotected by vegetation, the sloping areas are highly susceptible to water erosion.

A typical area of this site occurs 300 feet west of a point 12.9 miles north of Childress on U.S. Highway No. 83.

The following soils are in this site—

Harmon soils.

Areas of La Casa clay loam, Cottonwood soils, and Vernon complex are included with the Harmon soils. The Harmon stony loam of the La Casa-Harmon complex is also in this range site.

The soils in this site are described in the section "Descriptions of the Soils."

This site has a good variety of climax vegetation. As side-oats grama dominates, it has the apperance of a mid-grass site. Other decreasers on this site are blue grama, Arizona cottontop, and little bluestem. On the northern slopes and in places where moisture is more favorable, sand bluestem, Indiangrass, vine-mesquite, plains bristlegrass, and other decreasers occur. Decreasers make up some 70 percent of the climax vegetation.

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

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

Basal herbage cover in climax condition ranges from 15 to 20 percent.

If the site is used properly in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 500; good, 350; fair, 250; poor, 225.

SHALLOW REDLAND RANGE SITE

This site occurs on rolling hills, ridges, or gently undulating terrain (see fig. 28, *C*). The soils of this site were developed in red-bed material. In most areas they are underlain by red shaly clay. In some areas the red-bed material is interbedded with gypsum.

The surface layer consists of clay and clay loam. The subsoil is moderately to slowly permeable. If the surface layer is not protected by vegetation, water erosion is severe. In places stones and gravel occur on the surface and throughout the profile. In scattered areas there are outcrops of large ledge rock.

A typical area of this site occurs 1.5 miles south and 0.25 mile east of north entrance to W. N. and L. R. Reed Ranch, 7 miles southeast of Childress.

The soil complexes in this site are—

Vernon complex.
Vernon-Quinlan complex.
Vernon-Weymouth clay loams, 1 to 3 percent slopes.
Vernon-Weymouth clay loams, 3 to 5 percent slopes.

Areas of Tillman clay loam are included in some places.

The soils in this range site are described in the section "Descriptions of the Soils."

This mid- and short-grass site is characterized by blue grama, side-oats grama, and other decreasers. Smaller amounts of vine-mesquite, little bluestem, and sand bluestem occur on soils that contain gypsum, gravel, or extra water. The decreasers make up approximately 65 percent of the climax vegetation.

The dominant increaser is buffalograss. Tobosagrass, hairy grama, sand dropseed, perennial three-awn, and silver bluestem commonly occur.

Principal invaders include hairy tridens, sand muhly, Texas grama, red grama, mesquite, pricklypear, redberry juniper, and annuals.

Basal herbage cover in climax condition ranges from 10 to 20 percent.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 525; good, 375; fair, 275; poor, 250.

GYPLAND RANGE SITE

This site comprises areas that range from nearly level or rolling to steep and hilly. In places the site occurs in narrow bands or benches that form stairsteps to adjacent hills. In places these benches traverse the hills for several miles at the same elevation.

The distinctive characteristic of this site is the large amount of gypsum in the soils and its effect on vegetation. The soils range from clay to very fine sandy loam. The gypsum may occur in solid strata below the surface of the soil, on the surface as blisters of friable particles, or in platy crystalline form. In some areas limestone is interspersed with, or adjacent to, the soils of the site.

A typical area of this site occurs 3 miles northwest of Vest Ranch headquarters.

The following soils are in this site—

Rough broken land.
Cottonwood clay loam (in both Abilene-Cottonwood complexes.)

Some areas of Acme clay loam and Harmon stony loam are present as inclusions.

The soils in this site are described in the section "Descriptions of the Soils."

The climax vegetation is directly affected by the gypsum. Except in areas of almost pure gypsum, this site has a mid- and tall-grass appearance. Characteristic grasses are side-oats grama, little bluestem, and sand bluestem. In places where the gypsum content is 75 percent and higher, vegetation is sparse and side-oats grama (a decreaser) and hairy grama (an increaser) are dominant.

Besides side-oats grama, decreasers on the site include blue grama, Indiangrass, switchgrass, vine-mesquite, plains bristlegrass, and Arizona cottontop. Decreasers make up approximately 60 percent of the climax vegetation.

In addition to hairy grama, increasers on this range site are buffalograss, slim or rough tridens, riverchow panicgrass, black grama, silver bluestem, sand dropseed, and perennial three-awn. Also characteristic of the site are dotted gayfeather, black or feather dalea, and false brownweed (an invader).

The principal invaders are mesquite, redberry juniper, yucca, catclaw, Texas grama, hairy tridens, and numerous annuals.

Basal herbage cover in climax condition is small, approximately 5 percent.

Under proper use in average years, estimated production in pounds per acre of usable air-dry forage varies according to range condition as follows: Excellent, 450; good, 325; fair, 250; poor, 200.

ROUGH BROKEN (LOAMY) RANGE SITE

This breaks site has a distinct dendritic drainage pattern. Steep slopes and bluffs are characteristic (see fig. 28, *D*). Geologic erosion is generally quite severe. Narrow bands of alluvial land occur in places in the bottoms of draws.

The soils characteristic of this site have developed in weakly consolidated siltstone and very fine grained sandstone in which are interspersed thin strata of gypsum. The amount of gypsum significantly affects plant growth; it does not benefit growth throughout the entire site, however. If the site is not protected by vegetation, the high runoff further accelerates erosion.

A typical area of this site occurs 0.2 mile west on Farm-to-Market Road 2042 from a point 3 miles southwest of Childress on U.S. Highway No. 83.

The following land type is in this site—

Rough broken land.

Areas of Loamy alluvial land are present as inclusions in the draws of this land type. This site occurs in many places in association with the Mixed Land site. Some areas of Rough broken land, which are inclusions in the mapping unit Quinlan-Woodward loams, 8 to 20 percent slopes, are also in this range site.

The mapping unit in this site is described in the section "Descriptions of the Soils."

The decreasers on this site include side-oats grama, blue grama, little bluestem, and meadow dropseed. In places along the draws sand bluestem, Indiangrass, switchgrass, vine-mesquite, and Canada wildrye occur. The decreasers make up approximately 65 percent of the climax vegetation.

Increasers are hairy grama, black grama, silver bluestem, buffalograss, perennial three-awn, white tridens, sand dropseed, and slim or rough tridens.

The principal invaders are mesquite, redberry juniper, cactus, catclaw, condalias, hairy tridens, Texas grama, and numerous annuals.

The basal herbage cover in climax condition ranges from 5 to 15 percent.

Under proper use in average years, estimated production in pounds of usable air-dry forage varies according to range condition as follows: Excellent, 375; good, 250; fair, 150; poor, 125.

Management principles and practices

High production of forage and conservation of soil, water, and plants on rangelands are obtained by maintenance of range already in good and excellent condition and by improving native vegetation. This vegetation is improved by grazing management that encourages the growth of the better native forage plants and increases their number. Where brush invasion is severe, mechanical, chemical, or other means of control are sometimes needed in combination with good grazing management to eliminate undesirable plants and to help nature restore the most productive ones.

Leaf development, root growth, seed production, forage regrowth, and food storage are all essential stages in the growth of grass. Maximum forage yields and high livestock production are maintained by regulating grazing so as to allow these natural processes of growth.

Livestock are selective in grazing and constantly seek out the more palatable and nutritious plants. If grazing is not carefully regulated, the better forage plants decrease and are replaced by less productive grasses and by woody vegetation.

A part of the food produced in the green leaves of a plant is needed to maintain the vigorous root system that will permit growth. Therefore, the green leaves of plants cannot be grazed off completely without serious injury to the plant. If the foilage of grasses is reduced greatly, the root system is affected, and the plant so weakened that it cannot resist adverse weather.

Research and the experience of ranchers have shown that when about 50 percent, by weight, of the grass produced yearly is utilized, high production can be maintained or achieved. The forage that is left on the range accomplishes the following:

1. It serves as a mulch that increases the intake and storage of water and decreases evaporation. As a result grasses can cope better with droughts, and the periods of green grazing are prolonged.
2. It allows maximum root development. (Overgrazed grass cannot reach deep moisture, because root penetration depends on the manufacture of food within the leaves.)
3. It protects the soil from wind and water erosion.
4. It allows the better grasses to compete with nonpalatable invaders.
5. It enables grasses to store food in their roots for quick and vigorous growth following dormant periods.
6. It provides for greater reserves of feed for dry spells that otherwise might force the sale of livestock at a loss.

Range management should provide for reserve pastures or other feed during droughts or other periods of low forage production. Thus, the forage can be moderately grazed at all times. It is often desirable to keep part of the livestock, such as stocker steers, readily salable. Such flexibility allows the rancher to balance livestock production with forage production without the sale of breeding animals.

Management practices that improve range vegetation, that cost little to apply, and that are needed on all rangeland, regardless of other practices used, are defined as follows:

Proper range use.—The success of all other range practices depends on proper range use. A stocking rate and grazing system that will continuously produce the most forage and the greatest gain in weight of livestock should be used. Also, the proper class of livestock should be selected. A rate of grazing should be used that will maintain adequate residues for soil and water conservation and, in addition, improve the vegetation that has deteriorated.

Proper use of individual species is needed to improve the condition class of the range. Such use should be based on key grasses. These should be selected on a range site of determined range condition. They should be the best climax plants that grow on the range in sufficient quantity to justify their use as key plants. Not more than 50 percent, by weight, of the annual growth of the key species should be grazed off. The plants will then be able to compete with less palatable plants and will increase in number. Thus the quality and quantity of the forage will be improved.

Deferred grazing.—This is the postponement of grazing on a range so as to increase the vigor of the forage or to permit the desirable plants to reproduce naturally by seed. In addition, deferred grazing will build up a reserve of forage for later use. This practice is especially needed on range in poor and fair condition.

Deferred grazing, planned by pastures, will give rest periods to range grasses. These rest periods should be in a season that will allow key plants to seed, renew their vigor, and spread in the stand.

RANGE IMPROVEMENT PRACTICES

The following practices will improve range and facilitate good management.

Range seeding.—This is the establishment of perennial grasses for prevention of soil and water losses. This practice is also used to restore ranges that are in poor condition or to convert cropland to rangeland (see fig. 28, *E*).

Such mechanical aids as pitting, chiseling, or mechanical brush control are generally used when ranges in poor condition are overseeded. Overseeding of native rangeland is used mainly on the Hardland and Mixed Land sites in this county.

Converting cropland to rangeland by seeding to suitable perennial native grasses has been highly successful. The converted cropland consists mainly of fields that have lost surface soil and fertility through wind and water erosion.

Water development.—Water should be so located over the entire range that livestock will not have to walk more than a mile or two. If stock ponds and wells are strategically located, grazing will be evenly distributed.

Fencing.—Fences should be constructed as an aid to good management of livestock and ranges. Grazing is more evenly distributed by cross fencing the large pastures. Deferred grazing can be better achieved by using several pastures. Since different range sites produce different kinds or amounts of vegetation, fencing should follow mapped range sites as closely as possible.

Brush control.—Chemical or mechanical control of brush is needed on some range sites to improve the forage and also to make the handling of livestock easier. Mesquite control is needed on most of the deep and shallow Hardland sites (see fig. 28, *F*). Sand sagebrush and shin oak are the main woody species that need control on the Sandy Land site.

Range pitting or chiseling, or both.—These practices are sometimes needed to invigorate short grasses on areas of the Hardland site that are in poor condition. They are also used to prepare seedbeds before range seeding.

LIVESTOCK MANAGEMENT

Some of the needed practices in livestock management are as follows:

1. Use of grazing animals suitable for the available forage—generally, cattle for ranges that are predominantly grass, and sheep for ranges that have many weeds.
2. Use of a feed and forage program that provides for available range forage, concentrates, hay, and temporary pastures on cropland to keep livestock in good condition throughout the year.
3. Use of a breeding program that provides for continued animal improvement, the type of livestock suited to the range, and a supply of calves or lambs in seasons when forage is most nutritious.
4. Culling of nonproductive animals from the herds.

Windbreaks

Tree windbreaks reduce wind velocities on farms and ranches and thus help protect soil, crops, and farmsteads from wind and blowing dust. They also provide shelter for livestock, add beauty to the farm or ranch, and provide food and cover for birds and other wildlife.

Trees are hard to establish in Childress County. The only native trees are a few cottonwood, hackberry, and chinaberry trees along the streambanks.

If no extra water is available to get the trees established, they should be planted only in medium, moderately coarse, and coarse textured soils. If extra water is available, they can be grown on all the soils in the county.

Once the shrubs and trees are established, they must be cared for like any other growing crop. They should be protected from livestock, grazing, and fire. Cultivation is necessary to reduce competition from weeds.

Wildlife

Early settlers of Childress County found an abundance of wildlife. But as the settlement advanced, the cover was destroyed and the wildlife gradually decreased. In recent years, however, people have begun to realize the value and importance of wildlife.

Farmers and ranchers are mainly responsible for the production and welfare of wildlife. The abundance or scarcity of wildlife depends on how the land is used.

Childress County supports many different kinds of wildlife, though not in large numbers. In this county there are rabbits, coyotes, badgers, prairie dogs, skunks, squirrels, a few deer, and wild turkeys. Among the birds seen are blue and bobwhite quail, mourning doves, meadowlarks, robins, blackbirds, crows, hawks, and owls.

Good food and cover must be available if wildlife is to thrive. Many natural wildlife habitats occur in the county. Others could be prepared very easily. Almost every farm or ranch has areas that could provide food and cover. Some of these areas are windbreaks, fence rows, odd areas around gullies, streambanks, fields, ponds, and abandoned homesteads.

A general plan for improving or developing a wildlife area should include the following practices (*3*): (1) Protection of the site from fire and grazing; (2) adequate erosion control; (3) planting or maintaining low trees or shrubs on part of the area to furnish food and cover; (4) planting some type of good seed-producing plants if food is short; (5) an attempt to provide a source of food for the entire year.

Childress County has many farm ponds. Their primary purpose is to furnish water for livestock. Many will also make good fish ponds for recreation for the farm or ranch family.

Farm ponds used for fish should be at least a quarter of an acre in size and at least 8 feet deep over one-fourth of the area. Debris and shrubs should be removed from below the water line. The pond should be stocked with desirable species of fish. Fish that are well suited to Childress County are bass, bluegills, crappies, red-eared sunfish, and channel catfish.

The fish pond should be fenced to protect it from livestock. The pond should be fertilized. Undesirable pond weeds, such as cattails and moss, should be controlled. Regular fishing is necessary.

Fish are available from the U.S. Fish and Wildlife Service. Information on developing wildlife habitats and farm fish ponds can be obtained from the local county agent or personnel of the Soil Conservation Service.

Engineering Applications [3]

The information in this section, together with the soil maps and the information on soils given elsewhere in this report, can be used by engineers to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural structures, such as farm ponds, irrigation systems, and soil and water conservation practices.
3. Make preliminary evaluations of soil and ground conditions that will aid in the selection of highway and airport locations and in planning detailed soil investigations of the selected locations.
4. Locate probable sources of topsoil and other construction material for use in structures.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soils for the cross-country movement of vehicles and construction equipment.
7. Obtain supplemental information from other published maps, reports, and aerial photographs to make maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes in the particular area.
9. Select locations for pipelines.

It must be emphasized, however, that the soil maps and the descriptions of the soils in this report are generalized. The report therefore should be used in planning the more detailed field surveys that will need to be made to determine the in-place condition of the soil at the site proposed for construction.

Some of the terms soil scientists use to describe soils may be unfamiliar to the engineer. Many of these terms are defined in the Glossary.

Engineering Classification Systems

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (*1*). In this system soil materials are classified in seven principal groups. The groups range from A–1, in which are gravelly soils of high bearing capacity, to A–7, which consist of clay soils having a low strength when wet.

Within each group, the relative engineering value of the soil material is indicated by a group index number. These numbers range from 0 for the best material to 20 for the poorest. The group index numbers are determined by the gradation, liquid limit, and the plasticity index. They are shown in parentheses in table 6 in the column headed "AASHO."

Some engineers prefer to use the Unified soil classification system (*10*). In this system, soil material is divided into fifteen classes. Eight classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, SC), six for fine-grained material (ML, CL, OL, MH, CH, OH), and one for highly organic material (Pt). Mechanical analyses are used to determine the GW, GP, SW, and SP classes of material; mechanical analyses, liquid limit, and plasticity index are used to determine GM, GC, SM, SC, and fine-grained soils. The soils of the county have been classified only in the SW, SP, SM, SC, ML, CL, MH, and CH classes.

Engineering Properties of the Soils

Most of the engineering information in this section is given in tables 4, 5, and 6. The tables are discussed in the following paragraphs.

Table 4 gives brief descriptions of all the soils in Childress County and estimates on those properties that are significant to engineering.

In this table the Unified and AASHO classifications for the Abilene, Carey, Miles, Springer, Tillman, and Woodward series were based on test data furnished by the Texas Highway Department from samples in Childress County. The classifications for the Roscoe and Vernon series were based on test data furnished by the Texas Highway Department from samples from Haskell County, Tex. Classifications for the rest of the soils were based on data from field tests.

Also estimated in table 4 are grain size, permeability, available water capacity, reaction, dispersion, shrink-swell potential, and gypsum content.

In table 4 the column headed "Permeability" indicates the rate given in inches per hour that water moves through a soil material that is not compacted. The column headed "Available water capacity" gives the estimated number of inches of water held in each inch of soil depth when the soil is wet to field capacity. Field capacity is the amount

[3] This section by WILLIAM C. TATE, area engineer, Soil Conservation Service, Vernon, Tex.

of water the soil will hold available for plant use. The estimates in the two columns, "Permeability" and "Available water capacity," are particularly significant in irrigation and drainage.

The column headed "Reaction" gives the estimated intensity of soil acidity or alkalinity, expressed in pH—the logarithm of the reciprocal of the H-ion concentration. In this system of notation, pH 7.0 is neutral; lower values indicate acidity; and higher values show alkalinity.

The ratings in the column headed "Dispersion" indicate the degree and rapidity with which the soil structure breaks down or slakes in water. This is a measure of the granular stability of a soil. Sandy soils generally have high dispersion, and clayey soils generally have low dispersion.

The ratings in the column headed "Shrink-swell potential" indicate the volume change of the soil material to be expected with changes in moisture content. They are estimated primarily on the basis of the amount and type of clay present. In general, soils classified as CH and A–7 have a "High" shrink-swell potential. Clean sands and gravels (single grain) and those having small amounts of nonplastic to slightly plastic soil materials, have a "Low" shrink-swell potential.

The gypsum content is an estimate of the amount of gypsum that naturally occurs in the soil. Soils high in gypsum are usually more flocculated and more open than soils low in gypsum. The percentage of salinity was not estimated for the soil materials in table 4.

Estimates of the suitability of the soils for various engineering uses are given in table 5.

The estimates on adaptability to winter grading, suitability of the soil for road subgrade and road fill, suitability of the soil as a source of topsoil and sand and gravel, and drainage of the soil material for highways are probably of most interest to highway engineers. The estimates in the other columns of table 5 are primarily for conservation engineers.

As indicated in the table, most of the soils in the county can be graded in the winter; however, some soils, such as the Vernon complex, can be graded only under a limited moisture content. Ratings of soils for winter grading are based on moisture content and the texture of the soils. Plastic soils, when wet, are difficult to handle, to dry, and to compact.

The rating of the soils for road subgrade in table 5 is based on the estimated classification of the soil material. All ratings are based on the A and B horizons, unless a depth is referred to. Soils that have a high plasticity or a highly plastic clay layer such as Roscoe clay and Tillman clay loam, impede internal drainage and have a poor stability when wet. Such soils are rated "Very poor to poor." The silts and fine sands, which are very erodible, are rated "Poor to fair." This rating is based on their poor grading and general lack of stability unless they are properly confined. Sandy alluvial land and other coarse sandy soils are rated "Fair to excellent," because they have a high bearing capacity and a low shrink-swell potential.

The suitability of the soil for road fill material depends largely on the natural water content and the texture of the soil. The plastic soils, such as Roscoe clay and Tillman clay loam, are difficult to handle, to compact, and to dry to the desired water content. These soils are therefore rated "Poor." The coarser textured soils have a low compressibility and expansion but are difficult to place because they do not have enough binding material. They are rated "Fair to good."

The drainage ratings of the soil material in highways depend upon the depth to the water table, the permeability or porosity of the substratum, and the possibility of floods. Clay layers in the soil profile, as in Roscoe clay and Tillman clay loam, impede the drainage of water and prolong the period for which these soils are wet and have low bearing capacity; therefore, these soils are rated "Poor.". The sandy soils, such as Tivoli fine sand, have a very pervious substratum and are rated "Excellent." The only soil in Childress County that might be affected by a high water table is Loamy alluvial land.

The suitability of soils for reservoirs depends upon the amount of seepage expected. The highly plastic soils, such as Vernon-Weymouth clay loams, have very little, or no seepage, and are rated "Excellent." The coarser textured soils, such a Tivoli fine sand, do not have any binding or sealing characteristics and are rated "Poor."

The suitability of soils for embankments and their stability in dikes and levees depend largely on the texture of the soil and its natural water content. The clay loams, loams, and very fine sandy loams can be compacted, are generally well graded, and are rated "Fair to good." The highly plastic clay soils, such as Rough broken land, are subject to over compaction and are rated "Fair." The Cottonwood soils are rated "Very poor" because of poor stability caused by excessive gypsum.

The suitability of soils for waterways depends upon the depth, texture, and location of the soils. The upland clay loams, such as Abilene clay loam, are deep soils on which vegetation can generally be established. These soils are rated "Good." The sandy soils, such as Tivoli fine sand, are very susceptible to erosion by wind and water; also, vegetation is difficult to establish on them. Hence, they are rated "Poor."

Also given in table 5 are estimates of soil features affecting irrigation and field terraces and diversion terraces. These data are based on the interpretation of properties given in table 4 and local experience.

Engineering test data for samples from six soils of the Abilene, Carey, Miles, Springer, Tillman, and Woodward series are given in table 6. This data was furnished by the Bureau of Public Roads and the Texas State Highway Department for samples taken from 17 profiles in Childress County.

Some of the terms used in this table are discussed in the following paragraphs.

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

The *shrinkage ratio* is the volume change resulting from the drying of a soil material, divided by the loss of moisture caused by drying. The ratio is expressed numerically.

The *field moisture equivalent* is the lowest moisture content at which a smooth surface soil will absorb no more water in 30 seconds, if the water is applied in individual drops. It is the moisture content needed to fill all the pores in soils and to approach saturation in cohesive soils.

TABLE 4.—*Brief descriptions of the soils and estimated*

Map symbol	Soil	Description	Depth from surface	Classification	
				Texture USDA [1]	Unified [2]
			Inches		
AbA	Abilene clay loam, 0 to 1 percent slopes.	Outwash from Quaternary period; occurs as level, ancient terraces and weakly concave areas.	0–5	Clay loam	CL [4]
AbB	Abilene clay loam, 1 to 3 percent slopes.		5–8	Clay loam	CL
			8–14	Heavy clay loam.	CL [4]
			14–21	Light clay	CL
			21–44	Light clay	CL [4]
			44–80+	Heavy clay loam.	CL, CH
AcA	Abilene-Cottonwood complex, 0 to 1 percent slopes.	For properties of the Abilene soils of this complex, see Abilene clay loam, 0 to 1 percent slopes. Properties described here are for the Cottonwood soils, which are Lithosols that have developed from gypsum beds and contain an excess of gypsum. The Cottonwood soils are mapped only in complex with the Abilene soils.	0–4	Clay loam	CL
AcB	Abilene-Cottonwood complex, 1 to 3 percent slopes.		4–8	Clay loam	CL
			8–20	Gypsum beds	(5)
CaB	Carey loam, 1 to 3 percent slopes.	Silt-sand and sand-clay mixture; derived from Permian Red Beds; gently rolling, convex topography; low to medium plasticity.	0–8	Loam	CL, ML [4]
CaC	Carey loam, 3 to 5 percent slopes.		8–12	Light sandy clay loam.	CL
			12–25	Sandy clay loam.	ML–CL, CL [4]
			25–38	Light sandy clay loam.	CL, ML
			38–58	Heavy very fine sandy loam.	CL, ML [4]
			58–82+	Soft sandstone	SM
EfA	Enterprise fine sandy loam, 0 to 1 percent slopes.	Sand and silty sand; wind deposited; poorly graded; rolling topography; low plasticity.	0–6	Very fine sandy loam.	SM, ML
EfB	Enterprise fine sandy loam, 1 to 3 percent slopes.		6–16	Very fine sandy loam.	SM, ML
EfC	Enterprise fine sandy loam, 3 to 5 percent slopes.		16–60	Very fine sandy loam.	SM, ML
EmA	Enterprise very fine sandy loam, 0 to 1 percent slopes.				
EmB	Enterprise very fine sandy loam, 1 to 3 percent slopes.				
EmC	Enterprise very fine sandy loam, 3 to 5 percent slopes.				
EmD	Enterprise very fine sandy loam, 5 to 8 percent slopes.				
Gr	Gravelly broken land.[6]	Outwash from deposits of sand and gravel; topography is rolling to steep.	Not mapped in detail		
Ha	Harmon soils.	Solid dolomitic limestone overlain by a few inches of silt-clay mixture containing limestone fragments; topography is gently sloping.	0–8	Stony loam	CL, ML–CL
			8+	(5)	(5)
LaB	La Casa clay loam, 1 to 3 percent slopes.	Silt-clay mixture derived from Permian clay deposits; topography is gently sloping; medium to high plasticity.	0–8	Clay loam	CL
			8–24	Heavy clay loam	CL, CH
			24–40	Heavy clay loam	CL, CH
			40–72+	Clay loam	CL, CH

See footnotes at end of table.

physical properties significant to engineering

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential	Gypsum content
AASHO [3]	No. 4	No. 10	No. 200						
				Inches per hour	*Inches per inch of depth*	*pH*			
A-4,[4] A-6	[4] 100	[4] 100	[4] 75-95	0. 2-0. 5	0. 14-0. 21	7. 0-7. 5	Low to moderate.	Moderate	Low.
A-4, A-6	100	100	75-80	0. 2-0. 5	0. 14-0. 21	7. 0-7. 5	Low to moderate	Moderate	Low.
A-7-6 [4]	[4] 100	[4] 100	[4] 85-95	0. 2-0. 5	0. 17-0. 21	7. 5-8. 0	Low to moderate.	Moderate to high.	Low.
A-6, A-7-6	100	95-100	80-85	0. 2-0. 5	0. 17-0. 21	7. 5-8. 0	Low to moderate.	Moderate to high.	Low.
A-7-6[4]	[4] 95-100	[4] 95-98	[4] 85-90	0. 2-0. 5	0. 17-0. 21	8. 0-8. 5	Low to moderate.	Moderate to high.	Low.
A-6, A-7-6	100	95-100	85-90	0. 2-0. 5	0. 17-0. 21	8. 0-8. 5	Low to moderate.	High	Moderate.
A-4, A-6	100	100	85-90	0. 2-0. 5	0. 14-0. 21	7. 5-8. 0	Low to moderate.	Moderate	High.
A-4, A-6	100	100	85-90	0. 2-0. 5	0. 14-0. 21	7. 5-8. 0	Low to moderate.	Moderate	High.
([5])	([5])	([5])	([5])	([5])	([5])	([5])	([5])	Low	High.
A-4 [4]	[4] 100	[4] 100	[4] 60-65	0. 5-2. 0	0. 12-0. 20	7. 5-8. 0	Moderate	Low	Low.
A-4, A-6	100	95-100	65-70	0. 5-2. 0	0. 12-0. 20	7. 5-8. 0	Moderate	Moderate	Low.
A-4, A-6 [4]	[4] 100	[4] 95-100	[4] 65-70	0. 5-2. 0	0. 12-0. 20	7. 5-8. 0	Moderate	Moderate	Low.
A-4, A-6	95-100	95-100	60-65	0. 5-2. 0	0. 12-0. 20	7. 5-8. 0	Moderate	Low to moderate.	Low.
A-4 [4]	[4] 95-100	[4] 95-100	[4] 65-70	0. 5-2. 0	0. 12-0. 20	8. 0-8. 5	Moderate	Low	Low.
A-2	100	100	25-30	0. 5-2. 0	0. 08-0. 12	8. 0-8. 5	Low	Low	Low.
A-4	100	100	45-50	0. 8-2. 5	0. 12-0. 20	7. 5-8. 5	Moderate to high.	Low	Low.
A-4	100	100	45-50	0. 8-2. 5	0. 12-0. 20	7. 5-8. 5	Moderate to high.	Low	Low.
A-4	100	100	45-50	0. 8-2. 5	0. 12-0. 20	7. 5-8. 5	Moderate to high.	Low	Low.
A-4, A-6	100	95-100	75-80	0. 5-0. 8	0. 14-0. 18	7. 5-8. 5	Low	Low	Low.
([5])	([5])	([5])	([5])	([5])	([5])	([5])	([5])	([5])	Low.
A-6, A-7-6	100	99-100	75-80	0. 2-0. 5	0. 13-0. 21	7. 5-8. 0	Low to moderate.	Moderate to high.	Low.
A-7-6	100	100	85-90	0. 2-0. 5	0. 13-0. 21	7. 5-8. 0	Low to moderate.	High	Low.
A-7-6	100	100	85-90	0. 2-0. 5	0. 13-0. 21	7. 5-8. 5	Low to moderate.	High	Low to moderate.
A-7-6	100	100	85-90	0. 2-0. 5	0. 13-0. 21	7. 5-8. 5	Moderate	High	Moderate to high.

TABLE 4.—*Brief descriptions of the soils and estimated*

Map symbol	Soil	Description	Depth from surface	Classification	
				Texture USDA [1]	Unified [2]
			Inches		
Lh	La Casa-Harmon complex.	For properties of the La Casa soils of this complex, see La Casa clay loam, 1 to 3 percent slopes. For those of the Harmon soils, see the Harmon soils.			
Lo	Loamy alluvial land.	Silt-clay alluvial deposits; occasional to frequent floods on nearly level flood plains; stratified.	(7)	Loam to clay loam.	CL
MfA	Miles fine sandy loam, 0 to 1 percent slopes.	Silty sand or sand-silt mixture; derived from outwash or alluvium of Pliocene or Pleistocene age; slopes generally single; plasticity low.	0–12	Loamy fine sand	SM [4]
MfB	Miles fine sandy loam, 1 to 3 percent slopes.		12–30	Sandy clay loam	SM–SC [4]
			30–46	Light sandy clay loam.	SM, SC [4]
MfC	Miles fine sandy loam, 3 to 5 percent slopes.		46–66+	Fine sandy loam	SM, ML
MfC2	Miles fine sandy loam, 3 to 5 percent slopes, eroded.				
MfD2	Miles fine sandy loam, 5 to 8 percent slopes, eroded.				
MmA	Miles loam, 0 to 1 percent slopes.				
MmB	Miles loam, 1 to 2 percent slopes.				
MsB	Miles loamy fine sand, 0 to 3 percent slopes.				
MsC	Miles loamy fine sand, 3 to 5 percent slopes.				
Nc	Norwood clay loam.	Inorganic silt on clay-silt mixture; derived from alluvium from soils that originated in Permian Red Beds; subject to floods; nearly level topography; stratified; low to medium plasticity.	0–5	Clay loam	ML, CL
No	Norwood silt loam.		5–16	Clay loam	ML, CL
			16–60+	Clay loam	CL
QuE	Quinlan-Woodward loams, 8 to 20 percent slopes.	For properties of the Quinlan soils of this complex, see the Vernon-Quinlan complex. For those of the Woodward soils, see Woodward loam, 1 to 3 percent slopes.			
Rc	Roscoe clay.	Weakly depressed clay soil derived from old alluvial clays; nearly level, concave slopes; high plasticity.	0–5	Light clay	CH, CL
			5–18	Clay	CH, CL
			18–45	Clay	CH, CL
			45–84+	Clay	CH, CL
Rf	Rough broken land.	Rough, gullied areas comprise 60 to 75 percent of this land type; slopes range from 8 to 40 percent; overlies a mixture of Permian Red Bed shale and sandstone and gypsum material.	(7)	Clay to sandy loam.	ML, CL, CH.
Sa	Sandy alluvial land.	Sand and sand-silt mixture deposited as alluvium; nearly level topography; frequent floods; influenced by the meandering of rivers in the channel; low plasticity.	(7)	Very fine sand to coarse sand.	SM, ML, SP
SfB	Springer loamy fine sand, undulating.	Silty sand or silt-sand mixture of alluvial origin from Pliocene or Pleistocene period; generally well drained; generally hummocky; undulating topography; very susceptible to wind erosion; low plasticity.	0–12	Loamy fine sand	SM, SM–SP [4]
SnD	Springer and Nobscot soils, hummocky.		12–30	Fine sandy loam	SM, SM–SC [4]
			30–42	Light fine sandy loam.	SM, SM–SP
Sn3	Springer and Nobscot soils, severely eroded.		42–48+	Loamy fine sand	SM, SM–SP [4]
SpA	St. Paul silt loam, 0 to 1 percent slopes.	Silt-clay mixture derived from Permian sandy Red Beds; level to gently sloping topography; low to medium plasticity.	0–8	Silt loam	SM, SC
			8–18	Silty clay loam	CL

See footnotes at end of table.

physical properties significant to engineering—Continued

Classification—Continued: AASHO [3]	Percentage passing sieve—: No. 4	Percentage passing sieve—: No. 10	Percentage passing sieve—: No. 200	Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential	Gypsum content
				Inches per hour	*Inches per inch of depth*	*pH*			
A-6, A-7-6	100	95–100	75–90	0. 2–0. 5	0. 13–0. 21	7. 5–8. 5	Low to moderate.	Moderate to high.	Low.
A-2-4 [4]	[4] 100	[4] 100	[4] 15–25	0. 8–2. 5	0. 12–0. 20	7. 0–7. 5	Moderate to high.	Low	Low.
A-2-4 [4]	[4] 100	[4] 95–100	[4] 35–40	0. 5–2. 0	0. 13–0. 20	7. 0–7. 5	Moderate	Low	Low.
A-2-4, A-6	95–100	[4] 95–100	[4] 35–40	0. 5–2. 0	0. 13–0. 21	7. 5–8. 0	Moderate	Low to moderate.	Low.
A-4	100	100	45–50	0. 5–2. 0	0. 12–0. 20	7. 5–8. 0	Moderate	Low	Low.
A-4, A-6	100	100	85–90	0. 2–0. 5	0. 13–0. 21	7. 5–8. 0	Low to moderate.	Moderate	Low.
A-4, A-6	100	100	85–90	0. 2–0. 5	0. 13–0. 21	7. 5–8. 0	Low to moderate.	Moderate	Low.
A-6, A-7	100	100	85–90	0. 2–0. 5	0. 13–0. 21	7. 5–8. 0	Low to moderate.	Moderate to high.	Low.
A-7-6	100	100	85–90	0. 2 –0. 5	0. 13–0. 21	7. 5–8. 5	Low	High	Low.
A-7-6	100	100	85–90	0. 2 –0. 5	0. 13–0. 21	7. 5–8. 5	Low	High	Low.
A-7-6	100	100	85–90	0. 2 –0. 5	0. 13–0. 21	7. 5–8. 5	Moderate	High	Low.
A-7-6	100	100	85–90	0. 2 –0. 5	0. 13–0. 21	7. 5–8. 5	Moderate	High	Low.
A-4, A-6, A-7	95–100	75–85	65–70	0. 05–2. 0	0. 08–0. 21	7. 5–8. 0	Low to high	Low to high	Low to high.
A-2, A-4	90–100	60–97	15–75	0. 8–5. 0	0. 08–0. 12	7. 0–8. 0	Moderate to high.	Low	Low to moderate.
A-2-4, A-3 [4]	[4] 100	[4] 100	[4] 5–25	0. 8–2. 5	0. 08–0. 14	6. 5–7. 5	Moderate to high.	Low	Low.
A-2-4 [4]	[4] 100	[4] 100	[4] 20–25	0. 8–2. 5	0. 11–0. 18	6. 5–7. 5	Moderate	Low	Low.
A-2-4	100	100	15–20	0. 8–2. 5	0. 11–0. 14	7. 0–8. 0	Moderate	Low	Low.
A-2-4 [4]	[4] 100	[4] 100	[4] 15–20	0. 8–2. 5	0. 08–0. 14	7. 0–8. 0	Moderate to high.	Low	Low.
A-2-4, A-4	100	82–85	35–40	0. 2–0. 8	0. 13–0. 18	7. 5–8. 0	Low	Low	Low.
A-6, A-7-6	100	95–100	75–80	0. 2–0. 5	0. 13–0. 21	7. 5–8. 0	Low	Moderate	Low.

TABLE 4.—*Brief descriptions of the soils and estimated*

Map symbol	Soil	Description	Depth from surface	Classification	
				Texture USDA [1]	Unified [2]
			Inches		
SpB	St. Paul silt loam, 1 to 2 percent slopes.		18–38	Clay loam	CL
			38–48	Sandy clay loam	CL
			48–80+	Heavy very fine sandy loam.	ML, CL
TcA	Tillman clay loam, 0 to 1 percent slopes.	Clay-silt mixture developed from Permian clayey materials; nearly level to gently sloping topography; medium to high plasticity.	0–7	Clay loam	CL [4]
TcB	Tillman clay loam, 1 to 3 percent slopes.		7–12	Heavy clay loam.	CL [4]
TcB2	Tillman clay loam, 1 to 3 percent slopes, eroded.		12–32	Light clay	CL
			32–44	Light clay	CL [4]
			44–60+	Clay	CL, CH
TpA	Tipton clay loam, 0 to 1 percent slopes.	Clay-silt and sandy clay mixture developed from alluvial materials; topography is level to slightly rolling; occur in bench areas; medium plasticity.	0–6	Clay loam	CL, CL–CH
TpB	Tipton clay loam, 1 to 3 percent slopes.		6–10	Clay loam	CL, CL–CH
			10–30	Clay loam	CL, CL–CH
			30–45	Heavy clay loam.	CL, CH
			45–76	Heavy clay loam.	CL, CH
Tv	Tivoli fine sand.	Inorganic eolian sand of Quaternary age; dunelike; complex slopes, generally 100 feet or less in length; subject to wind erosion.	0–8	Fine sand	SP–SM
			8–60	Fine sand or sand.	SP–SM
VcB	Vernon-Weymouth clay loams, 1 to 3 percent slopes.	Inorganic clay and sand-clay mixture derived from clay and shale of Permian Red Beds; occasional to frequent floods; high plasticity.	0–6	Clay loam	CL, CL–CH
VcC	Vernon-Weymouth clay loams, 3 to 5 percent slopes.		6–18	Heavy clay loam.	CL, CL–CH
			18–30	Heavy clay loam.	CL, CL–CH
			30–48+	Clay	CH
Ve	Vernon complex.	Inorganic clay and sand-clay mixture derived from clay and shale of Permian Red Beds; few to many gullies; high plasticity.	0–5	Clay loam	CH
			5–12	Light clay	CH
			12–36+	Clay	CH
Vx	Vernon-Quinlan complex.	For properties of the Vernon soils of this complex, see the Vernon complex. Properties described here are for the Quinlan soils, which developed from sandy red beds and are mapped only in complexes.	0–10	Loam	ML, CL
			10+	Soft sandstone	SM
WoB	Woodward loam, 1 to 3 percent slopes.	Silt-sand and sand-clay derived from Permian sandy Red Beds; topography gently to strongly sloping; low plasticity.	0–7	Loam	CL, ML [4]
WoC	Woodward loam, 3 to 5 percent slopes.		7–20	Sandy clay loam.	CL [4]
			20–36	Heavy loam	CL [4]
			36–48+	Permian sandstone.	SM
WwD	Woodward-Quinlan loams, 5 to 12 percent slopes.	For properties of the Woodward soils of this complex, see Woodward loam, 1 to 3 percent slopes. For those of the Quinlan soils see the Vernon-Quinlan complex.			

[1] According to definitions in "Soil Survey Manual" (*8*).
[2] Based on "The Unified Soil Classification System," Technical Memorandum No. 3-357, 2 v. and appendix, Waterways Experiment Station, Corps of Engineers, March 1953, rev. 1957 (*10*).
[3] Based on "Standard Specifications for Highway Materials andMethods of Sampling and Testing, (pt. 1, ed. 7): "The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes." AASHO Designation M 145-49 (*1*).

physical properties significant to engineering—Continued

Classification—Continued	Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential	Gypsum content
AASHO [3]	No. 4	No. 10	No. 200						
				Inches per hour	*Inches per inch of depth*	*pH*			
A–6, A–7–6	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.0	Low to moderate.	Moderate to high.	Low.
A–6, A–7–6	100	95–100	75–80	0.2–0.5	0.13–0.21	8.0–8.5	Low	Moderate to high.	Low.
A–4, A–6	100	90–100	70–75	0.2–0.6	0.13–0.18	8.0–8.5	Low to moderate.	Low to moderate.	Low.
A–6 [4]	95–100	95–100	90–95	0.2–0.5	0.13–0.21	7.5–8.0	Low	Moderate	Low.
A–7–6 [4]	95–100	95–100	90–95	0.2–0.5	0.13–0.21	7.5–8.0	Low	Moderate to high.	Low.
A–7–6	95–100	95–100	90–95	0.2–0.5	0.13–0.21	7.5–8.5	Low	Moderate to high.	Low.
A–7–6	95–100	95–100	95–100	0.05–0.2	0.13–0.21	8.0–8.5	Low	Moderate to high.	Low.
A–7–6	95–100	95–100	95–100	0.05–0.2	0.13–0.21	8.0–8.5	Low	Moderate to high.	Low.
A–6, A–7	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.0	Low to moderate.	Moderate to high.	Low.
A–6, A–7	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.0	Low to moderate.	Moderate to high.	Low.
A–6, A–7	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.0	Low to moderate.	Moderate to high.	Low.
A–6, A–7–6	100	95–100	85–90	0.05–0.2	0.13–0.21	8.0–8.5	Low to moderate.	High	Low.
A–6, A–7–6	100	95–100	85–90	0.05–0.2	0.13–0.21	8.0–8.5	Low to moderate.	High	Low.
A–3	100	95–100	5–10	2.5–5.0	0.06–0.08	7.5–8.0	High	Low	Low.
A–3	100	95–100	5–10	2.5–5.0	0.06–0.08	7.5–8.0	High	Low	Low.
A–6, A–7–6	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.5	Low to moderate.	Moderate to high.	Low.
A–6, A–7–6	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.5	Low to moderate.	Moderate to high.	Low.
A–6, A–7–6	100	95–100	85–90	0.2–0.5	0.13–0.21	7.5–8.5	Low to moderate.	Moderate to high.	Low.
A–7–6	100	95–100	85–90	0.05–0.2	0.18–0.21	7.5–8.5	Low to moderate.	High	Low.
A–7–6	100	95–100	85–90	0.05–0.2	0.18–0.21	7.5–8.5	Low to moderate.	High	Low.
A–7–6	100	95–100	85–90	0.05–0.2	0.18–0.21	7.5–8.5	Low to moderate.	High	Low.
A–7–6	100	95–100	85–90	0.05–0.2	0.18–0.21	7.5–8.5	Low to moderate.	High	Low.
A–4, A–6	100	95–100	75–80	0.5–1.0	0.14–0.18	7.5–8.0	Moderate	Low to moderate.	Low.
A–2	100	100	25–30	1.0–1.5	0.08–0.12	7.5–8.5	Low	Low	Low.
A–4 [4]	[4] 95–100	[4] 95–100	[4] 75–80	0.5–1.0	0.14–0.18	7.5–8.0	Low to moderate.	Moderate to low.	Low.
A–4, A–6	[4] 95–100	[4] 95–100	[4] 80–85	0.5–1.0	0.14–0.18	7.5–8.0	Low to moderate.	Moderate to low.	Low.
A–4, A–6 [4]	[4] 95–100	[4] 85–90	85–90	0.5–1.0	0.14–0.18	7.5–8.5	Low to moderate.	Moderate to low.	Low.
A–2	100	100	25–30	1.0–1.5	0.08–0.12	7.5–8.5	Low	Low	Low.

[4] Based on test data shown in table 6.
[5] Properties not estimated.
[6] Not classified because of lack of information.
[7] Not mapped in detail.

TABLE 5.—*Engineering*

Map symbol	Soil	Adaptability to winter grading	Suitability of soil for—		Suitability as source of—	
			Road subgrade	Road fill	Topsoil	Sand and gravel
AbA AbB	Abilene clay loam, 0 to 1 percent slopes. Abilene clay loam, 1 to 3 percent slopes.	Good	Very poor; high shrink-swell potential.	Poor; high shrink-swell potential; moderate to high dispersion.	Good	Not suitable
AcA AcB	Abilene-Cottonwood complex, 0 to 1 percent slopes.[1] Abilene-Cottonwood complex, 1 to 3 percent slopes.[1]	Good	Very poor; high gypsum content.	Very poor; will not compact properly.	Poor	Not suitable
CaB CaC	Carey loam, 1 to 3 percent slopes. Carey loam, 3 to 5 percent slopes.	Fair to good	Fair; has moderate to high shrink-swell potential below 6 inches.	Fair; high shrink-swell potential below 6 inches.	Poor	Not suitable
EfA EfB EfC	Enterprise fine sandy loam, 0 to 1 percent slopes. Enterprise fine sandy loam, 1 to 3 percent slopes. Enterprise fine sandy loam, 3 to 5 percent slopes.	Excellent	Good to fair	Fair; erodible	Excellent	Not suitable to poor; excess fines.
EmA EmB EmC EmD	Enterprise very fine sandy loam, 0 to 1 percent slopes. Enterprise very fine sandy loam, 1 to 3 percent slopes. Enterprise very fine sandy loam, 3 to 5 percent slopes. Enterprise very fine sandy loam, 5 to 8 percent slopes.	Excellent	Fair to good if properly compacted.	Fair; erodible	Excellent	Not suitable to poor; excess fines.
Gr	Gravelly broken land	Excellent	Poor	Poor	Poor	Excellent
Ha	Harmon soils	Fair to good	Poor to a depth of 8 inches (shallow to bedrock); excellent below 8 inches.	Poor, shallow soils; stable if kept at low moisture content.	Poor	Not suitable; possible source of limestone for crushing.
LaB	La Casa clay loam, 1 to 3 prcent slopes.	Fair	Very poor; high shrink-swell potential.	Fair; high shrink-swell potential; moderate dispersion.	Good	Not suitable
Lh	La Casa-Harmon complex.[2]	----------	----------	----------	----------	----------
Lo	Loamy alluvial land	Poor; plastic soils, high water table.	Poor	Poor	Fair	Not suitable

See footnotes at end of table.

interpretations of the soils

Drainage of soil material for highways	Stability of soils in dikes or levees	Suitability of soils for reservoirs	Suitability for embankments	Suitability for waterways	Soil features affecting—	
					Irrigation	Field terraces and diversion terraces
Poor to fair	Poor; use with nearly flat side slopes.	Fair to good	Fair to good; use nearly flat side slopes; use for impervious cores and blankets.	Good	Low permeability.	Deep soil; high water-holding capacity; will crack when dry; low permeability.
Very poor; excessive seepage and piping because of gypsum content.	Very poor	Poor; excessive gypsum.	Very poor; unsuitable because of excessive gypsum.	Very poor	Gypsum at slight depth.	Gypsum at slight depth.
Poor to fair; slow internal drainage below 6 inches.	Poor; fair if used with nearly flat side slopes.	Good to excellent.	Fair; use with nearly flat side slopes.	Fair to good	Low permeability below a depth of 6 inches.	Deep soil; high water-holding capacity; moderate permeability.
Fair to good	Fair to good	Poor	Fair; can be used in places for cores.	Poor; easily erodible.	Moderate permeability affects surface system design.	No problem.
Fair to good	Fair to good	Poor	Fair; can be used in places for cores.	Poor; easily erodible.	Moderate permeability affects surface system design.	Rolling topography; wind erosion.
Excellent internal drainage.	Very poor	Very poor	Poor; highly erosive.	Poor	Stony surface; mostly sand and gravel below surface.	Not suitable because of steep topography and sand and gravel.
Good	Good to a depth of 8 inches; solid rock below 8 inches.	Fair to good; bedrock affects excavation; seeps in places.	Fair to a depth of 8 inches; below 8 inches suitable for pervious blankets and shells of dams.	Poor; bedrock limits shaping; very stable below a depth of 8 inches.	Shallow stony loam for upper 8 inches; bedrock below 8 inches.	Bedrock at a depth of 8 inches.
Fair to poor	Poor to fair; use with nearly flat side slopes.	Fair to good	Fair; use for impervious cores and blankets.	Good	Low permeability	Deep soil; high water-holding capacity; low to moderate permeability.
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Poor internal drainage.	Poor	Poor	Poor	Poor; frequent floods.	Frequent floods.	Frequent floods.

TABLE 5.—*Engineering*

Map symbol	Soil	Adaptability to winter grading	Suitability of soil for—		Suitability as source of—	
			Road subgrade	Road fill	Topsoil	Sand and gravel
MfA	Miles fine sandy loam, 0 to 1 percent slopes.	Excellent	Fair to good	Good; stable when dry	Good	Not suitable
MfB	Miles fine sandy loam, 1 to 3 percent slopes.					
MfC	Miles fine sandy loam, 3 to 5 percent slopes.					
MfC2	Miles fine sandy loam, 3 to 5 percent slopes, eroded.					
MfD2	Miles fine sandy loam, 5 to 8 percent slopes, eroded.					
MmA	Miles loam, 0 to 1 percent slopes.					
MmB	Miles loam, 1 to 2 percent slopes.					
MsB	Miles loamy fine sand, 0 to 3 percent slopes.					
MsC	Miles loamy fine sand, 3 to 5 percent slopes.					
Nc	Norwood clay loam	Good	Poor	Poor; unstable when wet.	Fair	Not suitable
No	Norwood silt loam.					
QuE	Quinlan-Woodward loams, 8 to 20 percent slopes:					
	Quinlan loams	Excellent	Poor for the upper 5 inches; good for below approximately 5 inches.	Poor for the upper 5 inches; good below approximately 5 inches.	Poor	Not suitable; in some areas is a source of sandstone for crushing below approximately 5 inches.
	Woodward loams	Good	Poor for the upper 30 inches; good below 30 inches.	Poor to fair for the upper 30 inches; good below 30 inches.	Fair	Not suitable to poor above 30 inches; sandstone below.
Rc	Roscoe clay	Fair	Poor; high shrink-swell potential.	Poor; high shrink-swell potential; high dispersion.	Fair	Not suitable
Rf	Rough broken land	Fair when dry; poor when wet.	Poor; high shrink-swell potential.	Poor; low to high shrink-swell potential; low to high dispersion.	Poor	Not suitable
Sa	Sandy alluvial land	Excellent	Fair to excellent	Fair; easily eroded by water and wind.	Poor	Poor to fair; material poorly graded.
SfB	Springer loamy fine sand, undulating.	Excellent	Poor to fair	Poor to fair; easily erodible by water if not protected.	Fair to good	Poor
SnD	Springer and Nobscot soils, hummocky.					
Sn3	Springer and Nobscot soils, severely eroded.					

See footnotes at end of table.

interpretations of the soils—Continued

Drainage of soil material for highways	Stability of soils in dikes or levees	Suitability of soils for reservoirs	Suitability for embankments	Suitability for waterways	Soil features affecting—	
					Irrigation	Field terraces and diversion terraces
Fair to good unless a high water table exists; easily erodible by water.	Poor to fair; fair when used with proper controls.	Poor; excessive seepage.	Poor to fair; good if used with proper controls.	Good; accumulations from wind erosion occur in places; easily erodible by water.	High permeability affects surface system design; complex slopes.	In some areas wind erosion is a problem if soil is not protected by adequate vegetation; gully erosion is a problem in places.
Poor to fair	Poor	Fair; has excessive seepage in places.	Poor; can be used in places with proper control.	Poor; frequent floods.	Frequent floods	Frequent floods.
Poor to fair	Fair; use with nearly flat side slopes.	Poor; excessive seepage.	Fair; use with nearly flat side slopes.	Poor; limited depth affects growth of vegetation and depth of excavation.	Shallow topsoil; low water-holding capacity.	Sandstone at a depth of 5 inches; subject to wind erosion.
Poor to fair	Fair; use with nearly flat side slopes.	Poor; excessive seepage.	Fair; use with nearly flat side slopes.	Fair; soil depth affects depth of excavation in places.	Soil depth affects leveling in places.	Wind erosion is a problem in places.
Poor; slow internal drainage; seasonally flooded; impervious substratum.	Poor; use with nearly flat side slopes.	Good; no seepage expected.	Poor; use for impervious cores and blankets.	Good	Low permeability; frequent floods; high water-holding capacity.	Frequent floods; will crack when dry.
Poor; internal drainage slow.	Fair; use with nearly flat side slopes.	Good to excellent.	Fair to good with nearly flat side slopes; use for impervious cores and blankets.	Not suitable	Low permeability; topography not suited to cultivation.	Not suitable.
Poor; subject to flooding.	Fair if protected from wind erosion and used with nearly flat side slopes.	Poor; excessive seepage.	Poor to good; if used in pervious sections, provides protection against erosion; use with nearly flat side slopes.	Poor; subject to accumulation from wind erosion; low available water-holding capacity; frequent floods; easily erodible.	High permeability; frequent floods; low available water-holding capacity.	Wind erosion; frequent damaging floods.
Good internal drainage.	Fair if used with nearly flat side slopes.	Poor; excessive seepage.	Fair if used with nearly flat side slopes.	Poor; accumulations from wind erosion; easily eroded by water.	High permeability; wind erosion problem on leveled area; rolling topography.	Wind erosion if not adequately protected.

TABLE 5.—*Engineering*

Map symbol	Soil	Adaptability to winter grading	Suitability of soil for—		Suitability as source of—	
			Road subgrade	Road fill	Topsoil	Sand and gravel
SpA SpB	St. Paul silt loam, 0 to 1 percent slopes. St. Paul silt loam, 1 to 2 percent slopes.	Good to excellent.	Poor to fair	Poor to fair	Good	Poor; might be source of sandstone below 70 inches.
TcA TcB TcB2	Tillman clay loam, 0 to 1 percent slopes. Tillman clay loam, 1 to 3 percent slopes. Tillman clay loam, 1 to 3 percent slopes, eroded.	Good	Very poor to poor; high shrink-swell potential.	Poor; stable if kept at low moisture content; high shrink-swell potential.	Fair	Not suitable
TpA TpB	Tipton clay loam, 0 to 1 percent slopes. Tipton clay loam, 1 to 3 percent slopes.	Good	Very poor; high shrink-swell potential below 10 inches.	Poor; fairly stable if kept at low moisture content.	Fair	Not suitable
Tv	Tivoli fine sand	Excellent	Poor to fair	Poor to fair; erodible	Fair	Poor
VcB VcC	Vernon-Weymouth clay loams, 1 to 3 percent slopes. Vernon-Weymouth clay loams, 3 to 5 percent slopes.	Good	Poor; high shrink-swell potential.	Poor; high shrink-swell potential; high dispersion.	Poor	Not suitable
Ve	Vernon complex	Fair when dry; poor when wet.	Very poor; high shrink-swell potential.	Very poor; high shrink-swell potential.	Poor	Not suitable
Vx	Vernon-Quinlan complex.[3]					
WoB WoC	Woodward loam, 1 to 3 percent slopes. Woodward loam, 3 to 5 percent slopes.	Good	Fair above 2 to 3 feet; good below.	Fair above 2 to 3 feet; good below.	Fair	In places is a source of sandstone for crushing below 26 inches.
WwD	Woodward-Quinlan loams, 5 to 12 percent slopes.[4]					

[1] The engineering interpretations are for the Cottonwood soils only. For the engineering interpretations of the Abilene soils in this complex, see Abilene clay loam, 0 to 1 percent slopes.

[2] For the engineering interpretations of the La Casa soils, see La Casa loam, 1 to 3 percent slopes; for those of the Harmon soils, see Harmon soils.

interpretations of the soils—Continued

Drainage of soil material for highways	Stability of soils in dikes or levees	Suitability of soils for reservoirs	Suitability for embankments	Suitability for waterways	Soil features affecting—	
					Irrigation	Field terraces and diversion terraces
Fair; slow internal drainage from 8 inches to 54 inches; good internal drainage below 54 inches.	Fair	Poor; excessive seepage below 70 inches.	Fair; may be used with proper controls.	Good if used with proper controls.	Low permeability	Deep soil; moderate water-holding capacity; moderate permeability.
Very poor; very slow internal drainage.	Fair to good if used with nearly flat side slopes.	Excellent	Fair if used with nearly flat side slopes; use for impervious cores and blankets; high shrink-swell potential.	Fair	Low permeability	Plastic and sticky when wet; high shrink-swell potential.
Poor; slow internal drainage.	Fair if used with nearly flat side slopes.	Excellent	Fair if used with nearly flat side slopes; use for impervious cores and blankets; high shrink-swell potential.	Fair	Low permeability	Plastic and sticky when wet; high shrink-swell potential.
Excellent internal drainage.	Fair if used with nearly flat side slopes and protected from wind erosion.	Poor to fair; excessive seepage.	Fair if used with nearly flat side. slopes; protect from wind erosion.	Poor; accumulations from wind erosion; easily erodible by water.	High permeability affects surface system design; low available water-holding capacity.	Wind erosion; complex slopes.
Poor; very slow internal drainage.	Fair if used with nearly flat side slopes; use in thin cores and blankets.	Excellent	Poor to fair if used with nearly flat side slopes; use in thin cores or blankets; high shrink-swell potential; high dispersion.	Poor; high shrink-swell potential; high dispersion; difficult to establish vegetation; easily eroded by water if not protected.	Low permeability; high dispersion.	High dispersion; high shrink-swell potential.
Poor; very slow internal drainage.	Fair if used with nearly flat side slopes; use in thin cores and blankets.	Excellent	Poor to fair, if used with nearly flat side slopes; use in thin cores or blankets; high shrink-swell potential.	Poor; rough, gullied topography; easily eroded by water; high dispersion; difficult to establish vegetation.	Low permeability; rough, gullied topography; generally not suited to cultivation.	High dispersion; high shrink-swell potential; gully erosion; low permeability.
Poor to good	Fair to good; fair if used with nearly flat side slopes.	Poor; excessive seepage.	Fair is used with nearly flat side slopes.	Fair; soil depth affects depth of excavation in places.	Soil depth affects leveling in places.	Wind erosion is a problem in places.

[3] For the engineering interpretations of the Vernon soils, see Vernon complex; for those of the Quinlan soils, see Quinlan loams.

[4] For the engineering interpretations of the Woodward soils, see Woodward loam, 1 to 3 percent slopes; for those of the Quinlan soils, see Quinlan loams under Quinlan-Woodward loams, 8 to 20 percent slopes.

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TABLE 6.—*Engineering*

Soil name and location	Parent material	Texas report number	Depth	Horizon
Abilene clay loam:			*Inches*	
0.5 mile west of Community Center School. (Modal profile.)	Clayey outwash material	59-194-R	0-6	A_p
		59-195-R	12-20	B_2
		59-196-R	36-47	C_{ca}
6 miles northeast of Childress. (Heavy B_2 horizon.)	Clayey outwash material	59-197-R	0-5	A_p
		59-198-R	11-40	B_2
3.9 miles east and 1.75 miles south of Childress courthouse. (Thick B_{ca} and C_{ca} horizons.)	Outwash material	59-203-R	0-5	A_p
		59-204-R	11-21	B_2
		59-205-R	66-78	C_{ca}
Carey loam:				
0.6 mile east and 1.1 miles south of Carey School. (Modal profile.)	Sandy Permian deposits	59-219-R	0-6	A_p
		59-220-R	12-25	B_2
		59-221-R	38-58	C_{ca}
1.7 miles south and 0.2 mile west of Childress. (Clayey B_2 horizon.)	Sandy Permian deposits	59-209-R	0-6	A_p
		59-210-R	12-30+	B_{21}
0.55 mile east of Carey School. (Light B_2 horizon.)	Sandy Permian deposits	59-216-R	0-6	A_p
		59-217-R	11-22	B_2
		59-218-R	35-52	C_{ca}
Miles loamy fine sand:				
1.25 miles north of Community Center School. (Modal profile.)	Quaternary deposits	59-189-R	0-10	A_p
		59-190-R	10-38	B_2
1.0 mile north of Community Center School. (Shallow, buried horizon.)	Quaternary deposits	59-187-R	0-12	A_p
		59-188-R	32-60+	D_1
3.3 miles north of Community Center School. (Thin B_2 horizon.)	Quaternary deposits	59-191-R	0-8	A_p
		59-192-R	8-16	B_2
		59-193-R	46-66	C
Springer loamy fine sand:				
0.15 mile east and 4.0 miles north of Community Center School. (Modal profile.)	Quaternary deposits	59-181-R	0-8	A_p
		59-182-R	8-15	B_2
		59-183-R	36-60+	C
3.45 miles north of Community Center School. (Clayey B_2 horizon.)	Quaternary deposits	59-184-R	0-8	A_p
		59-185-R	8-17	B_2
		59-186-R	32-62+	C
2.2 miles west and 6.0 miles north of Community Center School. (Sandy B_2 horizon.)	Quaternary deposits	59-178-R	0-8	A_p
		59-179-R	8-20	B_2
		59-180-R	20-60+	C
Tillman clay loam:				
1.8 miles south and 3.9 miles east of Childress courthouse. (Modal profile.)	Permian red-bed material	59-206-R	0-5	A_p
		59-207-R	5-18	B_2
		59-208-R	32-47	C_{ca}
1.4 miles south and 2.0 miles east of Kirkland. (Less limy C_{ca} horizon.)	Permian red-bed material	59-199-R	0-5	A_p
		59-200-R	11-30	B_{ca}
2.3 miles south and 1.2 miles east of Kirkland. (No C_{ca} horizon.)	Permian red-bed material	59-201-R	0-5	A_p
		59-202-R	5-20	B_2
Woodward loam:				
1.5 miles south of Carey. (Modal profile.)	Sandy Permian material	59-213-R	0-5	A_p
		59-214-R	5-13	AC
		59-215-R	13-26	C_{ca}
3.8 miles south of Childress. (Heavy AC horizon.)	Sandy Permian material	59-211-R	0-5	A_p
		59-212-R	5-18	AC

[1] Tests performed by Texas Highway Department in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

[2] Mechanical analyses according to the American Association of State Highway Officials Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette

test data [1]

Shrinkage		Field moisture equivalent	Mechanical analyses [2]							Liquid limit	Plasticity index	Classification	
			Percentage of fraction passing sieve—				Percentage smaller than—						
Limit	Ratio		No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.			AASHO [3]	Unified [4]
13	1. 93	21	--------	100	97	76	63	23	18	25	9	A–4(8)	CL.
14	1. 91	30	--------	100	97	82	75	41	36	44	20	A–7–6(13)	CL.
14	1. 89	28	100	95	91	83	76	42	35	45	27	A–7–6(16)	CL.
15	1. 84	25	--------	--------	100	96	88	36	27	31	12	A–6(9)	CL.
13	1. 95	28	--------	--------	100	98	93	55	46	44	25	A–7–6(15)	CL.
15	1. 85	27	--------	--------	100	94	83	34	28	35	16	A–6(10)	CL.
14	1. 91	32	--------	--------	100	95	85	48	40	49	28	A–7–6(17)	CL.
13	1. 94	29	98	98	97	92	87	48	40	47	27	A–7–6(16)	CL.
17	1. 74	20	--------	--------	100	60	43	13	11	21	3	A–4(5)	ML.
15	1. 84	23	--------	--------	100	72	63	28	26	31	15	A–6(9)	CL.
18	1. 77	19	--------	--------	100	62	47	18	17	23	4	A–4(5)	ML–CL.
16	1. 78	19	--------	--------	100	64	47	13	11	21	3	A–4(6)	ML.
16	1. 83	24	--------	--------	100	73	63	28	25	32	16	A–6(10)	CL.
16	1. 77	18	--------	100	99	64	47	14	12	21	4	A–4(6)	ML–CL.
16	1. 79	20	100	99	99	64	52	19	16	24	6	A–4(6)	ML–CL.
17	1. 78	20	97	96	96	64	48	19	16	24	5	A–4(6)	ML–CL.
14	1. 82	14	--------	100	81	15	10	4	4	17	2	A–2–4(0)	SM.
15	1. 83	18	--------	100	87	33	30	14	14	21	7	A–2–4(0)	SM–SC.
14	1. 82	15	--------	100	83	24	22	9	8	16	2	A–2–4(0)	SM.
15	1. 85	20	--------	100	89	39	36	21	19	28	15	A–6(2)	SC.
14	1. 82	15	--------	100	88	12	11	4	4	18	2	A–2–4(0)	SM.
17	1. 77	17	100	99	92	30	26	16	15	23	6	A–2–4(0)	SM–SC.
14	1. 88	14	99	99	89	34	28	11	10	17	3	A–2–4(0)	SM.
15	1. 81	13	--------	100	74	16	14	5	5	17	3	A–2–4(0)	SM.
15	1. 83	16	--------	100	84	25	23	10	10	18	3	A–2–4(0)	SM.
16	1. 76	16	--------	100	87	17	14	6	6	18	3	A–2–4(0)	SM.
15	1. 79	15	--------	100	73	8	7	3	3	19	3	A–3(0)	SM–SP.
18	1. 75	17	--------	100	88	21	20	15	14	23	7	A–2–4(0)	SM–SC.
15	1. 72	17	--------	100	82	11	10	6	6	18	2	A–2–4(0)	SM–SP.
15	1. 82	15	--------	100	82	24	18	6	5	16	2	A–2–4(0)	SM.
16	1. 79	15	--------	100	80	24	18	8	7	18	3	A–2–4(0)	SM.
16	1. 79	13	--------	100	94	27	19	8	8	17	2	A–2–4(0)	SM.
16	1. 82	26	--------	--------	100	92	75	34	23	33	16	A–6(10)	CL.
15	1. 87	31	--------	--------	100	94	88	46	40	45	23	A–7–6(14)	CL.
14	1. 90	26	97	93	91	85	81	45	38	41	23	A–7–6(13)	CL.
14	1. 91	26	99	99	97	91	81	40	25	32	14	A–6(10)	CL.
14	1. 94	28	99	97	96	91	86	50	43	44	23	A–7–6(14)	CL.
17	1. 81	29	--------	--------	100	97	91	38	30	35	16	A–6(10)	CL.
11	2. 09	33	--------	--------	100	97	95	53	47	47	26	A–7–6(16)	CL.
16	1. 80	21	99	99	98	82	64	17	14	23	5	A–4(8)	ML–CL.
17	1. 80	23	98	97	97	86	72	26	20	28	10	A–4(8)	CL.
17	1. 81	22	88	86	85	78	64	25	19	28	8	A–4(8)	CL.
17	1. 78	22	--------	100	99	74	57	16	14	22	3	A–4(8)	ML.
15	1. 85	25	--------	--------	100	84	70	29	25	33	16	A–6(10)	CL.

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

[3] Based on "Standard Specifications for Highway Materials and Methods of Sampling and Testing (pt. 1, ed. 7): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes." AASHO Designation M 145–49 (*1*).

[4] Based on "The Unified Soil Classification System." Technical Memorandum No. 3–357, 2 v. & appendix, Waterways Experiment Station, Corps of Engineers, March 1953, rev. 1957 (*10*).

The plastic limit is the moisture content at which the soil material passes from a solid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Formation and Classification of Soils

In this section the major factors that have influenced soil formation are discussed. In addition, the soils are classified by higher categories, and these categories are briefly described.

Factors of Soil Formation

Soil is the product of the forces of environment acting on soil materials deposited or accumulated by geologic processes. The characteristics of the soil at any point on the earth are determined by the interaction of five major factors—parent materials, climate, living organisms, relief, and time. All five of these factors influence the genesis of every soil, but the importance of each varies from one place to another. In one area one factor dominates the formation of a soil, and in another area a different factor is the most important in soil formation.

The interrelationships among these five factors are complex, and the effects of any one factor cannot be isolated and identified with certainty. It is convenient, however, to discuss each separately and to indicate the probable effects of each. The five factors are discussed as they are related to the soils in Childress County.

Parent Materials.—Childress County occurs within the geological formation called the Permian Red Beds. This formation is the result of sediments from old sea deposits and is about 4,000 to 5,000 feet thick. The Permian formation is subdivided into three groups. These are the Wichita, Clear Fork, and Double Mountain groups. The Double Mountain group is the upper part of the Permian formation and was the last to be deposited. It is about 2,000 feet thick. It occurs roughly between Wilbarger and Hall Counties and extends south about 200 miles. All of Childress County occurs within the Double Mountain group.

The deposits of the Double Mountain group are mainly red and gray shaly clay and soft sandstone that are interbedded with bands of gypsum and limestone. These materials were deposited about 100,000,000 years ago. The subdivisions of the Double Mountain group that occur in this county are the Blaine gypsum, Whitehorse sandstone, Cloud Chief gypsum, and Quartermaster formations (*5*).

After the Permian Sea had dried up, the deposits were subject to severe erosion. The Red Beds were exposed until about 750,000 years ago, or about the close of the Pliocene and the beginning of the Pleistocene periods. At this time the mountains of New Mexico and the Trans-Pecos Mountain region were uplifted (*6*). The present mountains of the Trans-Pecos area were formed by this movement. Next, the mountains of New Mexico and the Trans-Pecos area were severely eroded. As Texas tilts gently in a southeasterly direction towards the gulf, a thin sheet of sand, gravel, and clay was spread over most of the State. This period of deposition was known as the Lafayette epoch.

At the end of the Lafayette epoch, most of Texas was a level plain. Most of the rivers in the State were formed after this epoch. This epoch was followed by a period of erosion that has continued to the present. As a result of water erosion, all of the breaks, escarpments, streams, canyons, and so on, have gradually formed. A large area of Childress County has a thin mantle of outwash material from the Pliocene and Pleistocene periods.

The soils of Childress County were developed from four types of parent materials. They are classified as (1) soils developed in place from Permian shaly clay, soft sandstone, gypsum, and limestone; (2) soils developed from silty and sandy outwash materials that were deposited during the Pliocene and Pleistocene periods; (3) soils developed from eloian deposits along streams; and (4) soils developed from alluvial materials along flood plains of streams.

Most of the soils in the county have developed from Permian materials These soils occur in the higher areas. Some of the soils developed from these materials are very steep; others are very shallow. Some erode very easily, whereas others do not.

The soils developed from the outwash materials generally occur on the lower benches or valley slopes. Some soils were developed from silty materials. The sandy outwash materials were reworked by wind and water after they were deposited.

The soils developed from eolian materials occur along large streams. These materials were blown from the riverbeds. Generally, the coarser materials were deposited nearer the riverbeds, and the less sandy materials were deposited farther back. These eolian soils lack distinct horizonation.

The alluvial soils are very immature and lack distinct horizonation. They occur along the flood plains of streams where fresh materials are continually deposited. Their texture depends on the rate of water movement and the texture of the soils in the watershed. Some areas are sandy; others are silty or clayey. A characteristic that is common to all alluvial soils is that stratified layers of different textures occur throughout the profile.

The texture of the parent material affects the textures of the developed soil profile.

Climate.—Climate has had a uniform and definite effect on the development of the soils in Childress County. Precipitation, temperature, and wind are some of the influencing factors of climate.

The wet climate of past geological ages influenced the transportation and deposition of the parent materials. Later, as the soils began to develop, the climate became subhumid. The limited rainfall was not enough to leach the minerals from the soils. As a result, except for the sandy soils, most of the soils are high in fertility. The soils seldom get wet to a depth of more than 6 feet. Consequently, many soils have a horizon of calcium carbonate a few feet below the surface. Most of the young soils have lime throughout the horizons.

Temperatures have had some influence on the development of the soils. Summer temperatures are high, and winters are mild. The high temperatures and the low rainfall have limited the accumulation of organic matter in the soils.

Wind has had some effect on soil development in Childress County. After deposition by water, many of the sandier parent materials were later reworked. The result is a rolling topography. The eolian soils in the county were deposited by wind. Many of the sandier soils in cultivated areas are constantly being winnowed. The coarser sand grains are shifted, and the finer particles are sorted out and deposited elsewhere.

Living organisms.—Vegetation, micro-organisms, earthworms, and other forms of living organisms have contributed to the development of the soils.

Because of the climate, the soils in this county have developed under the influence of a grass cover. Parent materials have influenced the types of grasses. Short and mid grasses were dominant on the moderately fine textured soils, and mid and tall grasses were dominant on the medium, moderately coarse, and coarse textured soils.

The grass contributed large amounts of raw materials to the soils. Because of the climate, however, only moderate amounts of organic matter accumulated. As the plant roots decay, organic materials are distributed throughout the solum. These decaying roots leave small pores through which water and air can penetrate the solum more freely. The constant action of the grass roots also helps to mix the soil.

Organic materials influence the number of soil bacteria and other organisms in the soil. These micro-organisms, in turn, have some influence on soil development.

In some areas earthworms have influenced the development of the soil. Some soils in this county have a high concentration of worm casts and worm channels. The presence of a high concentration of worm casts generally indicates that the soils are fertile. The pores left by earthworms increase the intake of water and air and help the movement of plant roots into a soil.

In the past few years man has had some influence on the soils. Many ranges have been overgrazed, and the types of vegetation have been changed. Much of the land is now in cultivation. Cultivation has considerably reduced the organic-matter content of the soils. Compaction has decreased the rate of water and air movement into the soil. Erosion in many areas has reduced the thickness of the solum.

Relief.—Relief influences soil development in Childress County through its effect on drainage and runoff. The position on a landscape on which a soil develops influences the characteristics of that soil. Soils that have developed in low, concave areas in this county are dark, deep, and generally heavier textured than soils that have developed in more sloping areas. This is because the soils in low, concave areas receive extra water, have less runoff, and are subject to less erosion. In addition, these soils produce more residues and support more biological activity.

In large part, the soils in Childress County have developed on gently sloping to steep areas. These soils are lighter colored than those in level or concave areas. As the slope becomes steeper, the soils become less deeply developed. The soils on the steeper slopes are shallower, mainly because geologic erosion occurs as fast as the soils are developed.

Time.—The length of time that the soil-forming factors have acted upon a soil determines to a large degree the characteristics of that soil. Some parent materials that have been acted upon by soil-forming processes for only a short time show little profile development. Examples of such soils in Childress County are the bottom-land soils and the eolian sand dunes. Time is important in the development of these soils.

Soils that have been in place for long periods and that occur on nearly level to gentle slopes normally show the greatest profile development. In Childress County examples of these soils are the Abilene, Miles, and St. Paul. These soils have reached an equilibrium with their environment. Time is also important in the development of these soils.

Many shallow soils on steep slopes have been in the process of development as long as the well-developed, nearly level soils. Geologic erosion, however, has removed the effects of soil formation on the shallow soils, and such soils have not reached equilibrium with their environment. Here, relief is the dominant soil-forming factor rather than time. The Vernon, Weymouth, Harmon, and Quinlan are examples of these soils.

Classification of Soils by Higher Categories

Classification consists of an orderly grouping of defined kinds of soils into classes for comparisons and studies. The defined kinds of soils are placed or grouped into narrow classes for use in detailed soil surveys and in the application of knowledge within farms and fields. The narrow classes are then grouped into broader classes so that information can be applied to larger geographic areas.

Classes of soils defined on a comparable basis and of the same rank in a classification system comprise what is called a category. A comprehensive system of soil classification that will be useful in dealing with soils of a small field, as well as with the soils of a continent, must consist of a number of categories. The higher categories consist of fewer and broader classes than the lower categories.

The system of soil classification now being used in the United States consists of six categories, one above the other. Each successively higher category consists of a smaller total number of classes, and each of those classes has a broader range of characteristics than the classes of the category below. There are thousands of classes in the lowest category, but only three classes are in the highest category.

Beginning at the top, the six categories in the system of soil classification are the order, suborder, great soil group, family, series, and type. Only four of these categories are widely used. These are order, great soil group, series, and type. The suborder and family in this system have never been fully developed. The two lowest categories, series and types, are used primarily for the study of soils of small geographic areas, such as a county. The higher categories, orders, and great soil groups are used mostly for the study of soils of larger geographic areas, such as a continent.

All the soils in the United States are grouped into one of three classes in the highest category—that of soil orders. These soils are placed into about forty great soil groups, the next lower category. In the next lower category, there are about 6,000 series recognized in the United States. Many more will be recognized as the study of soils continues. There are probably at least twice as many soil types—the lowest category of soil classification—as soil series. From comparison of the number of orders, great soil groups, series, and types, it is obvious that the ranges permitted in the soil characteristics of a class in a higher category are very broad, whereas, ranges in the soil characteristics of classes in a lower category are very narrow.

The soil series and soil type are defined in the Glossary. The order and great soil groups are described in the following paragraphs.

The highest category, the order, consists of three classes, known as the zonal, intrazonal, and azonal orders. The zonal order comprises soils with evident, genetically related horizons that reflect the dominant influences of climate and living organisms in their formation. They have well-defined, or well-developed, horizons. The deep, well-developed soils in Childress County are in the zonal order. The intrazonal order includes soils that are not so well developed as the zonal soils. They have weakly developed soil horizons. They reflect the dominant influence of one or more local factors, such as topography or parent materials, over the effects of climate and living organisms. The azonal order comprises soils that lack distinct genetically related horizons because of one or more of the following—youth of parent materials, steep topography, and resistance of parent materials to change.

In the text of this report, these orders are often referred to as zonal soils, intrazonal soils, and azonal soils. All three of the orders occur in this county, and it is not unusual for all three orders to occur on one farm or in one field.

When soils are classified into one of the three orders, something is indicated about the factors of major importance in the formation of that soil and also something about the degree of horizonation.

The great soil group, the next lower category below the order, is used widely in this county in soil classification. Classes of soils in this category indicate a number of relationships in soil genesis and also indicate something of the fertility status, suitability for crops or trees, and the like.

Each great soil group consists of a large number of soil series with many internal features in common. Thus, all members of a single great soil group in either the zonal or intrazonal order have the same number and kind of definitive horizons in their profiles. These definitive horizons need not be expressed to the same degree, nor do they need to be of the same thickness in all soils within one great soil group. Specific horizons must be recognizable, however, in every soil profile of a soil series representing a given great soil group.

The classification of soil series in Childress County into great soil groups and orders follows. Each series recognized in the county has been classified on the basis of current understanding of the soils and their formation.

ZONAL ORDER:
- Reddish Chestnut soils:
  - Carey
  - La Casa
  - Miles
  - St. Paul
  - Tillman
- Chestnut soils:
  - Abilene
  - Tipton
- Reddish-Brown soils:
  - Nobscot
  - Springer

INTRAZONAL ORDER:
- Grumusols:
  - Roscoe

AZONAL ORDER:
- Regosols:
  - Enterprise
  - Quinlan
  - Tivoli
  - Weymouth
  - Woodward
- Lithosols:
  - Cottonwood
  - Harmon
  - Vernon
- Alluvial soils:
  - Norwood

The relationship of the outstanding morphological characteristics of the soils of Childress County to the factors of soil formation is briefly discussed in this section.

In Childress County the zonal order comprises three great soil groups: The Reddish Chestnut, Chestnut, and Reddish-Brown.

The Reddish Chestnut group is the most extensive in Childress County. These soils have a distinct A, B, and C horizon sequence. The surface layer is typically reddish brown to dark reddish brown and is friable. The subsoil is reddish brown to red and is heavier in texture than the surface layer. It becomes lighter colored and highly calcareous in the lower part. Although the soils in this group have a relatively high inherent fertility, the low rainfall and high rate of evaporation limit crop growth (*7*). The series in this group in Childress County are the Carey, La Casa, Miles, St. Paul, and Tillman.

The Chestnut soils have a dark-brown surface layer that grades to lighter colored horizons. These soils generally have a layer of accumulated calcium carbonate at a depth of 1 to 4 feet. (*9*). Their inherent fertility is very high, but crop growth is limited because of low rainfall. The series in this group in Childress County are the Abilene and Tipton.

The Reddish-Brown soils have a surface layer that is typically light reddish brown to reddish brown. In Childress County these soils have a low natural fertility and are generally not suitable for cultivation. The series in this group in the county are the Nobscott and Springer.

The intrazonal soils in Childress County are of the Grumusol great soil group.

Grumusols are dark and clayey; they swell when wet and shrink when dry; in this county they developed in weakly depressed lake areas. The only series in this group in the county is the Roscoe.

The azonal soils in the county are classified into three great soil groups: The Regosols, Lithosols, and Alluvial soils. These soils generally show only weak horizonation and have A, AC, and C horizons.

The Regosols are soils that lack development because of youthfulness, or because of geologic erosion on steep slopes. They have developed mostly in deposits of eolian sand, soft sandstone, or shale. The series in this group are the Enterprise, Tivoli, Quinlan, Weymouth, and Woodward.

The Lithosol great soil group consists of very shallow soils that show very little development. The texture of these soils varies, depending on the underlying materials. In this county the underlying materials are mostly limestone, gypsum, and shale. These soils are confined mostly to steep land. In Childress County the series in this group are the Cottonwood, Harmon, and Vernon.

Alluvial soils are those that are developing from transported and relatively recently deposited material (alluvium). There is little or no modification of the original materials by soil-forming processes. Alluvial soils are dark in color and high in natural fertility. They are also very productive. They occur mostly along the streams of the county. The only series in this group in Childress County is the Norwood.

Physical Geography of the County

In this section some of the important features of the climate of the county are discussed. Also given are brief discussions of the relief and drainage and the water supply.

Climate

The climate of Childress County is subhumid. The summers are warm and dry, and the summer days are generally clear. In July and August the temperature is often above 100° F. for several consecutive days.

The winters are mild and dry. Short periods when the temperature is below freezing are interspersed with mild, clear days. The soil is rarely frozen more than a few days at a time.

In the spring and summer, rainfall generally occurs as thunderstorms. It is common for a 3- to 5-inch rain to fall in only a few hours. The erosion, packing, and crusting that result from these intense rains cause considerable damage to fields. Distribution of rainfall is erratic and varies considerably throughout the county. Rain falls more slowly during fall and winter and is more widely distributed throughout the county. Long periods of drought are common during summer and winter.

The temperature and precipitation for the county, as recorded by the U.S. Weather Bureau station at Childress, Tex., is shown in table 7.

The average annual precipitation at Childress is 22.3 inches. The highest annual precipitation recorded was 50 inches in 1941. The lowest recorded was 11.3 inches in 1954. Rainfall is below average 6 out of 10 years. Half of the years receive 20.1 inches, or less. The few years that have high rainfall raise the average. If past data are used to predict the future, 10 to 20 inches of rainfall can be expected in about 50 percent of the years; 20 to 30 inches in about 40 percent of the years; 30 to 40 inches in about 9 percent of the years; and more than 40 inches in about 2 percent of the years (*4*).

The highest average rainfall is in spring and summer. May averages the most rainfall, 3.2 inches. January averages the lowest amount, 0.6 inch. A decrease in rainfall in July and August often reduces cotton yields.

TABLE 7.—*Temperature and precipitation at Childress Civil Aeronautics Administration Airport, Childress County, Tex.*

[Elevation, 1,951 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1954)	Wettest year (1941)	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	42. 8	84	5	1. 02	0. 73	1. 35	2. 1
January	39. 7	85	−13	. 62	. 09	. 78	1. 9
February	43. 3	95	−10	. 97	(3)	3. 36	2. 0
March	52. 3	100	2	1. 19	. 13	1. 35	1. 3
April	61. 7	98	22	2. 43	2. 41	6. 15	. 4
May	69. 7	107	27	3. 23	5. 89	8. 85	(3)
June	79. 0	111	46	2. 84	. 13	12. 05	(3)
July	83. 4	114	53	2. 04	. 10	. 47	(3)
August	82. 6	115	53	2. 28	1. 18	6. 07	0
September	75. 1	109	38	2. 68	. 14	2. 22	(3)
October	64. 0	101	30	2. 12	. 46	7. 25	(3)
November	50. 3	93	6	89	. 05	. 12	. 5
Year	62. 0	115	−13	22. 31	11. 31	50. 02	8. 2

[1] Average temperature based on a 40-year record, through 1955; highest temperature based on a 34-year record and lowest temperature based on a 32-year record, through 1952.

[2] Average precipitation based on a 56-year record, through 1955; wettest and driest years based on a 53-year record, in the period 1891–1955; snowfall based on a 48-year record, through 1952.

[3] Trace.

The county has an average frost-free period, or growing season, of 215 days. The average first killing frost in fall is November 4, and the last in spring is April 3. The earliest killing frost recorded in fall was on October 18, and the latest in spring was on May 1. Normally the early frost in fall does the most damage to growing crops. Late cotton is often damaged by early freezes. Late freezes in spring make fruit production hazardous. Fruit, however, is grown only for home use.

There is considerable wind in winter and spring. Severe winds and duststorms are common during these seasons. These storms generally occur as the wind shifts from the southwest to the northwest. Good cover must be maintained on the more sandy soils in these periods, or the soils are damaged in places. Hot, dry southwesterly winds are common in summer. High evaporation and low humidity cause drought and reduce crop yields. Because of drought, crop failures are common.

Hailstorms are common in spring and summer. Hail damages growing crops in some areas of the county almost every year. These areas are generally small. Tornadoes occur but are rare.

Snowfall is common in winter. It seldom stays on the ground more than 4 or 5 days. Ice storms occassionally occur in winter.

Variations in weather are the greatest risks in the agricultural economy of Childress County. Lack of rainfall at the proper time often causes crop failures or reduces crop yields. Because crops must be drought resistant, the number that is suited to the area is limited.

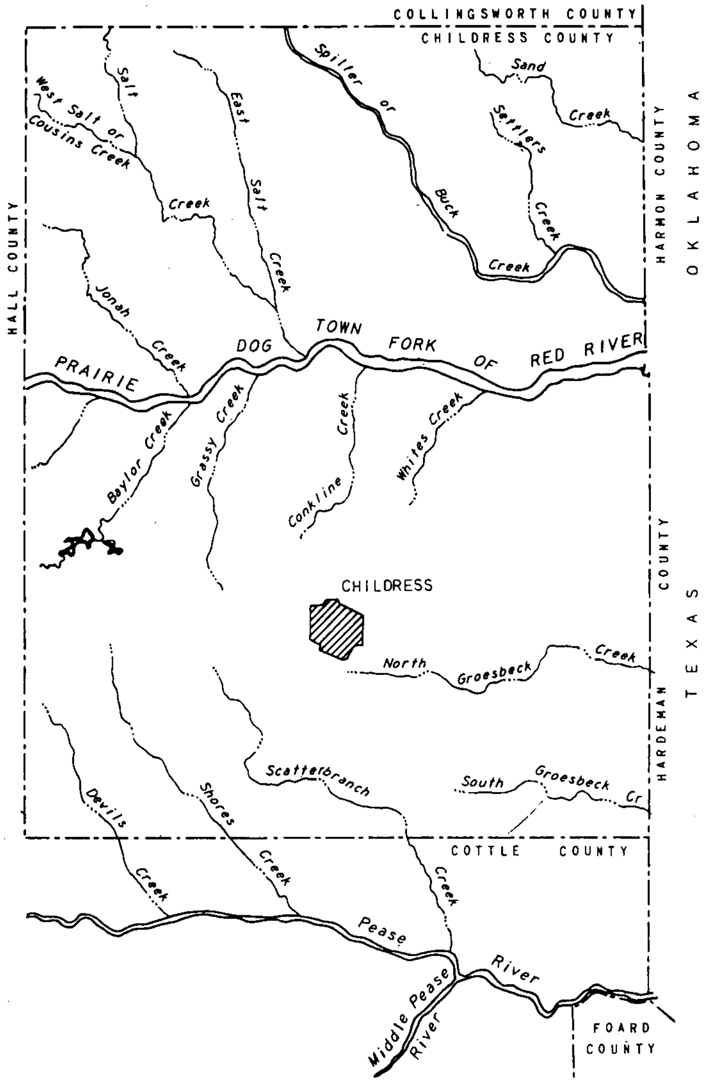

Figure 29.—**Drainage patterns in the county showing rivers and creeks.**

Relief and Drainage

Childress County occurs in the west-central part of the Rolling Plains Resource Area. The landscape is dominated by outcrops of sea deposits of Permian age. These deposits were later eroded and reworked by water and wind. The relief is now mainly rolling and hilly but ranges from nearly level to steep.

The general slope of the county is from northwest to southeast. Elevations range from 1,800 to 2,000 feet. The town of Childress, in the southern part of the county has an elevation of 1,951 feet.

There are three distinct drainage patterns in Childress County (fig. 29). Buck Creek and its tributaries drain the northeastern part. It flows in a southeastward direction. The Red River and its tributaries drain the northwestern and central parts of the county. This river flows in a west-to-east direction. The southern part of the county is drained by the tributaries of the Pease River, which flow southeastward across the northern part of Cottle County.

Except for a few concave areas where drainage is slow, the surface drainage of the soils is well developed.

Only small areas of bottom land are outside the river channels. During heavy rains, the wide channels of the large streams can carry most of the floodwaters. Some small overflow areas are scattered along the rivers. Except during floods, however, the streams have very little water. Most of the smaller tributaries do not carry water the entire year. There are a few springs in some of the creeks, mainly the salt creeks in the northwestern part of the county.

Except in extremely dry years, the Red River and Buck Creek have water most of the year. During the driest period, however, they cease flowing in places. The normal streams are generally only a few feet wide and a few inches deep. As a result of contamination from salt springs, most water is very salty.

Water Supply

The county is fairly well supplied with water. Most of it is of poor quality, as it is high in gypsum and other salts.

Most water for farm homes comes from wells. The depth of the wells varies from 100 to 300 feet. Some farmers and ranchers, mainly those in the northwestern and southern parts of the county, have to haul water or use cisterns. Some water for household use is hauled from surrounding towns. Most water for livestock comes from wells and ponds. In some areas the soils are too sandy or contain too much gypsum for construction of watertight ponds. In these areas wells are needed to furnish the entire supply of water for livestock. In a few areas perennial streams provide water for livestock.

Childress County obtains its water supply from two sources: (1) deep wells in the sandhills near Red River; and (2) Childress and Baylor Lakes located 10 miles west of Childress.

General Nature of the County

Some of the general characteristics of the county are discussed in this section. These include history, agricultural statistics, transportation and markets, industries, and schools and public facilities.

History

In 1887 the Texas Legislature created Childress County and named it after Gen. George C. Childress. He was a member of the committee that wrote the "Declaration of Independence" for the Republic of Texas.

In 1888 the Fort Worth and Denver Railroad Company completed the railroad from Fort Worth to Texline. After the railroad was built, farmers began to settle in the county. Settlement was slow, however, until after 1900, because of crop failures and the depressions in the 1890's. Most of the land in the county was first plowed between 1900 and 1930. The sandy land near the river was the first to be farmed, because it was highly productive and easily tilled.

In 1904 the Fort Worth and Denver Railroad shops were built in Childress. Since that time Childress has become an important shipping center.

Ranching was the first agricultural enterprise in the county; it began in the late 1870's. In the early years of settlement, corn and wheat were the main crops. However, by 1910 cotton had become the leading crop in the county. Grain sorghum gradually replaced corn as the main feed crop. Since 1910, the main source of income has been from cotton, wheat, and livestock. Ranching remains an important enterprise in the county. It is limited mostly to land unsuitable for cultivation.

Agricultural Statistics

Some statistics significant to the agriculture of the county are discussed in this section. Most of the information for 1954 and before is from the U.S. Census of Agriculture.

Size of farms

Until about 1935, there was an increase in the number of farms and a decrease in the size of farms in the county. Since that time, however, the number of farms has gradually declined and the size has gradually increased.

According to the agricultural census, the average farm in 1920 was about 321 acres, in 1930, about 292 acres, in 1950, about 507 acres, and in 1959, about 785 acres. Apparently, as agriculture becomes more mechanized, the average size of farms will continue to increase.

The farms of Childress County in 1954 and 1959 are listed by size as follows:

Size of farm:	*Number in 1954*	*Number in 1959*
Less than 10 acres	42	9
10 to 49 acres	29	23
50 to 99 acres	41	32
100 to 179 acres	130	74
180 to 259 acres	89	60
260 to 499 acres	195	155
500 to 999 acres	116	104
1,000 acres and over	64	69

Farm tenure

Up to about 1935, the number of tenant operators on farms gradually increased and by far outnumbered the owner-operators. Since that time, the number of tenants has gradually decreased. Farm managers have also decreased since 1935. In 1954, on the 706 farms reported, there were 446 owners, 258 tenants, and 2 managers in the county. In 1959, there were 348 owners, 173 tenants, and 5 managers.

Of the 258 tenants reported by the census in 1954, 205 were share tenants. These tenants usually furnish all the seed, implements, and labor and take care of the farm and buildings. They receive two-thirds to three-fourths of the crop, and the owner receives one-fourth to one-third.

Farm equipment and labor

During the 1930's and early 1940's, there was a big shift from horse-drawn implements to tractors and mechanical equipment. According to the agricultural census, there were 94 tractors in the county in 1930. In 1954 there were 908 tractors in the county, and in 1959 there were 1,036. The tractors are mostly medium to large. Larger tractors are used as farms increase in size. Many farms have more than one tractor. The number of mechanical harvesters has rapidly increased the past few years. These include combines and cotton strippers. Because of the increase in mechanical cotton harvesters, the demand for laborers to handpick cotton is gradually declining.

There is still a big demand for outside help during the growing season. In 1954 there were 753 hired workers on farms, and 53 of these worked more than 150 days. In 1959, there were 114 hired workers, who worked more than 150 days.

Crops

The acreages of the principal crops grown in the county are shown in table 8. Because of the wide variation of soils in the county and the small number of suitable crops, farming is not much diversified. The largest acreages are in cotton, wheat, and sorghum.

TABLE 8.—*Acreages of principal crops in given years*

Crops	1954	1959
	Acres	*Acres*
Cotton harvested	53, 052	44, 223
Small grain threshed or combined:		
Wheat	29, 760	4, 506
Barley	4, 133	506
Oats	397	234
Sorghum harvested for grain or for seed	12, 636	16, 153
Hay and forage sorghum	4, 955	6, 568
Corn for all purposes	125	75

Cotton.—This crop leads all other cultivated crops in acreage. Land to be planted to cotton is generally bedded the preceding winter and early spring. Beginning about the first of May, cotton is then planted in the beds. The crop is generally hoed once or twice and cultivated three to five times to kill weeds or undesirable vegetation. Picking begins about September and is generally completed by the end of the year. Harvesting is done by hand and by mechanical harvesters. Some cotton is grown on all soils, but it is best suited to the medium- and coarse-textured soils.

Wheat.—Land to be planted to wheat is generally fallowed in the summer. If there is enough rainfall, wheat is planted around the middle of September to the middle of October. If it grows well during the fall, it is generally pastured. Wheat matures about the first of June and is harvested with a combine. It is grown on all soils in the county but is best suited to the medium-textured and moderately fine textured soils.

Sorghum.—Land for sorghum is prepared as for cotton. Sorghum is generally planted about June. It is often used as a catch crop when others fail. Some is harvested for grain, and some is harvested in bundles for feed. It is generally harvested about October.

Minor crops.—Corn is a minor crop that is grown in small areas in the county. Other minor crops are rye, barley, and oats. These small grains are planted like wheat. A few areas of alfalfa are used for hay crops or for grazing. Vetch, winter peas, guar, and other legumes are planted in small acreages for soil improvement. There are also a few orchards of peaches for home consumption.

Livestock and livestock products

Table 9 shows the number of livestock and poultry on farms and ranches of Childress County in stated years. Cattle are by far the most important livestock in the county.

TABLE 9.—*Number of livestock on farms in stated years*

Livestock	1954	1959
	Number	*Number*
Horses and mules	359	380
Cattle and calves	14, 710	15, 623
Sheep and lambs	1, 485	278
Swine	864	1, 039
Chickens	[1] 33, 901	[1] 16, 517
Turkeys	2, 877	419

[1] Over 4 months old.

Cattle.—Beef cattle are dominant. Most of them are locally raised animals of high quality. Most ranchers use purebred bulls and have grade cows. A few have purebred herds. Many ranchers cull their herds annually and sell the old and inferior animals. Therefore, there is a gradual improvement in the quality of the herds.

Most of the larger ranches are in the northwestern, central, and southern parts of the county. Most farms, however, produce at least a few cattle. Because of the risks of crop production, farmers have learned that income from livestock helps to carry them over during years of crop failure. Many acres of shallow and steep soils had been seeded to grass at the time of the survey.

Most of the beef cattle are kept on rangeland the entire year. During winter, cottonseed cake and bundle feed are used to supplement the range forage. During summer, such crops as sudangrass are often used for temporary grazing. This allows the native grass to rest during part of the growing season and thus make some growth and produce some seed.

Some cattle are sold at the local auctions or at the auctions in nearby towns. The stockmen on larger ranches generally ship their cattle to markets at Fort Worth or Amarillo. Some sell their calves to feeders, who buy them for drylot feeding.

As there are only a few dairies in the county, dairying is of minor commercial importance. Most of the milk cows are raised by farmers and ranchers for home use. Surplus milk and cream are sold at local markets. The main dairy breeds are Holstein, Jersey, and Guernsey.

In 1954 the number of cows milked was 1,160, and during the same year, 135,459 gallons of milk were produced. In the 1930's and early 1940's the number of dairy cows reached a peak. Since then the number has gradually decreased.

Hogs.—Hog production has never been very high in Childress County. Few farmers have more than one or two sows because of the lack of good feed. Most of the hogs are marketed locally.

Horses and mules.—The number of horses and mules has rapidly declined since the use of the tractor became prevalent. At present horses are used only for ranching.

Sheep.—Sheep are of minor importance in the county. Sheep are raised in limited numbers, mainly because they damage grassland and are preyed on by coyotes.

Poultry.—Most farmers and ranchers keep some chickens. Only a few are commercial producers, however. Most of the chickens on farms are in small flocks kept mainly for home use. The local demand for poultry products is good.

Transportation and Markets

There are two railroads in the county. The main line of the Fort Worth and Denver Railway runs through Childress, Kirkland, and Carey. A branch line of this railroad goes from Childress north to Wellington and on to Pampa.

Roads and highways are well developed. United States Highway No. 287 goes east and west across the southern part of the county. It parallels the Fort Worth and Denver Railway and connects Amarillo and Wichita Falls, Tex. United States Highway Nos. 62 and 83 goes north and south through the center of the county. United States Highway No. 62 and State Highway No. 256 go east and west across the northern part of the county. Several hard-surface farm roads throughout the county connect the most thickly populated rural areas to main highways. More of these are under construction. Most of the county roads are well improved. Few ever become impassable, except for short periods during wet spells. Most of these roads follow section lines. The roads that go across large ranches are an exception.

Most farm products are marketed locally. These include such crops as cotton, small grain, and grain sorghum. Milk and poultry products are sold locally. Beef cattle are a principal source of income and are usually shipped to outside markets. There are five cotton gins in the county, four grain elevators, one meat-packing plant, and one auction-sale barn.

Industries

Agriculture is the main occupation in the county. Many rural families, however, depend on work off the farm for part of their livelihood. According to the 1954 census, there were 154 farmers that worked 100 days, or more, off their farms. The cotton gins, grain elevators, and other storage or processing plants hire many part-time employees during the seasonal rush period. The Fort Worth and Denver Railroad shops in Childress provide full-time employment for several hundred people.

Schools and Public Facilities

Almost all parts of the county are served by school buses. There are grade schools and a high school at Childress, grade schools at Tell, and a rural school at Community Center.

Churches of several denominations are located at Childress, Kirkland, Carey, and Tell. Childress has a hospital, as well as a public library and a large city park.

Telephones connect all the towns. According to the 1954 Census of Agriculture, of the 706 farms in the county, 239 had telephones and 605 had electricity. Piped running water was reported in 358 farm households. Almost all rural homes have butane or propane gas for heating.

Literature Cited

(1) AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS.
1955. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 7, 2 v., illus.

(2) BARTON, JACK H., AND MILLS, J. F.
1956. HOW DOES YOUR SOIL RATE. Tex. Agr. Ext. Serv. Bul. 836, 16 pp., illus.

(3) COOPER, E. H.
1958. IMPROVE YOUR FARM FISH POND. Tex. Agr. Expt. Sta., Bul. 213, 19 pp., illus.

(4) HILDRETH, R. J., AND THOMAS, GERALD W.
1956. FARMING AND RANCHING RISK AS INFLUENCED BY RAINFALL. 1. HIGH AND ROLLING PLAINS OF TEXAS. Tex. Agr. Expt. Sta. MP–154, 35 pp., illus.

(5) SELLARDS, E. H., ADKINS, W. S., AND PLUMMER, F. B.
1954. THE GEOLOGY OF TEXAS. Univ. Tex. Bul. 3232, v. 1, 1007 pp., illus.

(6) UDDEN, J. A., BAKER, C. L., AND BÖSE, EMIL.
1916. REVIEW OF THE GEOLOGY OF TEXAS. Univ. Tex. Bul. No. 44, 164 pp., illus.

(7) UNITED STATES DEPARTMENT OF AGRICULTURE.
1938. SOILS AND MEN. U.S. Dept. Agr. Ybk., 1232 pp., illus.

(8) ————
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handb. 18, 503 pp., illus.

(9) ————
1957. SOIL. U.S. Dept. Agr. Ybk., 784 pp., illus.

(10) WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. No. 3–357, 2 v. & appendix. Rev. 1957.

Glossary

Blowout. An area of soil from which most, or all, of the fine soil material has been removed by wind. Such an area appears as a shallow depression with a flat or irregular floor consisting of a resistant layer or accumulation of pebbles, or the water table may be at the surface. The soil is usually bare. Blowouts are common near dunes.

Calcareous soil. Soil that contains enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid. Soil that is alkaline in reaction because of the presence of free calcium carbonate. The pH is usually more than 7.8.

Caliche. A broad term for secondary calcareous material in layers near the surface. As the term is used, caliche may be soft and clearly recognized, as the C_{ca} horizon of the soil, or it may exist in hard, thick beds beneath the solum or exposed at the surface.

Clay. (1) As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. (2) As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Consistence, soil. The attributes of soil material that are expressed by the degree and kind of cohesion and adhesion or by the resistance to deformation or rupture. Terms commonly used to describe consistence are *loose*, *soft*, or *hard* when dry; *loose*, *friable*, or *firm* when moist; and *sticky* or *plastic* when wet. *Friable* soil, for example, is easily crumbled by the fingers.

Eolian deposits. Wind-deposited materials moved fairly short distances and accumulated in dunes; generally, coarse textured.

Erosion. The wearing away of the land surface by detachment and transport of soil materials through the action of wind and water.

Flood plain. The nearly level land along streams that overflow during floods.

Hardpan. A hardened or cemented soil layer.

Horizon, soil. A layer of soil, approximately parallel to the soil surface, with characteristics produced by soil-forming processes. The relative positions of the several soil horizons in the soil profile and their nomenclature are given below.

Horizon A. The master horizon consisting of (1) one or more mineral horizons of maximum organic accumulation; or (2) surface or subsurface horizons that are lighter in color than the underlying horizon and which have lost clay minerals, iron, and aluminum with resultant concentration of the more resistant minerals; or (3) horizons belonging to both of these categories.

Horizon B. The master horizon of altered material characterized by (1) an accumulation of clay, iron, or aluminum, with accessory organic material; or (2) blocky or prismatic structure together with other characteristics, (such as stronger colors, unlike those of the A horizons or the underlying horizons of nearly unchanged material); or (3) characteristics of both these categories. Commonly, the lower limit of the B horizon corresponds to the lower limit of the solum.

Horizon C. A layer of unconsolidated material, relatively little affected by the influence of organisms and in chemical, physical, and mineralogical composition presumed to be similar to the material from which at least part of the overlying solum has developed.

Horizon D. Any stratum underlying the C, or the B if no C is present, which is unlike the C, or unlike the material from which the solum has been formed.

Immature soil. A soil lacking clear individual horizons because of youthfulness.

Leveling, land. The reshaping of the land surface to a planned grade to provide a more suitable surface for the efficient application of irrigation water and to provide good surface drainage.

Mature soil. A soil with well-developed soil horizons.

Parent material. The unconsolidated mass of rock material (or peat) from which a soil profile develops.

Permeability. The readiness with which air, water, or plant roots penetrate into or pass through soil pores. The portion of the soil being discussed should be designated; for example, "the permeability of the A horizon."

pH. A term used to indicate the acidity and alkalinity of soils. A pH of 7.0 indicates precise neutrality; large numbers (up to 14.0), alkalinity; and smaller ones (down to 0.0), acidity.

Phase, soil. That subdivision of a soil type having variations in characteristics not significant to the classification of the soil in its natural landscape but significant to the use and management of the soil. The variations are chiefly in such external characteristics as relief, stoniness, or erosion. Thus Abilene clay loam, 0 to 1 percent slopes, is a soil phase.

Plowpan. A compacted layer formed in the soil immediately below plow depth.

Poorly graded soil. Coarse-grained soil with soil particles of fairly uniform size.

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

Relief. Elevations or inequalities of the land surface, considered collectively.

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

Semiarid climate. A climate characteristic of the regions between true deserts and subhumid areas. The vegetation is close-growing or scattered short grass, bunchgrass, or shrubs. Annual precipitation varies from as low as 15 inches in cool semiarid regions to as much as 45 inches in warm regions.

Series, soil. A group of soils having genetic horizons that, except for the texture of the surface soil, are similar as to differentiating characteristics and arrangement in the soil profile, and that developed from a particular type of parent material. A series may include two or more soil types that differ from one another in the texture of the surface soil.

Silt. (1) Individual mineral particles of soil that range in diameter from the upper size of clay, 0.002 millimeter, to the lower size of very fine sand, 0.05 millimeter. (2) Soil of the textural class silt contains 80 percent or more of silt and less than 12 percent of 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 soils includes the A and B horizons.

Structure. The arrangement of individual soil particles into aggregates with definite shape or pattern. Structure is described in terms of *grade*, *class*, and *type*.

Grade. Distinctness and durability of the aggregates. Grade is expressed as *weak*, *moderate*, or *strong*. Soil that has no visible structure is termed massive if coherent, or single grain if noncoherent.

Class. Refers to the size of the soil aggregates.

Type. Shape and arrangement of the aggregates. *Granular*, *subangular blocky*, and *blocky* types of structure predominate in soils of Childress County.

Subhumid climate. A climate between semiarid and humid. The vegetation is short and tall grasses or shrubs. The upper limit of rainfall may be as much as 60 inches in hot regions and as low as 20 inches in cool regions.

Subsoil. That part of the profile below plow depth. Technically, the B horizons of soils with distinct profiles.

Substratum. Any layer beneath the solum or true soil.

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

Terrace. An embankment or ridge constructed on or near the contour of sloping soils to intercept surplus runoff and to control erosion.

Texture, soil. The relative proportions of sand, silt, and clay particles in the soil (see Sand; Clay; Silt).

Coarse-textured soil. Contains a large proportion of sand, is loose and noncoherent when dry, and is generally relatively low in fertility and moisture-holding capacity; highly erodible.

Moderately coarse textured soil. High sand content but has enough silt and clay to form fragile clods; individual sand grains easily seen, and soil mass feels gritty; highly erodible.

Medium-textured soil. About equal proportions of sand, silt, and clay; generally friable but forms stable clods.

Moderately fine textured soil. Contains large amount of clay; generally absorbs water slowly and is more difficult to cultivate than coarse-textured soil.

Fine-textured soil. Contains large proportion of clay; normally hard when dry and plastic when wet.

Tilth, soil. The physical condition of a soil in respect to the fitness for the growth of plants.

Topography. The shape of the ground surface, such as hills, mountains, or plains.

Type, soil. A subdivision of the soil series based on the texture of the surface layer.

Undifferentiated soils. Two or more soils not regularly associated geographically that are mapped as a single group. An example of such a group in this county is Springer and Nobscot soils, hummocky.

Water table. The upper limit of the part of the soil or underlying rock that is wholly saturated with water.

Winnowing. Removal of fine soil particles by wind action.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 1, p. 6, for approximate acreage and proportionate extent of the soils, and table 3, p. 38, for estimated average yields under two levels of management]

			Capability unit		Range site	
Map symbol	*Mapping unit*	*Page*	*Symbol*	*Page*	*Name*	*Page*
AbA	Abilene clay loam, 0 to 1 percent slopes	8	IIce-3	32	Hardland	45
AbB	Abilene clay loam, 1 to 3 percent slopes	8	IIIe-2	33	Hardland	45
AcA	Abilene-Cottonwood complex, 0 to 1 percent slopes.	8	IIIsc-1	35	Hardland and Gypland.	45, 47
AcB	Abilene-Cottonwood complex, 1 to 3 percent slopes.	9	IVes-1	36	Hardland and Gypland.	45, 47
CaB	Carey loam, 1 to 3 percent slopes	10	IIe-1	31	Mixed Land	46
CaC	Carey loam, 3 to 5 percent slopes	10	IIIe-4	34	Mixed Land	46
EfA	Enterprise fine sandy loam, 0 to 1 percent slopes	11	IIIe-6	34	Sandy Loam	46
EfB	Enterprise fine sandy loam, 1 to 3 percent slopes	12	IIIe-6	34	Sandy Loam	46
EfC	Enterprise fine sandy loam, 3 to 5 percent slopes	12	IVe-2	35	Sandy Loam	46
EmA	Enterprise very fine sandy loam, 0 to 1 percent slopes.	12	IIce-2	32	Mixed Land	46
EmB	Enterprise very fine sandy loam, 1 to 3 percent slopes.	12	IIIe-4	34	Mixed Land	46
EmC	Enterprise very fine sandy loam, 3 to 5 percent slopes.	12	IIIe-4	34	Mixed Land	46
EmD	Enterprise very fine sandy loam, 5 to 8 percent slopes.	12	IVe-5	36	Mixed Land	46
Gr	Gravelly broken land	12	VIe-2	37	Gravelly	46
Ha	Harmon soils	14	VIIs-3	38	Very Shallow	47
LaB	La Casa clay loam, 1 to 3 percent slopes	15	IIIe-3	33	Hardland	45
Lh	La Casa-Harmon complex	15	VIes-1	37	Hardland and Very Shallow.	45, 47
Lo	Loamy alluvial land	15	Vw-2	36	Bottom Land (Loamy).	43
MfA	Miles fine sandy loam, 0 to 1 percent slopes	15	IIIe-5	34	Sandy Loam	46
MfB	Miles fine sandy loam, 1 to 3 percent slopes	16	IIIe-5	34	Sandy Loam	46
MfC	Miles fine sandy loam, 3 to 5 percent slopes	16	IVe-2	35	Sandy Loam	46
MfC2	Miles fine sandy loam, 3 to 5 percent slopes, eroded.	16	IVe-2	35	Sandy Loam	46
MfD2	Miles fine sandy loam, 5 to 8 percent slopes, eroded.	16	VIe-3	37	Sandy Loam	46
MmA	Miles loam, 0 to 1 percent slopes	16	IIce-2	32	Hardland	45
MmB	Miles loam, 1 to 2 percent slopes	17	IIIe-3	33	Hardland	45
MsB	Miles loamy fine sand, 0 to 3 percent slopes	17	IVe-3	35	Sandy Land	43
MsC	Miles loamy fine sand, 3 to 5 percent slopes	17	VIe-5	37	Sandy Land	43
Nc	Norwood clay loam	18	IIce-1	32	Bottom Land (Loamy).	43
No	Norwood silt loam	18	IIce-2	32	Bottom Land (Loamy).	43
QuE	Quinlan-Woodward loams, 8 to 20 percent slopes	19	VIe-4	37	Mixed Land and Bottom Land (Loamy).	46, 43
Rc	Roscoe clay	19	IIIw-1	34	Hardland	45
Rf	Rough broken land	19	VIIs-1	37	Gypland and Rough Broken (Loamy).	47, 48
Sa	Sandy alluvial land	20	Vw-1	36	Bottom Land (Sandy).	43
SfB	Springer loamy fine sand, undulating	20	IVe-3	35	Sandy Land	43
SnD	Springer and Nobscot soils, hummocky	21	VIIe-1	37	Sandy Land and Deep Sand.	43, 45
Sn3	Springer and Nobscot soils, severely eroded	21	VIIe-1	37	Sandy Land and Deep Sand.	43, 45
SpA	St. Paul silt loam, 0 to 1 percent slopes	23	IIce-2	32	Hardland	45
SpB	St. Paul silt loam, 1 to 2 percent slopes	23	IIe-1	31	Hardland	45
TcA	Tillman clay loam, 0 to 1 percent slopes	24	IIIs-1	35	Hardland	45
TcB	Tillman clay loam, 1 to 3 percent slopes	24	IIIe-1	33	Hardland	45
TcB2	Tillman clay loam, 1 to 3 percent slopes, eroded	24	IVe-1	35	Hardland	45
TpA	Tipton clay loam, 0 to 1 percent slopes	25	IIce-1	32	Hardland	45
TpB	Tipton clay loam, 1 to 3 percent slopes	25	IIIe-3	33	Hardland	45
Tv	Tivoli fine sand	26	VIIe-1	37	Deep Sand	45
VcB	Vernon-Weymouth clay loams, 1 to 3 percent slopes.	26	IVe-4	36	Shallow Redland	47
VcC	Vernon-Weymouth clay loams, 3 to 5 percent slopes.	27	VIe-6	37	Shallow Redland	47
Ve	Vernon complex	27	VIIs-2	38	Shallow Redland	47
Vx	Vernon-Quinlan complex	27	VIIs-2	38	Shallow Redland	47
WoB	Woodward loam, 1 to 3 percent slopes	29	IIe-1	31	Mixed Land	46
WoC	Woodward loam, 3 to 5 percent slopes	29	IIIe-4	34	Mixed Land	46
WwD	Woodward-Quinlan loams, 5 to 12 percent slopes	29	VIe-1	36	Mixed Land	46

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