

SOIL SURVEY

Hall County, Texas



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

Major fieldwork for this soil survey was done in the period 1961-63. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1963. The survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station; it is part of the technical assistance furnished to the Hall County Soil Conservation District.

HOW TO USE THIS SOIL SURVEY REPORT

THIS SOIL SURVEY of Hall County contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, or other structures; and in appraising the value of tracts of land for agriculture, industry, or recreation.

Locating Soils

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

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units, Capability Units, and Range Sites" can be used to find information in the report. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, range site, or any other group in which the soil has been placed.

Individual colored maps showing the relative suitability or limitations of soils for many specific purposes can be developed by using the soil map and information in the text. Interpretations not included in the text can be developed by grouping the soils according to their

suitability or limitations for a particular use. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils in the sections "Descriptions of the Soils" and "Use and Management of Soils."

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

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

Engineers and builders will find, under "Engineering Uses of the Soils," tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

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

Students, teachers, and others will find information about soils and their management in various parts of the text, according to their particular interest.

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

Cover picture: A typical landscape in Hall County. The trend is toward terracing and contour farming of cultivated land.

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NOTICE TO LIBRARIANS

Series year and series number are no longer shown
on soil surveys. See explanation on next page.

Issued February 1967

EXPLANATION

Series Year and Series Number

Series year and number were dropped from all soil surveys sent to the printer after December 31, 1965. Many surveys, however, were then at such advanced stage of printing that it was not feasible to remove series year and number. Consequently, the last issues bearing series year and number will be as follows:

Series 1957, No. 23, Las Vegas and Eldorado Valleys Area, Nev.	Series 1960, No. 31, Elbert County, Colo. (Eastern Part)
Series 1958, No. 34, Grand Traverse County, Mich.	Series 1961, No. 42, Camden County, N.J.
Series 1959, No. 42, Judith Basin Area, Mont.	Series 1962, No. 13, Chicot County, Ark.
	Series 1963, No. 1, Tippah County, Miss.

Series numbers will be consecutive in each series year, up to and including the numbers shown in the foregoing list. The soil survey for Tippah County, Miss., will be the last to have a series year and series number.

SOIL SURVEY OF HALL COUNTY, TEXAS

BY EARL R. BLAKLEY, SOIL SCIENTIST, SOIL CONSERVATION SERVICE

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

HALL COUNTY is in the southeastern part of the Texas Panhandle (fig. 1). It is bordered on the east by Childress County, on the north by Donley County,

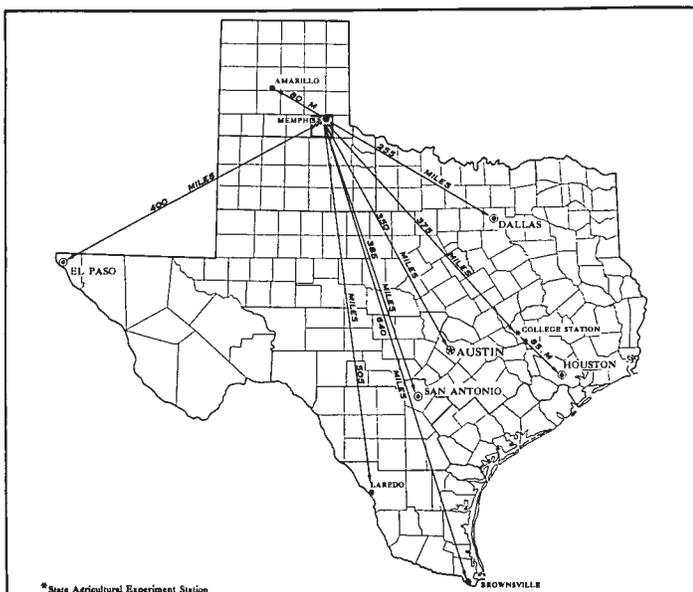


Figure 1.—Location of Hall County in Texas.

on the west by Briscoe County, and on the south by Motley and Cottle Counties. Memphis, the largest town and county seat, is in the northeastern part of the county. The elevation ranges from 1,900 feet in the southeastern corner to 2,400 feet in the west-central part.

Hall County occupies a total area of 583,040 acres. Agriculture is the primary enterprise. About 45 percent of the acreage is cultivated, and is mostly dryfarmed. The rest is used as range. Cotton has always been the dominant crop of the county, but a large acreage of grain sorghum is also grown. Small acreages of small grain, forage sorghum, and alfalfa are grown.

Cattle ranching is extensive in the county. The cattle are raised mainly for beef.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Hall 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 rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by 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 nationwide, uniform procedures. For successful use of this report, 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. Carey and Woodward, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, 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. Miles fine sandy loam and Miles loamy fine sand are two soil types in the Miles series. The difference in texture of their surface layers is apparent from their names.

Some soils 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 phases. The name of a soil phase indicates a feature that affects management. For example, Miles fine sandy loam, 0 to 1 percent slopes, is one of several phases of Miles fine sandy loam, a soil type that ranges from nearly level to sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photo-

graphs show roads, buildings, field borders, trees, and other details that greatly help in drawing soil 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 scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Quinlan-Woodward complex. The soil scientist may also show as one mapping unit two or more soils if the differences between them are so small that they do not justify separation for the purpose of the survey. Such a mapping unit is called an undifferentiated soil group; for example, Guadalupe and Tipton soils. Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Sandy alluvial land or Rough broken land, and are called land types rather than soils.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. The soil scientists set up trial groups, based on the yield and practice tables and other data, and test these groups by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this report shows, in color, the soil associations in Hall County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more

major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

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

The general soil map of Hall County shows nine soil associations in three general kinds of landscape. Six associations are on uplands that range from nearly level to hilly; two are in areas of rough, broken land; and one is in valleys without streams and on flood plains.

1. Enterprise-Tivoli association: Deep, nearly level to moderately steep soils near stream channels

This association consists of narrow bands of soils along the Prairie Dog Town Fork of the Red River. These soils developed mainly from material blown from dry areas of the riverbed. The materials range in texture from very fine sandy loam to fine sand. The topography ranges from nearly level to steep and dunny. This soil association is confined to an area parallel to the Prairie Dog Town Fork of the Red River. It occupies a total area of about 95,035 acres, which includes the channel of the Prairie Dog Town Fork, and makes up 16 percent of the county.

The major soils of this association are the Enterprise and Tivoli. The Lincoln and Yahola soils and Sandy alluvial land are of minor extent (fig 2). In Hall County the Lincoln soils are mapped only as an undifferentiated unit with the Yahola soils.

The Enterprise are deep, light-colored soils that have a very fine sandy loam or fine sandy loam surface layer and subsoil. They are less sandy than the Tivoli soils and are nearly level to moderately steep. These soils occupy a continuous strip beyond the Tivoli soils on each side of the river. Enterprise soils make up about 53 percent of the association.

The Tivoli soils are deep, light-colored sands that have dunny topography. They are closer to the river channel than the Enterprise soils. Generally, they occur in a band $\frac{1}{4}$ mile to 2 miles wide along the river. The largest areas are on the south side of the river. The Tivoli soils occupy about 22 percent of the association.

The rest of the association consists mostly of Sandy alluvial land, a miscellaneous land type, and Lincoln and Yahola soils. Sandy alluvial land is made up of variable textured alluvial material adjoining, and 1 to 3 feet above, the river channel. The surface layer is mostly sandy loam to sand and the subsoil is sand. Sandy alluvial land occupies about 9 percent of the association. The Lincoln and Yahola soils are also alluvial, but they occur a few feet higher than Sandy alluvial land. They have a sandy loam to sand surface layer and a sand subsoil. The Lincoln and Yahola soils occupy about 3 percent of the association. The river channel makes up about 13 percent of the areas of the association.

Most areas of the Enterprise soils of this association are cultivated and are moderately productive. Cotton

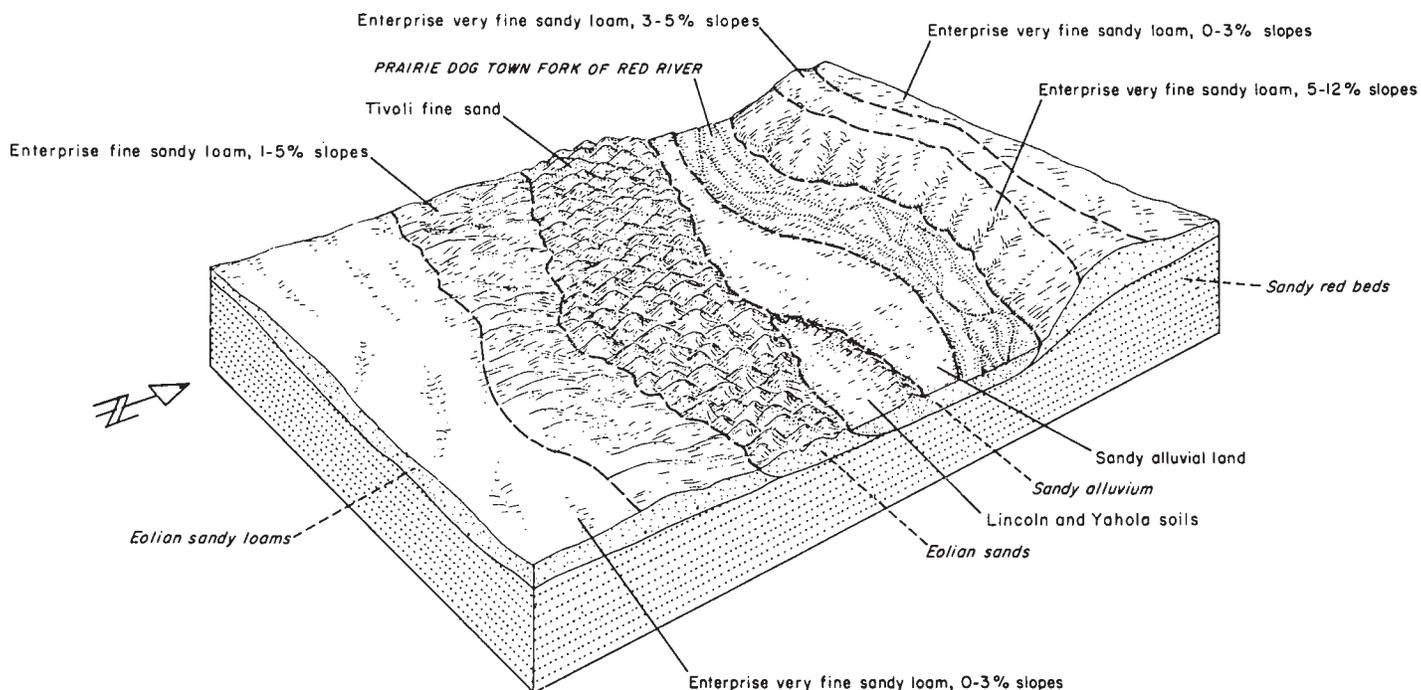


Figure 2.—Pattern of soils in the Enterprise-Tivoli soil association.

and grain sorghum are grown extensively. The average size of the farms in this association is about 400 acres. The Tivoli and Lincoln soils and Sandy alluvial land are suitable only for rangeland. In this association, most of these soils are in small ranches.

2. Carey-Woodward association: Deep and moderately deep, gently sloping to rolling soils on uplands

This association consists of loamy soils in the northeastern and southeastern parts of the county. The soils have developed in the soft, Permian red-bed sandstone or packsand formations that are typical in this area. The texture of the surface soil is loam. This association occupies a total area of about 93,285 acres and makes up 16 percent of the county.

The major soils of this association are the Carey and Woodward. Minor soils are the St. Paul and Quinlan (fig. 3). In Hall County the Quinlan soils are mapped only in a complex with the Woodward soils.

The Carey soils are deep and have a reddish-brown loam surface layer over a friable sandy clay loam subsoil. They are mostly gently sloping. The Carey soils occupy about 37 percent of the association.

The Woodward soils are similar to the Carey in color and texture but are only moderately deep. They differ from the Carey also in having free lime throughout their solum. They are mainly in steeper areas on ridges above the Carey soils, but they are also near the Quinlan soils along the steep ridges and breaks to natural drains. The Woodward soils are deeper than the Quinlan. They occupy about 35 percent of the association.

The St. Paul soils occupy the nearly level areas downslope from the other soils of this association. They are more silty, are darker, and have a more compact subsoil than the Carey soils. They are mostly brown to dark

brown. The St. Paul soils make up about 15 percent of this association.

The rest of the association is made up of Quinlan soils and a miscellaneous land type, Rough broken land, which are shallow and steep and have some severely eroded areas. The Quinlan soil occurs mostly on the steepest ridges and along breaks to natural drains. It occupies about 8 percent of the association. The gullied areas resulting from geologic erosion occur along the major drainageways of this association. They are mostly Rough broken land and make up about 5 percent of the association.

About 85 percent of the association has been cultivated. Some of the steeper areas have now reverted to permanent vegetation. The St. Paul and Carey soils are very productive. The Woodward soils are less productive and are more susceptible to water erosion because they are steeper. The Quinlan soils and Rough broken land are not suitable for cultivation because they are shallow and steep.

Cotton is the main cash crop grown on soils of this association, but a large acreage of grain sorghum is also grown. The average size of farms in this association is about 400 acres.

3. Woodward-Quinlan-Rough broken land association: Moderately deep to very shallow, gently sloping to steep soils on uplands

This association consists of gullied soils mostly in the south-central part of the county, but a small area is in the northwestern part. The association is made up of steep ridges separated by gullies. The soils have developed from soft, Permian sandstone. The texture of these soils is loam or very fine sandy loam. This association occupies a total area of about 148,875 acres and makes up 25 percent of the county.

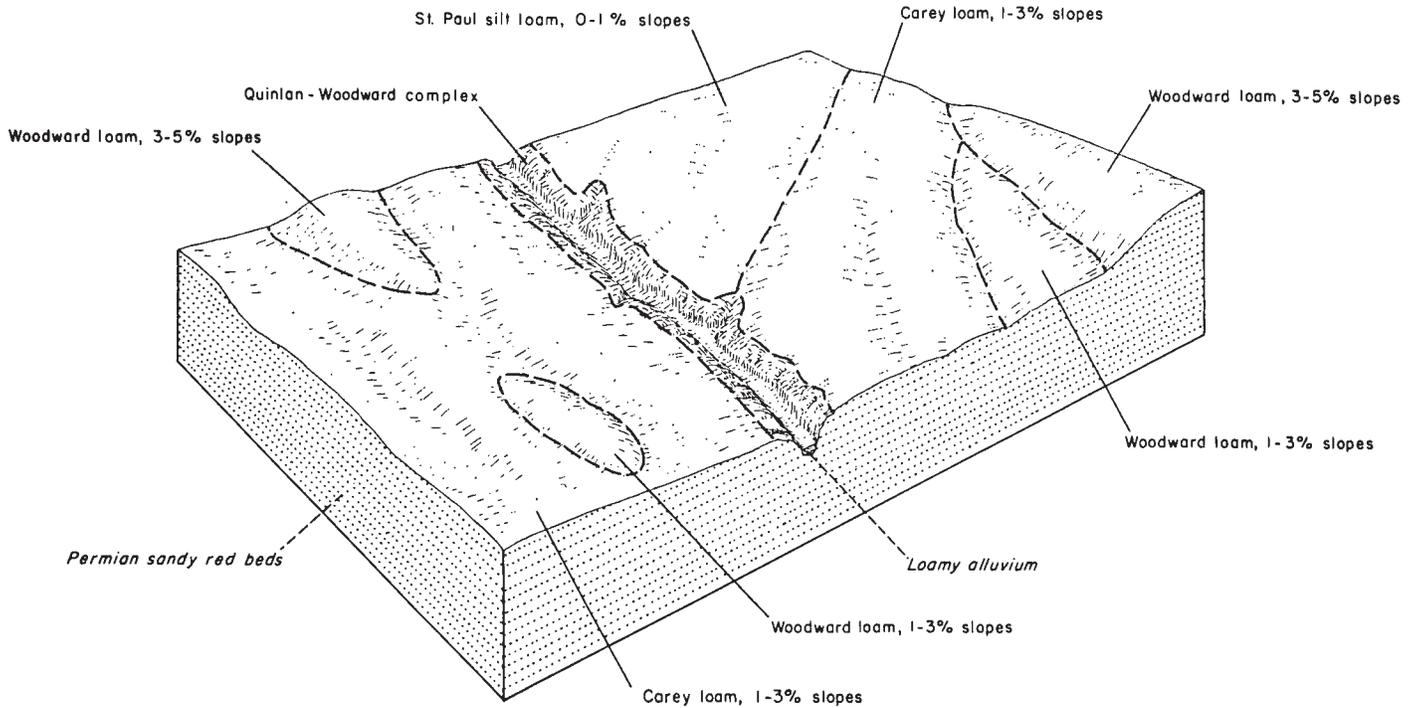


Figure 3.—Pattern of soils in the Carey-Woodward soil association.

This association consists mainly of Woodward and Quinlan soils and Rough broken land (fig. 4). The minor soils are the Yahola.

The Woodward are shallow to moderately deep, reddish-brown, loamy soils on the side slopes of ridges. They make up about 55 percent of the association.

The Quinlan soils are similar to the Woodward soils, but they are not so deep. They occur mostly on the top of ridges, and on the steepest side slopes. They make up about 25 percent of this association.

The gullies in this association were formed by geologic erosion that has cut into the soft sandstone. They occur

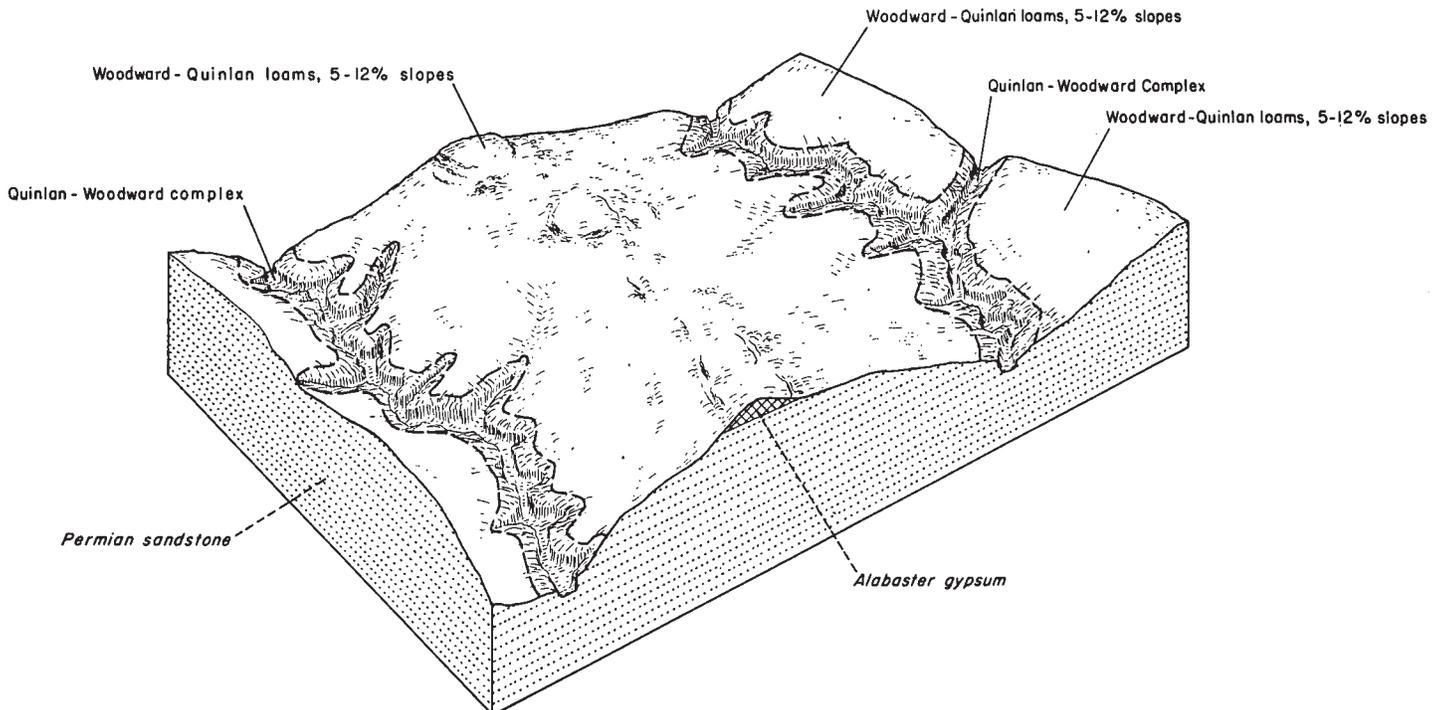


Figure 4.—Major soils of the Woodward-Quinlan-Rough broken land soil association.

along the drainageways between the ridges. The gullied areas are dominantly of Rough broken land. Their narrow, flat bottoms consist of Yahola soils. The gullies range from 30 to 300 feet in width and from 10 to 50 feet in depth. They make up about 20 percent of the association.

Most soils of this association are not suitable for cultivation. They are used as rangeland consisting mostly of short and mid native grasses. The association is used mostly for ranches. It has few public roads.

4. Quinlan-Woodward-Rough broken land association: Very shallow to moderately deep, gently sloping to steep soils on uplands

This soil association consists of a rough, broken area of soils in the west-central part of the county. It occurs mostly along the Little Red River and its tributaries. It has been severely dissected by geologic erosion that has cut into the silty and sandy, Permian red-bed formation. This association occupies a total area of about 46,640 acres and makes up 8 percent of the county.

This association consists of Quinlan and Woodward soils and Rough broken land.

The Quinlan soils are very shallow—less than 12 inches of soil overlie silty or sandy red-bed material. They occur in many small areas in those parts of the breaks that are less sloping than Rough broken land. They also occupy the ridges. They comprise about 50 percent of the association. The Woodward soils are shallow to moderately deep, reddish-brown, loamy soils on the side slopes of ridges. They make up about 10 percent of the association.

Rough broken land consists mostly of a mixture of silty and sandy red-bed materials that are exposed at the surface. The areas are very steep and dissected. This

land type occurs along the streams and deeper drainageways. It makes up about 40 percent of the association.

The soils of this association are not suitable for cultivation, because they are steep and shallow. Most areas have only a sparse cover of native vegetation. Grasses are mostly mid or tall. These soils are highly susceptible to water erosion. State Highway No. 70 is the only public road in the association, and there are few trails.

5. Miles-Springer association: Deep, nearly level to strongly sloping and hummocky soils on uplands

This association consists of sandy soils that have developed in sandy outwash of Pleistocene age. These soils occur mainly in the north-central and southwestern parts of the county. The surface layer is mostly loamy fine sand. This association occupies a total area of about 50,140 acres and makes up 9 percent of the county.

The major soils in this association are the Miles and Springer (fig. 5). Mansker soils and Gravelly broken land make up a minor part.

The Miles are deep, reddish-brown soils that have a loamy fine sand surface layer and a reddish-brown or red sandy clay loam subsoil. In most places they have smooth, nearly level to gentle slopes. The Miles soils make up about 60 percent of this association.

The surface layer of the Springer soils is similar to that of the Miles soils, but the subsoil of the Springer soils is a reddish-brown fine sandy loam. Most areas of the Springer soils are undulating to hummocky. These areas are intermixed with areas of the Miles soils. The Springer soils make up about 25 percent of the association.

The Mansker are moderately deep, calcareous, brown soils that have a fine sandy loam surface layer and a

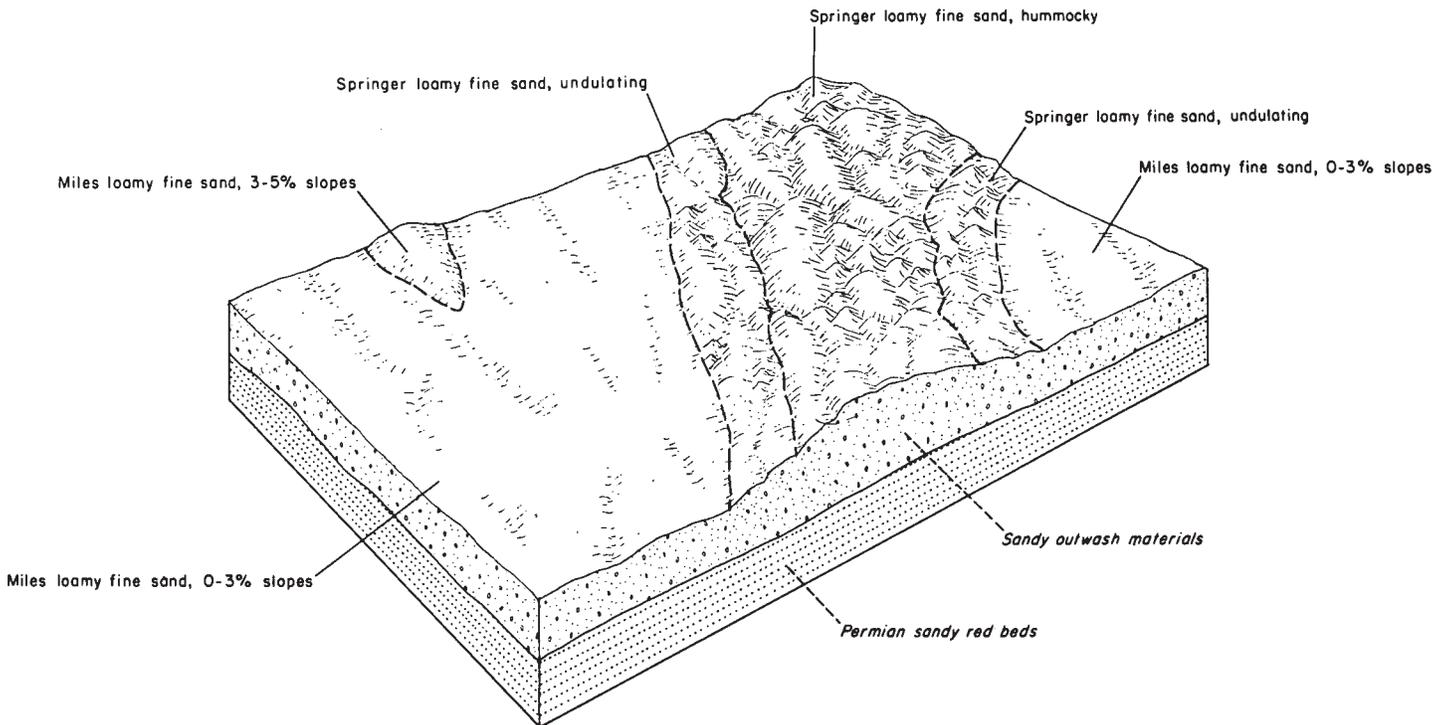


Figure 5.—Major soils of the Miles-Springer soil association.

sandy clay loam subsoil. They are on ridges along drains and in small areas surrounded by the Miles and Springer soils. The Mansker soils make up about 5 percent of the association.

Gravelly broken land is steep to rolling and occurs mostly along the larger drainageways and creeks. It consists of a mixture of outwash sand and gravel. It makes up about 5 percent of the association.

Also in this association are small areas of Miles fine sandy loam, and Nobscot, Brownfield, Woodward, Spur, and Yahola soils. The Woodward soils occur on ridges, and the Spur and Yahola soils are along small streams. These soils make up about 5 percent of the association.

Except for the Springer soils and Gravelly broken land, most areas of this association are cultivated. Much of the acreage of the Springer soils was cultivated at one time, but many areas were severely eroded by wind and have been taken out of cultivation. Gravelly broken land is too steep for cultivation. Native vegetation is mostly mid and tall grasses.

The soils of this association are highly susceptible to wind erosion because they have a sandy surface. Their natural fertility is low. A few irrigation wells have been dug. The dominant crops grown in the association are cotton and grain sorghum. The average size of farms is about 480 acres.

6. Miles-Olton-Woodward association: Deep and moderately deep, nearly level to strongly sloping or rolling soils on uplands

This association consists of soils on uplands in the northern and southwestern parts of the county. Some of the soils have developed in outwash materials, and some in sandy or silty, Permian red beds. In the northern part of the county, this association is characterized by broad, nearly level to gently sloping areas of soils from outwash materials. Intermixed throughout these areas are high,

broad ridges of steeper soils that have developed in silty and sandy red beds. In the southwestern part of the county, this association does not have high ridges. In this area the soils are mainly nearly level to gently sloping and have developed in loamy outwash materials. The texture of the surface soil is loam or fine sandy loam. This association occupies a total of about 75,795 acres and makes up 13 percent of the county.

The major soils of this association are the Miles, Olton, and Woodward. Minor soils are the Mansker and Weymouth (fig. 6).

The Miles soils are deep and have a reddish-brown fine sandy loam surface layer. They have a friable, sub-angular blocky sandy clay loam subsoil. They are mainly nearly level to gently sloping, but a few steeper areas occur along drainageways and on ridges. These soils occupy about 50 percent of the association.

The Olton are deep, reddish-brown, loamy soils that have a compact clay loam subsoil. These soils are nearly level to gently sloping and are near Miles fine sandy loam. The Olton soils occupy about 15 percent of the association.

The Woodward soils are moderately deep and have a reddish-brown loam surface layer and a permeable subsoil. They are mainly in the eastern and southern parts of the county. The Woodward soils are on the ridges above the Miles soils. They occupy about 13 percent of the association.

The Mansker are moderately deep, calcareous, brown soils that have a fine sandy loam surface layer and a sandy clay loam subsoil. They are mostly on the ridges and along drainageways in steeper areas above the Miles soils. The Mansker soils are near Miles fine sandy loam. They occupy about 10 percent of the association.

The Weymouth are moderately deep, calcareous, reddish-brown soils that have a loam surface layer and a friable subsoil. They are mainly in areas near the Olton

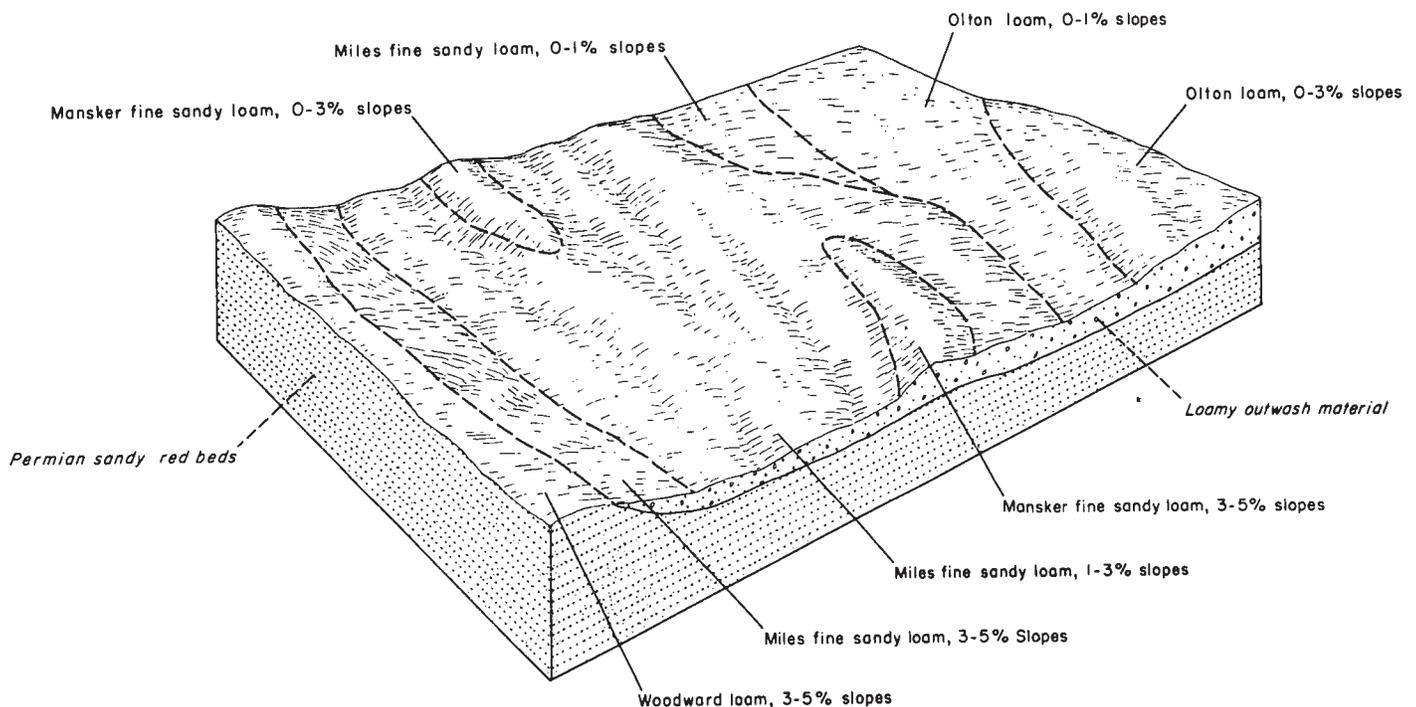


Figure 6.—Pattern of soils in the Miles-Olton-Woodward soil association.

soils but are on steeper ridges and along drainageways. They occupy about 8 percent of this association.

Also in this association are small areas of Miles loamy fine sand, and Altus, Tipton, Abilene, Springer, Yahola, and Spur soils that occupy about 4 percent of the association.

Except for the steepest parts, most areas of this association are cultivated. The Miles soils have high natural fertility and are very productive. The Woodward, Mansker, and Weymouth soils are less productive because they are not so deep, are steeper, and have lower fertility. Some areas of the soils that formerly were cultivated have now been returned to range. The steeper soils are highly susceptible to water erosion, and those that have a fine sandy loam surface layer are moderately susceptible to wind erosion. A few irrigation wells are in use throughout this association. Cotton and grain sorghum are the dominant crops grown. The average size of farms is about 320 acres.

7. Olton-Weymouth-Abilene association: Deep and moderately deep, nearly level to moderately sloping soils on uplands

This association consists of soils on uplands mainly in the southwestern part of the county. A small area is in the northeastern part. The main area is characterized by many ridges that are separated by narrow to broad valleys. This area extends from Turkey to Tampico. The soils in the valleys have developed in loamy outwash materials, and the soils on the ridges and steep slopes have developed in silty or sandy red beds. The texture of the surface layer of all the soils in this association is loam or clay loam. The association occupies a total area of about 32,650 acres and makes up 6 percent of the county.

The major soils in this association are the Olton, Weymouth, and Abilene (fig. 7). The minor soils are the

Woodward and Quinlan. In Hall County the Quinlan soils are mapped only in a complex with the Woodward soils.

The Olton are deep, reddish-brown, compact soils that have a loam surface layer to a depth of 5 to 10 inches. They have a blocky clay loam subsoil. Olton soils have nearly level to gentle slopes and are along valleys. They occupy about 32 percent of the association.

The Weymouth soils are moderately deep and have a loam surface layer 5 to 10 inches thick. The subsoil is friable heavy loam or clay loam 5 to 12 inches thick. These soils are mainly on ridges above the Olton soils and are gently sloping to moderately sloping. The Weymouth soils occupy about 30 percent of the association.

The Abilene are deep, dark, nearly level soils. The surface layer is brown clay loam 5 to 10 inches thick. The subsoil is dark-brown clay loam that has blocky structure. The Abilene soils are along the drainageways and in low areas downslope from the other soils in the association. They occupy about 17 percent.

The Woodward soils are moderately deep and have a loam surface layer. They are mostly on the steep slopes above the drainageways. The Quinlan soils are very shallow and also have a loam surface layer. They are on ridgetops and on steep slopes along drainageways. In this association most of the Woodward and Quinlan soils occur as a soil complex. They occupy about 18 percent of the association.

Also in this association are deep, severely eroded or gullied areas along the larger drainageways. These gullied areas are mainly of Rough broken land and occupy about 3 percent of the association.

Most areas of the Olton, Weymouth, and Abilene soils in this association are cultivated. The other soils are too steep for cultivation and are in range. The Olton and

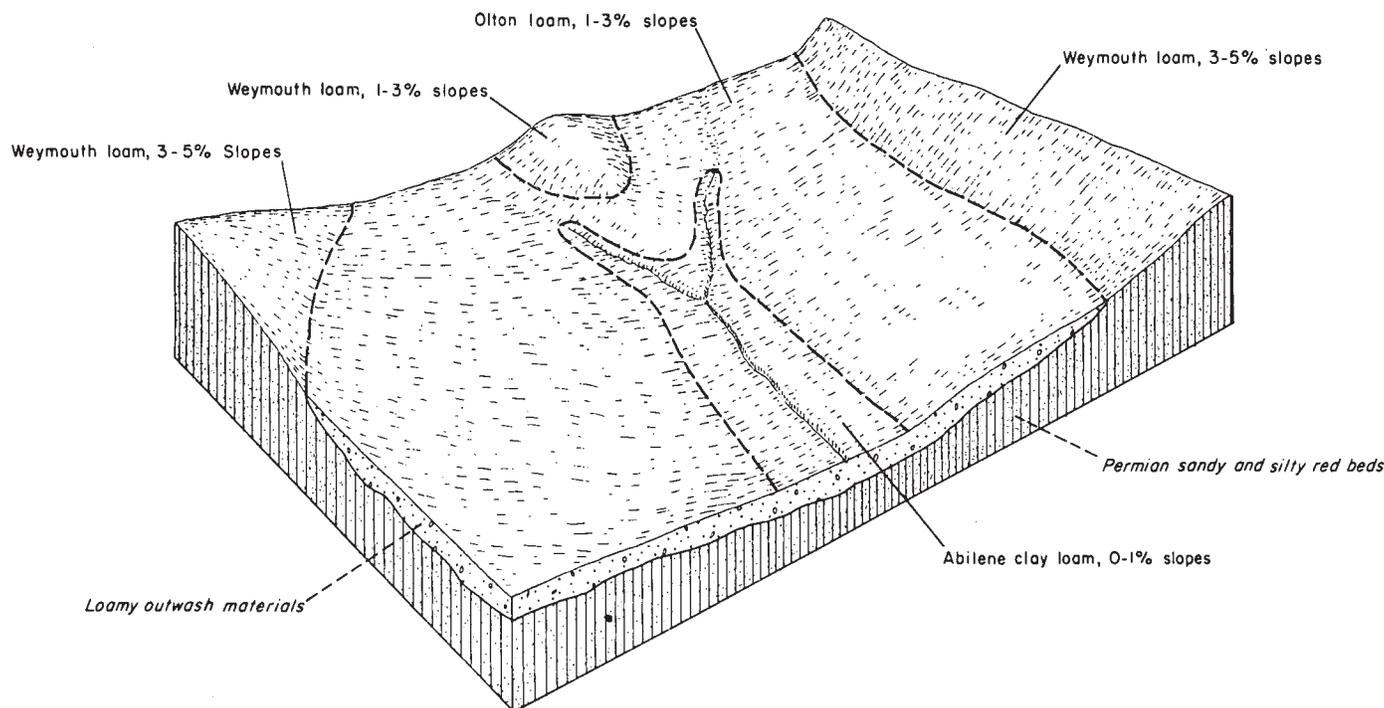


Figure 7.—Major soils of the Olton-Weymouth-Abilene soil association.

Abilene soils are moderately productive, but because of their compact, blocky subsoil, they are droughty. The Weymouth soils are less productive because they are shallow. Cotton and small grain are the dominant crops grown in this association. Some areas of the Weymouth soils that have been cultivated are now in grass. The soils of this association are moderately to highly susceptible to water erosion. The native plants are mainly short and mid grasses. The average size of farms in this association is about 640 acres.

8. Tipton-Yahola association: Deep, nearly level soils in valleys and on flood plains

This association consists of soils in valleys and on flood plains. They are mainly in scattered areas in the northwestern part of the county. These areas are along streams and in broad valleys in which the stream channels have ended. The soils have developed in calcareous, loamy alluvium or valley fill. The texture of the surface soil is mainly loam or fine sandy loam. This association occupies a total area of about 36,730 acres and makes up 6 percent of the county.

The major soils of this association are the Tipton and Yahola. Minor soils are the Spur and Altus.

The Tipton are deep, dark, nearly level soils. Their surface layer is a dark-brown loam 6 to 16 inches thick. The subsoil is reddish-brown, friable loam or clay loam. A few areas have a high water table and are imperfectly drained. Because the water is salty, these imperfectly drained areas are saline. A few areas near stream channels have a fine sandy loam to fine sand surface layer from overwash materials. The Tipton soils occupy about 55 percent of the association.

The Yahola are young, light-colored, bottom-land soils. Their surface layer and subsoil range from very fine sandy loam to fine sandy loam. They are in lower positions and are less developed than the Tipton soils. The Yahola are nearly level soils near streams or water channels. In a few places there is no stream channel near these soils. In most places new sediments are deposited continually on these soils by floodwater. The soils occupy about 17 percent of the association.

The Spur are young, light-colored, bottom-land soils. They have a loam surface layer and a friable loam or clay loam subsurface layer. These soils occupy positions similar to those occupied by the Yahola soils. The Spur soils make up about 12 percent of the association.

The Altus are deep, dark-colored, nearly level soils. They have a brown fine sandy loam surface layer 8 to 20 inches thick. The subsoil is dark-brown sandy clay loam that has subangular blocky structure. The Altus are nearly level soils in positions similar to those of the Tipton soils. They make up about 11 percent of the association.

Also in this association are small areas of Miles, Enterprise, and Tivoli soils and Sandy alluvial land. These areas make up about 5 percent of the association.

Nearly all of this association is cultivated. The soils have high natural fertility and are among the most productive in the county. Irrigation is widely used on these soils. Cotton and grain sorghum are the main crops grown. The average size of farms in this association is about 320 acres.

9. Nobscot-Brownfield association: Deep, nearly level to rolling and hummocky soils on uplands

This association consists of deep, sandy soils in the southwestern corner of the county. The soils have developed in sandy outwash materials that have been reworked by wind. The association occupies a total area of about 3,860 acres and makes up less than 1 percent of the county.

The major soils of this association are the Nobscot and Brownfield (fig. 8). The minor soils are Miles loamy fine sand and Springer soils.

The Nobscot soils are deep and have a light-colored, slightly bleached, fine sand surface layer to a depth of 12 to 28 inches. The subsoil is reddish or yellowish fine sandy loam or loamy fine sand. The Nobscot soils are rolling to hummocky. They occupy about 64 percent of the association.

The surface layer of Brownfield soils is similar to that of Nobscot, but their subsoil is reddish sandy clay loam at a depth of 15 to 30 inches. The Brownfield soils also are on flatter, smoother slopes than the Nobscot soils with which they are closely intermixed. They occupy about 34 percent of the association.

The Springer soils and Miles loamy fine sand are in small areas that make up about 2 percent of the association.

This association is mostly in native range. The natural fertility is low. Most areas of the Brownfield soils have been cultivated and were eroded. Most of the cultivated areas have reverted to native plants. The native grasses are mainly the tall species. Shin oak occurs in all uncultivated areas. The soils in this association are highly susceptible to wind erosion if the native vegetation is destroyed. The average size of farms is about 800 acres.

Descriptions of the Soils

The soil series and the mapping units in Hall County are described in this section. The procedure is to describe first each soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

The soil series contains a description of the soil profile, the major layers from the surface downward. This profile is considered typical, or representative, for all the soils of the series. If the profile for a given mapping unit differs from this typical profile, the differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit. Some technical terms are used in describing soil series and mapping units, simply because there are no nontechnical terms that convey precisely the same meaning. Many of the more commonly used terms are defined in the Glossary.

The acreage and proportionate extent of the mapping units are shown in table 1. Detailed technical descriptions of soil series are given in the section "Genesis, Classification, and Morphology of Soils."

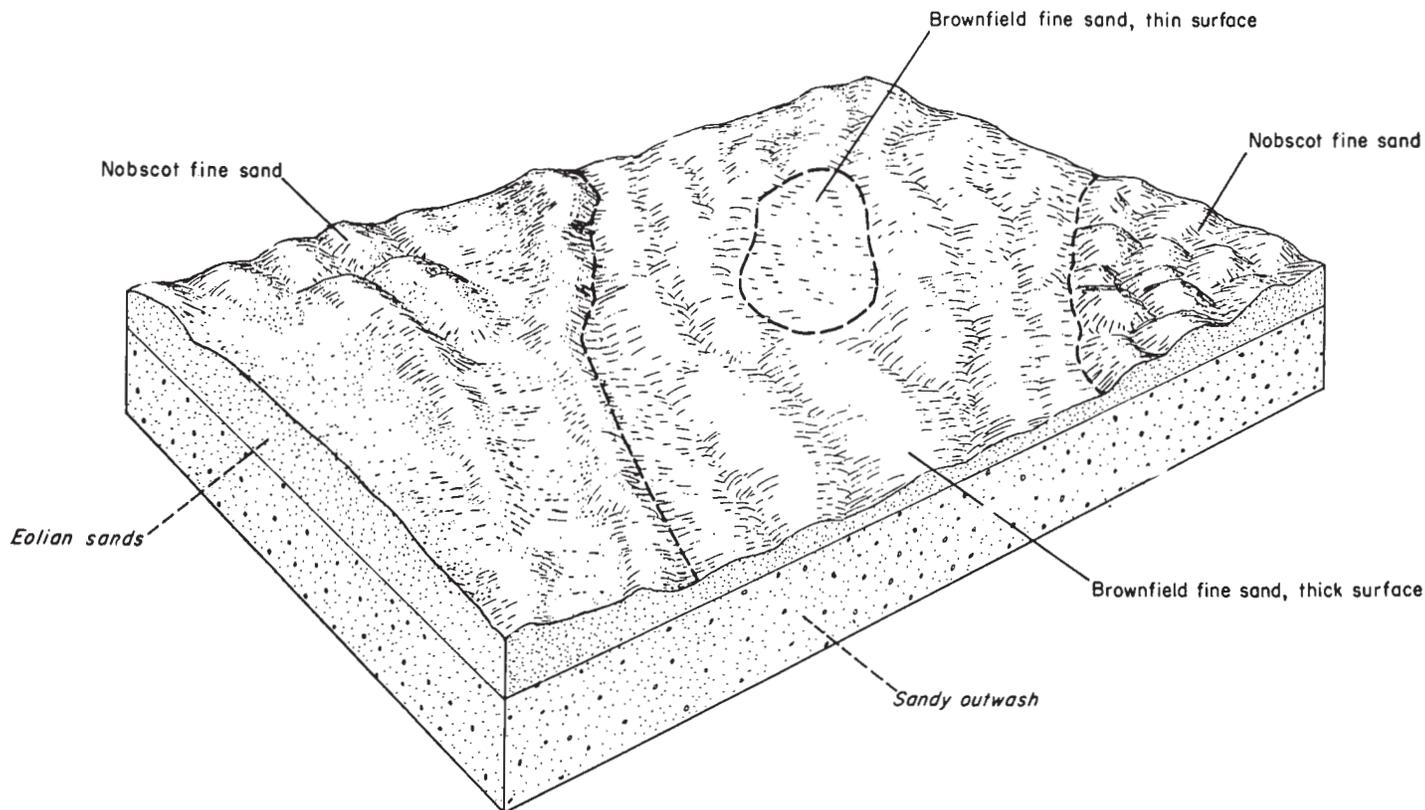


Figure 8.—Major soils of the Nobscot-Brownfield soil association.

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

Soil	Area	Extent	Soil	Area	Extent
	<i>Acres</i>	<i>Percent</i>		<i>Acres</i>	<i>Percent</i>
Abilene clay loam, 0 to 1 percent slopes.....	6,403	1.1	Miles fine sandy loam, 5 to 8 percent slopes.....	972	.2
Abilene clay loam, 1 to 3 percent slopes.....	404	(¹)	Miles loamy fine sand, 0 to 3 percent slopes.....	17,104	2.6
Active dunes.....	1,058	.2	Miles loamy fine sand, 3 to 5 percent slopes.....	3,250	.6
Altus fine sandy loam, 0 to 1 percent slopes.....	4,970	.8	Nobscot fine sand.....	2,360	.4
Arch and Cottonwood soils, 0 to 3 percent slopes.....	645	.1	Olton loam, 0 to 1 percent slopes.....	5,608	.9
Brownfield fine sand, thin surface.....	250	(¹)	Olton loam, 1 to 3 percent slopes.....	15,198	2.6
Brownfield fine sand, thick surface.....	874	.1	Quinlan-Woodward complex.....	82,853	14.1
Carey loam, 1 to 3 percent slopes.....	24,029	4.1	Rough broken land.....	7,505	1.3
Carey loam, 3 to 5 percent slopes.....	6,728	1.0	Sandy alluvial land.....	11,751	2.0
Enterprise fine sandy loam, 0 to 1 percent slopes.....	5,046	.8	Springer loamy fine sand, hummocky.....	1,799	.3
Enterprise fine sandy loam, 1 to 3 percent slopes.....	5,568	.9	Springer loamy fine sand, undulating.....	4,625	.8
Enterprise fine sandy loam, 3 to 5 percent slopes.....	2,122	.4	Springer soils, severely eroded.....	2,918	.5
Enterprise soils, wind-hummocky.....	2,240	.4	Spur loam.....	6,380	1.1
Enterprise very fine sandy loam, 0 to 1 percent slopes.....	6,645	1.1	Spur and Yahola soils.....	2,678	.4
Enterprise very fine sandy loam, 1 to 3 percent slopes.....	11,955	2.0	St. Paul silt loam, 0 to 1 percent slopes.....	9,455	1.6
Enterprise very fine sandy loam, 3 to 5 percent slopes.....	6,220	1.0	St. Paul silt loam, 1 to 2 percent slopes.....	2,763	.5
Enterprise very fine sandy loam, 5 to 12 percent slopes.....	4,373	.7	Tipton loam, 0 to 1 percent slopes.....	16,193	2.7
Gravelly broken land.....	2,348	.4	Tipton loam, 1 to 3 percent slopes.....	3,430	.6
Guadalupe and Tipton soils.....	1,861	.3	Tipton loam, somewhat poorly drained.....	650	.1
Latom stony loam, 3 to 12 percent slopes.....	950	.2	Tivoli fine sand.....	20,707	3.5
Loamy alluvial land, depressed.....	828	.1	Weymouth loam, 1 to 3 percent slopes.....	6,606	1.1
Lincoln and Yahola soils.....	4,983	.8	Weymouth loam, 3 to 5 percent slopes.....	18,077	3.0
Mansker fine sandy loam, 0 to 3 percent slopes.....	1,670	2.5	Woodward loam, 1 to 3 percent slopes.....	6,563	1.1
Mansker fine sandy loam, 3 to 5 percent slopes.....	4,081	.7	Woodward loam, 3 to 5 percent slopes.....	35,501	6.0
Mansker fine sandy loam, 5 to 12 percent slopes.....	5,785	.9	Woodward-Quinlan loams, 5 to 12 percent slopes.....	127,057	21.6
Miles fine sandy loam, 0 to 1 percent slopes.....	7,089	1.2	Yahola fine sandy loam.....	2,529	.4
Miles fine sandy loam, 1 to 3 percent slopes.....	20,103	3.3	Yahola very fine sandy loam.....	8,342	1.4
Miles fine sandy loam, 3 to 5 percent slopes.....	4,608	.8	Stream channels and water.....	16,330	2.7
			Total.....	583,040	100.0

Abilene Series

The Abilene series consists of deep, dark, loamy soils that have a compact subsoil. They are on smooth upland terraces and valleys in the northern and southwestern parts of the county. They have formed in loamy outwash materials.

The surface layer is brown or dark-brown clay loam about 8 inches thick. It is free of lime and has weak granular or subangular blocky structure.

The subsoil is brown or dark-brown clay about 32 inches thick. The upper part is dark-brown, friable clay loam that has subangular blocky structure. The lower part is brown or grayish-brown clay that has compact, blocky structure. The upper part has no lime, but the lower part contains free lime.

The substratum is calcareous, silty or clayey outwash or old alluvium. It contains accumulations of lime in the upper part. It is friable enough to be penetrated by plant roots.

The surface layer of the Abilene soils ranges from 5 to 12 inches in thickness. It ranges from loam to clay loam in texture. The subsoil ranges from clay loam to clay in texture, and from dark brown to brown or grayish brown in color. It is darkest in the upper part.

The Abilene soils have a darker color than the nearby Olton soils. They have a more compact, clayey subsoil than the Tipton soils. They are darker and more clayey than the Miles soils.

The Abilene soils have good surface drainage. They have moderately slow permeability, and their capacity to hold water is high. They have high natural fertility and are only slightly susceptible to erosion by water and by wind. These soils are droughty during periods of low rainfall.

Most areas of Abilene soils are cultivated. The crops grown are cotton, grain sorghum, and small grain. Irrigation is used in a few areas.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This soil occurs in scattered areas in the northern and southwestern parts of the county. Most of the areas are broad, and are nearly level to flat. They range from 10 to 600 acres in size. The slopes are dominantly less than 0.5 percent.

This soil is like the one described for the series. A few shallow rills and scattered shallow gullies occur along the drainageways.

Included in mapping are scattered areas of Olton loam, 0 to 1 percent slopes. These inclusions are mostly less than 5 acres in size and make up less than 5 percent of the mapping unit. Also included are small, scattered areas of Abilene clay loam, 1 to 3 percent slopes, and Weymouth loam, 1 to 3 percent slopes. About 10 percent of this mapping unit has a loam surface layer.

Most areas of this Abilene soil are cultivated. This soil is one of the most productive of wheat in the county. Wheat, cotton, and grain sorghum are grown extensively on it. The erosion hazard is slight. Because the soil has a compact subsoil, good residue management is needed to increase the water intake and yields. This soil is well suited to irrigation. (Capability unit IIc-4; Deep Hardland range site)

Abilene clay loam, 1 to 3 percent slopes (AbB).—This soil occurs in small, scattered areas along with Abilene clay loam, 0 to 1 percent slopes. The slopes average

about 1.5 percent. Most areas of this soil are less than 200 acres in size. They are about 300 to 800 feet wide and occur along drainageways.

This soil is slightly redder than the one described for the series, and its surface layer is only about 5 inches thick. In most areas water erosion has formed rills and a few shallow gullies. The eroded areas are mostly along drainageways and on the steeper slopes.

Included with this soil in mapping are areas of Olton loam, 1 to 3 percent slopes. These areas in most places are less than 10 acres in size and make up about 10 percent of the mapping unit. Also included are small, convex patches of Weymouth loam, 1 to 3 percent slopes, that make up about 5 percent.

Most areas of this Abilene soil are cultivated. The soil is best suited to wheat. Its susceptibility to water erosion is moderate to high. Because the soil has a compact subsoil, the water intake is slow. Runoff is rapid. Terraces and good management of residue are needed to control erosion and conserve moisture. The surface crusts readily after rains. The soil is moderately productive. (Capability unit IIIe-2; Deep Hardland range site)

Active Dunes

Active dunes (Ad) is a land type made up of the barren, active sand dunes that occur in a few small, scattered areas along the Prairie Dog Town Fork of the Red River. They are 100 to 600 acres in size.

These dunes range from 25 to 100 feet in height. They consist of light-colored, eolian sand or fine sand and show little or no soil development.

Active dunes occur near the Tivoli soils, but do not have the thin, darkened surface layer that is characteristic of those soils.

Active dunes are excessively drained and have a low water-holding capacity. They have low natural fertility. Most areas of dunes have either no vegetation or only a sparse cover. Because they are bare or sparsely covered, the dunes are constantly shifting. This land type has little value except possibly for wildlife; it should be protected from grazing. (Capability unit VIIIs-1)

Altus Series

The Altus series consists of deep, dark, friable, loamy soils that are well drained and have formed in old alluvium. These soils are inextensive in this county. They occur mostly in the northern part, in the valleys of small streams and drainageways. They are level to nearly level.

The surface layer is friable, brown fine sandy loam about 16 inches thick. It has weak, subangular blocky structure.

The subsoil is brown or dark-brown sandy clay loam about 20 inches thick. It has subangular blocky structure. The upper part is darker and contains less clay. The lower part contains free lime.

The substratum consists of loamy, friable, calcareous alluvium. In most areas lime has accumulated in the upper part.

The surface layer ranges from 8 to 20 inches in thickness. It ranges from brown to grayish brown in color.

The subsoil ranges from sandy clay loam to clay loam in texture and from dark reddish gray to dark brown in color. In most places depth to the substratum is 30 to 42 inches.

The Altus soils are darker and are in lower positions than the Miles soils. They are sandier and more mature than the Tipton soils.

The Altus soils are moderately permeable. They have high natural fertility and are very productive. Most areas are in low positions and receive extra water as run-off from surrounding soils. The soils are moderately susceptible to wind erosion.

All the acreage of these soils is cultivated. Cotton and grain sorghum are grown extensively, and irrigation is practiced in some areas.

Altus fine sandy loam, 0 to 1 percent slopes (A1A).— This soil occurs in nearly level, scattered areas in the northern part of the county. The slopes average about 0.3 percent. The areas range in size from 25 to 1,000 acres. Most areas are parallel to the drainageways and small streams.

This soil is like the one described for the series. A few areas are slightly eroded, and a few shallow gullies occur along the drainageways.

Mapped with this soil are areas that have a loam surface layer. These included areas occur in the low places and make up about 5 percent of the total acreage. Also included are areas of Miles fine sandy loam, 0 to 1 percent slopes. These occur in the more sloping areas and make up about 3 percent of the total acreage. Small areas of Tipton loam, 0 to 1 percent slopes, in slightly lower positions along drainageways are also mapped with this soil. These included areas are all less than 5 or 6 acres in size.

All the acreage of this Altus soil is cultivated and is highly productive. The soil is well suited to cotton and grain sorghum. Crops respond readily to fertilizer if adequate moisture is available. The hazard of wind erosion is moderate. Crop residue should be left on the surface as much as possible to control erosion and to conserve moisture. The soil is well suited to sprinkler irrigation. (Capability unit IIIe-4; Sandy Loam range site)

Arch Series

The Arch series consists of shallow upland soils. These soils developed in highly calcareous outwash materials intermixed with gypsum. They are inextensive and occur only in small, scattered areas mainly in the northern and northeastern parts of the county. They have nearly level to gentle slopes. In Hall County the Arch soils are mapped only in a complex with the Cottonwood soils.

The surface layer is brown loam about 8 inches thick. It has weak, granular or subangular blocky structure and contains free lime.

The subsoil is friable, brown or grayish-brown loam or light clay loam about 12 inches thick. It has weak, subangular blocky structure. Free lime is present.

The substratum consists of white or grayish-colored beds of calcium carbonate and gypsum several feet thick.

These materials are soft and chalky in the upper part but are more compact in the lower part.

The surface layer of these soils ranges from 6 to 12 inches in thickness and from brown to reddish brown in color. On the more nearly level slopes, the surface layer is thickest and has the darkest color. The subsoil ranges from brown or grayish brown to reddish brown in color. Depth to the substratum ranges from 12 to 30 inches, but in most places it is 16 to 24 inches.

The Arch soils are more deeply developed than the Cottonwood soils, which have formed in gypsum materials. They are not so deeply developed as the St. Paul, Abilene, and Tipton soils.

These soils are well drained and have moderate permeability. Their water-holding capacity is low to moderate because of the shallow depth. Fertility and productivity are low to moderate. The soils are slightly to moderately susceptible to water and wind erosion.

Most of these soils are cultivated. They are best suited to shallow-rooted crops and grass.

Arch and Cottonwood soils, 0 to 3 percent slopes (ArB).— This mapping unit consists of an undifferentiated group of Arch and Cottonwood soils. It occurs mainly in the northern and northeastern parts of the county in only a few small areas. The areas are irregular in shape and in most places are less than 100 acres in size. They are mostly gently sloping. The slopes are dominantly 1 to 2.5 percent.

The percentage of each soil in mapped areas of this undifferentiated group varies. In most areas, Arch loam makes up 75 to 80 percent of the total acreage. In an area 5 miles southwest of Lakeview, the Cottonwood soils make up about 25 to 30 percent. The Cottonwood soils occur in areas of 1 to 3 acres surrounded by the Arch soils (fig. 9).

Included in mapped areas of this unit are small areas along drainageways that are moderately eroded.

Most areas of these soils are cultivated. Because of their restrictive root zone, the soils are best suited to small grain, grain sorghum, and other shallow-rooted crops. Crops respond readily to fertilizer. The Cottonwood soils of this unit generally are not suitable for crops, but because of their small acreage, they are cultivated along with the

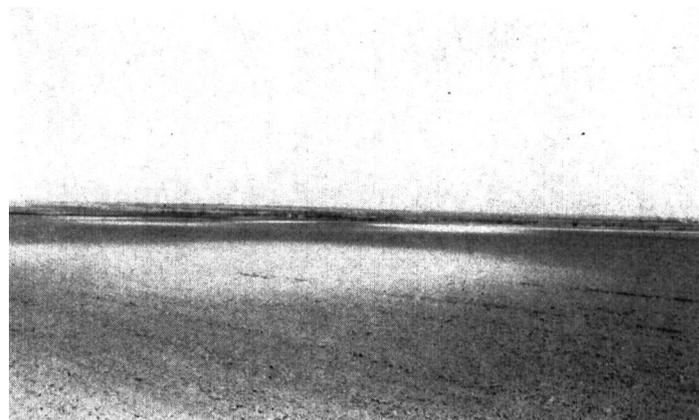


Figure 9.—An area of Arch and Cottonwood soils. The light-colored parts are Cottonwood soils.

Arch soils. They are better suited to native grass. (Arch part, capability unit IVe-7 and Mixedland range site; Cottonwood part, capability unit VIIIs-1 and Gypland range site)

Brownfield Series

The Brownfield series consists of deep, light-colored, sandy soils that have formed in sandy outwash or eolian materials. They are only in one small area in the southwestern corner of the county. They range from nearly level to moderately sloping.

The surface layer is light-brown to brown fine sand about 26 inches thick. The upper part is slightly darker than the lower part. This layer is structureless, loose, and free of lime.

The subsoil is reddish-brown sandy clay loam about 16 inches thick. It has subangular blocky structure and is free of lime.

The substratum is light-brown or light reddish-brown, structureless, loose sand or loamy sand. It is free of lime.

The surface layer ranges from 12 to 34 inches in thickness and from light reddish brown to light brown in color. The subsoil ranges from 10 to 24 inches in thickness and from red to reddish brown in color. In texture, the subsoil ranges from sandy clay loam to clay loam.

The Brownfield soils have a more clayey subsoil than the nearby Nobscot soils. They have a sandier surface layer than the Miles soils.

Brownfield soils are well drained and are moderately permeable. They have low natural fertility. They are highly susceptible to wind erosion.

Some areas of the Brownfield soils have been cultivated, but most areas now have been taken out of cultivation. These soils are best suited to permanent plants because of the hazard of wind erosion. Cotton is the main crop grown on Brownfield soils.

Brownfield fine sand, thick surface (Br).—This soil occurs mostly in one continuous area in the southwestern corner of the county. Slopes range from 0 to 5 percent but are dominantly 0.5 to 3 percent. The soil is mostly smooth and is nearly level to gently sloping in the areas that are in native range. In areas that have been cultivated, this soil has billowy microrelief.

This soil is similar to the one described for the series. In most areas that have been cultivated, the soil is moderately eroded, as shown by the many low dunes, 1 to 3 feet high, and the shallow blowouts. The original subsoil is exposed over 10 to 15 percent of the area.

Included with this soil in mapping are areas of Nobscot fine sand. These inclusions make up about 5 percent of the mapping unit. Also included are areas of Brownfield fine sand, thin surface, which occurs in low places and also makes up about 5 percent of the mapping unit. The inclusions are mostly less than 10 or 15 acres in size.

This Brownfield soil is highly susceptible to wind erosion. It is best kept in native vegetation, for once the protective cover is destroyed, the soil erodes readily. This soil is good for grass production, and the areas now in cultivation are better suited to native grasses. (Capability unit VIe-7; Deep Sand range site)

Brownfield fine sand, thin surface (Bf).—This soil is nearly level in most places and is near Brownfield fine

sand, thick surface. The slopes range from 0 to 3 percent but are dominantly 0.5 to 1.5 percent.

This soil has a thinner surface than the one described for the series. The surface layer ranges from 12 to 18 inches in thickness and has fine sand texture. The subsoil is sandy clay loam about 18 inches thick.

Included with this soil in mapping is Brownfield fine sand, thick surface. It makes up about 10 percent of the mapping unit. Also included is Miles loamy fine sand, 0 to 3 percent slopes, which makes up about 5 percent. The inclusions are less than 5 to 8 acres in size.

Most areas of this Brownfield soil are cultivated. The soil is highly susceptible to wind erosion. In most areas the sandy clay loam subsoil is close enough to the surface to be brought up by deep plowing. All available crop residue should be kept on the surface as much as possible to help control wind erosion. Cotton and grain sorghum are grown extensively on this soil, but it is best suited to permanent grasses. Crops respond readily to fertilizer. This is a good soil for grass. (Capability unit IVe-6; Sandyland range site)

Carey Series

The Carey series consists of deep, reddish-brown, friable upland soils (fig. 10). They occur extensively in the gently sloping, sandy, red-bed areas in the eastern part of the county.

The surface layer is reddish-brown, friable loam about 8 inches thick. It is free of lime and has weak, granular or subangular blocky structure.

The subsoil is about 36 inches thick. It is reddish brown, is moderately fine textured, and has subangular blocky structure. The lower part contains free lime and contains less clay than the upper part in most places.

The substratum is very fine grained soft sandstone or packsand. It is friable and is easily penetrated by roots and water. The upper part generally contains accumulations of lime.

The surface layer of the Carey soils ranges from 4 to 12 inches in thickness and from loam to very fine sandy loam in texture. The subsoil ranges from loam to clay loam in texture and from red to reddish brown in color. Generally, the steeper Carey soils have lighter colors and a coarser texture.

The Carey soils are deeper than the nearby Woodward soils, and their horizons are more distinct. They also have more clay in their subsoil and are leached free of lime to greater depths. They are lighter colored, have a more friable subsoil, and are steeper than the St. Paul soils.

The Carey soils are well drained. They have moderate permeability, and good water-holding capacity. Their natural fertility is high, and the soils are highly productive. They are slightly to moderately susceptible to both water and wind erosion.

Most areas of the Carey soils are cultivated. Cotton and grain sorghum are well suited, but cotton is grown most extensively. The soils are not irrigated.

Carey loam, 1 to 3 percent slopes (CaB).—This soil occurs extensively in the northeastern and southeastern parts of the county. The areas range from 25 acres to 2,000 acres in size. The slopes are dominantly about 2 percent.

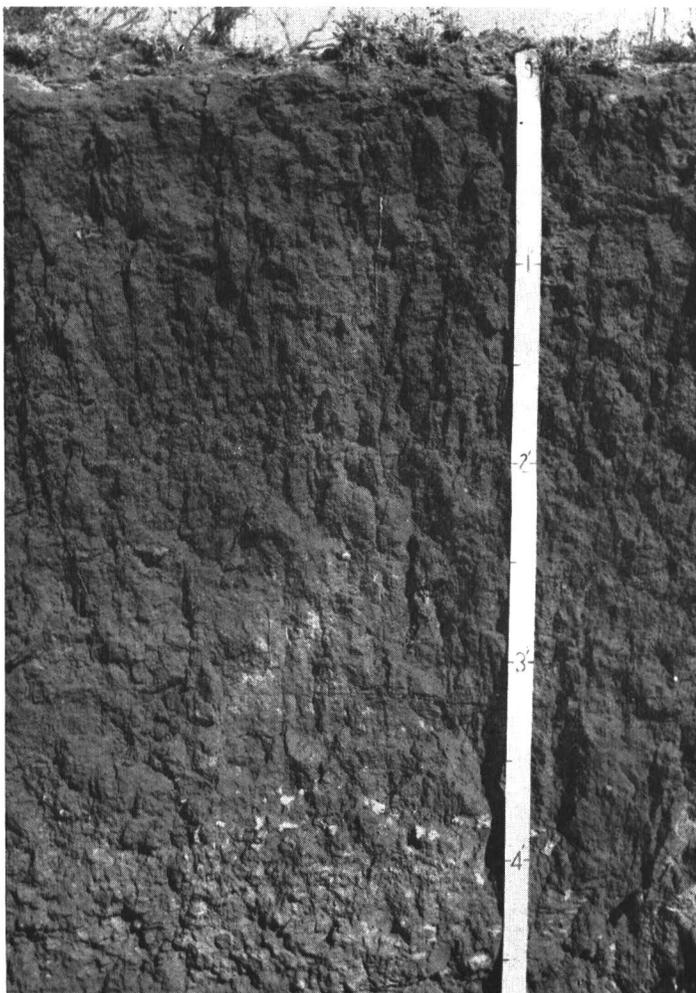


Figure 10.—Profile of Carey loam.

This soil is like the one described for the series. Most cultivated areas are slightly eroded, but a few are moderately eroded. Many rills are on the steeper slopes, and a few shallow gullies are along the drainageways.

Included with this soil in mapping are small areas of Woodward loam, 1 to 3 percent slopes, less than 5 or 10 acres in size. These areas make up about 8 percent of the mapping unit and are mostly on ridges. Also included are minor areas of St. Paul silt loam, 0 to 1 percent slopes, and 1 to 2 percent slopes. These areas are along drainageways and in low places.

Most areas of this Carey soil are cultivated. It is one of the most desirable soils in the county for cotton. Grain sorghum is also grown extensively. Natural fertility is moderate. During years that have adequate moisture, crops respond to fertilizer. The water erosion hazard is moderate if the soil is cultivated. Terraces and good management of crop residues are needed to conserve moisture and control erosion. (Capability unit IIe-1; Mixedland range site)

Carey loam, 3 to 5 percent slopes (CaC).—This soil occurs near Carey loam, 1 to 3 percent slopes. It is mostly on the steeper ridges above the less sloping soil. Slopes are mostly 3 to 4 percent. Areas of this soil range from 10 to 500 acres in size.

This soil has a thinner solum than the one described for the series. The surface layer is loam and is about 6 inches thick. The subsoil is loam or sandy clay loam about 30 inches thick. Most cultivated areas have many rills and a few shallow gullies along the drainageways.

Included with this soil in mapping are areas of Woodward loam. These included areas are on ridgetops and are mostly less than 10 acres in size. They make up about 12 percent of the mapping unit. Small scattered outcrops of alabaster gyprock occur near ridgetops.

Most areas of this Carey soil are cultivated. Cotton and grain sorghum are grown extensively. It is a good soil for cultivated crops. It has rapid runoff and is highly susceptible to water erosion. If the soil is cultivated, terraces are needed to control erosion. All available crop residue should be left on the surface to conserve moisture and control erosion. Crops on this soil respond to fertilizer during years of adequate moisture. (Capability unit IIIe-3; Mixedland range site)

Cottonwood Series

The Cottonwood series consists of very shallow, friable upland soils that have developed in chalky gypsum materials. They are not extensive and occur in only a few small areas on gentle slopes. In Hall County, Cottonwood soils are mapped only in a complex with Arch soils.

The surface layer is light-brown or brown, friable loam about 6 inches thick. It contains free lime.

The substratum consists of white or grayish-colored, calcareous, chalky gypsum in beds several feet thick.

The surface layer ranges from 3 to 12 inches in thickness and from light brown or brown to reddish brown in color.

The Cottonwood soils are not so deeply developed as the nearby Arch soils, which have developed from highly calcareous, gypsiferous, chalky earth materials.

The Cottonwood soils have very low fertility. They are well drained and are slightly susceptible to water erosion.

Most areas of these soils are cultivated because they occur along with the deeper Arch soils. They are best suited to native grasses.

Enterprise Series

The Enterprise series consists of deep, light-colored, friable upland soils (fig. 11). They formed in wind-deposited, loamy materials that were blown from the channels of the Prairie Dog Town Fork of the Red River and other major streams when the channels were dry. These soils occur mostly along the Red River in the central part of the county. They range from nearly level to moderately steep. The coarser textured soils are nearer to the stream channels, and the finer materials are farther away.

The surface layer is light reddish-brown or reddish-brown very fine sandy loam or fine sandy loam to a depth of 24 inches. This layer contains free lime and has weak, granular or subangular blocky structure. In cultivated areas, the plow layer is slightly lighter colored than the lower part.

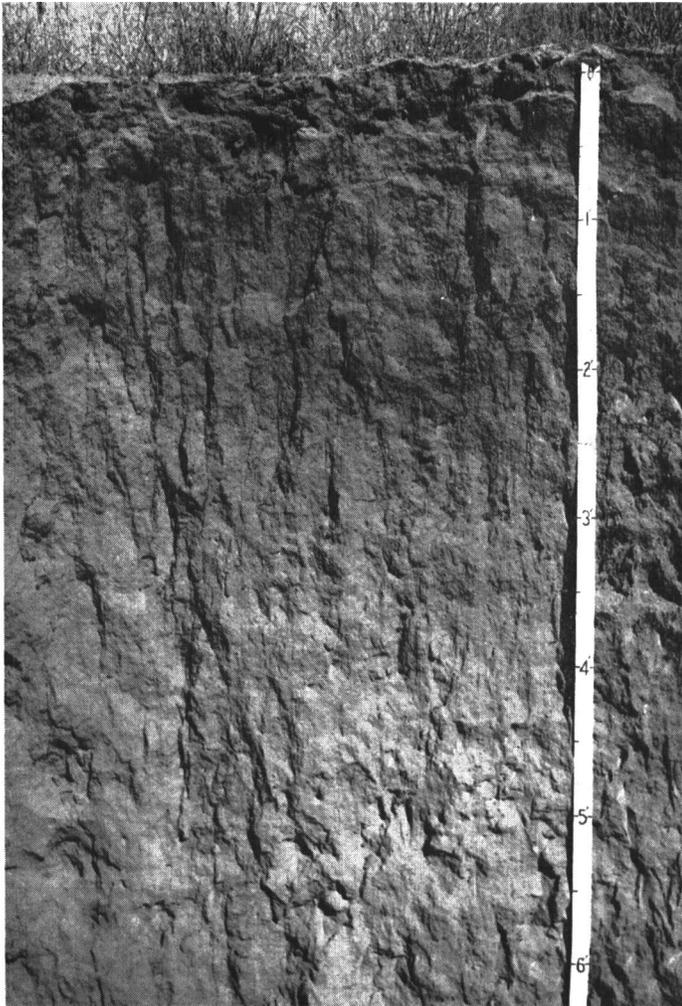


Figure 11.—Profile of Enterprise very fine sandy loam.

The subsurface layer is light reddish-brown very fine sandy loam or fine sandy loam that contains free lime. This soft, loamy, wind-deposited material is easily penetrated by roots. It ranges in thickness from 20 feet or more near the river channels to 1 or 2 feet at the outer edges. The mantle becomes progressively thinner as the distance from the river channels increases.

The thickness of the surface layer ranges from 15 to 34 inches and the color from light reddish brown to reddish brown. The texture of the surface layer ranges from loam or very fine sandy loam to fine sandy loam or loamy fine sand. The texture and color of the subsurface layer are similar to those of the surface layer.

The Enterprise soils are not so sandy as the Tivoli soils and do not have the duny topography that characterizes those soils. They are deeper than the Woodward soils, which have developed in soft sandstone material.

The Enterprise soils are well drained and are moderately rapidly permeable. They have a moderate water-holding capacity. Natural fertility is low to moderate. These soils are moderately to highly susceptible to wind erosion. The hazard of water erosion is slight in nearly level areas and moderate or high on the steep areas.

Most of these soils are cultivated. Cotton and grain sorghum are grown extensively. The soils are moderately productive. Crops on them respond well to fertilizer, especially in the sandier areas. A few areas are irrigated where water is available. The steep areas that are cultivated are better suited to native grasses.

Enterprise very fine sandy loam, 0 to 1 percent slopes (EmA).—This soil occurs in nearly level, scattered areas of the uplands bordering both sides of the Prairie Dog Town Fork of the Red River. The mapped areas range in size from 10 to 1,000 acres. The largest area is near Newlin.

This soil is slightly darker colored than the soil described for the series. The surface layer is a reddish-brown very fine sandy loam about 30 inches thick.

Included with this soil in mapping are a few areas that have a loam or silt loam surface layer. Also included are scattered narrow areas of Yahola very fine sandy loam along the drainageways.

All the acreage of this Enterprise soil is cultivated. The soil is very productive and is one of the most desirable soils in the county for cotton. Most areas receive extra water as runoff from surrounding higher soils. This soil is also well suited to grain sorghum. Crops respond to fertilizer only during years that have more than average rainfall. (Capability unit IIc-2; Mixedland range site)

Enterprise very fine sandy loam, 1 to 3 percent slopes (EmB).—This soil occurs mainly along both sides of the Red River in the central part of the county. The slopes are dominantly about 2 percent. The areas range from 25 to 2,000 acres in size.

This soil is like the one described for the series. A few rills and shallow gullies occur along the drainageways.

Included in mapping are small areas of Enterprise very fine sandy loam, 0 to 1 percent slopes, Enterprise very fine sandy loam, 3 to 5 percent slopes, and Enterprise fine sandy loam, 1 to 3 percent slopes. Also included at the extreme edges and mostly on ridges are areas of Woodward loam, 1 to 3 percent slopes. These inclusions are less than 5 or 10 acres in size and make up about 5 percent of the mapping unit.

This Enterprise soil is moderately susceptible to water erosion if cultivated. The wind erosion hazard is slight. Terraces and good residue management are needed to control erosion and conserve moisture.

Most areas of this soil are cultivated. The fertility is moderate, and crops respond to fertilizer if adequate moisture is available. Because this soil is well suited to cultivation, it is used extensively for cotton and grain sorghum. (Capability unit IIe-1; Mixedland range site)

Enterprise very fine sandy loam, 3 to 5 percent slopes (EmC).—This soil occurs mostly on ridges in scattered moderately sloping areas. The slopes are dominantly 3 to 4 percent. The areas range in size from 10 to 300 acres.

The surface layer is light reddish-brown very fine sandy loam about 20 inches thick. In most cultivated areas, it is slightly eroded; in a few areas it is moderately eroded. It has many rills and a few gullies along the drainageways. Sandy red beds occur at a depth of 2 to 6 feet in a few places.

Included in mapping are small areas of Enterprise very fine sandy loam, 1 to 3 percent slopes, and Enterprise very

fine sandy loam, 5 to 12 percent slopes. Also included are a few areas that have a fine sandy loam surface layer. On some of the ridges, Woodward loam, 3 to 5 percent slopes, is also included. The inclusions are mostly less than 5 acres in size and make up about 10 percent of the total acreage. Outcrops of alabaster gypsum are on some ridgetops.

Most areas of this Enterprise soil are cultivated. It is a good soil, but rapid runoff makes it highly susceptible to water erosion. Terraces should be used to reduce runoff. Good residue management also helps to control erosion and conserve moisture. Cotton and grain sorghum are grown extensively on this soil. It is moderately productive, and crops on this soil respond to fertilizer if adequate moisture is available. (Capability unit IIIe-3; Mixedland range site)

Enterprise very fine sandy loam, 5 to 12 percent slopes (EmD).—This soil occurs in strongly sloping to steep areas mostly along the north side of the Prairie Dog Town Fork of the Red River. The slopes are dominantly 5 to 10 percent. The areas of this soil are irregular in shape and range in size from 10 to 300 acres.

The surface layer is 15 to 18 inches thick. It is slightly lighter colored than that of the less sloping Enterprise soils. The few cultivated areas are slightly eroded to moderately eroded. These areas have many rills and a few gullies along the drainageways.

Included in mapping are areas of Enterprise soils that have a fine sandy loam surface layer. They make up about 5 percent of the mapping unit. Also included in the smoother areas are small areas of Enterprise very fine sandy loam, 3 to 5 percent slopes. Rough broken land that consists of escarpments and gullied areas along the north bank of the Prairie Dog Town Fork of the Red River make up about 2 percent.

Because of steep slopes and high susceptibility to erosion, this Enterprise soil is suitable only for permanent vegetation. Runoff is rapid. This is a very good soil for grass production. A few areas are cultivated, but are better suited to native grass. The dominant species of grass are blue grama, sideoats grama, and little bluestem. (Capability unit VIe-4; Mixedland range site)

Enterprise fine sandy loam, 0 to 1 percent slopes (EfA).—This soil occurs in nearly level, irregularly shaped areas along the Prairie Dog Town Fork of the Red River and along other major streams in the central and northern parts of the county. The areas are scattered and range in size from 25 to 1,000 acres.

The surface layer is reddish-brown fine sandy loam about 24 inches thick. The substratum is light reddish-brown fine sandy loam. A few areas are slightly wind eroded.

About 10 percent of the acreage mapped as this soil has a loamy fine sand surface layer because the wind has removed the finer particles from the plow layer. In valleys a few areas of alluvial soils that are similar to these soils are also included.

Most areas of this Enterprise soil are cultivated. Cotton and grain sorghum are grown extensively. The soil is moderately productive, and crops respond to fertilizer in most years. The wind erosion hazard is moderate. Crop residue should be kept on the surface as much as possible to control erosion. Most areas are low enough to receive extra water from runoff. (Capability unit IIIe-5; Sandy Loam range site)

Enterprise fine sandy loam, 1 to 3 percent slopes (EfB).—This soil occurs in gently sloping to undulating areas, mostly on the south side of the Prairie Dog Town Fork of the Red River between Estelline and Parnell. The areas range from 10 to 500 acres in size.

This soil has a reddish-brown fine sandy loam surface layer about 20 inches thick. The subsoil is light reddish-brown, very friable fine sandy loam. Most cultivated areas are slightly sandier in the upper part of the surface layer because the fine particles have been removed by wind. Wind erosion is a moderate hazard. A few shallow gullies and rills occur along drainageways.

About 15 percent of the acreage mapped as this soil has a loamy fine sand plow layer. Also included are a few small areas of Enterprise very fine sandy loam, 1 to 3 percent slopes.

Most areas of this Enterprise soil are cultivated. The soil is moderately susceptible to wind erosion and to water erosion. It erodes readily, however, when water moves over the surface. Crop residue management is needed to reduce the erosion hazard. Cotton and grain sorghum are grown extensively on the soil. It is moderately productive. (Capability unit IIIe-5; Sandy Loam range site)

Enterprise fine sandy loam, 3 to 5 percent slopes (EfC).—This soil occurs in small, scattered areas on side slopes of ridges. The areas are mostly less than 50 acres in size. A few areas along drainageways are severely eroded and have small gullies. Most of the cultivated areas have been slightly eroded by wind.

This soil is lighter colored and thinner than the less sloping Enterprise soils. It has a light reddish-brown surface layer about 16 inches thick. The surface layer and subsoil have fine sandy loam texture.

Included with this soil in mapping are areas that have a loamy fine sand surface layer because wind has removed the finer particles. These areas make up 15 percent of the mapping unit. Also included are a few areas of blowouts and dunes. The wind-eroded areas are usually less than 5 acres in size.

Most areas of this Enterprise soil are cultivated. It is a fair soil for cultivated crops but is highly susceptible to water and wind erosion. Runoff is rapid. Cotton and grain sorghum can be grown on this soil, but high-residue crops are best suited. Some areas are better suited to permanent grass. (Capability unit IVE-9; Sandy Loam range site)

Enterprise soils, wind-hummocky (Eh).—This mapping unit consists of Enterprise soils that have been moderately eroded by wind. They are undulating to hummocky and have slopes that are mostly 1 to 3 percent. The areas of this unit are scattered but occur mainly west of Estelline near the Prairie Dog Town Fork of the Red River. They are irregular in shape and range from 25 to 300 acres in size.

The surface layer is mostly fine sandy loam and loamy fine sand. In 60 to 75 percent of the areas, it is loamy fine sand. The subsoil is fine sandy loam, and this material is exposed in 10 to 20 percent of the areas. Small dunes 1 to 3 feet high cover 20 to 30 percent of the total area of this unit.

All the acreage of these soils has been cultivated. Most areas are now idle or have reverted to grass. The soils are highly susceptible to wind erosion. They have

low fertility and are best suited to permanent grass. (Capability unit IVE-9; Sandy Loam range site)

Gravelly Broken Land

Gravelly broken land (Gr) is a land type consisting of a mixture of outwash gravel and sand. The areas are small, irregular, and scattered, and they occur mostly along the larger drainageways and streams in the northern part of the county. The deposits range from 3 to 20 feet in thickness. The slopes range from 3 to 25 percent but are dominantly between 5 and 15 percent. Mapped areas of this land type range from 25 to 500 acres in size.

The areas consist of numerous narrow ridges that are broken by deep drains (fig. 12). The tops of the ridges



Figure 12.—View of Gravelly broken land showing typical topography.

range from 25 to 200 feet in width. The bottoms of the drains range from 10 to 30 feet in width. The vertical distance from the tops of the ridges to the bottoms of the drains ranges from 30 to 60 feet.

Gravelly broken land consists of a mixture of stratified sand and gravel in varying amounts. Gravel, mostly less than 2 inches in diameter, generally makes up 50 to 80 percent of this land type. The sand is very coarse. The tops of the ridges are capped with gravel in most places.

Included in mapped areas of this unit are small areas of Springer loamy fine sand, Miles loamy fine sand, and Miles fine sandy loam. Most of the inclusions occur near the edges of this unit and are less than 10 or 15 acres in size. Gravel pits are common in many areas.

All areas of this unit are in range. Runoff is very rapid. Most areas support only a sparse cover of vegetation, and the dominant plant species are sideoats grama, blue grama, and little bluestem. Careful management is required to keep the plants vigorous. (Capability unit VIa-1; Gravelly range site)

Guadalupe Series

The Guadalupe series consists of calcareous, grayish-brown alluvial soils. They occur in narrow bands parallel to Oaks Creek and other small streams in the northern part of the county.

The surface layer is fine sandy loam to a depth of 15 inches. It is brown, very friable, and moderately alkaline.

The substratum is dark-brown, moderately alkaline loam. It contains thin lenses of sandier material.

The surface layer ranges from 12 to 18 inches in thickness and from brown to grayish brown in color.

The Guadalupe soils are sandier than the Spur soils. They are browner than the Yahola soils.

These soils have moderate fertility, and most areas are cultivated.

In Hall County, the Guadalupe soils are mapped only in an undifferentiated soil group with the Tipton soils.

Guadalupe and Tipton soils (Gt).—This undifferentiated group of soils occurs in narrow bands parallel to small streams in the northern part of the county. They consist of sandy materials that were deposited near the streams by floodwaters. Most areas are occasionally flooded. These soils are nearly level; slopes are mostly 0.3 to 0.5 percent. These soils are not extensive, and most areas are less than 100 acres in size.

In most places the water table is at a depth of 3 to 6 feet. The hazard of wind erosion is moderate to high. Fertility is moderate. These soils are best suited to small grain or grain sorghum. They are also well suited to bermudagrass if water for irrigation is available. (Capability unit IIIe-4; Loamy Bottomland range site)

Latom Series

The Latom series consists of very shallow, stony soils. They have formed in materials from hard sandstone. These soils are not extensive. They occur mostly on the top of the sandstone buttes in the northeastern part of the county (fig. 13). They are gently sloping to steep.

The surface layer is brown stony loam about 4 inches thick. It has weak, granular structure and contains free lime. Small stones are on the surface and throughout the surface layer.

The substratum is hard sandstone that is generally covered by a thin coating of lime. The lime and sandstone materials are several feet thick.

The surface layer ranges from 1 to 10 inches in thickness and from brown to reddish brown in color.

The Latom soils are darker colored than the Quinlan soils. They are underlain by hard sandstone rock, whereas the Quinlan soils are underlain by soft sandstone material.

The Latom soils have low productivity because they are very shallow. They are suitable only for range. The grasses grown are mostly buffalograss, blue grama, and sideoats grama.

Latom stony loam, 3 to 12 percent slopes (LaD).—This soil occurs in small, scattered areas in the northeastern part of the county. Most areas cover the tops of the sandstone buttes. The areas range in size from 10 to 300 acres. Slopes mostly range from 3 to 10 percent.

Included in mapping are small areas of Rough broken land that are on escarpments downslope from these soils. Also included are small areas of Quinlan loam.

All the acreage of this Latom soil is in range, but it is suitable for only limited grazing. The dominant plants are sideoats grama and blue grama. The soil has a shallow root zone and is capable of producing only a limited amount of vegetation. Careful management is

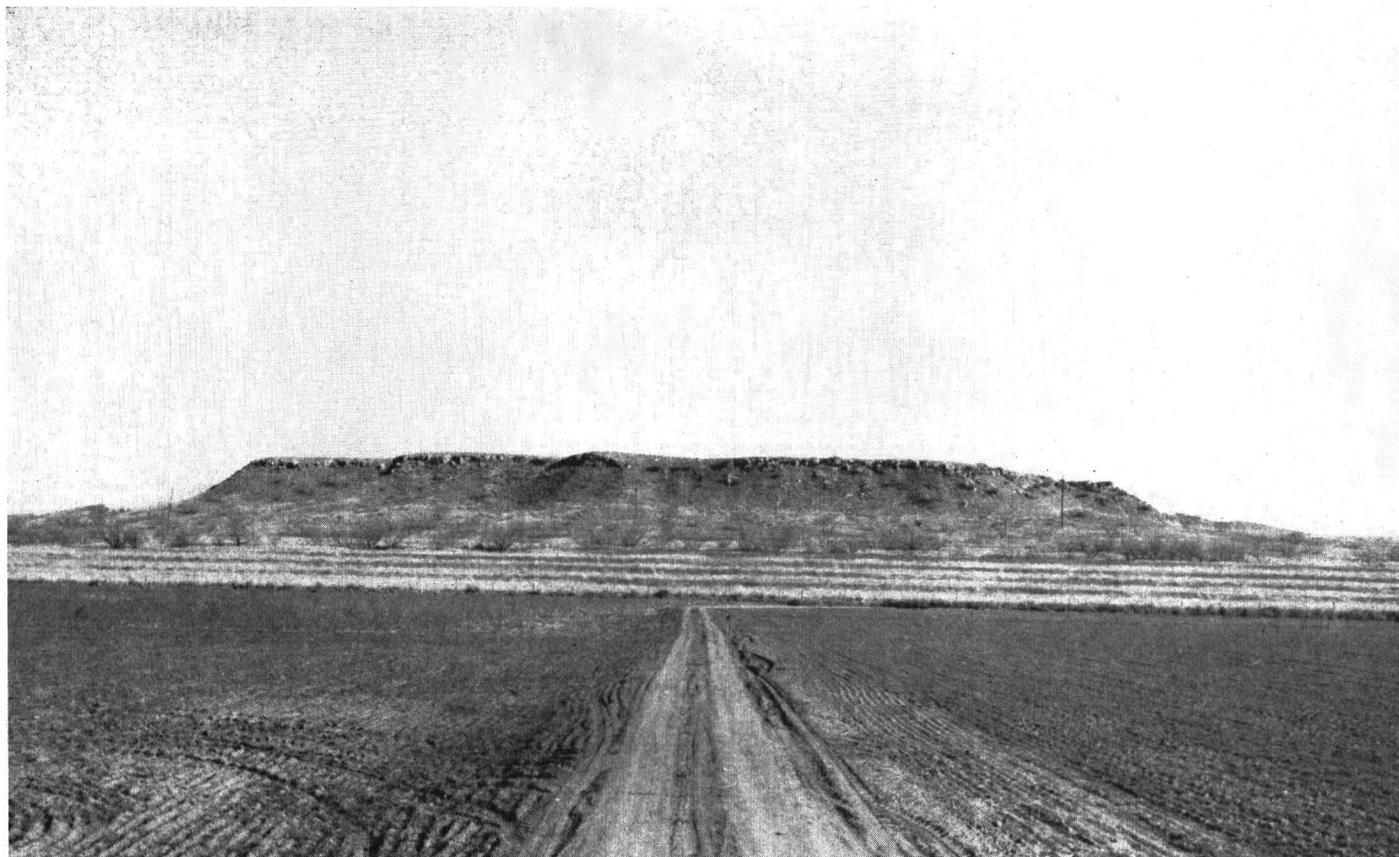


Figure 13.—View of a butte in Hall County that is capped with Latom stony loam.

required to maintain a vigorous growth of grass. (Capacity unit VII_s-1; Very Shallow range site)

Lincoln Series

The Lincoln series consists of light-colored, sandy, alluvial soils that have a very sandy subsoil. They are not extensive and occur mainly in small, scattered areas on the level flood plains along the Prairie Dog Town Fork of the Red River and along large streams in the northern part of the county.

The surface layer is fine sandy loam or loamy fine sand to a depth of 24 inches. It is reddish brown or light reddish brown, is structureless, and contains free lime. It is stratified with thin lenses of sandy and silty materials.

The substratum consists of coarse sandy riverwash that is yellowish red to pink and is structureless.

The color of the surface layer ranges from light reddish brown to reddish brown or reddish yellow. The texture ranges from fine sandy loam to loamy fine sand. Depth to the sandy substratum is 15 to 30 inches in most places. The texture of the substratum ranges from sand to a mixture of sand and gravel. The color ranges from reddish yellow to pink or light reddish brown. A water table occurs at a depth of 2 to 4 feet in most places.

The Lincoln soils are sandier than the Yahola soils, which occur in similar positions, and are less variable. They are higher than Sandy alluvial land and, consequently, are flooded less frequently.

These soils have a low water-holding capacity and low fertility. They are generally too wet for cultivation because of the high water table. The free water also contains a large amount of salts that, in most places, makes the soils saline. The soils are best suited to permanent grass. In Hall County the Lincoln soils are mapped only in an undifferentiated group with the Yahola soils.

Lincoln and Yahola soils (Ly).—This undifferentiated group of soils occurs on the nearly level flood plains of large streams in narrow areas parallel to the stream channels. These soils range from 25 to 500 acres or more in size. The larger areas are along the Prairie Dog Town Fork of the Red River. Most areas are flooded occasionally, but a few are cut off from the river by the Tivoli soils.

This group consists of Lincoln and Yahola soils that are so closely associated that it is not practical to separate them on a map of the scale used. Most areas are a mixture of both soils, but a few are almost entirely Lincoln soils. The Lincoln soils comprise 75 to 90 percent, and Yahola soils 10 to 25 percent, of the total acreage of this group.

The Lincoln soils in this group are similar to the one described for the Lincoln series. The Yahola soils are similar to Yahola fine sandy loam. Some of the Yahola soils, however, have a sandy substratum at a depth of 3 to 4 feet.

Included in mapping are small areas of Tivoli fine sand. Also included are small areas of Sandy alluvial land,

which occur in lower positions. These areas make up about 5 percent of the total acreage. A few areas are included that have a billowy surface and are slightly eroded by wind.

This undifferentiated group of soils is mostly in range. A few areas that were cultivated have now been returned to grass, for which they are best suited. (Lincoln soils, capability unit Vw-2 and Sandy Bottomland range site; Yahola soils, capability unit IIIe-5 and Loamy Bottomland range site)

Loamy Alluvial Land

Loamy alluvial land, depressed (Ld) is a land type that consists of the natural lakes, or potholes, that occur throughout the county but mostly in the northern part. This land type is not extensive, and areas range in size from 5 acres to 600 acres. Most areas of this unit have large drainageways flowing into them and have no outlets. Many areas contain water most of the time, but a few areas contain water only during wet periods.

The texture of the soil materials is variable. It ranges from sandy loam to clay loam. In most places the texture is similar to the texture of the surface layer of the surrounding soils. Most of the areas have received several feet of recent loamy sediment. The sediment is distinctly stratified.

Included in mapped areas are a few areas of permanent water. These areas have large drainageways flowing into them.

All areas of this unit are naturally poorly drained, and most have excess water. They are best suited to wildlife and range. A few areas are farmed during dry periods, and a few have been drained so that they can be farmed more often. (Capability unit Vw-1; Loamy Bottomland range site)

Mansker Series

The Mansker series consists of moderately deep, calcareous upland soils that have formed in outwash materials (fig. 14). They occur in small, scattered areas throughout the northwestern and southwestern parts of the county. They range from nearly level to strongly sloping.

The surface layer is brown fine sandy loam about 7 inches thick. It has weak, granular structure, contains a large amount of free lime, and is very friable.

The subsoil is brown to reddish-brown sandy clay loam that has weak, subangular blocky structure. It is porous, contains much free lime, and is about 11 inches thick.

The substratum is loam or fine sandy loam and contains a large amount of free lime. Lime has accumulated in the upper part. The substratum is readily penetrated by plant roots.

The surface layer ranges from 4 to 12 inches in thickness and from brown to light brown in color. The subsoil ranges from fine sandy loam to sandy clay loam in texture. The depth to the substratum ranges from 10 to 24 inches, but in most places it is 16 to 20 inches. The texture of the substratum ranges from sandy loam to sandy clay loam.

The Mansker soils are browner and have developed in sandier materials than the Weymouth soils. They are not so deeply developed as the nearby Miles soils.

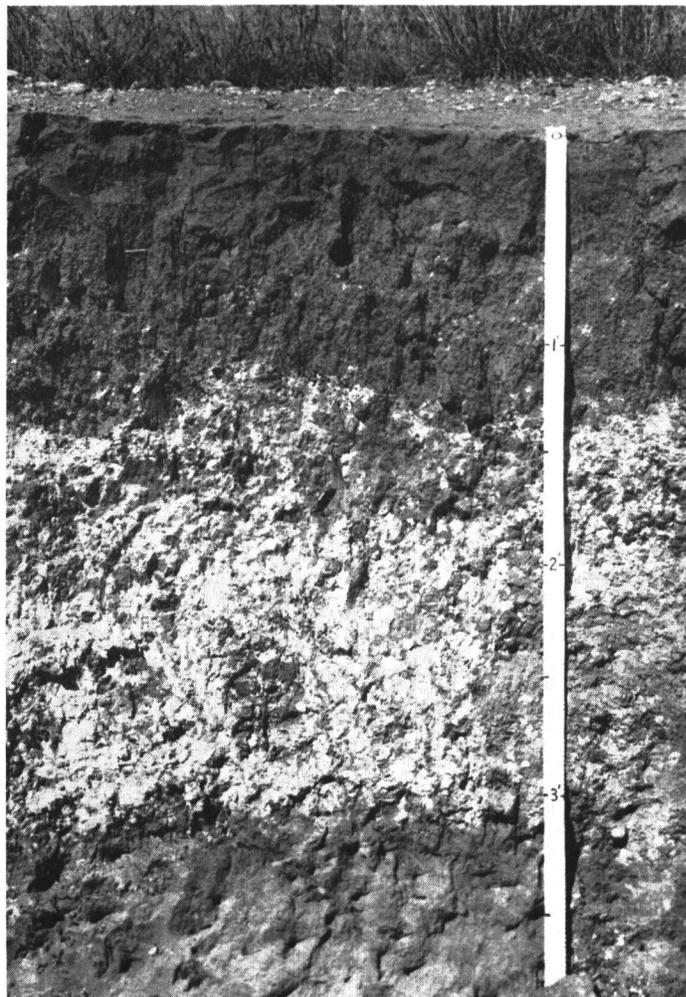


Figure 14.—Profile of Mansker fine sandy loam.

The Mansker soils are well drained and are moderately permeable. Their capacity to store moisture is moderate. Their natural fertility is low to moderate. The hazard of wind erosion is moderate, and the hazard of water erosion is slight to high, depending on the degree of slope.

Crop yields are moderate on these soils. Grain sorghum is grown most extensively. The soils are best suited to native grasses.

Mansker fine sandy loam, 0 to 3 percent slopes (MaB).—This soil is nearly level to gently sloping. The slopes are mostly 0.8 to 2.5 percent. The areas are irregular in shape and range from 10 to 500 acres in size. This soil occurs mainly on ridges and is most extensive in the northern and southwestern parts of the county.

This soil is like the one described for the Mansker series. A few areas are moderately eroded. There are many rills on the steeper slopes and a few shallow gulches along the drainageways.

Included with this soil in mapping are areas that have a loam surface layer. They make up about 5 percent. A few areas are included that have a loamy fine sand surface layer. Small areas of Miles fine sandy loam, 1 to 3 percent slopes, make up about 5 percent of the total acreage. Also included in mapping are small areas of

Mansker fine sandy loam, 3 to 5 percent slopes. The inclusions are less than 5 or 6 acres in size.

Most areas of this soil are cultivated. The soil is fair for cultivation and is moderately productive. The wind erosion hazard is moderate if the soil is cultivated, and the water erosion hazard is slight to moderate. Cotton and grain sorghum are grown extensively. Crops readily respond to fertilizer in most years. Terraces are needed on the steeper cultivated slopes to reduce erosion. (Capability unit IIIe-8; Sandy Loam range site)

Mansker fine sandy loam, 3 to 5 percent slopes (MaC).—This moderately sloping soil occurs in small, scattered areas mostly on ridges. The areas range from 10 to 300 acres in size. The slopes are dominantly about 4 percent.

This soil is slightly thinner than the one described for the Mansker series. The surface layer is about 5 inches thick. Depth to the substratum is about 16 inches. Most cultivated areas are slightly eroded to moderately eroded. The soil has many shallow rills and a few small gullies along the drainageways.

Included in mapping are a few areas of Mansker fine sandy loam, 0 to 3 percent slopes, and Mansker fine sandy loam, 5 to 12 percent slopes. Also included are small areas of Miles fine sandy loam, 3 to 5 percent slopes. A few areas are included that have a loamy fine sand surface layer. The inclusions are less than 5 or 10 acres in size and make up about 10 percent of the total acreage.

Much of the acreage of this soil has been cultivated, but some is now in permanent grass. Runoff is rapid. The soil is poor for cultivated crops but is good for grass production. Because it is highly susceptible to erosion, it is best suited to permanent grass. Grain sorghum is the dominant crop grown when the soil is cultivated. (Capability unit IVe-5; Sandy Loam range site)

Mansker fine sandy loam, 5 to 12 percent slopes (MaD).—This strongly sloping to steep soil occurs on ridges and along drainageways in small, scattered areas that range from 10 to 500 acres in size.

The surface layer is fine sandy loam about 5 inches thick. The subsoil is fine sandy loam or loam. The depth to the substratum is 12 to 15 inches. The few cultivated areas are moderately eroded to severely eroded and have many shallow gullies along drainageways.

Included in mapping are areas that have a loamy fine sand surface layer. They make up about 10 percent of the mapping unit. Also included are areas of Springer loamy fine sand that make up about 5 percent. Small areas of Mansker fine sandy loam, 3 to 5 percent slopes, and a few areas that are on steep to rough broken topography are also included.

Most areas of this soil are in range. The soil is good for producing grass. The small cultivated areas are better suited to native grasses than to crops. The soil is highly susceptible to water erosion if cultivated. Grasses well suited to this soil are little bluestem, sideoats grama, and blue grama. (Capability unit VIe-3; Sandy Loam range site)

Miles Series

The Miles series consists of deep, reddish-brown, friable, upland soils (fig. 15). They have formed in outwash or old alluvial materials. These soils are very exten-

sive, particularly in the northern and southwestern parts of the county. They are nearly level to strongly sloping.

The surface layer is reddish-brown fine sandy loam about 7 inches thick. It is friable, has granular structure, and is free of lime.

The subsoil is reddish-brown sandy clay loam about 33 inches thick. It has subangular blocky structure, is friable, and is free of lime. The upper part is darker colored, and the lower part contains less clay.

The substratum consists of friable outwash materials that are readily penetrated by roots and water. The texture is sandy clay loam or fine sandy loam. It contains free lime.

The surface layer ranges from fine sandy loam to loamy fine sand in texture. It ranges from 5 to 20 inches in thickness and from reddish brown to brown in color. The subsoil ranges from sandy clay loam to clay loam in texture and from reddish brown to red in color. The thickness of the subsoil ranges from 20 to 48 inches or more. The substratum ranges from light reddish brown to light red or yellowish red in color and from loam or sandy clay loam to fine sandy loam in texture. In some places the upper part of the substratum contains a large amount of free lime.

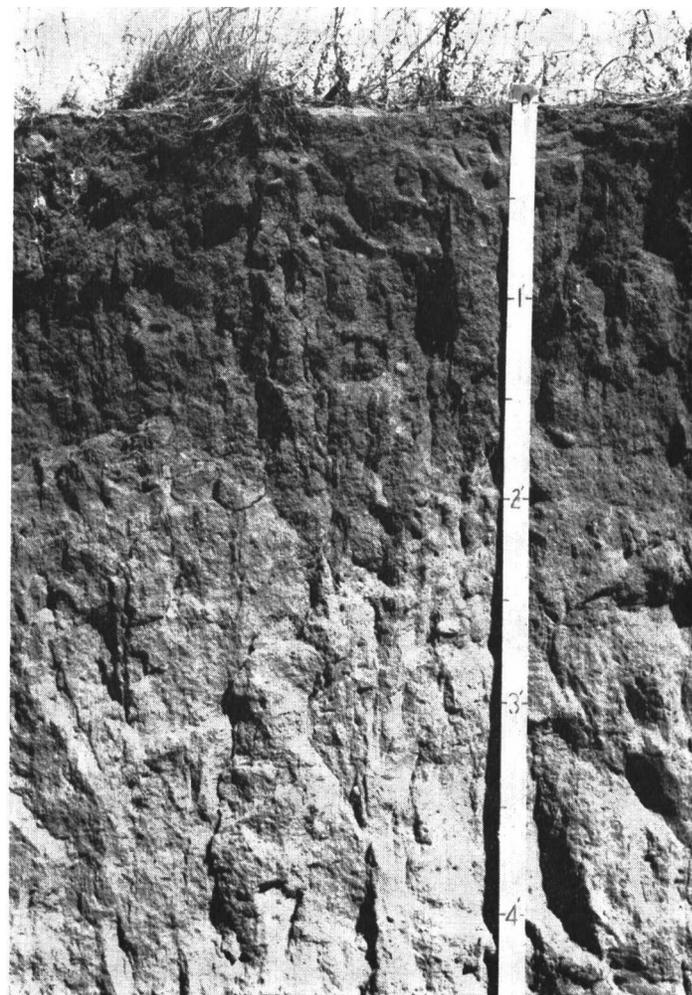


Figure 15.—Profile of Miles fine sandy loam.

The Miles soils are redder and have a less clayey and compact subsoil than the Abilene soils. They also have a less clayey and compact subsoil than the Olton soils. They are not so dark as the Tipton and Altus soils and occur in higher positions. The Miles soils are deeper and more developed than the Mansker and Weymouth. They are not so sandy as the Springer, Brownfield, and Nobscot soils.

The Miles soils are well drained, moderately permeable, and have a high capacity to store moisture and release it to plants. They have moderate to high fertility. Crops on the sandier types respond well to fertilizer, especially nitrogen. The soils are moderately to highly susceptible to erosion by wind and water.

Most areas of these soils are cultivated, and all crops grown in the area are suited. Cotton and grain sorghum are grown extensively. Some of these soils are irrigated. They are well suited to grasses.

Miles fine sandy loam, 0 to 1 percent slopes (MfA).—This soil is nearly level and is well drained. The slopes are mostly 0.3 to 0.8 percent. The areas of this soil are scattered and range from 10 to 500 acres in size. In some places the finer soil particles have been removed from the surface layer by winnowing.

The surface layer is brown fine sandy loam about 10 inches thick. It is darker than that of the more sloping Miles soils because it receives extra water and has less runoff. The upper part of the subsoil is also darker than that of the more sloping soils. It has a brown color.

Included in mapping are areas of Altus fine sandy loam, 0 to 1 percent slopes. They make up about 5 percent of the unit. Areas that have a loam surface layer make up about 3 percent. Also included in mapping are smaller areas of Olton loam, 0 to 1 percent slopes, and of Abilene clay loam, 0 to 1 percent slopes. In a few areas the surface layer is loamy fine sand. These inclusions make up about 7 percent of the total acreage.

Most areas of this soil are cultivated. This is a good soil and is very productive. Cotton and grain sorghum are the crops best suited. Crops respond to fertilizer if moisture is adequate. The wind erosion hazard is moderate. This soil is well suited to sprinkler irrigation. (Capability unit IIIe-4; Sandy Loam range site)

Miles fine sandy loam, 1 to 3 percent slopes (MfB).—This gently sloping soil is extensive in the northern and southwestern parts of the county. The areas range from 10 to 2,000 acres in size but are dominantly 100 acres or more.

This soil is like the one described for the Miles series. Most cultivated areas are slightly eroded by wind, and the surface layer is winnowed. A few areas have a billowy surface, and a few shallow gullies occur along the drainageways.

Included in mapping are a few areas that have loam and loamy fine sand surface layers. Small, scattered areas of Mansker fine sandy loam and Woodward loam occur in mapped areas on convex ridges. Also included are small areas of Miles fine sandy loam, 0 to 1 percent slopes, and of Miles fine sandy loam, 3 to 5 percent slopes. These inclusions are less than 5 or 10 acres in size and make up about 10 percent of the total acreage.

Most areas of this soil are cultivated. This is a good soil and is moderately fertile. Cotton and grain sorghum are grown extensively. Crops on this soil respond to

fertilizer in most years. The erosion hazard is moderate if the soil is cultivated. Terraces and good crop residue management help to control erosion and to conserve moisture. The soil is suitable for sprinkler irrigation. (Capability unit IIIe-4; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes (MfC).—This moderately sloping soil occurs in small, scattered areas. The slopes average about 4 percent. The areas range from 10 to 400 acres in size but are dominantly less than 100 acres. This soil occurs mostly on ridges above Miles fine sandy loam, 1 to 3 percent slopes.

Thickness of the combined surface layer and subsoil layer is slightly less than that of the soil described for the Miles series. The surface layer is fine sandy loam about 6 inches thick. The subsurface layer is sandy clay loam about 26 inches thick. Most areas of this soil are cultivated and are slightly eroded by wind. Many of the cultivated areas are also slightly to moderately eroded by water, and a few areas along drainageways are severely eroded. A few gullies occur.

Included in mapping are small areas of Miles fine sandy loam, 1 to 3 percent slopes, and Miles fine sandy loam, 5 to 8 percent slopes. Also included are a few areas that have a loamy fine sand surface layer. Mansker fine sandy loam, 3 to 5 percent slopes, makes up about 5 percent of this mapping unit. Small areas of Woodward loam, 3 to 5 percent slopes, are included in places on ridge tops. The inclusions are mostly less than 5 or 10 acres in size.

This soil is moderately to highly susceptible to erosion by water and wind. Runoff is rapid. This soil is fair for cultivation. It is best suited to grain sorghum and other crops that produce a large amount of crop residue. The residue should be kept on the surface to help control erosion. Crops readily respond to fertilizer. Terraces are used in most areas to reduce runoff. This soil is very good for the production of grass. (Capability unit IVE-4; Sandy Loam range site)

Miles fine sandy loam, 5 to 8 percent slopes (MfD).—This soil occurs on strongly sloping ridges in the northern part of the county in only a few areas. These areas are irregular in shape and range from 25 to 200 acres in size. The slopes are mostly 5 to 7 percent.

This soil is thinner than the one described for the Miles series. The surface layer is about 5 inches thick. The subsoil is sandy clay loam about 24 inches thick.

Included with this soil in mapping are areas of Mansker fine sandy loam, 5 to 12 percent slopes. They make up about 5 percent of the unit. Also included are small areas of Woodward-Quinlan loams, 5 to 12 percent slopes. About 10 percent of the mapping unit has a fine sandy loam subsoil.

This soil is too steep for safe cultivation because of the erosion hazard. Runoff is very rapid. Fertility is moderate. The soil is very good for grass production. Among the dominant species are sideoats grama, blue grama, and little bluestem. A few areas that have been cultivated have now been returned to grass. (Capability unit VIe-5; Sandy Loam range site)

Miles loamy fine sand, 0 to 3 percent slopes (MmB).—This soil is nearly level to gently sloping. The slopes are dominantly 0.5 to 1.5 percent. The soil is extensive, and the areas range from 25 to 2,000 acres in size.

The surface layer is reddish-brown loamy fine sand about 16 inches thick. The subsoil is reddish-brown

sandy clay loam about 32 inches thick. The substratum is fine sandy loam. It is free of lime.

Included with this soil in mapping are areas of Springer loamy fine sand, undulating. These areas make up about 5 percent of the mapping unit and in most places are less than 10 acres in size. Also included are a few areas that have a fine sandy loam surface layer and some small, scattered areas of Mansker fine sandy loam, 0 to 3 percent slopes. These included soils make up about 10 percent of the total acreage.

This soil is highly susceptible to wind erosion. Most areas are cultivated and are slightly to moderately eroded. The finer particles have been removed by wind. A few areas are moderately eroded by water, especially along the drainageways.

This soil is fairly well suited to cultivation. It is best suited to grain sorghum and other crops that produce large amounts of crop residue. Cotton is also grown extensively. Crops respond readily to fertilizer. Crop residue should be kept on the surface to help control erosion. Deep plowing is commonly used to bring clayey material to the surface to reduce wind erosion. (Capability unit IVE-6; Sandyland range site)

Miles loamy fine sand, 3 to 5 percent slopes (MmC).—This soil occurs in small, scattered areas of irregular shape that are less than 300 acres in size. Most areas are in the northern part of the county. The slopes are mostly 3 to 4 percent.

The surface layer is loamy fine sand about 12 inches thick. The subsoil is a light sandy clay loam about 24 inches thick. The substratum is fine sandy loam.

Included with this soil in mapping are areas of Springer loamy fine sand, hummocky. These areas make up about 12 percent of the mapping unit. Also included are a few areas of Miles fine sandy loam, 3 to 5 percent slopes, and small areas of Mansker fine sandy loam, 3 to 5 percent slopes, and of Miles loamy fine sand, 0 to 3 percent slopes. These inclusions are less than 12 or 15 acres in size.

This soil is not suitable for cultivation because of the steep slopes and a high erosion hazard. Fertility is low. A few areas are cultivated, but they are better suited to grass. If irrigated, this soil can be farmed, but careful management is required. Most areas that have been in cultivation are now moderately eroded, and a few areas are severely eroded. Gullies occur along the drainageways. This is a good soil for grass production. The dominant species are sideoats grama, little bluestem, indiagrass, and switchgrass. (Capability unit VIe-6; Sandyland range site)

Nobscot Series

The Nobscot series consists of light-colored, deep, well-drained, sandy soils. They have formed in sandy wind-deposited materials. They are not extensive and occur in only one small area in the southwestern corner of the county. They are gently sloping to rolling and hummocky.

The surface layer is brown or light-brown, loose fine sand, about 17 inches thick. The upper part is slightly darker than the lower part.

The subsoil is yellowish-red sandy loam about 27 inches thick. It has a weak, subangular blocky structure, is very friable, and is free of lime.

The substratum is reddish-yellow, loose sand that is free of lime.

The surface layer ranges from 15 to 30 inches in thickness and from light brown to brown in color. The texture of the subsoil ranges from loamy fine sand to fine sandy loam.

The Nobscot soils have a more sandy subsoil than the nearby Brownfield soils. They are sandier throughout than the Springer and Miles soils.

The Nobscot soils are rapidly permeable and have a low water-holding capacity. They have very low natural fertility and are highly susceptible to wind erosion. Because they are highly susceptible to erosion, these soils are suitable only for range. A few areas have been cultivated but are now in grass.

Nobscot fine sand (Nb).—This soil has a billowy to hummocky surface. The slopes are mostly 2 to 6 percent. This soil occurs only in one small area in the southwestern corner of the county.

Included in mapping are small areas with dunes similar to those on Tivoli soils. Also included in low places are areas of Springer loamy fine sand, undulating, and Brownfield fine sand, thick surface. Each of these inclusions makes up about 5 percent of the total acreage.

Most areas of this soil are in native range. If cultivated, the soil is highly susceptible to wind erosion. The few areas that have been cultivated are now severely eroded. These areas should be seeded to grass. Fertilizer is necessary to establish a good grass cover. The areas in native range have a dense cover of shinnery. Among the native species of grasses are sand bluestem, little bluestem, indiagrass, and switchgrass. (Capability unit VIe-7; Deep Sand range site)

Olton Series

The Olton series consists of deep, loamy, reddish-brown, upland soils. They have formed in loamy outwash materials. These soils are nearly level to gently sloping. They are in the northern and southwestern parts of the county.

The surface layer is reddish-brown loam about 7 inches thick. It has weak, granular structure and is mildly alkaline.

The subsoil is reddish-brown clay loam about 40 inches thick. It has compact, blocky structure. The upper part contains no lime, but the lower part contains free lime. The lower part is more friable than the upper part.

The substratum is red light clay loam. It is readily penetrated by roots. The upper part contains accumulations of lime.

The surface layer ranges from reddish brown to brown in color and from 4 to 14 inches in thickness. The subsoil ranges from red to reddish brown in color and from sandy clay loam to clay loam in texture. The depth to the substratum is 32 to 54 inches.

The Olton soils are redder than the Abilene soils. They are more clayey than the Miles soils. They are deeper and have better expressed horizons than the Weymouth and Mansker soils.

The Olton soils are well drained and have moderately slow permeability. Their natural fertility is high, and their capacity to store moisture is good. The wind ero-

sion hazard is slight, and the water erosion hazard is slight to moderate. The soils are very productive.

Most areas of these soils are cultivated. Cotton, small grain, and grain sorghum are grown. In some areas the soils are irrigated.

Olton loam, 0 to 1 percent slopes (OtA).—This soil occurs in broad, nearly level or flat areas and in valleys. Slopes average about 0.5 percent. The areas range from 25 to 2,500 acres in size. The soil is extensive in the northern and southwestern parts of the county.

The surface layer is brown loam about 10 inches thick. The subsoil is reddish-brown clay loam about 45 inches thick. A few shallow gullies occur along drainageways in the steeper areas.

Included with this soil in mapping are areas of Abilene clay loam, 0 to 1 percent slopes. They occur in low, concave areas and along drainageways and make up about 5 percent of the mapping unit. Also included are soils that have a sandy clay loam or clay loam surface layer. They make up about 5 percent. Small areas of Miles fine sandy loam, 0 to 1 percent slopes, and of Olton loam, 1 to 3 percent slopes, are also included. These inclusions are mostly less than 5 acres in size.

This soil has few limitations and is very productive. The erosion hazard from wind and water is slight. Slight surface crusting occurs after rains of high intensity but can generally be prevented if crop residue is left on the surface. In dry years, some areas tend to be droughty. This soil is well suited to irrigation, and many fields are irrigated. (Capability unit IIc-4; Deep Hardland range site)

Olton loam, 1 to 3 percent slopes (OtB).—This soil occurs in gently sloping, convex areas. Slopes are mostly 1 to 2 percent. The areas are irregular in shape and range from 10 to 1,000 acres in size. This soil is extensive in the northern and southwestern parts of the county.

This soil is similar to the one described for the Olton series. Some areas are slightly to moderately eroded along the drainageways, as shown by rills and a few shallow gullies.

Included in mapping are areas of Weymouth loam, 1 to 3 percent slopes, that occur on ridges. They make up about 5 percent of the mapping unit. Areas of Miles fine sandy loam, 1 to 3 percent slopes, are also included and make up about 3 percent. A few areas of Olton loam, 0 to 1 percent slopes, and a few areas of soils that have free lime throughout the profile are also included. About 2 percent of the acreage mapped as this soil has a sandy clay loam or clay loam surface layer. The inclusions are usually less than 5 or 10 acres in size.

Most areas of this soil are cultivated. It is a good soil and is highly productive. The wind erosion hazard is slight, and the water erosion hazard is moderate. Use of terraces and good management of crop residue help to reduce erosion and to conserve moisture. The soil is well suited to irrigation, and some areas are irrigated. (Capability unit IIIe-2; Deep Hardland range site)

Quinlan Series

The Quinlan series consists of reddish, loamy, very shallow soils (fig. 16). These soils are moderately sloping to steep and occur mainly on ridges. They have formed in soft sandstone material of Permian age. These

soils are extensive in the southern and west-central parts of the county.

The surface layer is loam to a depth of 12 inches. It is red, is very friable, and contains free lime.

The substratum consists of soft, silty or sandy red beds. The materials are red to light red in color.

The surface layer ranges from 4 to 15 inches in thickness and from light red or red to reddish brown in color. The texture of the surface layer ranges from loam to very fine sandy loam. The substratum in most places consists of soft, sandy or silty red beds, but in a few places it is hard sandstone.

These soils are not so deep nor so well developed as the Woodward soils. They are more developed than the Latom soils, which are underlain by sandstone. They are redder than the Cottonwood soils, which formed in gypsum materials.

The Quinlan soils have a low water-holding capacity and low fertility. They are also highly susceptible to water erosion. Runoff is rapid.

These soils are not suitable for cultivation, because they are shallow and steep. They are well suited to grass production.

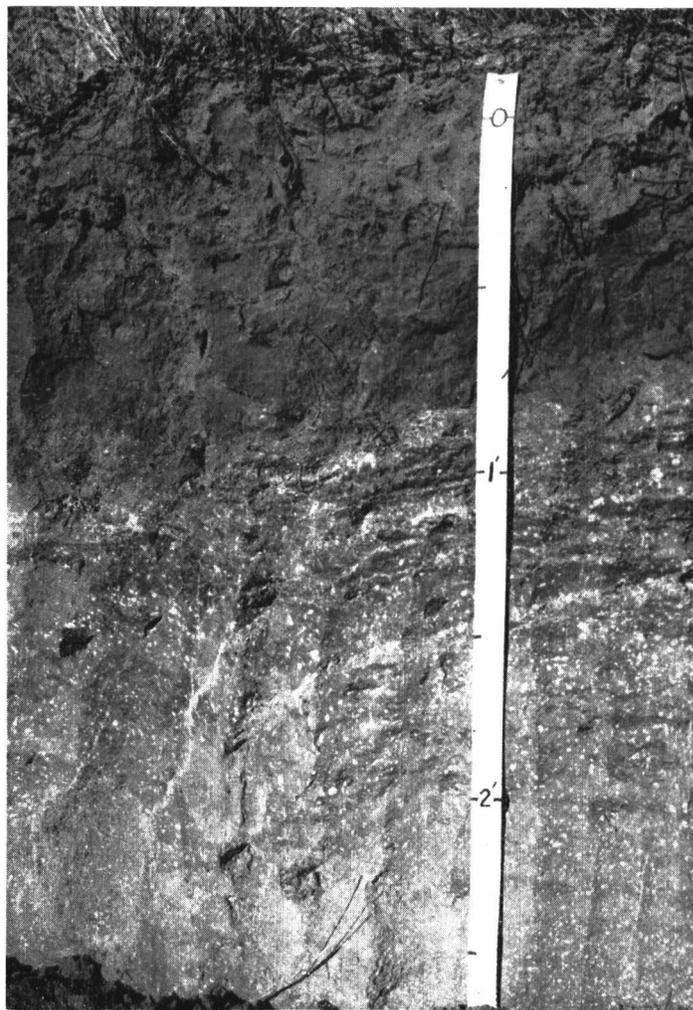


Figure 16.—Profile of Quinlan loam. Sandy red beds are at a depth of 12 inches.

In Hall County, the Quinlan soils are mapped only in a complex with the Woodward soils.

Quinlan-Woodward complex (Qw).—This mapping unit consists of areas of gullies and associated soils in the eastern and southern parts of the county. These areas occur along drainageways and are the result of geologic erosion that cut into the soft sandstone materials (fig. 17). Slopes range from 5 to 25 percent. This complex of soils is closely associated with all the soils in the county that have formed over Permian sandstone materials. A vast network of gullies occurs in all the sandy red-bed areas. Most areas range from several hundred to several thousand acres in size.

The gullies range from 10 to 50 feet in depth and from 30 to 300 feet in width. Most of them have a flat bottom that ranges from 10 to 100 feet in width. The pattern consists of a continuous main gully and many secondary gullies that branch off the main one. In many places the upper ends of these gullies have been cut back into the steep ridges that separate the two soils in the complex.

The soils that make up this complex are mostly Woodward loam and Quinlan loam, which occur above the rims of the gullies. These soils are similar to the ones described

respectively for the Woodward and the Quinlan series. Rough broken land, which consists of the steep escarpments and broken soils on the side slopes of the gullies, and Yahola very fine sandy loam, which consists of the alluvial soils in the bottom of the gullies, are included in this mapping unit.

The composition of this complex of soils is variable. The Quinlan and the Woodward soils generally make up from 30 to 75 percent. Rough broken land makes up 10 to 60 percent, and Yahola very fine sandy loam makes up 5 to 30 percent. The average composition of several representative areas is as follows: Quinlan loam, 30 percent; Woodward loam, 25 percent; Rough broken land, 30 percent; and Yahola very fine sandy loam, 15 percent.

These soils are highly erodible and are suitable only for range. Except for the steep, broken areas, most areas have a cover of vegetation. The dominant species are sideoats grama, blue grama, and little bluestem. Most of the steeper areas are inaccessible to livestock. (Quinlan loam, capability unit VIe-4 and Mixedland range site; Woodward loam, capability unit VIe-4 and Mixedland range site; Rough broken land part, capability unit VIIs-2 and Rough Breaks range site)



Figure 17.—View of a typical area of the Quinlan-Woodward complex.

Rough Broken Land

Rough broken land (Rb) occurs mostly in a large, continuous area in the western part of the county along the Little Red River and its tributaries. It has resulted from geologic erosion that cut into sandy and silty Permian red-bed formations. The areas of this land type are deeply dissected and have many deep gullies and drainageways. The depth of the gullies ranges from 50 to 150 feet in most places. These gullies are separated by narrow ridges (fig. 18). The slopes range from 20 to 40 percent in most areas, but some almost vertical escarpments occur. Rough broken land also forms a part of the Quinlan-Woodward complex of soils.

This land type consists mostly of exposed, silty and sandy, red-bed materials. Soft, granular, or sugarlike, gypsum material is interbedded with these materials. Strata, or ledges, of hard alabaster gyprock 1 to 3 feet thick crop out in most areas. In most places these strata are 10 to 20 feet apart vertically.

Areas of Woodward-Quinlan loams, 5 to 12 percent slopes—which occur in less sloping positions on ridgetops, along drainageways, and below steep escarpments—are included with this land type in mapping. They make up about 8 percent of the total acreage. Small areas of Cottonwood soils are also included.

This land type is highly susceptible to water erosion and is very erodible in most places. It has only a sparse

This land type is highly susceptible to water erosion,

It is suitable only for limited grazing and for wildlife. (Capability unit VIIIs-2; Rough Breaks range site)

Sandy Alluvial Land

Sandy alluvial land (Sa) is a land type consisting of mixed, sandy, alluvial soils that occur on the low, nearly level flood plains of the Prairie Dog Town Fork of the Red River and other large streams. Most areas are 1 to 3 feet above the stream channels and are frequently flooded. This land is most extensive along the Prairie Dog Town Fork of the Red River. Areas range in size from 25 to 2,000 acres or more.

The surface layer is mostly stratified loamy sand, sand, or sandy loam. The texture is variable, and it is often changed as new material is deposited by floodwaters. Thin strata of loam or clay loam are common in the surface layer.

The subsurface layer of this land type is very sandy and is mostly riverwash sand and fine gravel. This sandy stratum occurs at a depth of 12 to 20 inches.

Sandy alluvial land is sandier than the Spur and Yahola soils. It has more variable texture and occurs in lower positions than the nearby Lincoln soils.

In most areas of this land type, the water table is 1 to 3 feet from the surface. The water table fluctuates considerably, depending on rainfall. The ground water is saline and makes most areas of Sandy alluvial land saline.



Figure 18.—View of Rough broken land showing the steep slopes of this land type.

Included in mapping are areas that have a loam or clay loam surface layer. These areas make up about 5 percent of the total acreage and occur in places where the floodwaters move very slowly. Also included are small areas of Lincoln and Yahola soils, in slightly higher positions, and a few narrow bands of Tivoli fine sand, mostly less than 5 acres in size, near stream channels.

This land type is suitable only for grazing and for wildlife. Most areas have a cover of salt-tolerant plants, such as saltceder, alkali sacaton, and inland saltgrass. Among other species that occur in most areas are little bluestem, sand bluestem, indiagrass, and switchgrass. (Capability unit Vw-2; Sandy Bottomland range site)

Springer Series

The Springer series consists of light-colored, deep, well-drained, sandy soils that formed in sandy outwash materials. These soils are nearly level to moderately sloping and occur in scattered areas in the northern and southwestern parts of the county.

The surface layer is a reddish-brown loamy fine sand about 12 inches thick. It is structureless and free of lime.

The subsoil is a reddish-brown fine sandy loam about 30 inches thick. It has weak, subangular blocky structure and moderately rapid permeability. The lower part contains slightly less clay than the upper part.

The substratum is a reddish, loose loamy fine sand. It is free of lime.

The surface layer ranges from 6 to 20 inches in thickness. The texture of the subsoil ranges from loamy fine sand to heavy fine sandy loam. The subsoil ranges from red or reddish brown to yellowish red in color, and from 24 to 40 inches in thickness.

The Springer soils have a more sandy subsoil than the Miles soils. They have a less sandy surface layer than the Brownfield and Nobscoot soils.

The Springer soils are highly susceptible to wind erosion. The water erosion hazard is slight to moderate. The capacity of the soils to store moisture is low. Natural fertility is low, and permeability is moderately rapid.

Because of their high susceptibility to erosion, these soils are best suited to permanent grass.

Springer loamy fine sand, undulating (Sf).—This soil is nearly level to gently sloping. The areas are irregular in shape and from 10 to 1,000 acres in size. The slopes are mostly 0.5 to 3 percent.

This soil is similar to the one described for the Springer series. Most areas are slightly eroded to moderately eroded. Small dunes and blowouts make the surface billowy to undulating.

The small dunes are common in old cultivated fields. They range from 1 to 3 feet in height. The subsoil material is exposed in small blowouts in a few places. In most places fencerows bordering the cultivated fields have accumulations 4 to 8 feet high. A few gullies occur along drainageways. In most places the gullies are 2 to 4 feet deep and 6 to 12 feet across.

Included with this soil in mapping are a few areas that have a fine sandy loam surface layer. Inclusions of Miles loamy fine sand, 0 to 3 percent slopes, make up about 5 percent of this unit. Severely eroded areas each make up about 5 percent of the total acreage. Small areas of Springer loamy fine sand, hummocky, are also included

with this soil in mapping. The inclusions are less than 10 or 15 acres in size.

Most areas of this soil have been cultivated. Many of these areas have been returned to native plants. This soil is poorly suited to crop production. It has low fertility and is highly susceptible to wind erosion. Crops that produce large amounts of residue can be grown, but careful management is required. The soil is best suited to permanent grasses, such as sand bluestem, little bluestem, switchgrass, and indiagrass. Fertilizer may be needed to get a good stand of grass established. (Capability unit IVe-11; Sandyland range site)

Springer loamy fine sand, hummocky (Sb).—This moderately sloping soil is mostly in the northern part of the county. The slopes are dominantly 3 to 5 percent. The areas are irregular in shape and from 10 to 400 acres in size.

The surface layer is loamy fine sand about 8 inches thick. The subsoil is a fine sandy loam about 26 inches thick. In cultivated areas the surface is undulating to hummocky, and there are many small dunes and blowouts. A few shallow gullies also occur along drainageways.

Included with this soil in mapping are areas of Springer loamy fine sand, undulating. These occur in less sloping positions and make up about 5 percent of the total acreage. Also included are areas of Miles loamy fine sand, 3 to 5 percent slopes, which make up about 3 percent. About 5 percent of the acreage in this unit is severely eroded.

This soil is suitable only for range. It is highly susceptible to erosion by wind and water. Most areas that have been cultivated have now been taken out of cultivation. The soil has a high potential for grass production, and cultivated areas should be established in grass for greater benefits. Sand bluestem, little bluestem, switchgrass, and indiagrass are suitable grasses. The soil has very low fertility, and fertilizer is needed to establish desirable plants. (Capability unit VIe-6; Sandyland range site)

Springer soils, severely eroded (Sf3).—These soils are similar to the other Springer soils, but they are more eroded. They are gently sloping to moderately sloping and make up old fields that have been cultivated and abandoned. The soils have been severely damaged by erosion. The erosion has been caused mostly by wind, but in a few areas it has been caused by water, especially in the steeper places. The areas range from 20 to 500 acres in size.

These soils are characterized by many dunes and blowouts. In most places the blowouts are 1 to 3 feet deep and 50 to 200 feet across. The subsoil material is exposed in 10 to 20 percent of the blowout areas. Associated with these areas are small dunes that range from 2 to 6 feet in height and from 15 to 200 feet across at the base. A few gullies that range from 3 to 10 feet in depth and from 10 to 25 feet across occur along the drainageways. The fence rows bordering fields have accumulations of soil material 5 to 10 feet high in most places.

For best use of these soils, they should be established in native plants. Establishment is difficult because the soils are highly susceptible to wind erosion if they are disturbed. They have very low fertility, and fertilizer is needed to get grass established. A crop of sorghum should first be established, then the grass should be seeded directly in the litter left by the sorghum. Among the most suitable species of grass are little bluestem, sand

bluestem, indiangrass, and switchgrass. After the grasses are established, careful management is required to maintain a cover at all times. (Capability unit VIe-6; Sandy land range site)

Spur Series

The Spur series consists of well-drained, reddish-brown, loamy soils on bottom lands. They have formed in loamy alluvial sediments that were deposited by floodwaters. They are in narrow, nearly level areas along the flood plains of the streams and are occasionally flooded. Most areas are in the northern part of the county.

The surface layer is loam to a depth of 10 inches. It is reddish brown, has a weak, granular structure, and contains free lime. It contains thin lenses of sandy loam or silt loam.

The subsurface layer is light reddish-brown clay loam or silty clay loam that has weak, subangular blocky structure. This layer is distinctly stratified, contains free lime, and is friable. The lower part contains less clay than the upper part.

The surface layer ranges from 7 to 20 inches in thickness and from light reddish brown to reddish brown in color. The texture of the subsurface layer ranges from loam or silt loam to clay loam or silty clay loam.

Spur soils, as mapped in Hall County, include some soils that were in the Norwood series in the soil survey of adjacent Childress County.

The Spur soils are not so sandy as the Yahola and Lincoln soils. They are not so dark as the Tipton soils and are not so well developed.

The Spur soils have a high capacity to hold water and high natural fertility. They are very productive because they receive extra water as runoff from higher lying soils.

Cotton, grain sorghum, and small grain are grown extensively on these soils. Most areas are cultivated, and a few are irrigated.

Spur loam (Sm).—This soil occurs on nearly level flood plains along small streams throughout the county. The areas are narrow and are parallel to the stream channels; a few are along old, dry stream channels. Most areas range from 50 to 500 acres in size.

This soil is like the one described for the Spur series.

Included in mapping are areas of Yahola soils, which occur in similar positions and make up about 5 percent of the total acreage. Also included are a few areas of Tipton loam, 0 to 1 percent slopes, and of Lincoln soils. A few areas are included in the western part of the county that have a water table within 1 to 3 feet of the surface. Because the water is salty, the soil in some of these areas is saline.

Most areas of this soil are cultivated. Because it has few limitations, this soil is one of the most productive and desirable in the county. It is well suited to most crops grown. It is also well suited to irrigation, and some areas are irrigated. (Capability unit IIc-3; Loamy Bottomland range site)

Spur and Yahola soils (So).—This undifferentiated group of alluvial soils occurs on the nearly level flood plains along the large drainageways and small creeks. Most areas are narrow and are parallel to the streams. This soil occurs throughout the county in scattered areas that range from 100 to 800 acres in size.

These soils are so intricately mixed that it is not practical to separate them in mapping. The acreage of each soil varies considerably from one place to another. Some areas contain mostly Spur soils, and other areas contain mostly Yahola soils. On the average, the composition is about 40 to 50 percent Spur soils and 50 to 60 percent Yahola soils.

The Yahola soils in this group are like Yahola very fine sandy loam and Yahola fine sandy loam, described under the Yahola series. The Spur soils are similar to Spur loam, but the texture of their surface layer is more variable. It ranges from fine sandy loam to clay loam. Because the soils are flooded frequently, the texture of the surface layer often changes as new sediments are deposited.

Included in mapping are small areas of Sandy alluvial land.

Most areas of these soils are in range. Because they are frequently flooded, these soils are best suited to permanent grass. They are excellent soils for grass production. (Capability unit Vw-1; Loamy Bottomland range site)

St. Paul Series

The St. Paul series consists of deep, dark-colored, well-drained, silty soils. They have formed in old alluvium or sandstone materials of Permian origin. In most places they are nearly level, but in a few they are gently sloping. The soils are extensive in the northeastern and southeastern parts of the county.

The surface layer is brown silt loam about 8 inches thick. It has a weak, granular or subangular blocky structure and is free of lime.

The subsoil is brown to reddish-brown silty clay loam about 28 inches thick. It has subangular blocky structure, is compact, and is free of lime. The upper part is darker and contains less clay than the lower part.

The substratum consists of loamy alluvial or sandstone materials. The materials are friable and are easily penetrated by roots. In most places the upper part contains an accumulation of free lime.

The surface layer ranges from 6 to 15 inches in thickness and from brown to reddish gray in color. The subsoil ranges from brown to reddish brown in color and from loam to clay loam in texture. Depth to the underlying materials ranges from 32 to 60 inches but in most places is less than 48 inches. The underlying materials range from loamy old alluvium to soft sandstone. Some of these materials contain large amounts of soft gypsum.

These soils are darker and have a more compact subsoil than the nearby Carey soils. They have a less clayey subsoil than the Abilene soils.

These soils have high natural fertility and are very productive. They receive extra water from surrounding higher soils. They have a high capacity to hold water but are slightly droughty during dry periods. They are moderately to slowly permeable. The surface drainage is slow.

All the acreage of these soils is cultivated. Cotton, small grain, and grain sorghum are grown extensively. The soils are not irrigated, as suitable water is not available.

St. Paul silt loam, 0 to 1 percent slopes (SpA).—Areas of this soil range from large, broad flats to narrow tracts along drainageways that in many places have weakly concave relief. The size of the areas ranges from 10 to 2,000 acres. Slopes are dominantly less than 0.5 percent. This soil generally occurs in lower positions than the adjacent soils, and most of the more narrow areas receive extra water as runoff from the higher soils.

This soil is similar to the one described for the St. Paul series. A few rills and shallow gullies occur along drainageways.

Included in mapping are small areas of St. Paul silt loam, 1 to 2 percent slopes. Also included on the steeper slopes are a few small areas of Carey loam, 0 to 1 percent slopes. The inclusions are less than 5 or 10 acres in size. Small occasional outcrops of gyprock occur. About 10 percent of the acreage mapped as this soil has a very fine sandy loam or loam surface texture.

This soil has few limitations and is one of the most productive soils in the county. It is well suited to cotton, wheat, and grain sorghum. Fertility is high. (Capability unit IIc-2; Deep Hardland range site).

St. Paul silt loam, 1 to 2 percent slopes (SpB).—This soil occurs mostly in narrow, gently sloping areas along drainageways. The areas are usually less than 200 acres in size. Most areas have concave relief and receive extra water as runoff from higher soils.

The surface layer is slightly thinner than that of St. Paul silt loam, 0 to 1 percent slopes. It is about 6 inches thick. The subsoil is about 24 inches thick. It is not so compact as that of the less sloping soil and contains less clay. A few rills and shallow gullies are along drainageways.

Included in mapping are some areas of Carey loam, 1 to 3 percent slopes, on ridges. They make up about 5 percent of the total acreage. Also included in some places are a few low areas of St. Paul silt loam, 0 to 1 percent slopes. Some areas mapped as this soil have a very fine sandy loam surface texture. These inclusions make up about 8 percent of the total acreage.

This soil is moderately susceptible to water erosion. Terraces and good management of crop residue are used to reduce erosion. This is a good soil and is very productive. Cotton, wheat, and grain sorghum are grown. (Capability unit IIe-1; Deep Hardland range site)

Tipton Series

The Tipton series consists of deep, dark, well-drained, loamy soils of the uplands. These soils have formed in loamy, old alluvial materials. They occur mostly in valleys and on stream terraces and are extensive in the northwestern part of the county. Most areas are nearly level, but a few are gently sloping.

The surface layer is loam to a depth of 12 inches. It is brown or dark brown, has a weak, granular or sub-angular blocky structure, and contains free lime.

The subsoil is reddish-brown or light reddish-brown clay loam about 31 inches thick. It has a weak, sub-angular blocky structure, contains free lime, and is very friable. The lower part contains more lime than the upper part.

The substratum is light reddish-brown loam to silt loam.

The surface layer ranges from 6 to 16 inches in thickness and from brown or dark brown to reddish gray in color. The subsoil ranges from loam to clay loam or silty clay loam in texture and from reddish gray to reddish brown in color. The underlying material ranges from loam to silt loam and consists of old alluvium.

Tipton soils are darker and siltier than the Miles soils and are not so well developed. They are more developed and are in higher positions than the Spur soils. They are not so sandy as the Altus soils.

These soils have very high natural fertility and are very productive. They have a high capacity to hold water. Most areas receive extra water as runoff from the higher soils. The hazard of wind erosion is slight. The water table is commonly at a depth of 4 to 10 feet.

Cotton and grain sorghum are grown extensively on these soils. All the acreage is cultivated, and some is irrigated.

Tipton loam, 0 to 1 percent slopes (TpA).—This soil occurs mostly in broad, nearly level, flat areas that range from 100 to 2,000 acres in size. The largest is west of Plaska. In some of the areas there are no streams, and the water spreads over the soil. Drainage ditches are used to remove the water.

This soil is similar to the soil described for the Tipton series. A few rills are on the steeper slopes, and a few gullies are along the drainageways.

Included in mapping are small areas of Tipton loam, somewhat poorly drained, that have a water table near the surface. Also included are a few small areas of Guadalupe and Tipton soils along small creeks and drainage ditches, and some small areas of Altus fine sandy loam. About 10 percent of the acreage mapped as Tipton loam, 0 to 1 percent slopes, has a silt loam or silty clay loam surface layer. Also, small areas of Olton loam, 0 to 1 percent slopes, that occur in positions above the Tipton soils are included.

This soil is very productive and is among the most desirable for cultivation in the county. Cotton, wheat, and grain sorghum are grown extensively. The soil is well suited to irrigation. The erosion hazard is slight. (Capability unit IIc-2; Mixedland range site)

Tipton loam, 1 to 3 percent slopes (TpB).—This gently sloping soil occurs in small, scattered areas, usually along drainageways. It has concave relief and receives extra water as runoff from higher soils. The areas range from 10 to 200 acres in size.

This soil has a loam surface layer 8 inches thick. It has a loam subsoil 28 inches thick. A few rills and shallow gullies occur along natural drainageways.

Included in mapping are small areas of Olton loam, 1 to 3 percent slopes. These areas are on the steeper slopes and are less than 5 or 10 acres in size. About 5 percent of the acreage mapped as this soil is Tipton loam, 0 to 1 percent slopes.

Most areas of this soil are cultivated. Cotton, wheat, and grain sorghum are grown extensively. It is a good soil and is very productive. It is moderately susceptible to water erosion. Use of terraces and good management of crop residue help to control erosion and to conserve moisture. This soil is suitable for irrigation. (Capability unit IIe-1; Mixedland range site)

Tipton loam, somewhat poorly drained (Ts).—This soil consists of areas of Tipton loam, 0 to 1 percent slopes,

that have a water table within 1 to 2 feet of the surface. The few areas of this soil in the county range from 50 to 300 acres in size. The water in the water table contains a large amount of salts, and as a result the soil is saline. In most places a white surface crust forms in bare areas. This soil is cultivated, but crop failures are common. It is a poor soil for cultivation. The salinity is most harmful during wet years. If the areas are drained and the water table lowered, the soil is not saline. Cotton and alfalfa are grown, but bermudagrass is best suited to this soil. (Capability unit IIIw-1; Mixedland range site)

Tivoli Series

The Tivoli series consists of deep, light-colored, very sandy soils. They have formed in recently deposited, windblown, sandy materials. These materials have been blown from the larger stream channels and deposited nearby. Most areas are on the eastern and southern sides of the streams. All the Tivoli soils have sand dunes. They are extensive along the Prairie Dog Town Fork of the Red River and the larger creeks in the northern part of the county.

The surface layer to a depth of 6 inches is reddish brown, is loose, and contains free lime. The dark color is the only evidence of soil development.

The substratum is light reddish-brown, loose fine sand that has not been altered since it was blown from the river channels.

The darkened surface layer ranges from 4 to 12 inches in thickness and from fine sand to loamy fine sand in texture.

The Tivoli soils are more sandy than the Enterprise soils. They have topography similar to that of Active dunes, but they have a darkened surface layer and a cover of vegetation that are lacking in dunes.

The Tivoli soils have very low fertility and a very low capacity to hold water. They are excessively drained and are highly susceptible to wind erosion if the plant cover is removed. They are suitable only for range and for wildlife. Most areas have a cover of sand sagebrush, shin oak, yucca, and skunkbush.

Tivoli fine sand (Tv).—This soil consists of sandhills that occur near the larger streams. Sand dunes are on all areas. In most places the dunes are from 10 to 50 feet high, and from 25 feet to several hundred feet in diameter at the base. Areas of this soil range from 50 acres to several thousand acres in size. Some areas along the Red River form a continuous band for several miles; the largest is between Parnell and Estelline. Smaller areas are along the larger streams throughout the northern part of the county.

This soil is like the one described for the Tivoli series. The vegetation is dominantly tall grasses, such as little bluestem, sand bluestem, indiagrass, switchgrass, and sideoats grama.

Included with this soil in mapping are small areas that have a fine sandy loam surface layer. These areas are along the edge of the Tivoli soils and make up about 3 percent of the total acreage. Small depressions between the dunes make up about 2 percent. These depressions in most places are less than 2 acres in size and are not so

sandy. Also included are a few small areas of Active dunes.

This is a fair soil for grass production, but careful management is required to prevent overgrazing. The soil is highly susceptible to wind erosion if the native protective cover is destroyed. (Capability unit VIIe-1; Deep-Sand range site)

Weymouth Series

The Weymouth series consists of moderately deep, loamy, highly calcareous soils that are well drained and have formed in silty or light clayey outwash materials of Permian age. They are extensive in the western and northern parts of the county. These soils occur mainly on ridges and are gently sloping to moderately sloping.

The surface layer is reddish-brown, friable loam about 7 inches thick. It contains free lime and has a weak, sub-angular blocky structure. A few, hard lime concretions are on the surface.

The subsoil is reddish-brown clay loam about 11 inches thick. It has a subangular blocky structure and contains free lime.

The substratum is silty or clayey red-bed and outwash materials. The upper part contains a large accumulation of free lime.

The surface layer ranges from 5 to 10 inches in thickness and from reddish brown to brown in color. The texture of the surface layer ranges from loam to clay loam. The subsoil ranges from red to reddish brown in color and from loam to clay loam in texture. Depth to the underlying materials ranges from 10 to 24 inches.

The Weymouth soils are more clayey than the Woodward soils. They are redder and less sandy than the Mansker soils. They are not so deeply developed as the Miles and Olton soils.

These soils have low fertility and are moderately productive. The hazard of water erosion is moderate to high. The soils are moderately permeable and have a good water-holding capacity.

Most areas of Weymouth soils have been cultivated, but the steeper soils in some areas have been returned to grass. Cotton and small grain are grown most extensively. In most areas those soils are not irrigated.

Weymouth loam, 1 to 3 percent slopes (WeB).—This soil is on gently sloping ridges. It occurs extensively in the southwestern and northern parts of the county. Slopes are dominantly 2 to 3 percent. The areas range from 10 to 400 acres in size and are irregular in shape.

This soil is like the one described for the Weymouth series. Most cultivated areas are slightly eroded, and a few are moderately eroded. Small rills are on the steeper slopes, and a few shallow gullies are along the drainageways.

Included with this soil in mapping are small areas of Woodward loam, 1 to 3 percent slopes. These make up about 8 percent of the mapping unit and are less than 5 or 10 acres in size. Also included are small areas of Quinlan loam on ridgetops, and a few areas of Mansker fine sandy loam, 0 to 3 percent slopes, that are mostly in lower areas along drains. Most included areas are less than 5 acres in size.

Most areas of this soil are cultivated. This is a fairly good soil and is moderately productive. The erosion

hazard is slight to moderate. Terraces reduce the hazard of water erosion. Good management of crop residue helps to reduce erosion and to conserve moisture. Cotton, wheat, and grain sorghum are grown, but the soil is best suited to grain sorghum and small grain. It is well suited to native grasses, and some formerly cultivated areas have been returned to grass. (Capability unit IIIe-7; Mixedland range site)

Weymouth loam, 3 to 5 percent slopes (WeC).—This soil occurs extensively on ridges. Slopes are dominantly 3 to 4 percent. The areas range from 10 to 1,000 acres in size.

This soil is slightly thinner than the one described for the Weymouth series. The surface layer is 5 or 6 inches thick. Depth to the substratum is about 16 inches. Most cultivated areas are slightly eroded to moderately eroded. They have many rills, and a few gullies are along drainageways.

Included with this soil in mapping are areas of Woodward loam, 3 to 5 percent slopes, that make up about 10 percent of the mapping unit, and areas of Quinlan loam that make up 5 percent. These included areas are less than 5 or 10 acres in size. Also included along drainageways are small areas of Mansker fine sandy loam, 3 to 5 percent slopes.

The cultivated areas of this soil have rapid runoff and are highly susceptible to erosion by water. Terraces are needed to reduce erosion. This is a poor soil for crop production and requires careful management, but it is good for grass production. Some cotton is grown on this soil, but grain sorghum and other crops that produce large amounts of residue are better suited. If the residue is left on the surface, it aids in conserving moisture and controlling erosion. Some areas that formerly were cultivated have been returned to grass. (Capability unit IVe-2; Mixedland range site)

Woodward Series

The Woodward series consists of moderately deep, reddish-brown, loamy upland soils (fig. 19). They have formed in soft sandstone material of Permian age. These rolling to hilly soils on ridges are extensive in the eastern and southern parts of the county. In places they are mapped in a complex with the Quinlan soils.

The surface layer is loam or very fine sandy loam to a depth of 10 inches. It is reddish brown, is friable, and contains free lime.

The subsoil is red, friable loam or very fine sandy loam about 12 inches thick. It has a weak, subangular blocky structure and contains free lime.

The substratum consists of light-red, soft sandstone materials. The upper part has an accumulation of free lime. These materials are easily penetrated by moisture and roots.

The surface layer ranges from reddish brown to light reddish brown in color and from 6 to 14 inches in thickness. The texture of the subsoil ranges from very fine sandy loam or loam to sandy clay loam. The color ranges from red to reddish brown. Depth to the substratum ranges from 15 to 40 inches but is dominantly 18 to 28 inches.

The Woodward soils are not so deep nor so well developed as the Carey soils. Also, they are not so deep as the

Enterprise soils but are deeper and more developed than the Quinlan soils. They are less clayey than the Weymouth soils.

The Woodward soils are well drained. They have a moderate ability to store moisture and have moderate fertility. They are moderately to highly susceptible to water erosion and slightly susceptible to wind erosion.

The less sloping Woodward soils are largely cultivated, but the steeper soils are mostly in range. Cotton and grain sorghum are grown extensively in the cultivated areas but are not irrigated. These soils are well suited to native grasses.

Woodward loam, 1 to 3 percent slopes (WoB).—This gently sloping soil is mostly in the northeastern and southeastern parts of the county, mainly on ridges. The areas range from 10 to 200 acres in size.

This soil is slightly thicker than the one described for the Woodward series. The thickness of the surface layer is about 12 inches. The depth to the substratum is about 24 to 26 inches. A few rills and shallow gullies are along the drainageways.

Included in mapping are areas of Woodward loam, 3 to 5 percent slopes. These included areas are from 2 to 5 acres in size and make up about 5 percent of the total acreage. Also included are lower, less sloping areas of

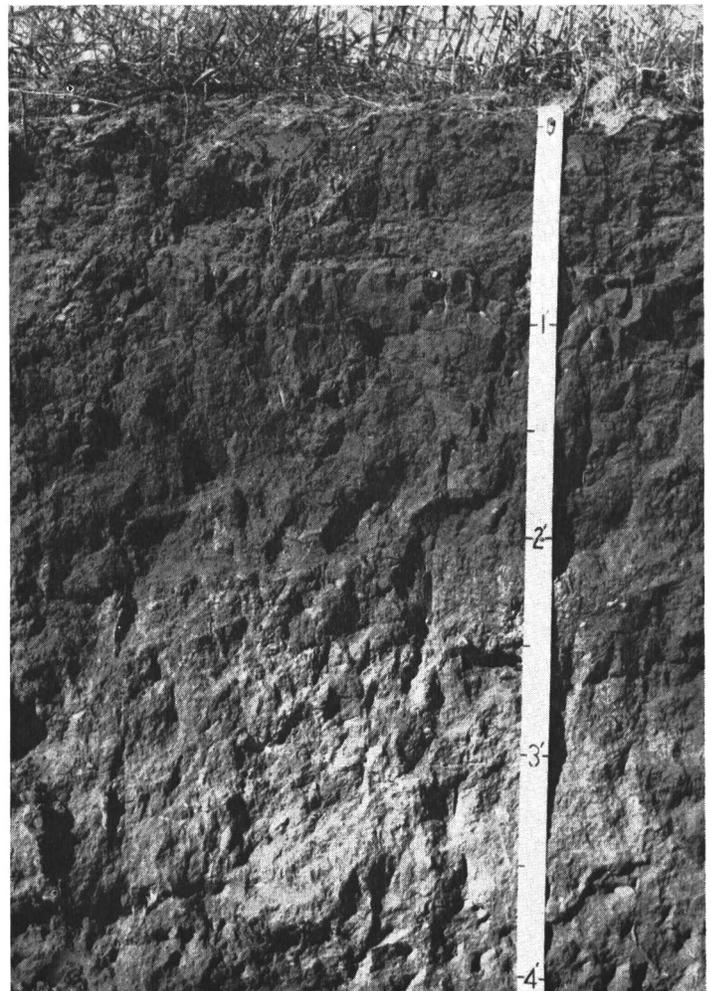


Figure 19.—Profile of Woodward loam. Cca horizon at 2 feet.

Carey loam, 1 to 3 percent slopes. They are mostly less than 5 to 8 acres in size and make up about 8 percent. Also in this unit are a few small inclusions of Quinlan loam and a few small outcrops of alabaster gypsum near ridgetops.

Most areas of this soil are cultivated. This is a good soil and is moderately productive. Cotton and grain sorghum are grown extensively. Crops respond to fertilizer if moisture is adequate. The soil is moderately susceptible to erosion by water and wind. Terraces are needed to reduce runoff. All crop residue should be managed to reduce runoff and conserve moisture. (Capability unit IIe-1; Mixedland range site)

Woodward loam, 3 to 5 percent slopes (WoC).—This soil is mostly on ridges and in convex positions above the Carey and Quinlan soils. Slopes are dominantly about 4 percent. The areas are of irregular shape. They range from 10 to 600 acres in size. Most areas, however, cover less than 300 acres.

This soil is typical of the one described for the Woodward series. A few areas along drainageways are moderately eroded. A few small gullies are along the drainageways, and many rills are on the steeper slopes.

Included in mapping are areas of Carey loam, 3 to 5 percent slopes. These make up about 3 percent of the total acreage. Also included on ridgetops are areas of Quinlan loam that make up about 5 percent, and areas of Woodward loam, 1 to 3 percent slopes, that make up about 2 percent. Small outcrops of alabaster gypsock are common in some places, especially on ridgetops.

Much of this soil is cultivated. It is fairly well suited to crop production and well suited to good grass production. Cotton and grain sorghum are grown extensively. Crops respond to fertilizer if moisture is adequate. Because runoff is rapid, the soil is highly susceptible to water erosion. Some areas that formerly were cultivated have now returned to grass. Most cultivated areas are terraced to reduce erosion. (Capability unit IIIe-3; Mixedland range site)

Woodward-Quinlan loams, 5 to 12 percent slopes (WwD).—This complex of soils consists mostly of Woodward loam and Quinlan loam. These soils are moderately sloping to steep. This complex of soils is extensive in the county, mainly in the eastern, southern, and west-central parts. The areas range from 25 to 2,000 acres in size.

The Woodward soils in this complex are typical of the Woodward loam described for the series; however, many areas of these soils do not have an accumulation of lime in the upper part of the substratum. The depth to the substratum is 24 to 36 inches. The Quinlan soils in this complex are typical of the Quinlan loam described for the Quinlan series.

The composition of this complex of soils is quite variable, but Woodward soils are dominant. Normally, they make up 50 to 80 percent of the complex, and Quinlan soils 20 to 50 percent. In several typical areas Woodward soils average 70 percent, and Quinlan 30 percent. In a few areas, however, the soils are mainly Woodward, and in others they are mainly Quinlan.

The Woodward soils are most commonly on the side slopes and between the ridges. The Quinlan soils are most commonly on the ridgetops.

Included with this complex of soils in mapping are small areas of Cottonwood soils. They make up about 2

percent of the mapping unit. Small areas of Carey soils are included in a few places. Small outcrops of alabaster gypsock occur mainly on ridgetops.

Some areas of these soils have been cultivated, but most of them have been returned to grass. Because of the steep slopes and the high susceptibility of the soils to water erosion, all areas of this complex of soils should be in grass. The soils are excellent for grass production. Among the dominant species are buffalograss, sideoats grama, blue grama, and little bluestem. Most areas of this complex of soils that have been cultivated are moderately eroded to severely eroded. (Capability unit VIe-4; Mixedland range site)

Yahola Series

The Yahola series consists of light-colored, loamy, well-drained, alluvial soils that have a permeable subsoil. They are on the flood plains of streams and have formed in recent alluvium deposited by floodwaters. Most areas are occasionally flooded. These soils occur along stream channels in small, narrow areas scattered throughout the county.

The surface layer is reddish-brown very fine sandy loam about 16 inches thick. It has a weak, subangular blocky structure, contains free lime, and is very friable.

The subsurface layer is a light reddish-brown very fine sandy loam. It is stratified with thin layers of siltier materials. This layer is very friable and is easily penetrated by roots and water.

The surface layer ranges from loam or very fine sandy loam to fine sandy loam in texture and from light reddish brown to reddish brown in color. It ranges from 10 to 24 inches in thickness. The subsurface layer ranges from loam to fine sandy loam in texture. Thin strata of silt loam or clay loam also occur in the subsurface layer. The color of this layer ranges from light reddish brown to reddish brown.

The Yahola soils are less sandy than the Lincoln soils. They are more sandy than the Spur soils. The Yahola soils are in higher positions and are less sandy than Sandy alluvial land.

The Yahola soils have moderately rapid permeability and moderate to high fertility. They have a moderate capacity to hold water. They are very productive because they receive extra water as runoff from soils at higher elevations. The hazard of wind erosion is slight to moderate.

Most areas of these soils are cultivated. Cotton is the dominant crop, but all the crops suited to this area can be grown. Some of the areas are irrigated.

Yahola very fine sandy loam (Yv).—This soil occurs in narrow areas that are mostly on the nearly level flood plains of small streams. A few areas are above the present flood plain. A few areas also are in flat areas below the end of the stream channel, where water flows over the soil. The areas range from 50 to 1,000 acres in size.

This soil is like the one described for the Yahola series.

Included in mapping are small areas of Yahola fine sandy loam. Also included are areas of Spur loam that make up about 5 percent of the mapping unit. A few areas are included that have a high water table near the

surface. The water contains salt and makes these areas slightly saline.

This is a good soil, and it is highly productive. Cotton and grain sorghum are grown extensively. Crops respond to fertilizer if moisture is adequate. The hazard of wind erosion is slight. (Capability unit IIc-3; Loamy Bottomland range site)

Yahola fine sandy loam (Yf).—This soil is similar to Yahola very fine sandy loam but is slightly sandier. It occurs mostly along the small streams in the northwestern part of the county. The areas range from 25 to 300 acres in size. Most areas are occasionally flooded, but a few are above the present flood stage.

This soil is sandier throughout than the one described for the Yahola series.

The surface layer is fine sandy loam about 15 inches thick. The subsurface layer is fine sandy loam. A few cultivated areas have an undulating to billowy surface that has resulted from soil blowing.

Included with this soil in mapping are small areas of Yahola very fine sandy loam. These areas make up about 5 percent of the mapping unit and are less than 10 acres in size. Also included are a few areas near stream channels that have a loamy fine sand surface layer.

This soil is mostly cultivated. Cotton and grain sorghum are well suited. The soil is moderately productive, and crops respond readily to fertilizer. The soil is moderately susceptible to wind erosion. Crop residues should be kept on the surface as much as possible to reduce wind erosion. (Capability unit IIIe-5; Loamy Bottomland range site)

Use and Management of Soils

In this section the general management of cropland and irrigated pasture and some practices that are basic to good conservation farming are discussed. The system of land capability classification used by the Soil Conservation Service is briefly explained. Each soil in the county is placed in a capability group, and the management for each group is discussed. Yield predictions for two levels of management are given for all soils in the county that are suitable for cultivation. Also discussed are the use of soils for range, wildlife habitats, windbreaks, and engineering work.

General Management of Cropland ¹

Climate is the factor that most affects the agriculture of Hall County. The chief hazards result from the variable but normally low rainfall, severe droughts, occasional rains of high intensity, high wind velocities, and hail. Consequently, the main purposes of management are to conserve moisture, protect the soils from erosion by wind and water, improve the physical condition of the soils, and maintain fertility.

In the following paragraphs, the general management practices commonly required in the county are discussed. For management practices for specific soils, see the subsection "Management of soils by capability units."

¹ This subsection was prepared by JACK DOUGLAS, agronomist, Soil Conservation Service.

Control of soil blowing

Soil blowing, or wind erosion, is one of the greatest hazards to cropland in Hall County. It is caused by winds blowing at high velocity over bare soil. The soils most susceptible to wind erosion are those with loamy fine sand and fine sandy loam surface layers. Examples are the Miles, Springer, and Enterprise soils.

A number of methods are used in Hall County to help control soil blowing. These include (1) keeping crop residue on the surface as a protective cover during the most critical periods of soil blowing, usually in fall, winter, and spring; (2) stubble mulching, or leaving a protective cover of crop residue on the surface and planting the next crop in it; (3) using equipment for tillage and harvesting that leaves most of the crop residue on or anchored to the surface; and (4) mulching with organic residue, generally cotton burs and cotton-gin trash.

Emergency measures that are used to control wind erosion when there is not enough crop residue on the surface are (1) tillage that causes roughening or clodding of the surface layer and (2) deep plowing. Deep plowing is used to increase the content of clay in a sandy surface layer. Such plowing has proved to be effective on Miles loamy fine sand. These emergency measures provide only temporary protection.

Control of water erosion

The control of water erosion is important in Hall County because many soils are rolling or sloping and rains often are of high intensity. The soils most susceptible to water erosion are those that are moderately sloping. On those that have gentle slopes, the water erosion hazard is moderate. The soils most susceptible to water erosion are the Carey, Woodward, Enterprise, Miles, Weymouth, and Mansker.

Sheet erosion is most common in Hall County. Rill and gully erosion also occur.

Stubble mulching, terracing and contour farming, and grassed waterways (fig. 20) are used to protect the soils from water erosion and to conserve moisture.

Stubble mulching, used for controlling wind erosion, is also effective in controlling water erosion and in conserving moisture. This practice reduces evaporation, catches and holds snow until it melts and the moisture enters the soil, reduces the impact of raindrops, and provides a higher rate of penetration by water. It is most effective on the more clayey soils, such as the Abilene and Olton.

Terracing and contour farming are used to control water erosion and conserve moisture. On nearly level soils, these practices are needed mainly to conserve moisture, but on steeper soils they are needed primarily to control water erosion. Contour farming without terraces is sufficient to control erosion on soils that are nearly level, such as the St. Paul and Altus.

Grassed waterways are broad channels built to carry runoff at a safe, nonerosive rate. They carry away runoff that has collected in natural drainageways or that has been discharged from terraces or diversions. These waterways are most effective if they are stabilized with vegetation and protected from grazing and fire.

Cropping systems

A flexible cropping system is required on the soils used for crops in Hall County for efficient crop production.

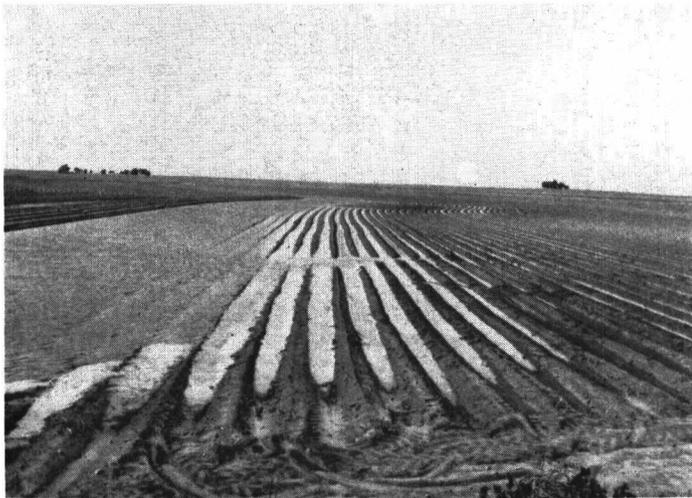


Figure 20.—*Top*, residue from small grain left on the surface by stubble mulching; *middle*, water is held in this field, which has been terraced and contour farmed; *bottom*, this grassed waterway removes excess water without erosion.

Only a few crops are suited to the soils of the county. All crops grown must be drought resistant. Cotton, grain sorghum, and small grain are the major crops. Among the minor crops are alfalfa and forage sorghum. The cropping sequence varies widely among the farm operators in the county.

The main cash crop is cotton, which is a soil-depleting crop. Soils on which it is grown continuously are not protected from blowing or washing. Consequently, a crop that produces a large amount of residue is needed in the cropping sequence with cotton to keep the soil as productive as possible. Examples of crops that produce a large amount of residue are small grain, grain sorghum, forage sorghum, sudangrass, and perennial grasses.

The most effective cropping system in Hall County is one that includes crops that produce enough residue to control erosion and to keep the soils in good condition. Soils that are shallow, have a sandy surface layer, and have steep slopes require more intensive management than other soils.

Most of the soils in Hall County have moderate to high natural fertility when dryland farmed. The exceptions are the soils that have a sandy surface layer, such as the Miles, Springer, and Brownfield. Crops on these soils readily respond to fertilizer in most years. Crops on the soils that have a fine sandy loam surface layer, such as the Miles, Enterprise, and Altus, respond to fertilizer in years of average or above-average rainfall. Crops on the soils that have a loam or clay loam surface layer respond to fertilizer only during years of abundant rainfall. The nutrients most lacking in the soils of Hall County are nitrogen and phosphorus.

If irrigated, the crops on most soils readily respond to fertilizer. The most effective rates and kinds of fertilizer can be determined by soil tests. Soil tests can be arranged through representatives of the Agricultural Extension Service.

Seeding grass on cultivated land

Because of steep slopes, shallow soils, or unstable sand, many cultivated areas in Hall County are highly susceptible to erosion and are better suited to permanent grass. The most feasible way to control erosion on these areas is to establish native grass. Also, the grass improves the physical condition and fertility of the soil.

The most desirable species of grasses for seeding on moderately fine textured and medium textured soils, such as the Woodward, Quinlan, and Weymouth, are buffalograss, blue grama, and sideoats grama. The most desirable species for seeding on moderately coarse textured and coarse textured soils, such as the Miles, Springer, and Brownfield, are sideoats grama, little bluestem, sand bluestem, switchgrass, indiagrass, weeping lovegrass, and sand lovegrass.

Care is needed in establishing native grasses on these soils, as most of the grasses are very sensitive in the seedling stage. Plantings are most successful if seeded in litter. A forage sorghum that has been drilled close, and mowed at a height of 6 or 8 inches before its seed has matured, provides adequate protection. The grass can then be seeded in the litter the following winter or early in spring.

New strains of grass are constantly being developed. For the latest information on grasses, consult the local

office of the Soil Conservation Service or county agricultural agent.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils 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. Eight capability classes are in the broadest grouping and 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.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as 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 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. Hall County has no soils in class I. Class V can contain, at the most, only subclasses *w*, *s* and *c*, because the soils in it are susceptible to little or no erosion but have other limitations that confine 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 according to 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. In this report the capability classification applies only to soils used in a system of dry-land farming. If they are irrigated, many soils can be put in a more favorable capability class.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

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

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

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

Capability unit IIe-1.—Deep to moderately deep, medium-textured, gently sloping soils.

Subclass IIce. Soils that have some limitations because of limited rainfall and the risk of erosion.

Capability unit IIce-2.—Deep, medium-textured, nearly level soils that have a moderately rapid to moderately slowly permeable subsoil.

Capability unit IIce-3.—Deep, medium-textured, nearly level, bottom-land soils.

Capability unit IIce-4.—Deep, moderately fine textured to medium-textured, nearly level soils that have a compact, moderately slowly permeable subsoil.

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

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

Capability unit IIIe-2.—Deep, moderately fine textured and medium-textured, gently sloping soils that have a compact, moderately slowly permeable subsoil.

Capability unit IIIe-3.—Deep to moderately deep, medium-textured, moderately sloping soils that have a moderately permeable to moderately rapidly permeable subsoil.

Capability unit IIIe-4.—Deep, moderately coarse textured, nearly level to gently sloping soils that have a moderately permeable subsoil.

Capability unit IIIe-5.—Deep, moderately coarse textured, nearly level to gently sloping soils that have a moderately rapidly permeable subsoil.

Capability unit IIIe-7.—Moderately deep, medium-textured, gently sloping soils.

Capability unit IIIe-8.—Moderately deep, moderately coarse textured, nearly level to gently sloping soils.

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

Capability unit IIIw-1.—Deep, medium-textured, nearly level soils that are slightly wet because of a high water table.

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

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

Capability unit IVe-2.—Moderately deep, medium-textured, moderately sloping soils.

Capability unit IVe-4.—Deep, moderately coarse textured, moderately sloping soils that have a moderately rapidly permeable subsoil.

Capability unit IVe-5.—Moderately deep, moderately coarse textured, moderately sloping soils.

Capability unit IVe-6.—Deep, coarse-textured, nearly level to gently sloping soils that have a moderately permeable subsoil.

Capability unit IVE-7.—Shallow, medium-textured, nearly level to gently sloping soils.

Capability unit IVE-9.—Deep, moderately coarse textured, moderately sloping soils that have a moderately rapidly permeable subsoil.

Capability unit IVE-11.—Deep, coarse-textured, nearly level to gently sloping soils that have a moderately rapidly permeable subsoil.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass Vw. Soils subject to frequent flooding.

Capability unit Vw-1.—Loamy, nearly level soils on flood plains of streams.

Capability unit Vw-2.—Sandy, nearly level soils on flood plains of streams.

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

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

Capability unit VIe-3.—Steep, moderately coarse textured, moderately deep soils.

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

Capability unit VIe-5.—Deep, moderately coarse textured, strongly sloping soils.

Capability unit VIe-6.—Deep, coarse-textured, nearly level to moderately sloping soils.

Capability unit VIe-7.—Deep, very sandy, nearly level to moderately sloping soils.

Subclass VIIs. Soils generally unsuitable for cultivation and limited for other uses by their moisture capacity, stones, or other features.

Capability unit VIIs-1.—Steep, gravelly soils.

Class VII. Soils that, without major reclamation, have very severe limitations that make them unsuitable for 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 dune sands.

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

Capability unit VIIIs-1.—Very shallow and stony soils.

Capability unit VIIIs-2.—Very shallow, steep, rough broken soils.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Subclass VIIIIs. Rock or soil materials that have little potential for production of vegetation.

Capability unit VIIIIs-1.—Deep, loose, dune sands.

Management of soils by capability units

In the following pages, each capability unit is described, and the soils in it are listed. Also, some suggestions are given for the use and management of the soils in each unit.

The suggestions for the use of soils in each capability unit must be interpreted with judgment. A soil cannot always be managed by itself. Generally, a field contains several soils, and each soil may differ from the others, but all will probably be farmed together. Consequently, land use, kinds of crops, and erosion control practices must be adjusted on each farm or ranch.

CAPABILITY UNIT He-1

The soils in this capability unit are deep to moderately deep, medium textured, and gently sloping. The permeability of the subsoil is moderately rapid to moderately slow. The soils are—

Carey loam, 1 to 3 percent slopes.

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

St. Paul silt loam, 1 to 2 percent slopes.

Tipton loam, 1 to 3 percent slopes.

Woodward loam, 1 to 3 percent slopes.

These soils are very friable and easily tilled. They hold moderate to large amounts of moisture, and they readily release it to crops. Natural fertility is moderate to high. Plant roots, moisture, and air readily penetrate these soils. The risk of water erosion is slight to moderate, and the risk of wind erosion is slight.

The soils are extensive in the county. Most areas are cultivated. Cotton, small grain, and grain sorghum are grown. The soils are also well suited to native grasses. They are suitable for irrigation if water is available.

Conserving moisture and controlling erosion are the main conservation practices needed. Terraces and contour farming help control water erosion and aid in conserving moisture. Favorable yields can be produced and erosion controlled by mulching with cotton burs or by growing, about half the time, a crop that produces much residue. If left on the surface as much as possible, the residue is most effective in controlling erosion, increasing intake of water, reducing surface crusting, and maintaining good tilth. Emergency tillage helps to control wind erosion during periods when there is no crop residue.

Crops on these soils respond to added commercial fertilizer during years of average to high rainfall. Crops are most likely to respond to nitrogen. If the soils are irrigated, crops on them readily respond to fertilizer. The soils should be fertilized according to needs determined by soil tests.

CAPABILITY UNIT Hcc-2

This capability unit consists of deep, medium-textured, nearly level soils. The permeability of the subsoil is moderately slow to moderately rapid. The soils are—

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

St. Paul silt loam, 0 to 1 percent slopes.

Tipton loam, 0 to 1 percent slopes.

These are among the most productive soils in the county. They have high natural fertility. They hold a large amount of moisture, which they readily give up to plants. They are very friable and easily tilled. The hazard of wind erosion is slight.

The soils are extensive. Most areas are cultivated. They are well suited to cotton, sorghum, and small grain but are used mainly for cotton. They are also well suited to native grasses.

These soils have few limitations. Conserving moisture and controlling erosion are the main conservation practices needed. Cropping sequences are needed that provide residue to protect the soils and help control erosion, that increase the intake of moisture, and that maintain fertility and tilth. A suitable cropping sequence is 2 years of cotton and 1 year of grain sorghum or small grain. Mulching with cotton burs can be substituted for the growing of grain sorghum or small grain. Crop residue provides the greatest benefits if it is kept on the surface as much as possible. The residue helps to control erosion, improve fertility, and increase the intake of water. Terracing and contour farming of these soils also help to increase the intake of water. Emergency tillage should be used as needed to control wind erosion during periods when no crop residue is available.

These soils do not normally need fertilizer unless they are irrigated. If they are irrigated, the soils should be fertilized according to needs determined by soil tests.

CAPABILITY UNIT IIC-3

This capability unit consists of deep, medium-textured, nearly level bottom-land soils. Slopes range from 0 to 1 percent. The soils are—

Spur loam.

Yahola very fine sandy loam.

These soils may be flooded occasionally. They have high fertility and are highly productive. They are very friable and easily tilled. They have a moderate to high capacity to store moisture, and they supply it readily to plants. The hazard of wind erosion is slight.

These soils are extensively cultivated. Most crops grown in the county are well suited, but cotton is grown most extensively. Native grasses are also well suited.

These soils have few limitations. Conserving moisture and controlling erosion are the main conservation practices needed. Grain sorghum, small grain, or other crops that produce a large amount of residue can be grown occasionally in the cropping system to help to reduce erosion, increase the moisture intake, and maintain fertility and tilth. Mulching with cotton burs also provides adequate residue for erosion control. Crop residue is most effective if it is kept on the surface. It helps to keep the soils productive. Emergency tillage helps to control wind erosion during periods when no crop residue is on the surface.

Crops on these soils normally do not respond to added fertilizer, except during wet years. If irrigated, crops readily respond to fertilizer. Fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT IIC-4

This capability unit consists of deep, moderately fine textured and medium-textured, nearly level soils that have a compact, moderately slowly permeable subsoil. The soils are—

Abilene clay loam, 0 to 1 percent slopes.

Olton loam, 0 to 1 percent slopes.

These soils have high natural fertility. They have a clayey subsoil, which tends to impede water, air, and root movement. During years of low rainfall, they are more droughty than any of the other soils with similar slopes. The hazard of wind and water erosion is slight. The surface crusts readily after rains.

Most areas of these soils are cultivated. Cotton and small grain are grown most extensively. Grasses are also well suited. The soils are well suited to irrigation if water is available.

These soils have few limitations. Improving tilth, increasing moisture intake, and controlling erosion are the main conservation practices needed. Growing a crop that produces a large amount of residue or mulching occasionally with cotton burs helps to maintain good tilth, to reduce surface crusting, and to improve the moisture intake. These practices also reduce the hazard of erosion. Terracing the longer, steeper slopes and contour farming also help to increase the moisture intake of these soils. Crop residue is of greatest benefit if left on the surface.

Crops on dryfarmed areas normally respond to added fertilizer only during wet years. If they are irrigated, the soils should be fertilized according to the needs determined by soil tests.

CAPABILITY UNIT III-2

This capability unit consists of deep, moderately fine textured to medium-textured, gently sloping soils that have a compact, moderately slowly permeable subsoil. The soils are—

Abilene clay loam, 1 to 3 percent slopes.

Olton loam, 1 to 3 percent slopes.

These soils have high natural fertility and are moderately productive. Their ability to store moisture is high. Because of their clayey subsoil, which tends to restrict the movement of water, air, and roots, these soils are droughty during periods of low rainfall. The risk of wind erosion is slight, and the risk of water erosion is moderate. The surface crusts readily after rains.

Most areas of these soils are cultivated. Small grain and cotton are grown most extensively. Nearly all crops normally grown in this area, however, can be grown on these soils. Wheat is especially well suited. Native grasses are also well suited. The soils are suitable for irrigation if water is available.

Controlling erosion, conserving moisture, and improving the tilth are the main conservation practices needed. Terraces and contour farming are needed to reduce erosion and to conserve moisture. Mulching with cotton burs or growing about half the time a crop that produces much residue greatly helps to improve tilth, reduce surface crusting, control erosion, and increase the water intake. The residue is most effective if left on the surface. Small-grain residue is most effective if the soil is stubble mulched. If crop residue is not available, emergency tillage may be needed to protect the soils from wind erosion.

If the soils are dryfarmed, crops normally respond to added fertilizer only during wet years. If the soils are irrigated, fertilizer is needed for economic yields. Fertilizer should be applied according to the results of soil tests.

CAPABILITY UNIT IIIe-3

The soils in this capability unit are deep to moderately deep, medium textured, and moderately sloping. The permeability of the subsoil is moderate to moderately rapid. The soils are—

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

These soils are very friable and easily tilled. Their natural fertility and productivity are moderate. They have good water-holding capacity and give up moisture freely to plants. Plant roots and moisture move freely through these soils. The risk of water erosion is moderate to high.

These soils are cultivated extensively. Cotton and grain sorghum are the main crops grown. The soils are well suited to native grasses.

Controlling water erosion and conserving moisture are the main conservation practices needed. A complete system of terraces is needed to reduce runoff. Grain sorghum, small grain, or other crops that produce much residue are needed most of the time. Cotton burs applied as a mulch can be substituted for the residue from grain sorghum or small grain. If the residue is left on the surface as much as possible, it gives effective protection from erosion, helps to reduce surface crusting, maintains the organic-matter content, and improves tilth. If crop residue is not available, emergency tillage may be needed to help control wind erosion.

Crops on these soils normally respond to added commercial fertilizer during moderately wet to wet years. Fertilizer should be applied according to the results of soil tests and crop needs.

CAPABILITY UNIT IIIe-4

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

- Altus fine sandy loam, 0 to 1 percent slopes.
- Miles fine sandy loam, 0 to 1 percent slopes.
- Miles fine sandy loam, 1 to 3 percent slopes.
- Guadalupe and Tipton soils.

These soils are very friable and are easily tilled. They are moderately permeable to moisture, and roots move freely through them. They have moderate to high fertility. The hazard of wind erosion is moderate, and that of water erosion is slight.

The soils are extensive in the county. Most areas are cultivated. Cotton and grain sorghum are the main crops grown on these soils, but most of the crops suited to this area can be grown. Native grasses are well suited. The soils are suitable for irrigation if water is available.

Controlling wind erosion and conserving moisture are the main conservation practices needed on these soils. A satisfactory cropping sequence includes, about one-half of the time, a crop that produces enough residue to control wind erosion adequately and to keep the soils in good physical condition, or a mulch of cotton burs can be used. The residue is most effective if left on the surface as much as possible. It protects the soil from blowing, improves the tilth, and helps to maintain the organic-matter content. The residue can be worked into the soil after the critical period of wind erosion in the spring. The gentle slopes should be terraced and farmed on the

contour to reduce water erosion and to increase the intake of water. If terraces are not used, crops producing much residue must be grown continuously for adequate protection of the soils from water erosion. Emergency tillage should be used as needed during critical periods of wind erosion if crop residue is not available.

If the soils are dryfarmed, crops respond to added fertilizer during years that have average or above-average rainfall. Nitrogen is needed most. If the soils are irrigated, fertilizer must be used for favorable yields. Fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT IIIe-5

The soils in this capability unit are deep, moderately coarse textured, and nearly level to gently sloping. The subsoil has moderately rapid permeability. The soils are—

- Enterprise fine sandy loam, 0 to 1 percent slopes.
- Enterprise fine sandy loam, 1 to 3 percent slopes.
- Yahola fine sandy loam.
- Lincoln and Yahola soils (Yahola fine sandy loam part).

These soils have moderate natural fertility and are moderately productive. Water is readily absorbed, and roots and water move freely through the subsoil. The risk of wind erosion is moderate, and that of water erosion is slight.

Most of these soils are cultivated. Cotton and grain sorghum are best suited to these soils. Native grasses are also well suited. These soils are suitable for irrigation if water is available.

Protecting the soils from wind erosion and conserving moisture are the main conservation practices needed. For adequate control of erosion on these soils, a crop that produces much residue, such as grain sorghum or small grain, is needed in the cropping sequence. Mulching with cotton burs much of the time also gives adequate protection. The residue provides maximum benefits if it is kept on the surface. It can be worked into the soil after the critical period of wind erosion in the spring. Emergency tillage or surface roughening also helps to reduce wind erosion during the critical period when adequate cover is not available.

Crops on these soils readily respond to commercial fertilizer in most years. Nitrogen is needed most, but phosphate may also be needed. All fertilizer applications should be based on needs determined by soil tests.

CAPABILITY UNIT IIIe-7

The only soil in this capability unit is Weymouth loam, 1 to 3 percent slopes. It is moderately deep, medium textured, and gently sloping.

This soil has a moderately deep root zone and is only moderately productive. It is very friable and easily tilled, and its ability to hold moisture is fair. It has moderate natural fertility and is moderately susceptible to erosion by water and wind.

Shallow-rooted crops, such as sorghum and small grain, are best suited to this soil. Cotton is grown extensively. Native grasses are also well suited.

Conserving moisture and controlling erosion are the main conservation practices needed on this soil. For good erosion control, crops that produce much residue, such as grain sorghum or small grain, should be grown

in the cropping sequence most of the time. Mulching with cotton burs can be substituted for the growing of small grain or grain sorghum. The residue is most effective if left on the surface as much as possible. It improves the tilth, increases intake of water, reduces erosion, and helps to maintain the organic-matter content. Terraces and contour farming are needed to reduce runoff and to control water erosion.

Except in dry years, crops on this soil respond to commercial fertilizer. Fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT IIIe-8

The only soil in this capability unit is Mansker fine sandy loam, 0 to 3 percent slopes. It is moderately deep, moderately coarse textured, and nearly level to gently sloping.

This soil has low to moderate fertility and is moderately productive. It is very friable and easily tilled. It is only moderately deep, but the substratum is easily penetrated by moisture and roots. The risk of wind erosion is moderate, and that of water erosion is slight to moderate.

The crops grown on this soil are mostly cotton and grain sorghum. Native grasses also grow well.

Controlling wind erosion and conserving moisture are the main practices needed on this soil. Terraces are necessary on the steeper slopes to reduce water erosion and to increase the intake of water. A crop that produces much residue should be grown in the cropping system most of the time, or a mulch of cotton burs should be used to help control wind erosion. The residue is also effective in increasing the intake of water and improving the tilth.

The residue can be worked into the soil after the critical period of wind erosion is over. Emergency tillage or surface roughening is effective in reducing wind erosion during critical periods when no residue is on the surface.

Crops on these soils respond to fertilizer in most years. Nitrogen is needed most. Fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT IIIw-1

The only soil in this capability unit is Tipton loam, somewhat poorly drained. It is deep, medium textured, and nearly level. This soil is slightly wet because of a high water table.

This soil has high fertility but is moderately productive. The water in the water table is saline and makes the soil slightly to moderately saline in most places.

Cotton and alfalfa are the main crops grown on this soil. Bermudagrass is well suited.

The main conservation practice needed on this soil is the removal of saline water. If the water table is lowered, the salinity will be reduced. Drainage is the most effective way of removing the water. A cover or mulch is needed on this soil at all times to keep evaporation to a minimum. If this soil is not covered, the salts accumulate at the surface as the water evaporates. As long as the water table is high, either crops that produce much residue or cover crops should be grown on these soils as much of the time as possible. If the water table is lowered by drainage, the same cropping system used for

Tipton loam, 0 to 1 percent slopes (Capability unit IIc-2), is suitable for this soil.

CAPABILITY UNIT IVe-2

The only soil in this capability unit is Weymouth loam, 3 to 5 percent slopes. It is moderately deep, medium textured, and moderately sloping.

This soil has low natural fertility and low productivity. It is friable and easily tilled. Its ability to store moisture and release it to plants is fair. The hazard of water erosion is moderate to high.

Cotton, sorghum, and small grain are grown on this soil. The soil is best suited to grain sorghum, small grain, and native grasses.

The main conservation practice needed is the control of water erosion. A complete system of terraces is needed to keep runoff to a minimum. This soil is best suited to a cropping sequence that includes only crops that produce much residue. Crop residue should be left on the surface as much as possible. This helps to control erosion, reduce runoff, and improve tilth.

CAPABILITY UNIT IVe-4

The only soil in this capability unit is Miles fine sandy loam, 3 to 5 percent slopes. It is deep, moderately coarse textured, and moderately sloping. The permeability of the subsoil is moderately rapid.

This soil has moderate fertility and is moderately productive. The hazard of wind erosion is moderate, but the hazard of water erosion is high. The soil has a fair ability to store moisture and to release it to plants.

Cotton and grain sorghum are the crops most extensively grown on this soil. Crops that produce much residue and permanent grasses are best suited.

If this soil is cultivated, the control of erosion is the main management practice needed. The cropping sequence should consist mainly of crops that produce much residue. Cotton can be grown successfully without damage to the soil if a mulch of cotton burs is applied after harvest. Crop residue provides effective protection from erosion if it is kept on the surface as much as possible. Terraces are needed to reduce water erosion. Emergency tillage that roughens the surface during the critical periods of wind erosion when no cover is available helps reduce wind damage.

Crops on this soil readily respond to fertilizer. Nitrogen is needed most. Fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT IVe-5

The only soil in this capability unit is Mansker fine sandy loam, 3 to 5 percent slopes. It is moderately deep, moderately coarse textured, and moderately sloping.

This soil has low fertility. It stores a moderate amount of moisture, but it readily releases it to plants. The subsoil is very friable and is easily penetrated by moisture and roots. The hazard of wind and water erosion is moderate to high.

Cotton and grain sorghum are grown on this soil. Native grasses or crops that produce much residue are best suited.

The main management practice needed on this soil is protection from erosion. Terraces are necessary to reduce the water erosion. A satisfactory cropping system

includes continuous, close-growing or drilled crops that produce much residue. The residue is most effective if it is left on the surface as much as possible. The residue also helps in conserving moisture and improving productivity.

Fertilizer is needed on this soil for favorable yields. It should be applied according to needs determined by soil tests.

CAPABILITY UNIT IVe-6

This capability unit consists of deep, coarse-textured, nearly level to gently sloping soils that have a moderately permeable subsoil. The soils are—

Brownfield fine sand, thin surface.
Miles loamy fine sand, 0 to 3 percent slopes.

These soils are highly susceptible to wind erosion and are slightly susceptible to water erosion. They have low natural fertility. They store a moderate amount of moisture, which is readily available to plants. The subsoil is readily penetrated by air, water, and roots.

These soils are extensive in the county, and most areas are cultivated. Crops that produce much residue and native grasses are best suited. If the soils are irrigated, bermudagrass is well suited.

Controlling wind erosion and improving the fertility of these soils are the main management practices needed. The cropping sequence should consist of crops that produce much residue most of the time. Cotton can be successfully grown without severe erosion damage to the soils if a mulch of cotton burs is applied after cotton is harvested. The greatest benefits for controlling wind erosion are obtained when crop residue is kept on the surface. Deep plowing is effective in bringing clay to the surface and in reducing wind erosion. Terraces and diversions are effective on the steeper and longer slopes in reducing runoff and controlling water erosion. If crop residue is not available, emergency tillage may be needed to keep wind erosion to a minimum.

Crops growing on these soils readily respond to fertilizer. Nitrogen is needed most, but fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT IVe-7

The only soil in this capability unit is the Arch part of the undifferentiated group of Arch and Cottonwood soils, 0 to 3 percent slopes. This soil is shallow, medium textured, and nearly level to gently sloping.

The Arch soil in this unit has moderate fertility, moderate productivity, and a shallow root zone. The hazard of wind erosion is slight, and that of water erosion is slight to moderate. The capacity of the Arch soil to store moisture is low. Shallow-rooted crops, such as small grain and grain sorghum, are best suited. Native grasses are also well suited.

Conserving moisture and controlling erosion are the main conservation practices needed. The cropping sequence should consist entirely of crops that produce much residue. The residue is most effective if left on the surface as much of the time as possible. Terraces may be needed on the steeper slopes to control erosion.

Crops readily respond to fertilizer, which should be applied according to needs determined by soil tests.

CAPABILITY UNIT IVe-9

This capability unit consists of deep, moderately coarse textured, moderately sloping soils that have a moderately rapidly permeable subsoil. The soils are—

Enterprise soils, wind-hummocky.
Enterprise fine sandy loam, 3 to 5 percent slopes.

These soils have low fertility and low productivity. The risk of wind and water erosion is moderate to high. The capacity of these soils to store water is low. Plant roots and water readily penetrate the soils.

Cotton and grain sorghum are grown extensively. Crops that produce much residue or permanent grasses are best suited.

Controlling erosion and maintaining fertility are the main management practices needed. Crops that produce much residue should be grown continuously. Cotton can successfully be grown without damage to the soils if a mulch of cotton burs is applied each year. Crop residue gives the most protection from erosion if kept on the surface as much of the time as possible. Residue also increases the intake of water and improves the physical condition of the soils. Emergency tillage, or roughening of the surface during critical periods of wind erosion when no cover is available, aids in reducing wind erosion.

Crops on these soils readily respond to commercial fertilizer. Nitrogen is needed most. Fertilizer should be applied according to crop needs and the results of soil tests.

CAPABILITY UNIT IVe-11

The only soil in this capability unit is Springer loamy fine sand, undulating. It is deep, coarse textured, and nearly level to gently sloping. Permeability of the subsoil is moderately rapid.

The soil is highly susceptible to wind erosion and slightly susceptible to water erosion. The fertility and water-holding capacity are low.

Cotton and grain sorghum are grown. Crops that produce much residue and native grasses are best suited. If irrigation water is available, bermudagrass is well suited.

Controlling wind erosion and maintaining fertility are the main management practices needed. The cropping sequence should include only crops that produce much residue, such as small grain or close-growing forage sorghum. Crop residue is most effective in controlling wind erosion if left on the surface.

Crops readily respond to fertilizer. Fertilizer should be applied according to needs determined by soil tests.

CAPABILITY UNIT Vw-1

This capability unit consists of loamy, nearly level soils on the flood plains of streams. The soils are—

Loamy alluvial land, depressed.
Spur and Yahola soils.

These soils are subject to frequent damage by floods. Many areas have a high water table, and a few are saline. The soils have high natural fertility and are productive.

These soils are suitable only for range and wildlife. They produce a wide variety of plants. Under good management, the soils can produce a large amount of usable forage. Bermudagrass grows well in most places.

The saline areas, however, produce only saltgrass, alkali sacaton, and other salt-tolerant plants.

The soils in this unit are in the Loamy Bottomland range site. Among the management practices needed for good production of forage are rotation grazing, deferred grazing, and proper stocking. The grasses should be allowed to produce seed occasionally to maintain a vigorous growth. Mesquite and other woody plants should be controlled.

CAPABILITY UNIT Vw-2

This capability unit consists of sandy, nearly level soils on the flood plains of large streams. The soils are—

- Lincoln and Yahola soils (Lincoln part).
- Sandy alluvial land.

Most areas of these soils are subject to recurrent damage by floods. Also in most areas, the water table is within 1 to 3 feet of the surface, and wetness is a hazard. In most places the water is saline and makes the soils saline. The soils are moderately productive. They are highly susceptible to wind erosion if a cover is not maintained.

These soils are suitable only for range and wildlife. Under good management, they produce much useable forage. Bermudagrass is well suited. Many of the areas, however, produce only salt-tolerant plants, such as saltgrass and alkali sacaton. Old cultivated fields are best suited to permanent grasses.

The soils of this unit are in the Sandy Bottomland range site. Desirable plant species are very productive. Some areas need to be seeded to desirable grasses. A cover should be maintained at all times. If the soils are left unprotected, salts tend to accumulate near the surface as a result of evaporation. At least one-half of the growth of grass should be left, and grazing should be deferred occasionally to allow grasses to produce seed.

CAPABILITY UNIT VIe-3

The only soil in this capability unit is Mansker fine sandy loam, 5 to 12 percent slopes. It is steep, moderately coarse textured, and moderately deep.

This soil is highly susceptible to water erosion and moderately susceptible to wind erosion. Because of these hazards, it is not suitable for cultivation. The areas now cultivated are mostly moderately eroded and are better suited to native grass. Sideoats grama and little bluestem are best suited. The grass should be seeded in litter, and a good stand obtained before grazing.

This soil is in the Sandy Loam range site. It produces a wide variety of plants. Careful management is required to prevent invasion of the site by undesirable plants. Rotation grazing, deferred grazing, proper stocking, and other management practices should be used. Not more than one-half of the annual growth of vegetation should be removed. Woody plants, such as mesquite and sand sagebrush, may need to be controlled.

CAPABILITY UNIT VIe-4

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

- Enterprise very fine sandy loam, 5 to 12 percent slopes.
- Quinlan-Woodward complex (Woodward loam and Quinlan loam parts).
- Woodward-Quinlan loams, 5 to 12 percent slopes.

If cultivated, these soils are highly susceptible to water erosion because of their steep slopes. They have low fertility. A large acreage has been cultivated, and in many places the soils are moderately eroded to severely eroded. Most of the eroded areas are in grass. All the cultivated areas are better suited to permanent grass, which would control erosion. Sideoats grama and blue grama are well suited. Native grasses should be seeded in litter, and a good stand should be established before grazing.

These soils are in the Mixedland range site. They are capable of producing large amounts of herbage. Careful management is required for favorable yields, and proper stocking must be maintained to prevent overgrazing. Occasional deferred grazing allows the grass to produce seed. A good cover is needed at all times to control erosion. At least one-half of the annual growth of grass should be left on the land. On the larger areas, fences can be used for better grazing distribution. Mesquite is a common invader of ranges on these soils and may need to be controlled.

CAPABILITY UNIT VIe-5

The only soil in this capability unit, Miles fine sandy loam, 5 to 8 percent slopes, is deep, moderately coarse textured, and strongly sloping.

This soil is highly susceptible to water erosion and is not suitable for cultivation. The fertility is low to moderate. Most of the acreage is in range. The few fields in cultivation are better suited to native grasses. The soil is good for the production of grass. Sideoats grama and little bluestem are best suited. The grass should be seeded in litter, and a good stand should be established before grazing.

This soil is in the Sandy Loam range site. It provides excellent grazing if properly stocked. If it is overgrazed, such invaders as sand sagebrush and three-awn increase. Mesquite, sand sagebrush, and other woody species may need to be controlled. If deferred and rotated grazing are used occasionally, grass will produce seed.

CAPABILITY UNIT VIe-6

This capability unit consists of deep, coarse-textured, nearly level to moderately sloping soils. They are—

- Miles loamy fine sand, 3 to 5 percent slopes.
- Springer loamy fine sand, hummocky.
- Springer soils, severely eroded.

These soils are highly susceptible to wind erosion if a cover is not maintained. They are not suitable for cultivation. Their natural fertility is very low. A large acreage of these soils has been cultivated, but most of it has reverted to grass. All the acreage should be in native grasses. The grasses best suited are indiangrass, switchgrass, sand bluestem, and little bluestem. Fertilizer, especially nitrogen, is needed in most areas to obtain a good cover. The grasses should be planted in litter, and a good stand should be established before grazing.

The soils of this unit are in the Sandyland range site. They are capable of producing favorable yields of grass if carefully managed. If deferred grazing is used occasionally, grass will produce seed. A good cover maintained at all times helps to control wind erosion. Shinnery, sand sagebrush, mesquite, and other brush should

be controlled. In the large areas, fences can be used to provide more uniform grazing. If at least one-half of the annual growth of grass is left on the land at all times, it will insure good protection from erosion, conserve moisture, and maintain a vigorous growth of plants.

CAPABILITY UNIT VIc-7

This capability unit consists of deep, very sandy, nearly level to moderately sloping soils. They are—

Brownfield fine sand, thick surface.
Nobscoot fine sand.

Because these soils have a very sandy surface layer, they are highly susceptible to wind erosion. A good cover is needed at all times. The soils are suitable only for range and for wildlife. The few areas that were formerly cultivated have been mostly returned to range. Native grasses should be established in these areas. The grasses best suited are indiagrass, switchgrass, sand bluestem, and little bluestem. Fertilizer is needed for establishing vegetation on these soils. The grass should be seeded in litter of sorghum residue, and a good stand obtained before grazing.

The soils of this unit are in the Deep Sand range site. They are capable of producing a large amount of herbage. Careful management is needed to prevent overgrazing on these soils. If the range is overgrazed, undesirable plants rapidly replace the more desirable grasses. If deferred grazing is used occasionally, grass will produce seed. It may be necessary to control shinnery, sand sagebrush, and other woody plants. At least one-half of the annual growth of grass should be left on these soils at all times to insure protection from wind erosion, and to keep the grass vigorous. Fences may be needed to insure more uniform grazing.

CAPABILITY UNIT VIc-1

The only mapping unit in this capability unit is Gravelly broken land. It is steep to very steep and gravelly.

Because it has steep slopes and contains a large amount of gravel, this land type is suitable only for range and for wildlife. It is fair for grass production but is highly susceptible to erosion if a cover is not maintained.

This land type is in the Gravelly range site. It requires intensive range management. Deferred grazing and rotation grazing may be needed occasionally to allow plants to produce seed and to maintain vigorous growth. A cover of vegetation is needed at all times.

CAPABILITY UNIT VIIc-1

The only soil in this capability unit, Tivoli fine sand, consists of deep dune sand.

This soil is highly susceptible to wind erosion. It is suitable only for range and wildlife. It has low fertility and limited capacity to store moisture.

This soil is in the Deep Sand range site. It requires careful management for economical production. Good plant cover should be maintained at all times, and the natural cover should never be destroyed. Occasional deferred grazing allows the grass to produce seed and to maintain a vigorous growth. At least half of the annual growth of vegetation should be left on the soil to protect it from wind erosion. Control of skunkbush, sand sagebrush, and other undesirable species should be

done only by spraying or moving. Fences may be needed for better distribution of livestock.

CAPABILITY UNIT VIIc-1

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

Arch and Cottonwood soils, 0 to 3 percent slopes (Cottonwood part).
Latom stony loam, 3 to 12 percent slopes.

These soils are suitable only for range and wildlife because they are steep and very shallow. They have low natural fertility, their root zone is shallow, and their ability to store moisture is low. Most areas support only a sparse cover of vegetation.

The Latom soil is in the Very Shallow range site, and the Cottonwood soil is in the Gypland. Careful management is required for economical production. Deferred grazing used occasionally allows grass to produce seed. If the range is properly stocked, a good cover can be maintained.

CAPABILITY UNIT VIIc-2

This capability unit consists of very shallow, very steep, rough broken land. The mapping units are—

Quinlan-Woodward complex (Rough broken land part).
Rough broken land.

These land types are steep and are highly susceptible to water erosion. They are suitable only for limited grazing and for wildlife. Most areas produce only a sparse cover of vegetation, and many areas are only partly accessible to livestock. This is a poor site for grass production.

These land types are in the Rough Breaks range site. The plants are mostly sideoats grama, blue grama, and little bluestem. Intensive range management is needed. If grazing is deferred occasionally, grass will produce seed. Proper stocking is needed to prevent overgrazing. Fences and additional water facilities may be needed for better distribution of grazing. Not more than one-half of the annual growth of grass should be removed.

CAPABILITY UNIT VIIIc-1

The only mapping unit in this capability unit, Active dunes, consists of deep, loose, dune sand. This land type is not suitable for producing commercial plants; it is suitable only for wildlife. It is highly susceptible to wind erosion and does not have a cover of vegetation needed to stabilize the dunes, which are constantly shifting. The fertility and water-holding capacity are very low. Some areas have a sparse cover of vegetation.

All areas of this unit should be fenced and protected from grazing. This land type was not placed in a range site.

Yield Predictions

Yield predictions for the principal crops on soils of Hall County are shown in table 2. The predictions are based on the results of research and on information received in interviews with farmers and others who have knowledge of the soils and yields in the county.

The yield predictions for cotton, grain sorghum, and wheat on soils under an average level and under a high

level of management are given in table 2. Soils that are used only for range are not included in table 2. Although crops other than those listed in table 2 are grown in Hall County, their yields are not given, as they are grown only in a small acreage and reliable data are not available.

The yield predictions in table 2 are for dryfarmed soils. No yields are predicted for irrigated soils, but yields on them are considerably higher. Crops under irrigation in Hall County can normally be expected to yield two to three times as much as those under dryland farming. The average yield for cotton under irrigation is about 1.5 bales per acre, but yields range from 1 to 2 bales. Fertilizer is needed on all the soils for the most economic yields. The soils most irrigated in the county are the Miles, Altus, Tipton, Abilene, Spur, Olton, and Yahola.

The yields to be expected under a high, or improved, level of management are shown in columns B of table 2.

The high level of management includes all of the best known methods of farming. The practices used under this level of management are as follows:

1. Rainfall is conserved by using all necessary conservation practices. Among these practices are a properly maintained terrace system, contour farming, and stubble mulching.
2. Crop residue is managed for effective erosion control.
3. Soil fertility is maintained by timely application of fertilizer in kinds and amounts based on soil tests and crop needs, and by growing and managing suitable soil-improving crops.
4. Soil tilth is maintained by using suitable cropping sequences that maintain an adequate supply of organic matter; by tilling, harvesting, and grazing at optimum moisture content to avoid

TABLE 2.—Yield predictions for principal crops under two levels of management

[Yields in columns A are obtained under an average level of management; those in columns B are obtained under a high level of management. Absence of data indicates that the crop normally is not grown on the soil]

Soil ¹	Cotton (lint)		Grain sorghum		Wheat		Soil ¹	Cotton (lint)		Grain sorghum		Wheat	
	A	B	A	B	A	B		A	B	A	B	A	B
	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Bu.</i>	<i>Bu.</i>		<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Bu.</i>	<i>Bu.</i>
Abilene clay loam, 0 to 1 percent slopes	165	190	1,000	1,250	16	20	Miles fine sandy loam, 0 to 1 percent slopes	250	310	1,200	1,500		
Abilene clay loam, 1 to 3 percent slopes	140	160	900	1,100	14	18	Miles fine sandy loam, 1 to 3 percent slopes	200	250	1,100	1,350		
Altus fine sandy loam, 0 to 1 percent slopes	260	320	1,200	1,500			Miles fine sandy loam, 3 to 5 percent slopes	165	190	900	1,150		
Arch and Cottonwood soils, ² 0 to 3 percent slopes	100	120	550	750	6	8	Miles loamy fine sand, 0 to 3 percent slopes	160	230	1,000	1,300		
Brownfield fine sand, thin surface	190	250	1,000	1,200			Olton loam, 0 to 1 percent slopes	165	190	1,000	1,250	16	20
Carey loam, 1 to 3 percent slopes	200	250	1,100	1,400	13	17	Olton loam, 1 to 3 percent slopes	140	160	800	1,000	13	17
Carey loam, 3 to 5 percent slopes	175	210	900	1,200			Springer loamy fine sand, undulating	130	180	800	1,050		
Enterprise fine sandy loam, 0 to 1 percent slopes	210	265	1,100	1,300			Spur loam	250	325	1,250	1,600	15	21
Enterprise fine sandy loam, 1 to 3 percent slopes	175	225	1,000	1,250			St. Paul silt loam, 0 to 1 percent slopes	200	260	1,100	1,350	15	20
Enterprise fine sandy loam, 3 to 5 percent slopes	150	180	850	1,000			St. Paul silt loam, 1 to 2 percent slopes	180	240	1,000	1,300	13	18
Enterprise soils, wind-hummocky	110	150	600	800			Tipton loam, 0 to 1 percent slopes	275	350	1,400	1,800	16	22
Enterprise very fine sandy loam, 0 to 1 percent slopes	250	325	1,200	1,500			Tipton loam, 1 to 3 percent slopes	215	275	1,150	1,450	14	18
Enterprise very fine sandy loam, 1 to 3 percent slopes	190	235	1,100	1,300			Tipton loam, somewhat poorly drained	175	225	1,000	1,200		
Enterprise very fine sandy loam, 3 to 5 percent slopes	165	200	900	1,150			Weymouth loam, 1 to 3 percent slopes	125	160	750	900		
Guadalupe and Tipton soils ³	180	230	1,000	1,200			Weymouth loam, 3 to 5 percent slopes	110	130	700	850		
Mansker fine sandy loam, 0 to 3 percent slopes	130	170	800	1,000			Woodward loam, 1 to 3 percent slopes	180	240	1,000	1,300		
Mansker fine sandy loam, 3 to 5 percent slopes	110	125	700	850			Woodward loam, 3 to 5 percent slopes	150	190	900	1,100		
							Yahola fine sandy loam	210	275	1,100	1,400		
							Yahola very fine sandy loam	240	310	1,200	1,500		

¹ Soils not listed in this table are not used for stated crops.

² Arch part only; Cottonwood part is not suitable for cultivation.

³ Guadalupe part only; for Tipton part, see Tipton loam, 0 to 1 percent slopes.

soil compaction; and by using minimum but timely tillage to control weeds and prepare a seedbed.

5. Measures are used consistently and at the proper time for control of insects, diseases, and weeds.
6. Improved crop varieties or strains are used.

The yields to be expected under an average, or ordinary, level of management are shown under columns A of table 2. Under this level of management, one or more of the practices used under the high level of management are omitted. Practices most commonly omitted are (1) using crop residue effectively, (2) maintaining soil fertility, and (3) cropping in a suitable sequence. This is the level of management now practiced by the majority of farmers in the county.

Use of Soils for Range ²

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

Ranching and livestock farming in the county

At the time of the survey, ranching and livestock farming were conducted on 41 ranch units, comprising a total of about 300,000 acres of grassland. These units ranged from 750 acres to 77,000 acres in size. Most of the forage in this county is produced on native grassland; however, more than 90 percent of the livestock units have cropland that is planted each year to crops for grazing.

All units use the cow-calf plan of operation. Some ranchers supplement their regular herd by purchasing steers each year; others lease for grazing the forage grown on cropland each year. If extra stock is obtained in the fall, it is disposed of the next spring. The number of animals obtained is determined by the amount of surplus forage produced on native grassland during the growing season and by estimates of the amount of grazing available from cropland. The number of extra stock purchased is smaller in years of low rainfall and larger in years of high rainfall.

Obtaining steers in the fall enables the rancher to control the amount of native grass consumed throughout the growing season. He can then make efficient use of his forage while maintaining adequate plant cover for soil and water conservation.

Range sites and condition classes

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

² This section was prepared by JOE B. NORRIS, range conservationist, Soil Conservation Service.

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

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

As the decreasers are reduced or eliminated by continued grazing, the plants that were not grazed first increase. These plants are called *increasers*. As grazing continues, the successively less desirable plants dominate the site. As the decreasers and the increasers are thinned or eliminated, plants from other sites or areas farther away invade the site. These plants are called *invaders*.

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

Descriptions of range sites

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

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

In some places soils are so intermingled that they cannot feasibly be mapped separately. A mixture of range sites often results from such a complex of soils or an undifferentiated group. In a few places, each of the soils that make up the complex or group are in the same range site. Because the land type, Active dunes, is not suitable for range, it was not placed in a range site.

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

DEEP HARDLAND RANGE SITE

This range site is made up of nearly level to gently sloping upland soils of the plains. Few slopes are greater than 3 percent. The soils in this site are—

AbA	Abilene clay loam, 0 to 1 percent slopes.
AbB	Abilene clay loam, 1 to 3 percent slopes.
OtA	Olton loam, 0 to 1 percent slopes.
OtB	Olton loam, 1 to 3 percent slopes.
SpA	St. Paul silt loam, 0 to 1 percent slopes.
SpB	St. Paul silt loam, 1 to 2 percent slopes.

These deep soils have a large capacity to hold both water and plant nutrients. They absorb water slowly because of a clayey, slowly permeable subsoil. As a result, they are somewhat droughty and produce short to mid grasses.

Blue grama, sideoats grama, vine-mesquite, Arizona cottontop, and western wheatgrass are the main decreaseers. Among the increaseers are buffalograss, tobosagrass, and Texas wintergrass. Invaders are hairy tridens, Texas grama, mesquite, pricklypear, condalia, and annual weeds. An immediate decrease of sideoats grama and blue grama results from continuous overgrazing. As the range deteriorates, buffalograss and tobosagrass increase.

Pitting or chiseling is often used to open up the soil temporarily so that it takes in water rapidly. This supplemental water stimulates plant vigor and increases the chances for plant survival. Sustained improvement of the site is best obtained by maintaining a healthy stand of grass at all times.

This site is capable of high production. Plants on it respond well to good management. They deteriorate more slowly under heavy grazing on this soil than on most sites, but they improve very slowly after deterioration. The total annual yield of herbage of the site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 1,500 pounds in less favorable years to 2,300 pounds in favorable years.

MIXEDLAND RANGE SITE

This range site is made up of gently sloping to steep soils in uplands that have rolling hills and well-defined drainage patterns. The drainageways are generally well grassed.

The soils in this site are—

ArB	Arch and Cottonwood soils, 0 to 3 percent slopes, (Arch part).
CaB	Carey loam, 1 to 3 percent slopes.
CaC	Carey loam, 3 to 5 percent slopes.
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 12 percent slopes.
Qw	Quinlan-Woodward complex (both soils).
TpA	Tipton loam, 0 to 1 percent slopes.
TpB	Tipton loam, 1 to 3 percent slopes.
Ts	Tipton loam, somewhat poorly drained.
WeB	Weymouth loam, 1 to 3 percent slopes.
WeC	Weymouth loam, 3 to 5 percent slopes.
WoB	Woodward loam, 1 to 3 percent slopes.
WoC	Woodward loam, 3 to 5 percent slopes.
WwD	Woodward-Quinlan loams, 5 to 12 percent slopes.

Most of these soils are deep, but a few are shallow or very shallow. They absorb water readily. Fertility is moderate to high. The ability to store water and plant

nutrients is good. Water is readily released to plants. If unprotected, the steeper areas are highly susceptible to water erosion.

Among the potential plants of this site are such decreaseers as sideoats grama, blue grama, Arizona cottontop, plains bristlegrass, western wheatgrass, and vine-mesquite. On soils that contain gypsum, little bluestem and sand bluestem may occur. The increaseers are buffalograss, hairy grama, tall dropseed, and silver bluestem. The invaders are Texas grama, sand muhly, red grama, hairy tridens, mesquite, condalia, tasajillo, pricklypear, and annual plants. An immediate decrease of sideoats grama is the first result of overgrazing. Blue grama remains in protected places, but buffalograss and tall dropseed increase. If the range is overgrazed annually, the buffalograss decreases and annual grasses and weeds invade.

This site has a potential for high production. Plants respond well to good management and recover rapidly after the site has been overused. The total annual yield of herbage, expressed in pounds per acre of air-dry weight, ranges from 1,600 pounds in less favorable years to 2,400 pounds in favorable years.

SANDY BOTTOMLAND RANGE SITE

This range site is made up of nearly level land adjacent to the rivers and large streams in the county.

The mapping units are—

Ly	Lincoln and Yahola soils (Lincoln part).
Sa	Sandy alluvial land.

These are sandy soils that have a very sandy subsoil. Most areas are flooded frequently. Because they receive extra water, plant growth is favorable. Many areas have a high water table, and a few areas are saline.

This site produces many kinds of vegetation. Among the decreaseers are sand bluestem, indiangrass, switchgrass, little bluestem, sideoats grama, and Canada wild-rye. Increaseers are meadow dropseed, Texas bluegrass, western wheatgrass, silver bluestem, vine-mesquite, and hairy grama. Alkali sacaton is an increaseer in saline areas. Invaders are sand dropseed, buffalograss, three-awn, hooded windmillgrass, western ragweed, sand sagebrush, mesquite, inland saltgrass, and saltcedar.

Floodwaters may frequently deposit material on this site. In some places the deposits are large enough to change the site from one of good grass to one of nearly bare ground. But the site normally produces a large amount of forage. Because it produces a wide variety of both summer and winter plants and is readily accessible to livestock, the site is often overgrazed. Intensive treatment and management are necessary to sustain economic production.

This site is highly productive. Plants deteriorate rapidly if overgrazed but respond well to good management. The total annual yield of herbage on this site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 2,200 pounds in less favorable years to 3,500 pounds in favorable years.

LOAMY BOTTOMLAND RANGE SITE

This range site is made up of nearly level to gently sloping soils and land types adjacent to rivers and intermittent streams.

The mapping units in this range site are—

- Gt Guadalupe and Tipton soils.
- Ly Lincoln and Yahola soils (Yahola part).
- Ld Loamy alluvial land, depressed.
- Sm Spur loam.
- So Spur and Yahola soils.
- Yf Yahola fine sandy loam.
- Yv Yahola very fine sandy loam.

These are deep, loamy, and highly fertile soils. Their ability to store moisture is good, and they readily release it to plants. Most areas are occasionally flooded or receive extra water from surrounding soils. A few areas have a high water table, and a few are saline.

This site has the highest potential production of any in the county. The extra water received from floods and from runoff from the adjacent uplands provides good growing conditions for tall grasses. The dominant tall grasses, or decreaseers, are indiangrass, switchgrass, little bluestem, Canada wildrye, sand bluestem, and sideoats grama. Increaseers are vine-mesquite, meadow dropseed, Texas wintergrass, white tridens, and western wheatgrass. The invaders are buffalograss, three-awn, western ragweed, mesquite, pricklypear, and annual weeds.

Plants on this site respond well to management. They deteriorate rapidly under heavy use but recover rapidly.

The total annual yield of herbage of the site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 2,000 pounds in less favorable years to 3,400 pounds in favorable years.

GYPLAND RANGE SITE

The Cottonwood part of Arch and Cottonwood soils, 0 to 3 percent slopes (ArB) is the only soil in this range site. This soil occurs in nearly level to gently sloping areas. Small areas are interspersed with other soils in many places throughout other sites.

This soil is very shallow. It has low fertility and a low capacity to store moisture. The soil is highly susceptible to water erosion. The percentage of gypsum in the soil directly affects the kind and amount of vegetation the site is capable of producing. The site normally produces mid to tall grasses. Little bluestem, sideoats grama, and blue grama are the main decreaseers produced. Other decreaseers produced in lesser amounts are sand bluestem, indiangrass, and switchgrass. In areas where the content of gypsum is large, the decreaseers are dominantly sideoats grama and hairy grama and a smaller amount of little bluestem. Increaseers are buffalograss, fall witchgrass, Reverchoni panicum, black grama, and silver bluestem. Among the invaders are hairy tridens, Texas grama, mesquite, redberry juniper, catclaw, and annual weeds.

In areas where the content of gypsum is extremely large, the annual yield of herbage is materially reduced and ranges from 750 pounds, air-dry weight per acre, in favorable years to 250 pounds in less favorable years. Normally, however, the annual yield of herbage for the site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 500 pounds in less favorable years to 1,100 pounds in favorable years.

ROUGH BREAKS RANGE SITE

This site is made up of steep, severely gullied areas and escarpments (fig. 21). Geologic erosion is severe.



Figure 21.—Rough Breaks range site on Rough broken land part of the Quinlan-Woodward complex of soils. The vegetation is mainly little bluestem.

The mapping units in this range site are—

- Rb Rough broken land.
- Qw Quinlan-Woodward complex (Rough broken land part).

This site is quite variable. It consists mainly of sandy and silty red-bed materials, intermixed with beds of gypsum and some caliche. It is highly susceptible to water erosion.

The decreaseers are sideoats grama, blue grama, and little bluestem. Increaseer grasses are hairy grama, black grama, buffalograss, and silver bluestem. Dominant among the many invading plants are Texas grama, hairy tridens, mesquite, redberry juniper, pricklypear, and catclaw.

This site has only a sparse cover of vegetation in most places. Erosion is generally severe. Good range management is essential on this site to maintain a grass cover that will control runoff and reduce erosion.

Much of this site is inaccessible to livestock. It is capable of producing only a small amount of usable forage. Plants do not respond well to management and recover very slowly after overgrazing.

The total annual yield of herbage on a site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 500 pounds in less favorable years to 900 pounds in favorable years.

SANDY LOAM RANGE SITE

This range site is made up of nearly level to moderately steep soils of the upland plains. Slopes are seldom more than 8 percent.

The soils in this range site are—

- A1A Altus fine sandy loam, 0 to 1 percent slopes.
- EfA Enterprise fine sandy loam, 0 to 1 percent slopes.
- EfB Enterprise fine sandy loam, 1 to 3 percent slopes.
- EfC Enterprise fine sandy loam, 3 to 5 percent slopes.
- Eh Enterprise soils, wind-hummocky.
- MaB Mansker fine sandy loam, 0 to 3 percent slopes.
- MaC Mansker fine sandy loam, 3 to 5 percent slopes.
- MaD Mansker fine sandy loam, 5 to 12 percent slopes.
- MfA Miles fine sandy loam, 0 to 1 percent slopes.
- MfB Miles fine sandy loam, 1 to 3 percent slopes.
- MfC Miles fine sandy loam, 3 to 5 percent slopes.
- MfD Miles fine sandy loam, 5 to 8 percent slopes.

These soils are deep and moderately deep. Permeability of the subsoil is moderate and moderately rapid. The soils absorb water readily and lose little through runoff. They have a good capacity to store moisture, and they readily release it to plants. If unprotected, they are moderately susceptible to water erosion.

The decreaseers are sideoats grama, little bluestem, Arizona cottontop, plains bristlegrass, and vine-mesquite. Increaseers are buffalograss, blue grama, hairy grama, and silver bluestem. The invaders are fall witchgrass, mesquite, sand sagebrush, pricklypear, yucca, and annual plants.

This site produces many kinds of plants. It also absorbs light rainfall effectively, yet contains sufficient clay to hold moisture for long periods of time. Because of this combination of favorable factors, this is a highly desirable site for ranching. Plants on the site deteriorate rapidly under heavy grazing. They respond readily, however, to good management, and recover rapidly.

The total annual yield of herbage of a site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 1,800 pounds in less favorable years to 2,500 pounds in favorable years.

DEEP SAND RANGE SITE

This site is made up of soils that are undulating to hummocky or contain sand dunes. In most areas the dunes have been stabilized.

The soils in this range site are—

- Br Brownfield fine sand, thick surface.
- Nb Nobscot fine sand.
- Tv Tivoli fine sand.

These sandy soils have a low water-holding capacity. They have moderate to rapid permeability and absorb water readily. They have low fertility. If unprotected, they are highly susceptible to wind erosion.

Among the decreaseers of this site are indiangrass, switchgrass, little bluestem, and sand bluestem. The increaseers are sideoats grama, hairy grama, silver bluestem, and giant dropseed. The invaders are gummy lovegrass, red lovegrass, tumblegrass, and many annual plants. Shin oak was once only a small part of the plant community, but now, after the better forage plants were overgrazed, it has increased throughout the site and is dominant in many places. Effective brush control is needed to reduce the percentage of shin oak and increase the yield of herbage (fig. 22).

This site is capable of high production if kept in good to excellent condition. Plants deteriorate rapidly under heavy use but respond well to management.

The total annual yield of herbage on a site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 1,400 pounds in less favorable years to 3,400 pounds in favorable years.

SANDYLAND RANGE SITE

The soils of this site are mainly nearly level or gently sloping, but some range from gently undulating to hummocky.

The soils in this range site are—

- Bf Brownfield fine sand, thin surface.
- MmB Miles loamy fine sand, 0 to 3 percent slopes.
- MmC Miles loamy fine sand, 3 to 5 percent slopes.

- Sb Springer loamy fine sand, hummocky.
- Sf Springer loamy fine sand, undulating.
- Sf3 Springer soils, severely eroded.

These deep sandy soils have moderate to moderately rapid permeability. They absorb water readily, but their ability to store moisture is low to moderate. They have low fertility. If unprotected, they are highly susceptible to wind erosion.

Many kinds of vegetation can be produced on this site. Indiangrass, sand bluestem, switchgrass, sand lovegrass, and little bluestem are decreaseers. Among the increaseers are sideoats grama, hairy grama, silver bluestem, giant dropseed, plains bristlegrass, and Arizona cottontop. The invaders are gummy lovegrass, tumblegrass, red lovegrass, yucca, and mesquite. Shin oak and sand sagebrush were once a minor part of the original plant community. After prolonged heavy grazing of the range, however, these plants have increased and now make up a large percentage of the total vegetation.

These soils are capable of producing large amounts of vegetation when in good to excellent condition. Plants on this site deteriorate rapidly under heavy grazing but respond well to good management.

The total annual yield of herbage on a site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 1,300 pounds in less favorable years to 3,000 pounds in favorable years.

GRAVELLY RANGE SITE

Gravelly broken land (Gr) is the only mapping unit in this range site. This land type consists of gently sloping to steep, rolling, gravelly hills (fig. 23). These slopes are very gravelly.

This gravelly land type has a low water-holding capacity and low fertility. The gravel on the surface helps to control erosion and conserve moisture. Most areas have only a sparse cover of vegetation.

This site can produce many kinds of vegetation. Ranchers consider this site good winter range because it produces a large amount of black grama. Among the decreaseers are sideoats grama, blue grama, black grama, little bluestem, and Arizona cottontop. Smaller amounts



Figure 22.—Deep Sand range site. The soil is Nobscot fine sand. The vegetation is mostly sand bluestem, little bluestem, indiangrass, switchgrass, sand sagebrush, and shin oak.



Figure 23.—Gravelly range site. The typical vegetation includes little bluestem, sideoats grama, black grama, and yucca.

of sand bluestem, indianguass, and switchgrass may also occur in the more favored spots. Among the increasers are hairy grama, buffalograss, silver bluestem, Texas wintergrass, and a small amount of shin oak. The invaders are Texas grama, sand muhly, hairy tridens, fall witchgrass, mesquite, catclaw, pricklypear, and many annual plants.

Under heavy grazing, plants on this site deteriorate rapidly. Invaders, such as sand sagebrush and annuals, rapidly replace sideoats grama, blue grama, and little bluestem. Plants recover slowly after overgrazing.

The total annual yield of herbage on a site in excellent condition, expressed in pounds per acre of air-dry weight, ranges from 1,100 pounds in less favorable years to 1,800 pounds in favorable years.

VERY SHALLOW RANGE SITE

Latom stony loam, 3 to 12 percent slopes (LaD) is the only soil in this range site. This soil is gently sloping to rolling and sometimes occurs on knolls or steep escarpments.

This soil has a very shallow root zone. In most places it is less than 10 inches deep and has many sandstone fragments on the surface. Fertility is low. The capacity to store water is limited. The hazard of water erosion is high.

Soil depth greatly influences the kinds of vegetation produced on this site. On slopes that have deeper soil and receive occasional runoff from above, tall grasses are produced. Generally, this site produces mid grasses. The decreasers are sideoats grama, little bluestem, and blue grama. Increasers are buffalograss, hairy grama, silver bluestem, slim tridens, and black grama. The invaders are many and include hairy tridens, sand dropseed, Texas grama, red grama, sand muhly, mesquite, pricklypear, condalia, yucca, redberry juniper, and annual plants.

This site supports only a sparse cover of vegetation. Plants do not respond well to management. Careful management is required to maintain a cover.

The total annual yield of herbage on a site in excellent condition, expressed in pounds per acre of air-dry

weight, ranges from 1,200 pounds in less favorable years to 1,800 pounds in favorable years.

Use of Soils for Wildlife

In this section the wildlife in the county is briefly discussed, and the soil associations have been placed in four broad wildlife groups.

Wildlife in the county

Many farmers and ranchers in Hall County are finding that the use of the soils for wildlife is profitable, under proper management. The demands for places to hunt and fish are increasing each year, and areas used as wildlife habitats are providing economic returns to the owners from hunting and fishing permits. About 55 percent of the county is in range that consists mainly of rough, broken, and steep land that is suitable for wildlife. Also, much of the cultivated land is idle or is in crops that provide a good habitat for wildlife.

Hall County originally had an abundance of wildlife—buffalo, antelope, deer, prairie chicken, and other species. The early settlers, buffalo hunters, and the overgrazing by livestock have nearly exterminated these species. Large numbers of quail, doves, turkeys, hawks, and various songbirds; of rabbits and other small animals; and of predators are still in the county. Quail, doves, and turkeys are of most interest to farmers, ranchers, and sportsmen. Careful management is needed to maintain suitable numbers of these species.

There are many farm ponds and a few natural lakes in the county that are used primarily for livestock water. Many of these ponds and lakes are stocked with fish and provide fishing and other recreation. Other ponds could be stocked easily. The major species of fish suited to ponds in this area are largemouth bass, bream, and channel catfish. Ponds stocked with fish require good management for a good production. Management includes fertilizing, controlling undesirable vegetation, fencing, protecting from livestock, and regular fishing.

Wildlife groups

Each of the four wildlife groups in the county consists of two or more of the soil associations discussed in the section "General Soil Map" and shown on a map at the back of the report. In the following paragraphs, the topography and the wildlife food and cover in each group are described, and the principal wildlife species are named.

WILDLIFE GROUP 1

This group consists of the Tipton-Yahola soil association and the Enterprise-Tivoli soil association. The soils in this group are in narrow bands along Prairie Dog Town Fork of the Red River, the Little Red River, Mulberry Creek, and other major streams. This group includes the bottom lands along the streams and the sandy soils adjacent to the bottom lands on each side of the streams. The vegetation is mainly mid and tall grasses, such as sideoats grama, little bluestem, sand bluestem, indianguass, and switchgrass. Among the woody plants are cottonwood, hackberry, willow, skunkbush, sand sagebrush, and shin oak. This group provides excellent food, cover, and water for wildlife. The

principal wildlife species are squirrels, rabbits, bobcats, coyotes, quail, doves, turkeys, and songbirds.

WILDLIFE GROUP 2

This group consists of the Quinlan-Woodward-Rough broken land soil association and the Woodward-Quinlan-Rough broken land soil association. These soils make up the rough, steep, and broken landscapes in the western and southern parts of the county. Except along the many drainageways, most areas have only a sparse cover of vegetation. The plants are mostly sideoats grama, blue grama, and little bluestem. The woody plants are mostly redberry juniper and mesquite. Food and cover for wildlife are limited on this site, and often the supply is short. The principal wildlife species are rabbits, bobcats, coyotes, quail, doves, and songbirds.

WILDLIFE GROUP 3

This group consists of the Carey-Woodward soil association, the Miles-Olton-Woodward soil association, and the Olton-Weymouth-Abilene soil association. The associations are made up of fine sandy loams, loams, and clay loams that are nearly level to rolling. These soils are mainly cultivated, but scattered areas of rangeland are intermixed with the cultivated areas. The rangeland is confined mostly to the steep slopes and along drainageways and small creeks. The native vegetation is blue grama, sideoats grama, little bluestem, and mesquite. Food for wildlife is plentiful on this group during the summer months and is in good supply during specific periods. Sufficient cover, however, is not always available. The principal wildlife species are rabbits, bobcats, coyotes, quail, doves, and songbirds.

WILDLIFE GROUP 4

This group consists of the Miles-Springer soil association and the Nobscot-Brownfield soil association. The soils are sandy and are nearly level to undulating. Except for the sandier and steeper areas, they are mostly cultivated. Many areas that were formerly cultivated have now reverted to grass or are idle. The native vegetation is mostly sideoats grama, little bluestem, sand bluestem, indiagrass, and switchgrass. The woody plants are shin oak, sand sagebrush, and mesquite. This group provides good food and cover for wildlife. The principal wildlife species are rabbits, bobcats, coyotes, quail, doves, and songbirds.

Windbreaks

Tree windbreaks are valuable in reducing the wind velocity on farms and ranches. They are used to protect soils, crops, and farmsteads from damaging wind and blowing dust. They also provide shelter for livestock, as well as shelter and food for birds and other wildlife, and add beauty to the farm or ranch.

In Hall County, windbreaks are used mainly to protect farmsteads and feedlots. Some field windbreaks have been used to protect sandy fields in the past but have not proved very effective. Many of these old, established field windbreaks have been removed.

Trees are somewhat hard to establish in Hall County, and the success of tree windbreaks depends largely on good care and protection. The coarse textured and mod-

erately coarse textured soils are most suitable for tree plantings. The soils most suitable are the Miles fine sandy loams, Altus fine sandy loams, Enterprise fine sandy loams, Miles loamy fine sands, and Springer loamy fine sands. If water for irrigation is available, trees can be established on all soils in the county. The trees should be watered as needed until they are well established.

The trees and shrubs most suitable for windbreaks in the county are Siberian elm, redcedar, cottonwood, Russian-olive, and Osage-orange. Two or three rows of trees are most practical for a windbreak. They should include at least one row of tall trees and one row of evergreens. They should be planted in a two-directional pattern at right angles so they will give greater protection from the prevailing west and north winds.

After the trees have been planted, they must be cultivated and cared for like any growing crop. They must also be protected from fire and from trampling and grazing by livestock.

Information on planting windbreaks can be obtained from the local office of the Soil Conservation Service and the county agricultural agent. These offices can also supply information on where good seedlings can be obtained.

Engineering Uses of the Soils ³

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

The information contained in this report can be used by engineers to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, farm ponds, irrigation systems, terrace systems, and other structures, for soil and water conservation.
3. Make preliminary evaluation of soil and ground conditions that will aid in selecting highway, airport, pipeline, and cable locations and in planning detailed investigations at the selected sites.
4. Locate probable sources of sand and gravel.
5. Correlate performance of engineering structures with soil mapping units to develop information for preliminary planning that will be useful in designing and maintaining engineering practices and structures.
6. Determine the suitability of soil mapping units for cross-country movement of vehicles and construction equipment.

³ This subsection was prepared by CALVIN M. JACKSON, agricultural engineer, Soil Conservation Service.

7. Supplement the information obtained from other published maps and reports and aerial photographs to make soil maps and reports that can be used readily by engineers.
8. Locate sites that require special methods or the use of special designs to insure satisfactory structures.

The engineering interpretations reported here can be useful for many purposes. It should be emphasized that they may not eliminate the need for sampling and testing at the site of specific engineering works that involve heavy loads or where the excavations are deeper than the depth of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used by the soil scientist may not be understood by engineers, and some terms have a special meaning in soil science. Several of these terms are defined in the Glossary at the back of the report.

Engineering classification systems

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (1).⁴ This system of classifying soil materials is based on mechanical analyses, plasticity, and field performance of soils in highways. In this system all soil materials are classified in seven principal groups. The groups range from A-1 (gravelly soils of high bearing capacity and the best for subgrades) to A-7 (clay soils having low strength when wet and the poorest for subgrades).

The seven basic soil groups have been divided according to the relative engineering value of the soil materials and given a group index number. Group index numbers range from 0 for the best subgrades to 20 for the poorest. Increasing values of the group index within each basic soil group reflect the reduction of the load-carrying capacity of subgrades, the combined effect of increasing liquid limits and plasticity indexes, and decreasing percentages of coarse material. The group index number is shown in parentheses after the soil group number in table 5.

Some engineers prefer to use the Unified soil classification system, which was established by the Corps of Engineers, U.S. Army (11). This system is based on the texture and plasticity of soils and their performance as material for engineering construction. In this system the soil materials are placed in 15 classes, 8 for coarse-grained material, 6 for fine-grained material, and 1 for highly organic material. The soil material is designated by a descriptive name and a letter symbol indicating its principal characteristics.

Engineering properties, interpretations, and soil test data

Much of the information in this subsection is in tables 3, 4, and 5. In table 3 are brief descriptions of each soil in the county and estimates of physical and chemical properties significant in engineering. Engineering interpretations of the soils in the county are given in table 4, and test data for selected soils are given in table 5.

For each soil in the county, the physical properties of its major horizons in a typical profile are given in table 3. Also given are the textural classification used by the United States Department of Agriculture (5), estimates of the Unified classification of the material, and estimates of the classification used by the American Association of State Highway Officials. The particle size, permeability, available water capacity, reaction, and shrink-swell potential given in this table are based on the laboratory test data in table 5. Estimates of these properties for soils not in table 5 are based on field experience and performance.

Permeability is estimated for the soil as it occurs in place. The estimates are based on soil structure and porosity and are compared with permeability tests on undisturbed cores of similar soil material. Permeability in inches per hour gives an estimate of the rate that water percolates through soil material that is not compacted.

The available water capacity in inches per inch of soil depth is the approximate amount of capillary water in the soil when it is wet to field capacity. When the soil is air dry, this amount of water will wet the soil material described to a depth of 1 inch without deeper percolation.

Reaction is the estimated degree of acidity or alkalinity expressed in pH values. In this system of notation, pH 7 is precisely neutral; a value lower than pH 7 indicates acidity, and a higher value indicates alkalinity.

The shrink-swell potential is an indication of the volume change that occurs in the soil with a change in moisture content. This potential is based on volume-change tests or on observance of other physical properties and characteristics of the soil. In general, soils classed as CH (inorganic clays of high plasticity) have a high or very high shrink-swell potential; soils classed as SP (poorly graded sands) or SM (silty sands) have a low shrink-swell potential.

In table 4 some engineering interpretations are given for the soils in Hall County. The suitability of the soils for specific purposes is rated, and soil features that may affect the selection, design, or application of stated practices are listed. The ratings and features are based on the information in table 3, the test data for the soils listed in table 5, and field experience.

The suitability of soils for road fill and topsoil is rated good, fair, poor, or not suitable. Where needed, a statement limiting the rating or explaining the reason for it is added. All the ratings are for the A and B horizons of the soils.

The texture, plasticity, and content of water determine the suitability of a soil for road-fill material. All plastic soils, such as Abilene clay loam, are difficult to work, to compact, and to dry to the desired moisture content. Plastic soils should be compacted at the optimum moisture content or slightly above it. These soils are rated *poor* for road fill. The coarse-textured soils have a low degree of compressibility and expansion; therefore, they are rated *fair to good*.

Some of the soils are rated *poor* as a source of topsoil because the material is too sandy to have high fertility. Suitability as source of topsoil applies only to the surface layer.

Features that affect highway location, dikes and levees, reservoir areas and embankments of farm ponds, agricul-

⁴ Italic numbers in parentheses refer to Literature Cited, p. 77.

tural drainage, irrigation, terraces and diversions, and waterways are listed in table 4.

The drainage of soil material affects the location of highways. Drainage depends on the height of the water table, permeability of the substratum, and the number and duration of floods. Clay layers, such as those in Abilene clay loam and Rough broken land, are impervious, and these soils are therefore poor to very poor for highway location. The sandy soils, such as Tivoli fine sand, have a very permeable substratum and are excellent for highway location.

The suitability of the soils for dikes or levees and embankments depends largely on texture, permeability, shrink-swell potential, moisture content, and plasticity index. In general, the soils of this county are suitable for these uses. The clay loams, loams, and very fine sandy loams can be compacted and are generally well graded; they have fair to good suitability for dikes or levees and embankments. The coarse-textured soils have low compressibility and low expansion, but they are difficult to place because they do not contain enough binding material. They have fair to good suitability for dikes or levees and embankments.

The suitability of soils for reservoirs for farm ponds depends mainly on seepage and permeability. The highly plastic soils, such as Abilene clay loam, have very little or no seepage and their suitability for reservoirs is excellent. Because the coarse-textured soils, such as Tivoli fine sand, do not contain any binding or sealing material, they have excessive seepage. Therefore, their suitability for reservoirs is poor. In some places the alluvial material in the drainageways at the site of construction can be removed and replaced with finer textured material that reduces seepage. The proposed area for an emergency spillway should be investigated to determine the suitability of the excavated material for use in the embankment, for erodibility of the material, and for its stability on slopes. In the proposed reservoir area, the investigation should determine the seepage rate, embankment stability, uplift pressures, and piping potential, if such determinations seem advisable.

The Blaine gypsum formation extends into the eastern side of Hall County, and gypsum formations are scattered throughout the county. As a result, excessive seepage occurs, and the number of failures of dams in the areas of these formations has been high.

Many sites, especially those in areas of deep canyons, are not desirable for ponds. Because of the shortage of a suitable source of water for livestock in these areas, however, ponds should be built where possible. Sites in these areas should be carefully selected and all possibilities for failure investigated before construction.

In general, surface and internal drainage of the soils in Hall County are not serious problems. Soil features affecting the agricultural drainage are permeability, depth to layers that influence the rate of water movement through the soil, and height of the water table. In Hall County, Loamy alluvial land, depressed, is one of the soils that is affected by a high water table.

Two types of irrigation systems are suitable for use on the soils in the county—furrow and sprinkler. The furrow type of irrigation should be limited to the fine-textured soils. In most places it is necessary to level the

soils before furrow irrigation can be used. Sprinkler irrigation, however, is suitable for all the soils in the county that can be irrigated and is generally the type used. At present, irrigation is used chiefly as a supplemental practice.

The three soil properties particularly important to the irrigator are soil texture, soil structure, and soil depth. The relationship of these properties to one another should be considered in estimating the capacity of the soil to store water for plants (available moisture-holding capacity); the rate that water enters the soil (intake rate); and the rate of movement of water through the soil (permeability). Statements about these and other features that affect irrigation are shown in table 4. Irrigation hazards related to slope are not shown.

In Hall County, level terraces are constructed on cropland to conserve moisture and to control erosion. They are constructed on deep soils that are capable of absorbing and storing extra water without appreciable crop damage. They are not applicable to the deep sands or to soils that are too shallow, stony, or steep to permit practical and economical installation and maintenance. Closures at the end of the terraces that are approximately two-thirds of the effective height of the terraces are generally used to store the runoff above each terrace. When the terrace channel is filled, the excess water flows around the closure into a protected spillway without causing erosion.

Diversion terraces are channels that have a supporting ridge on the lower side. They are constructed across the slope to intercept runoff and to divert it to sites or prepared outlets where it can be used or disposed of safely. In Hall County diversion terraces are used to protect the soils and conservation structures or irrigation systems in the lower lying areas from damaging runoff from higher lying areas. Diversion terraces can be used on many of the soils in the county.

Generally, natural waterways or depressions are reshaped and seeded to suitable plants to dispose of excess surface water discharged by level terraces, diversion terraces, or natural concentrations without causing erosion. This practice is necessary on all sites where more protection is needed to control erosion.

Waterways require extensive maintenance on most of the soils in Hall County. Nearly all the soils are subject to accumulations of windblown soil or are subject to erosion by wind and water. In some places grade stabilization structures are needed to protect the outlet of the waterway. For this purpose, reinforced concrete structures with a headwall type of spillway may be used, or earth dams with a drop inlet. The earth dams may impound water permanently or may be "dry" dams.

The engineering test data for five soils are given in table 5. Samples were taken, by horizons, from 15 soil profiles and tested by the Texas State Highway Department according to standard procedures of the American Association of State Highway Officials (1). Three profiles of each soil were sampled. The first is a modal profile, or a profile most typical for that soil as it occurs in Hall County. The second and third are nonmodal profiles, or profiles that vary from the modal but are in the range allowed for that series.

TABLE 3.—*Estimated physical and*
[Dashed lines indicate mapping unit is

Symbol	Soil	Depth from surface	Classification	
			USDA texture	Unified
AbA	Abilene clay loam, 0 to 1 percent slopes.	<i>Inches</i> 0-16	Clay loam.....	CL, ML.....
AbB	Abilene clay loam, 1 to 3 percent slopes.	16-30	Clay.....	CL, CH.....
		30-76	Clay loam.....	CL, CH.....
Ad	Active dunes.	0-72	Sand.....	SP.....
AIA	Altus fine sandy loam, 0 to 1 percent slopes.	0-16	Fine sandy loam.....	SM.....
		16-32	Sandy clay loam.....	CL, CH.....
		32-72	Light sandy clay loam.....	CL.....
ArB	Arch and Cottonwood soils, 0 to 3 percent slopes: Arch component.	0-8	Loam.....	ML.....
		8-34	Heavy loam.....	MH.....
		34-48	Gypsum bed.....	MH.....
	Cottonwood component.	0-6	Loam.....	CL.....
		6-24	Gypsum bed.....	MH.....
Bf	Brownfield fine sand, thin surface.	0-26	Fine sand.....	SM.....
Br	Brownfield fine sand, thick surface.	26-42	Sandy clay loam.....	SC.....
		42-52	Fine sandy loam.....	SM.....
		52-60	Fine sand.....	SM.....
CaB	Carey loam, 1 to 3 percent slopes.	0-8	Loam.....	CL, ML.....
CaC	Carey loam, 3 to 5 percent slopes.	8-28	Light sandy clay loam.....	CL, ML.....
		28-72	Heavy loam.....	CL, ML.....
		72-90	Soft sandstone.....	SP, SM.....
EfA	Enterprise fine sandy loam, 0 to 1 percent slopes.	0-22	Fine sandy loam.....	SM.....
EfB	Enterprise fine sandy loam, 1 to 3 percent slopes.	22-60	Fine sandy loam.....	SM.....
EfC	Enterprise fine sandy loam, 3 to 5 percent slopes.			
Eh	Enterprise soils, wind-hummocky.	0-15	Fine sandy loam to loamy fine sand.	SM, ML.....
		15-60	Fine sandy loam.....	SM, ML.....
EmA	Enterprise very fine sandy loam, 0 to 1 percent slopes.	0-24	Very fine sandy loam.....	ML, CL.....
EmB	Enterprise very fine sandy loam, 1 to 3 percent slopes.	24-72	Very fine sandy loam.....	ML, CL.....
EmC	Enterprise very fine sandy loam, 3 to 5 percent slopes.			
EmD	Enterprise very fine sandy loam, 5 to 12 percent slopes.			
Gr	Gravelly broken land.			
Gt	Guadalupe and Tipton ¹ soils (Guadalupe component).	0-15	Fine sandy loam to loamy fine sand.	SM, ML.....
		15-60	Loam.....	CL, ML.....
LaD	Latom stony loam, 3 to 12 percent slopes.	0-4	Stony loam.....	CL.....
		4-12	Sandy limestone.....	CL.....
Ld	Loamy alluvial land, depressed.			
Ly	Lincoln and Yahola ² soils (Lincoln component).	0-8	Fine sandy loam to loamy fine sand.	SM.....
		8-24	Loamy fine sand.....	SM.....
		24-60	Riverwash sand.....	SM.....
MaB	Mansker fine sandy loam, 0 to 3 percent slopes.	0-7	Fine sandy loam.....	SM.....
MaC	Mansker fine sandy loam, 3 to 5 percent slopes.	7-42	Sandy clay loam.....	SM, SC.....
MaD	Mansker fine sandy loam, 5 to 12 percent slopes.	42-60	Loam.....	ML.....
MfA	Miles fine sandy loam, 0 to 1 percent slopes.	0-7	Fine sandy loam.....	SM.....
MfB	Miles fine sandy loam, 1 to 3 percent slopes.	7-40	Sandy clay loam.....	SM, SC.....
MfC	Miles fine sandy loam, 3 to 5 percent slopes.	40-60	Sandy clay loam.....	SM, SC.....
MfD	Miles fine sandy loam, 5 to 8 percent slopes.			

See footnotes at end of table.

chemical properties of the soils

variable and properties were not estimated]

Classification—Continued ASSHO	Percentage passing sieve—			Permeability <i>Inches per hour</i>	Available water capacity <i>Inches per inch of soil</i>	Reaction <i>pH</i>	Shrink-swell potential
	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
A-4, A-6	100	100	85-90	0.2-0.5	0.14-0.21	7.5	High.
A-6, A-7	100	100	85-90	0.2-0.5	0.13-0.21	7.8	High.
A-6, A-7	100	100	80-85	0.2-0.5	0.13-0.21	8.3	High.
A-3	100	90-95	2-5	3.0-8.0	0.07-0.08		Low.
A-2, A-4	100	85-100	30-40	0.8-2.5	0.14-0.18	7.5	Low.
A-4, A-6	100	100	75-80	0.5-0.8	0.13-0.21	8.3	High.
A-2, A-4	100	100	70	0.8-1.0	0.14-0.18	8.3	Moderate.
A-4	100	100	75-80	0.2-0.8	0.13-0.21	8.3	Moderate.
A-6	100	100	85-90	0.2-0.5	0.13-0.21	8.3	High.
A-6	100	100	80-85	0.2-0.8	0.13-0.21	8.3	High.
A-4	100	100	85-90	0.2-0.8	0.13-0.21	8.3	Moderate.
A-6	100	100	80-85	0.2-0.8	0.13-0.21		High.
A-4, A-6	100	100	25-30	1.0-3.0	0.08-0.12	7.0	Low.
A-4, A-6	100	95-100	65-70	1.0-3.0	0.08-0.12	7.0	Low.
A-2, A-4	100	100	35-40	1.0-3.0	0.08-0.12	7.0	Low.
A-4, A-6	100	100	20-25	1.0-3.0	0.08-0.12	7.0	Low.
A-4	100	100	60-65	0.5-2.0	0.12-0.20	7.5	Low to moderate.
A-4, A-6	100	95-100	65-70	0.5-2.0	0.12-0.20	7.5	Moderate.
A-4, A-6	95-100	95-100	65-70	0.5-2.0	0.12-0.20	8.3	Moderate to high.
A-3	100	100	5-15	0.5-2.0	0.08-0.12	8.3	Low.
A-2, A-4	100	100	35-40	0.8-2.5	0.13-0.20	8.3	Low.
A-2, A-4	100	100	35-40	0.8-2.5	0.13-0.20	8.3	Low.
A-2, A-4	100	100	45-55	0.8-2.5	0.12-0.20	8.3	Low.
A-2, A-4	100	100	45-55	0.8-2.5	0.12-0.20	8.3	Low.
A-4(8)	100	100	85-90	0.8-2.5	0.12-0.20	8.3	Low.
A-4(8)	100	100	85-90	0.8-2.5	0.12-0.20	8.3	Low.
A-2, A-4	100	100	45-55	0.8-2.5	0.12-0.20	8.3	Low.
A-4	100	100	75-80	0.2-0.5	0.13-0.21	8.3	Moderate.
A-4, A-6	80-85	75-80	50-55	0.2-0.8	0.13-0.20		Moderate.
A-4	90-100	90-100	50-60	0.2-0.8	0.12-0.20		Moderate.
A-2	100	90-95	25-30	0.8-2.5	0.11-0.14	8.3	Low.
A-2	100	90-95	25-30	0.8-2.5	0.11-0.14	8.3	Low.
A-1, A-2	100	50-60	10-15	2.5-5.0	0.08-0.13	8.3	Low.
A-2, A-4	100	100	15-20	0.8-2.5	0.11-0.14	8.3	Low.
A-4, A-6	100	100	70-80	0.2-0.5	0.13-0.21	8.3	Moderate.
A-4	100	100	75-80	0.8-2.5	0.13-0.21	8.3	Moderate.
A-4(2)	100	100	35-40	0.5-0.8	0.13-0.21	7.0	Low.
A-4, A-6	100	100	35-40	0.5-0.8	0.13-0.21	7.2	Low to moderate.
A-4(3)	90-95	80-85	40-45	0.8-2.0	0.11-0.14	8.3	Low.

TABLE 3.—Estimated physical and

Symbol	Soil	Depth from surface	Classification	
			USDA texture	Unified
MmB MmC	Miles loamy fine sand, 0 to 3 percent slopes. Miles loamy fine sand, .3 to 5 percent slopes.	<i>Inches</i> 0-16 16-48 48-72	Loamy fine sand Sandy clay loam Fine sandy loam	SM SC, SM SM
Nb	Nobscot fine sand.	0-17 17-44 44-60	Fine sand Sandy loam Fine sand	SM SM, SC SM
OtA OtB	Olton loam, 0 to 1 percent slopes. Olton loam, 1 to 3 percent slopes.	0-12 12-34 34-84	Loam Clay loam Clay loam	CL CL, CH CL, CL-CH
Qw	Quinlan ³ -Woodward ⁴ complex. ⁵			
Rb	Rough broken land.	0-100	Silt loam to very fine sandy loam.	SC, CL, CH, SM.
Sa	Sandy alluvial land.			
Sb Sf Sf3	Springer loamy fine sand, hummocky. Springer loamy fine sand, undulating. Springer soils, severely eroded.	0-12 12-30 30-60	Loamy fine sand Fine sandy loam Loamy fine sand	SM SM SM
Sm So	Spur loam. Spur and Yahola ² soils (Spur component).	0-10 10-60	Loam Clay loam	ML ML
SpA SpB	St. Paul silt loam, 0 to 1 percent slopes. St. Paul silt loam, 1 to 2 percent slopes.	0-15 15-54 54-60	Silt loam Silty clay loam Loam	CL CL CL
TpA TpB Ts	Tipton loam, 0 to 1 percent slopes. Tipton loam, 1 to 3 percent slopes. Tipton loam, somewhat poorly drained.	0-12 12-42 42-60	Loam Clay loam Loam	CL, ML CL CL, ML
Tv	Tivoli fine sand.	0-6 6-60	Fine sand Fine sand	SM SP-SM
WeB WeC	Weymouth loam, 1 to 3 percent slopes. Weymouth loam, 3 to 5 percent slopes.	0-7 7-30 30-60	Loam Clay loam Loam	CL CL CL
WoB WoC	Woodward loam, 1 to 3 percent slopes. Woodward loam, 3 to 5 percent slopes.	0-10 10-22 22-30 30-60	Loam Loam Very fine sandy loam Sandy red bed	CL CL-ML CL-ML CL
WwD	Woodward ⁴ -Quinlan loams, 5 to 12 percent slopes (Quinlan component).	0-12 12-48	Loam Sandy red bed	SM SP, SM
Yv Yf	Yahola very fine sandy loam. Yahola fine sandy loam.	0-60	Very fine sandy loam to fine sandy loam.	SM

¹ For data on Tipton component, see Tipton soils.² For data on Yahola component, see Yahola soils.³ For data on Quinlan component, see Quinlan component of Woodward-Quinlan loams, 5 to 12 percent slopes.

chemical properties of the soils—Continued

Classification—Continued ASSHO	Percentage passing sieve—			Permeability <i>Inches per hour</i>	Available water capacity <i>Inches per inch, of soil</i>	Reaction <i>pH</i>	Shrink-swell potential
	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)				
A-2.....	100	95-100	25-45	0.8-2.5	0.12-0.20	7.0	Low.
A-2, A-4.....	100	95-100	35-40	0.5-2.0	0.13-0.20	7.0	Low.
A-2, A-4.....	100	100	40-45	0.5-2.0	0.12-0.21	7.5	Low.
A-2.....	100	100	15-25	2.5-5.0	0.07-0.1	7.0	Low.
A-2, A-4.....	100	100	30-40	2.5-5.0	0.07-0.1	6.5	Low.
A-2.....	100	100	15-25	2.5-5.0	0.07-0.1	7.0	Low.
A-6.....	100	95-100	85-95	0.2-0.5	0.13-0.21	7.5	High.
A-6, A-7.....	100	95-100	85-90	0.2-0.5	0.13-0.21	7.5	High.
A-6, A-7.....	100	95-100	85-95	0.2-0.5	0.13-0.21	8.3	High.
A-1, A-7.....	95-100	75-85	45-70	0.05-2.0	0.08-0.21		Low to high.
A-2.....	100	100	10-15	0.8-2.5	0.08-0.14	7.0	Low.
A-2.....	100	100	20-25	0.8-2.5	0.11-0.18	7.0	Low.
A-2.....	100	100	15-20	0.8-2.5	0.08-0.14	7.5	Low.
A-4.....	100	100	85-90	0.2-0.5	0.13-0.21	8.3	Moderate.
A-4.....	100	100	85-90	0.2-0.5	0.13-0.21	8.3	Moderate.
A-6.....	100	100	85-90	0.2-0.5	0.13-0.21	7.5	Moderate.
A-6.....	100	95-100	65-70	0.2-0.5	0.13-0.21	8.0	Moderate.
A-6.....	100	100	85-90	0.2-0.5	0.13-0.21	8.3	Moderate.
A-4.....	100	100	75-80	0.2-0.5	0.13-0.21	8.3	Moderate.
A-6.....	100	95-100	85-90	0.2-0.5	0.13-0.21	8.3	High.
A-4.....	100	100	75-80	0.2-0.5	0.13-0.21	8.3	Moderate.
A-2.....	100	95-100	15-20	2.5-5.0	0.07-0.08	8.0	Low.
A-3.....	100	95-100	10-15	2.5-5.0	0.07-0.08		Low.
A-4.....	100	100	80-90	0.2-0.8	0.13-0.21	8.3	Moderate.
A-4.....	100	100	75-85	0.2-0.8	0.13-0.21	8.3	High.
A-4.....	100	100	80-90	0.2-0.8	0.13-0.21	8.3	Moderate.
A-4.....	95-100	95-100	85-90	0.5-1.0	0.14-0.18	8.0	Low.
A-4.....	95-100	95-100	80-85	0.5-1.0	0.14-0.18	8.3	Low.
A-4.....	75-80	75-80	60-65	0.5-1.0	0.14-0.18	8.3	Low.
A-4.....	95-100	95-100	55-60	0.5-1.0	0.14-0.18	8.3	Low.
A-2.....	100	95-100	35-40	0.5-1.0	0.14-0.18	8.3	Moderate.
A-3.....	100	100	10-15	1.0-1.5	0.08-0.12	8.3	Low.
A-2, A-4.....	100	100	25-50	0.8-2.5	0.13-0.20	8.3	Low.

⁴ For data on Woodward component, see Woodward soils.

⁵ For data on Rough broken land that occurs in this complex, see Rough broken land.

TABLE 4.—*Engineering*

Soils and map symbols	Suitability as a source of—		Soil features affecting—	
	Road fill	Topsoil	Highway location	Dikes or levees
Abilene clay loam (AbA, AbB).	Poor to fair; high shrink-swell potential.	Good.....	Poor to fair drainage; impervious below a depth of 20 inches.	Flat slopes are stable to fairly stable.
Active dunes (Ad).	Fair; lacks binding material.	Not suitable; low fertility.	Low stability.....	Low stability; no binding material; susceptible to piping.
Altus fine sandy loam (A1A).	Good.....	Good.....	Moderate permeability; moderate shrink-swell potential; slow internal drainage below a depth of 16 inches.	Stable fill with good compaction and erosion control.
Arch and Cottonwood soils, 0 to 3 percent slopes (ArB): Arch component.	Poor; will not compact properly.	Poor; strongly calcareous; shallow.	Weak, subangular blocky structure; very friable when moist; moderate permeability.	Excessive gypsum content: use only flat slopes.
Cottonwood component.	Poor.....	Poor; strongly calcareous; shallow.	Weak, granular structure; soft when dry, very friable when moist; moderate permeability.	High gypsum content; use flat slopes.
Brownfield fine sand (Bf, Br).	Fair.....	Poor; low fertility.....	Good internal drainage.....	Stable fill if flat slopes and sodding are used; fertilizer needed in most places; erodible.
Carey loam (CaB, CaC).	Fair to good.....	Good.....	Moderate permeability; good internal drainage.	Stable fill if proper compaction and erosion control are used.
Enterprise fine sandy loam (EfA, EfB, EfC).	Good.....	Fair.....	Good internal drainage; moderately rapid permeability.	Stable fill if proper compaction, erosion control, and flat slopes are used; good for cores.
Enterprise soils, wind-hummocky (Eh).	Fair to good.....	Poor.....	Fair to good internal drainage.	Stable fill if proper compaction, erosion control, and flat slopes are used; good for cores.
Enterprise very fine sandy loam (EmA, EmB, EmC, EmD).	Fair to good.....	Good.....	Fair to poor drainage; soil materials fair to good.	Stable fill if proper compaction, erosion control, and flat slopes are used.
Gravelly broken land (Gr).	Poor.....	Poor.....	Excellent internal drainage.....	Shallow, gravelly soil; unstable.
Guadalupe and Tipton ¹ soils (Gt): Guadalupe component.	Fair to good.....	Poor.....	Fair drainage; subject to overflow.	Stable fill if proper compaction and erosion control are used.

See footnotes at end of table.

interpretation of soils

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
No seepage hazard.	Stable to fairly stable; use flat slopes.	Poor; slow internal drainage.	Slow permeability; easily compacted; slow intake rate.	Stable fill; no hazard of wind erosion.	Resistant to erosion; fertile; no hazard of wind erosion.
Excessive seepage; no binding material.	Low stability; no binding material; subject to wind and water erosion.	Excessively drained.	Low fertility; low water-holding capacity; rapid intake rate.	Highly susceptible to wind and water erosion; unstable.	Highly susceptible to wind and water erosion.
Moderate permeability.	Stable fill if proper compaction and erosion control are used.	Internal drainage poor below a depth of 16 inches; moderate permeability.	Moderate permeability; fair water-holding capacity; deep; erodible; fast intake rate.	Stable fill; susceptible to wind erosion.	Moderate fertility; susceptible to wind erosion and deposition.
Moderate permeability; high gypsum content.	High gypsum content; use only flat slopes.	Weak, subangular blocky structure; slightly hard when dry; moderate permeability.	Moderate permeability; moderate intake rate; moderate water-holding capacity.	Stable fill; susceptible to water and wind erosion.	Shallow soil; moderate fertility; subject to water and wind erosion.
Seepage problem; high gypsum content; moderate permeability.	High gypsum content; use only flat slopes.	Weak, granular structure; compact; moderate permeability.	High gypsum content; shallow; moderate intake rate; moderate water-holding capacity.	High gypsum content; subject to water erosion, shallow soils.	Low fertility; susceptible to wind and water erosion; shallow.
Very permeable; too sandy.	Stable fill if flat slopes and sodding are used; erodible; low fertility.	Good internal drainage; rapid permeability.	Fast intake rate; low fertility; deep; low water-holding capacity; rapid permeability.	Unstable fill; susceptible to wind erosion; too sandy.	Low fertility; subject to wind erosion and deposition.
Moderate permeability.	Stable fill if proper compaction and erosion control are used.	Good internal drainage.	Moderate permeability; moderate water-holding capacity; moderate intake rate.	Stable fill-----	Fertile; susceptible to wind erosion and deposition.
Rapid permeability.	Stable fill if proper compaction, erosion control, and flat slopes are used.	Rapid internal drainage; rapid permeability.	Rapid permeability; low water-holding capacity; rapid intake rate.	Poor stability; susceptible to wind erosion.	Susceptible to wind and water erosion; subject to wind deposition.
Rapid permeability.	Stable fill if proper compaction, erosion control, and flat slopes are used.	Rapid permeability.	Rapid permeability; rapid intake rate; low water-holding capacity.	Poor stability; susceptible to wind erosion.	Subject to wind erosion and deposition; low fertility.
Moderately rapid permeability.	Stable fill if proper compaction and erosion control are used; good for cores or dikes.	Moderately rapid permeability; rapid internal drainage.	Moderately rapid permeability; rapid intake rate; moderate water-holding capacity.	Stable fill-----	Fertile soil; erodible.
Very rapid permeability.	Unstable; highly erodible.	Very rapid internal drainage; very rapid permeability.	Very rapid permeability; rapid intake rate.	Poor stability; shallow soil.	Steep slopes; sandy and gravelly; low fertility.
Moderately rapid permeability.	Stable fill if properly compacted.	Medium internal drainage; water table at 3 to 6 feet.	Moderately rapid permeability; rapid intake rate.	Unsuitable; too sandy.	Susceptible to wind erosion; subject to occasional flooding.

TABLE 4.—Engineering

Soils and map symbols	Suitability as a source of—		Soil features affecting—	
	Road fill	Topsoil	Highway location	Dikes or levees
Latom stony loam (LaD).	Poor to fair.....	Not suitable.....	Slow permeability; shallow soil.	Shallow soil; stable fill.....
Loamy alluvial land, depressed (Ld).	Poor.....	Poor.....	Variable texture; subject to frequent flooding; high sedimentation.	Variable texture; construction characteristics variable.
Lincoln and Yahola ² soils (Ly): Lincoln component.	Fair to good.....	Poor.....	Water table generally high, at depth of less than 5 feet; poor drainage.	Flat slopes needed; low compressibility; compaction good if properly controlled.
Mansker fine sandy loam (MaB, MaC, MaD).	Fair to good.....	Fair.....	Poor drainage; high shrink-swell potential.	Medium compressibility; compaction difficult; close control essential.
Miles fine sandy loam (MfA, MfB, MfC, MfD).	Good.....	Good.....	Good drainage; low dispersion; low compressibility.	Stable fill with proper compaction and erosion control.
Miles loamy fine sand (MmB, MmC).	Good to fair.....	Fair.....	Low dispersion; low compressibility; good drainage.	Stable fill with good compaction and erosion control.
Nobscot fine sand (Nb).	Fair; lacks binding material.	Poor.....	Low dispersion; low compressibility; good drainage.	Poor to fair stability; good compaction and erosion control essential; very little binder material.
Olton loam (OtA, OtB).	Poor to fair.....	Good.....	Slow permeability; high compressibility; moderate dispersion.	Stable fill; flat slopes needed; high shrink-swell potential.
Quinlan-Woodward complex ³ (Qw).				
Spur loam (Sm).	Fair; unstable when wet.	Fair.....	Medium to high compressibility; subject to flooding; moderate dispersion.	Stable fill; close control essential; compaction difficult.
Rough broken land (Rb).	Fair to poor.....	Poor.....	Low to high dispersion; slow permeability; high compressibility.	Stable fill; impervious cores and blankets.
Sandy alluvial land (Sa).	Good if drained and properly compacted.	Poor.....	Low dispersion; rapid permeability; low compressibility.	Stable if properly controlled.
Springer loamy fine sand (Sb, Sf). Springer soils, severely eroded (Sf3).	Good to poor; satisfactory if drained and properly compacted.	Fair.....	Moderately rapid permeability; low dispersion; low compressibility.	Stable if properly controlled; no binder material.
Spur ⁴ and Yahola ² soils (So).				

See footnotes at end of table.

interpretation of soils—Continued

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Slow permeability.	Stable fill-----	Slow internal drainage; sandy limestone rock below a depth of 4 feet.	Shallow soil; slow permeability; slow intake rate.	Soil too shallow and too rocky.	Erodible; shallow soil.
Variable texture; variable permeability.	Variable texture; construction characteristics variable.	Subject to frequent flooding; covered by water much of the time.	Intake rate, water-holding capacity, and permeability variable.	Subject to frequent flooding.	Covered by water much of the time; subject to high sedimentation.
Very rapid permeability.	Low compressibility; compaction good if properly controlled.	High water table; subject to overflow.	Rapid intake rate; low water-holding capacity; rapid permeability.	Too sandy; unstable; complex slopes.	Susceptible to wind and water erosion; subject to wind deposition.
Moderate permeability.	Medium compressibility; close control essential for compaction.	Fair internal drainage; moderate permeability.	Shallow soil; moderate permeability; moderate intake rate.	Stable fill; subject to wind and water erosion.	Shallow soil; subject to water and wind erosion.
Moderately rapid permeability.	Stable fill if proper compaction and erosion control are used.	Moderately rapid permeability; good internal drainage.	Moderately rapid permeability; low water-holding capacity; rapid intake rate.	Stable fill-----	Fertile soil; susceptible to wind erosion.
Rapid permeability; excessive seepage.	Stable fill if proper compaction and erosion control are used.	Rapid permeability--	Rapid permeability; rapid intake rate; low water-holding capacity.	Stable fill; wind erosion hazard.	Susceptible to wind erosion and deposition.
Rapid permeability; excessive seepage.	Poor to fair stability; good for cores and dikes; use flat slopes.	Rapid permeability--	Rapid permeability; rapid intake rate; low water-holding capacity.	Unstable fill; wind erosion hazard.	Wind erosion hazard; low fertility.
Slow permeability.	Stable fill; flat slopes needed; high shrink-swell potential.	Slow permeability---	Slow intake rate; high water-holding capacity; slow permeability.	Stable fill-----	Moderate fertility; resistant to erosion.
Moderate permeability.	Stable fill but close control essential.	Moderate permeability and stratification.	Moderate permeability; moderate intake rate; frequently flooded.	Frequently flooded.	Frequently flooded; saline spots.
Slow permeability.	Stable fill-----	Slow permeability---	Slow permeability; slow intake rate; high water-holding capacity.	Stable fill; steep slopes.	Low fertility; erodible; steep slopes; nonarable.
Rapid permeability; excessive seepage.	Stable if properly controlled.	Rapid permeability--	Rapid permeability; low water-holding capacity; rapid intake rate.	Too sandy; unstable fill-----	Easily eroded; very susceptible to wind deposits.
Moderately rapid permeability; excessive seepage.	Stable if properly controlled.	Moderately rapid permeability.	Moderately rapid permeability; rapid intake rate; low water-holding capacity.	Unstable; wind erosion hazard.	Wind erosion hazard; low fertility.

TABLE 4.—*Engineering*

Soils and map symbols	Suitability as a source of—		Soil features affecting—	
	Road fill	Topsoil	Highway location	Dikes or levees
St. Paul silt loam (SpA, SpB).	Fair.....	Excellent.....	Slow permeability; moderate dispersion; medium compressibility.	Stable fill; moderate shrink-swell potential; moderate compressibility.
Tipton loam (TpA, TpB, Ts).	Good.....	Excellent.....	Low to moderate dispersion; slow permeability; high compressibility.	Stable; impervious cores and blankets.
Tivoli fine sand (Tv).	Fair; lacks binding material.	Poor.....	Low dispersion; rapid permeability; low compressibility.	Stable fill if flat slopes and sodding are used; subject to wind erosion.
Weymouth loam (WeB, WeC).	Fair.....	Fair.....	Moderately slow permeability; high compressibility; moderate dispersion.	Stable fill; good for impervious cores and blankets; high shrink-swell potential.
Woodward loam (WoB, WoC).	Fair.....	Fair.....	Moderately rapid permeability; low dispersion.	Stable fill; moderate compressibility.
Woodward ⁵ -Quinlan loams, 5 to 12 percent slopes (WwD): Quinlan component.	Poor.....	Poor.....	Low compressibility; moderate permeability.	Stable fill if flat side slopes are used.
Yahola fine sandy loam (Yf). Yahola very fine sandy loam (Yv).	Fair to good.....	Fair to good.....	Low dispersion; rapid permeability; low compressibility.	Stable fill; not suitable for shells, good for impervious cores.

¹ For engineering interpretations of the Tipton component, see Tipton loam.

² For engineering interpretations of the Yahola component, see Yahola very fine sandy loam.

³ For engineering interpretations of the Quinlan component, see the Quinlan component of Woodward-Quinlan loams, 5 to 12 percent slopes; for interpretations of the Woodward component, see Woodward loam; for interpretations of Rough broken land, which is also in this complex, see Rough broken land.

interpretation of soils—Continued

Soil features affecting—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment				
Slow permeability.	Stable fill; moderate compressibility; shrink-swell potential.	Slow permeability.	Slow permeability; slow intake rate; high water-holding capacity.	Stable fill.	Fertile soil; resistant to erosion.
Moderate permeability.	Stable fill; impervious cores and blankets.	Moderate permeability.	Moderate permeability; moderate intake rate; high water-holding capacity.	Stable fill.	Fertile soil; moderately resistant to erosion.
Very rapid permeability.	Stable fill if flat slopes and sodding are used.	Very rapid permeability.	Very rapid permeability; very low water-holding capacity; rapid intake rate.	Too sandy; unstable; subject to wind erosion.	Low fertility; subject to severe wind erosion.
Moderately slow permeability.	Stable fill; good for impervious cores and blankets.	Moderately slow permeability.	Slow intake rate; slow permeability; high water-holding capacity; shallow soils.	Stable fill; shallow soils.	Moderate fertility; resistant to erosion; gentle to steep slopes.
Moderately rapid permeability.	Stable fill; moderate compressibility.	Moderately rapid permeability.	Moderately rapid permeability; moderate water-holding capacity; shallow soils.	Stable fill.	Gentle to moderately steep slopes; moderate fertility; subject to wind erosion.
Moderate permeability.	Stable fill if flat side slopes are used.	Moderate permeability.	Moderate permeability; very shallow soil; low water-holding capacity.	Shallow soil; steep slopes.	Shallow soil; steep slopes; low fertility.
Rapid permeability.	Stable fill; good only for impervious cores.	Rapid permeability; occasionally flooded.	Rapid intake rate; rapid permeability; low water-holding capacity.	Stable fill.	Subject to wind erosion and deposition.

⁴ For engineering interpretations of the Spur component, see Spur loam.

⁵ For engineering interpretations of the Woodward component, see Woodward loam.

TABLE 5—Engineering test data for soil

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

Soil name and location	Parent material	Texas report No.	Depth	Horizon	Shrinkage		
					Limit	Lineal	Ratio
Enterprise very fine sandy loam: 0.3 mile S. of NE. corner of sec. 796, Block H, W. & N. RR. Co. (Modal.)	Eolian sands.	62-206-R	0-6	Ap	18	3.5	1.69
		62-207-R	24-48	AC	20	3.5	1.66
5 miles NW. of Estelline and 1 mile W. of U.S. Highway No. 287, and 100 ft. S. of county road. (Siltier than Modal.)	Eolian sands.	62-208-R	0-6	Alp	17	2.6	1.74
		62-209-R	28-48	AC	16	5.0	1.79
5 miles NW. of Estelline and 1.5 miles W. of U.S. Highway No. 287, and 100 ft. N. of county road. (Thin solum over red beds.)	Eolian sands.	62-210-R	0-6	Ap	19	2.5	1.68
		62-211-R	48-60	R	17	5.3	1.78
Miles fine sandy loam: 0.35 mile S. of the NW. corner of sec. 71, Block 18, H. & G.N. RR. Co. (Modal.)	Sandy outwash materials.	62-236-R	0-6	Ap	15	2.5	1.80
		62-237-R	13-28	B2	14	8.3	1.86
		62-238-R	40-60	C	17	4.0	1.75
0.5 mile S. of Turkey Cemetery on Farm Road 656, and 0.1 mile E. and 100 ft. S. of county road. (Heavy textured B horizon.)	Sandy outwash materials.	62-241-R	0-7	Ap	14	2.4	1.86
		62-242-R	13-28	B2	13	10.4	1.90
0.2 mile E. of SW. corner of sec. 2, Block 20, H. & G.N. RR. Co. (Light-textured B horizon.)	Sandy outwash materials.	62-239-R	0-6	Ap	14	2.9	1.85
		62-240-R	6-22	B2	14	4.4	1.85
St. Paul silt loam: 0.1 mile W. of the SE. corner of sec. 9, Block 18, H. & G.N. RR. Co. (Modal.)	Old alluvium.	62-220-R	0-7	Ap	16	7.4	1.85
		62-221-R	15-25	B21	16	7.0	1.80
		62-222-R	36-54	Cca	15	13.6	1.85
0.15 mile S. of the NE. corner of sec. 76, Block H, W. & N. RR. Co. (Heavy textured B horizon.)	Old alluvium.	62-223-R	6-12	B1	13	11.7	1.89
		62-224-R	12-22	B21	23	6.8	1.64
		62-225-R	42-60	Cca	11	15.3	1.97
0.6 mile W. and 0.7 mile S. of the NW. corner of sec. 20, Block R, T. A. Thompson Survey. (Light-textured B horizon.)	Permian sandstone.	62-226-R	0-6	Ap	18	2.8	1.72
		62-227-R	12-28	B21	15	7.3	1.82
		62-228-R	40-60	C	15	5.1	1.81
Tipton loam: 0.25 mile E. of the SW. corner of sec. 111, Block 1, S.P. RR. Co. (Modal.)	Outwash or old alluvium terrace material.	62-212-R	0-7	Ap	15	6.7	1.82
		62-213-R	15-25	B21	16	10.3	1.85
		62-214-R	43-60	B3	15	11.1	1.85
0.5 mile S. and 0.1 mile W. of the NE. corner of sec. 57, S.P. RR. Co. (Heavy textured B horizon.)	Outwash or old alluvium terrace material.	62-218-R	5-12	A12	16	9.0	1.79
		62-219-R	19-48	B2	13	11.7	1.89
1.4 miles S. and 0.25 mile E. of the NW. corner of sec. 54, S.P. RR. Co. (Light-textured B horizon.)	Outwash or old alluvium terrace material.	62-215-R	0-7	A1p	16	5.8	1.82
		62-216-R	24-33	B22	16	7.1	1.80
		62-217-R	33-60	B3	18	4.6	1.77
Woodward loam: 0.25 mile S. and 0.1 mile W. of the NE. corner of sec. 55, Block H, A.B. and M. Survey. (Modal.)	Permian sandstone.	62-229-R	0-5	Ap	18	2.9	1.73
		62-230-R	10-20	AC	17	4.7	1.78
		62-231-R	22-30	Cca	16	5.9	1.80
NE. corner of sec. 41, Block 2, T. & P. RR. Co. (Heavier textured.)	Clayey red beds.	62-234-R	7-16	AC	16	7.3	1.79
		62-235-R	26-48	R	12	16.3	1.94
0.5 mile E. of the SW. corner of sec. 121, Block 1, S.P. RR. Co. (Deep.)	Permian sandstone.	62-232-R	5-12	A12	17	3.0	1.76
		62-233-R	36-60	C	18	2.4	1.71

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

samples taken from 15 soil profiles

procedures of the American Association of State Highway Officials (AASHO) (1)

Mechanical analysis ¹								Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—			AASHO			Unified ²	
¾-in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.					0.002 mm.
		100	99	85	56	10	9	25	4	A-4(8)	ML-CL.
		100	99	85	63	15	13	26	4	A-4(8)	ML-CL.
			100	69	46	13	10	22	3	A-4(7)	ML.
			100	82	56	21	17	26	7	A-4(8)	ML-CL.
			100	89	61	13	10	24	3	A-4(8)	ML.
100	98	98	96	85	69	22	20	27	9	A-4(8)	CL.
	99	99	89	44	28	10	8	19	3	A-4(2)	SM.
	99	98	90	62	50	26	23	30	17	A-6(8)	CL.
	99	97	86	51	36	15	13	24	5	A-4(3)	ML-CL.
		100	95	45	28	13	10	18	3	A-4(2)	SM.
		100	97	59	50	33	30	33	20	A-6(9)	CL.
	99	98	88	38	26	13	11	19	4	A-4(1)	SM-SC.
	100	99	86	38	30	16	14	22	6	A-4(1)	SM-SC.
			100	92	66	28	20	29	13	A-6(9)	CL.
			100	84	67	27	23	30	14	A-6(10)	CL.
		100	98	87	77	45	38	44	28	A-7-6(16)	CL.
		100	99	84	65	34	28	37	22	A-6(13)	CL.
	99	98	90	65	54	16	3	38	14	A-6(8)	ML-CL.
				85	75	43	37	44	28	A-7-6(16)	CL.
		100	99	80	53	18	14	23	5	A-4(8)	ML-CL.
		100	99	73	54	23	20	29	13	A-6(9)	CL.
	100	99	98	67	44	20	17	24	6	A-4(6)	ML-CL.
		100	99	76	63	23	18	28	11	A-6(8)	CL.
		100	97	85	76	35	27	36	19	A-6(12)	CL.
			100	82	75	36	28	37	23	A-6(13)	CL.
	100	99	99	95	80	30	22	35	27	A-6(15)	CL.
		100	99	90	76	43	36	37	22	A-6(13)	CL.
		100	97	74	58	23	18	27	10	A-4(8)	CL.
		100	97	82	66	24	20	30	13	A-6(9)	CL.
		100	97	80	64	19	16	26	6	A-4(8)	ML-CL.
	99	99	98	87	52	14	8	22	4	A-4(8)	ML-CL.
100	98	97	94	74	57	19	15	25	6	A-4(8)	ML-CL.
100	80	76	72	60	48	18	12	27	7	A-4(5)	ML-CL.
³ 98	94	93	92	67	50	23	18	30	12	A-6(7)	CL.
³ 98	95	91	88	72	63	39	33	49	32	A-7-6(17)	CL.
	100	99	98	59	45	13	10	23	4	A-4(5)	ML-CL.
100	99	98	98	53	36	11	9	21	3	A-4(4)	ML.

² SCS and BPR have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-SC and ML-CL.

³ 100 percent passes 1½-inch sieve.

Some of the terms used in table 5 are defined in the following paragraphs.

As moisture is removed, the volume of 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 soil will not change. In general, the lower the shrinkage limit, the higher the content of clay.

Lineal shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture is reduced from the stipulated percentage to the shrinkage limit (2).

The *shrinkage ratio* is the volume change resulting from the drying of soil material, divided by the loss of moisture caused by drying. The ratio is expressed numerically.

The engineering soil classifications in table 5 are based on data obtained by mechanical analyses and by tests to determine the liquid limit and the plastic limit. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes to a liquid state. The *plasticity index* is the numerical difference between the plastic limit and the liquid limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

Genesis, Classification, and Morphology of Soils

The purpose of this section is to present the outstanding morphologic characteristics of the soils of Hall County and to relate them to the factors of soil formation. Physical and chemical data are limited for these soils, and the discussion of soil genesis and morphology is correspondingly incomplete.

The section consists of three main parts. The first part tells how the soils of Hall County were formed. In the second part the soil series are placed in higher categories according to the current system of classification. In the third part the morphology of the soils is discussed, and the profile of a soil representative of each soil series is technically described.

Factors of Soil Formation

Soil is produced by the action of soil-forming processes on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by five main factors: (1) The physical and mineralogical composition of the parent materials; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time these forces have acted on the material.

Climate and living organisms, chiefly vegetation, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The

parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil. It may be much or little, but some time is always required for the development of distinct soil horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one, unless conditions are specified for the other four. Many of the processes of soil formation are unknown. The five main factors are discussed in the following paragraphs as they are related to the soils of Hall County.

Parent material

The soils in Hall County have developed mainly from (1) Permian red-bed materials, (2) outwash materials of the Pliocene to Pleistocene periods, (3) eolian materials of the Quaternary period, and (4) recent alluvial materials.

The Permian red-bed materials consist of old sea deposits and are 4,000 to 5,000 feet thick. The Permian red beds are subdivided into three groups (3)—the Wichita, the Clear Fork, and the Double Mountain, which is the youngest and uppermost. All of Hall County is within the area covered by the Double Mountain group. The deposits of this group are about 1,500 to 2,000 feet thick and are mainly soft, very fine grained sandstone, pack sand, and silty shale. In many areas these materials are interbedded with layers of soft and hard gypsum. These Permian materials are exposed over a large area in the southern and eastern parts of the county. The relief of this area ranges from nearly level or rolling to steep. Soils that have formed in the more nearly level parts are the deep, well-developed St. Paul and Carey soils. Those that formed in the steeper parts are less well developed and consist of the Woodward, Weymouth, and Quinlan soils.

In the northern and southwestern parts of the county, a mantle of outwash materials was deposited on the Permian red beds during the Pliocene to Pleistocene period (8). These outwash deposits range from a few feet to 50 feet in thickness. They range from clayey to sandy, but quartz pebbles are mixed in them. The finer textured outwash materials were deposited by slow-moving water and have smooth topography. The deep, well-developed Abilene and Olton soils have formed in these materials. The sandy outwash materials were deposited by faster moving water. Some of these sandier materials were reworked later by wind into an undulating to hummocky surface. The soils that developed in these materials are the Miles, Altus, Mansker, Springer, Brownfield, and Nobscot.

The eolian materials occur mostly along the Prairie Dog Town Fork of the Red River. They were blown out of the dry river channels and deposited in a narrow band parallel to the river. They are mostly sand of varying grain size. The coarser textured sand was deposited as dunes nearest the river. The Tivoli soils formed in this sand. The finer sand was carried farther away from the river channels and has a smooth surface. The Enterprise soils formed in this sand. All of the soils that formed in eolian materials are deep, but they are immature and lack distinct horizons.

Soils that formed in the recent alluvial materials are also immature and lack distinct horizons. These soils occur along the flood plains of streams, where floodwaters continually deposit fresh materials. The texture of these materials depends on the rate at which the water moves and the texture of the soils in the watershed. Some areas are sandy; others are silty or clayey. The stratified layers of different texture that occur throughout the profile are a common characteristic of alluvial soils. In Hall County the soils formed in recent alluvial materials are the Spur, Yahola, and Lincoln.

Climate

Climate has had a uniform and definite effect on the development of the soils in Hall County. Precipitation, temperature, and wind are the more important influences of climate.

The wet climate of past geologic ages has influenced the transportation and deposition of the parent material. Later, as the soils began to develop, the climate became subhumid. The limited rainfall has not been heavy enough to leach the minerals from the soils. As a result, most soils, except the sandy ones, have fairly high fertility. The soils seldom get wet to a depth below 6 feet. Consequently, many of them have a calcium carbonate horizon a few feet below the surface. The Olton and Carey soils are good examples. Most of the immature soils have lime throughout their profile. Examples of these are the Enterprise and Woodward soils. The light rainfall has also limited the vegetation mostly to grasses.

Temperature has influenced the development of soils. Summers are hot, and winters are mild. The high temperature and the low rainfall have limited the accumulation of organic matter in the soils. The organic matter has been broken down almost as fast as it has accumulated. As a result, the soils contain a small amount of organic matter. The high temperature has caused much evaporation, which has reduced the effectiveness of rainfall.

Wind has had some effect on the development of soils. After they were deposited by water, many of the sandier parent materials were reworked by wind, and a rolling to hummocky surface resulted. The Nobscot and Brownfield soils are examples. The eolian soils were also deposited by wind. Because of the high winds now common in this area, many of the cultivated soils are constantly winnowed. The soil materials are constantly shifting, and the finer particles are being sorted out and deposited elsewhere. These finer particles are in the air during dust storms. The wind, along with high temperature and low humidity, also causes a high rate of evaporation and dries the soils rapidly.

Plant and animal life

Plant and animal life in various forms influences the development of soils. In Hall County, plants, micro-organisms, earthworms, and other forms of living organisms have contributed to the development of the soils.

The soils have developed under a grass cover. Short and mid grasses are dominant on the medium-textured soils, and mid to tall grasses are dominant on the moderately coarse textured to coarse textured soils. The grasses have contributed large amounts of organic materials to the soils. Because of the high temperatures, however,

only moderate amounts of organic matter have accumulated. As the grass roots decayed, they left small pores in the soil through which water and air could penetrate the solum more freely. The grass roots also help to mix the soil.

Soil bacteria and other micro-organisms have had some influence on soil development. They decompose the organic materials and hasten soil development. The number of these organisms are influenced by the amount of organic materials present.

Earthworms have been active in the soils in some periods. The worms aid in soil development by working and churning the soil. They make the soil more porous and improve the physical condition. This, in turn, increases the movement of water, air, and roots through the soil. Worm pores and worm casts make up as much as 20 or 30 percent of the subsoil of some of the soils.

Prairie dogs, badgers, moles, and other burrowing animals have influenced soil development in this area by churning and reworking the soils. This burrowing has increased soil development and made the materials more friable.

Relief

Relief has influenced soil development in Hall County through its effect on drainage and runoff. Soil characteristics are influenced by the position in the landscape in which the soil develops. Soils that have formed in low, concave areas, such as the St. Paul and Abilene, are darker, deeper, and finer textured than soils that have formed in more sloping areas. The low, concave areas receive extra water, have less runoff, and are subject to less erosion. In addition, the greater amount of plant residue produced and the increased biological activity in these areas contribute to soil development.

A large part of the soils in Hall County formed on slopes ranging from gently sloping to steep. As the slope increases, the soils are progressively lighter colored and less well developed. The soils that formed on the steeper slopes are shallower and are lighter colored because they have more runoff and more erosion. On steep slopes geologic erosion often removes soil material almost as fast as it is formed. The very shallow Quinlan soils are an example. These soils have been developing as long as the Carey and Woodward soils, but because they occur in less favorable positions, they have not formed deep, clearly expressed horizons.

Time

The length of time that the soil-forming factors have acted upon parent materials determines, to a large degree, the characteristics of the soil formed. This applies mainly to soils that are in favorable positions for soil development. The soils that have been acted upon for only a short time show little soil development. In Hall County examples of such soils are the Enterprise, Spur, and Yahola. Soils that are in similar positions, but which have been acted upon for a long period of time by soil-forming processes, show greater development and are deeper. Examples are the Abilene, St. Paul, Olton, and Miles soils.

Time has less effect on the soils that form on steeper slopes. Many of the shallow soils on steep slopes have been developing as long as the deep, well-developed soils

in more nearly level areas, but other factors of soil formation have influenced their development. On these soils relief is the major factor, and geologic erosion has offset soil development. The Quinlan, Weymouth, and Cottonwood soils are examples in Hall County.

Classification of Soils

Soils are classified so that we may more easily remember their significant characteristics. Classification enables us to assemble knowledge about soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First, through classification, and then through the use of soil maps, we can apply our knowledge of soils to specific tracts or parcels of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in managing farms, fields, and woodlands; in developing suburbs; in engineering work; and in many other ways. Likewise, soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of natural classification of soils are now in general use in the United States. One of these is the 1938 system (9), with later revisions (7). The other, a new system based on the comprehensive classification system as revised in June, 1964 (4, 6), was placed in

general use by the Soil Conservation Service in 1965. The new system is subject to further revision; nevertheless, it is shown in this report (see table 6).

The 1938 system, with later revisions, consists of six categories. In the highest of these, the soils of the whole country have been placed in three orders. The next two categories, the suborder and the family, have never been fully developed. As a consequence, they have not been used very much in the past. More attention has been centered on lower categories, the great soil group, the soil series, and the soil type.

Under the new system, all soils are also placed in six categories. They are, beginning with the most inclusive, the order, the suborder, the great group, the subgroup, the family, and the series (4). In this system, the criteria used as a basis for classification are observable or measureable properties. The properties are so chosen, however, that soils of similar mode of origin are grouped together.

In table 6, each soil series of Hall County is placed in its family, subgroup, suborder, and order of the new classification system, and in its great soil group of the older system. In the following paragraphs the order, suborder, great groups, subgroups, families, and series of the new classification system are discussed.

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those

TABLE 6—Classification of soil series

Series	New classification				1938 system with later revisions
	Family	Subgroup	Suborder	Order	Great soil group
Abilene.....	Fine, mixed, thermic.....	Typic Argiustoll.....	Ustoll.....	Mollisol.....	Chestnut.
Altus.....	Fine loamy, mixed, thermic.....	Typic Argiustoll.....	Ustoll.....	Mollisol.....	Chestnut.
Arch.....	Fine loamy, mixed, thermic.....	Typic Calciorthid.....	Orthid.....	Aridisol.....	Calcisol.
Brownfield.....	Fine loamy, siliceous, thermic.....	Typic Halplustalf.....	Ustalf.....	Alfisol.....	Reddish Brown.
Carey.....	Fine silty, mixed, thermic.....	Typic Argiustoll.....	Ustoll.....	Mollisol.....	Reddish Chestnut.
Cottonwood.....	Loamy, thermic, very thin (less than 10 inches).	Typic Haplorthent.....	Orthent.....	Entisol.....	Lithosol.
Enterprise.....	Coarse silty, mixed, thermic.....	Typic Haplustoll.....	Ustoll.....	Mollisol.....	Regosol.
Guadalupe.....	Coarse loamy, siliceous, calcareous, thermic.	Cumulic Haplorthent.....	Orthent.....	Entisol.....	Alluvial.
Latom.....	Loamy, thermic, very thin (less than 10 inches).	Lithic Haplorthent.....	Orthent.....	Entisol.....	Lithosol.
Lincoln.....	Sandy, siliceous, nonacid, thermic.....	Cumulic Normipsamment.	Psamment.....	Entisol.....	Alluvial.
Mansker.....	Fine loamy, mixed, thermic.....	Typic Calcicustoll.....	Ustoll.....	Mollisol.....	Calcisol.
Miles.....	Fine loamy, mixed, thermic.....	Mollic Haplustalf.....	Ustalf.....	Alfisol.....	Reddish Chestnut.
Nobscot.....	Coarse loamy, siliceous, thermic.....	Typic Haplustalf.....	Ustalf.....	Alfisol.....	Reddish Brown.
Olton.....	Fine, mixed, thermic.....	Typic Argiustoll.....	Ustoll.....	Mollisol.....	Reddish Chestnut.
Quinlan.....	Fine silty, mixed, thermic, thin.....	Typic Eutrochrept.....	Ochrept.....	Inceptisol.....	Regosol.
Springer.....	Coarse loamy, siliceous, thermic.....	Typic Haplustalf.....	Ustalf.....	Alfisol.....	Reddish Brown.
Spur.....	Fine loamy, mixed, thermic.....	Cumulic Haplustoll.....	Ustoll.....	Mollisol.....	Alluvial.
St. Paul.....	Fine silty, mixed, thermic.....	Typic Argiustoll.....	Ustoll.....	Mollisol.....	Chestnut.
Tipton.....	Fine silty, mixed, thermic.....	Typic Argiustoll.....	Ustoll.....	Mollisol.....	Chestnut.
Tivoli.....	Sandy, siliceous, nonacid, thermic.....	Typic Normipsamment.....	Psamment.....	Entisol.....	Regosol.
Weymouth.....	Fine loamy, mixed, thermic.....	Typic Calcicustoll.....	Ustoll.....	Mollisol.....	Calcisol.
Woodward.....	Fine silty, mixed, thermic.....	Typic Haplustoll.....	Ustoll.....	Mollisol.....	Regosol.
Yahola.....	Coarse loamy, siliceous, calcareous, thermic.	Cumulic Haplorthent.....	Orthent.....	Entisol.....	Alluvial.

that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates.

Table 6 shows the five soil orders in Hall County—Entisols, Inceptisols, Aridisols, Mollisols, and Alfisols. Entisols are recent soils. They are without genetic horizons or have only the beginnings of such horizons. In Hall County this order included many, but not all, of the soils that formerly were called Alluvial soils, Regosols, and Lithosols. Inceptisols are soils on young, but not recent, land surfaces. In Hall County this order includes some soils that formerly were called Regosols. Aridisols are soils that have a light-colored surface horizon and are dry most of the time. In Hall County this order includes soils that formerly were called Calcisols. Mollisols are soils that have thick surface layers that are dark, friable, and soft and that contain more than 1 percent of organic matter. In Hall County this order includes soils that formerly were called Reddish Chestnut, Chestnut, Regosols, Calcisols, and Alluvial soils. Alfisols are soils that contain clay-enriched B horizons that have high base saturation. In Hall County this order includes soils that formerly were called Reddish Chestnut and Reddish Brown soils.

SUBORDER: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of water-logging, or soil differences resulting from the climate or vegetation.

GREAT GROUP: Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated, or those that have pans that interfere with the growth of roots or the movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 6 for the new classification system.

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group and orders called intergrades, that have properties of one great group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Normipsamment (a typical Normipsamment).

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

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

in the profile. A soil series is given the name of a geographic location near the place where that series was first observed and mapped.

Morphology of Soils

In this subsection the soil series in the county are briefly discussed and a detailed description of a representative profile of each series is given.

The marks that the soil-forming factors leave on the soil are recorded in the soil profile—a succession of layers or horizons from the surface down to bedrock or into the parent material. The horizons differ in one or more properties, such as color, texture, structure, consistence, porosity, and reaction. They may be thick or thin.

Most soil profiles contain three main horizons called A, B, and C. In some immature soils, the B horizon has not developed.

The A horizon is the surface layer. It can be either the horizon of accumulated organic matter, called the A1; or the horizon of maximum loss by leaching of dissolved or suspended materials, called the A2.

The B horizon lies immediately beneath the A horizon and is called the subsoil. It is a horizon of maximum accumulation of dissolved or suspended materials, such as iron or clay. The B horizon is usually firmer than the horizons immediately above and below, and it may have blocky structure.

Next in order is the C horizon. It has been little affected by the soil-forming processes, but it can be material that has been modified by weathering.

ABILENE SERIES

The soils of the Abilene series are in the Typic Argiustoll subgroup and the fine, mixed, thermic family. They have developed in calcareous, clayey outwash or old alluvium, probably of Pleistocene age. These soils are moderately extensive and occur in scattered areas in the northern and southwestern parts of the county. They are mainly nearly level. The slopes are dominantly less than 1 percent, but in a few areas they are as much as 2 percent. Abilene clay loam is the only soil type mapped in Hall County.

The Abilene soils are similar to the Olton soils, but they are darker and have thicker A and B1 horizons. They are brown to grayish in hues of 7.5YR to 10YR; whereas the Olton soils are red to reddish brown in hues of 2.5YR to 5YR. The Abilene soils are more mature and have a more compact and blocky subsoil than the Tipton soils. They are siltier, are darker, and have a more compact and blocky B horizon than the Miles soils. The Abilene soils occur in positions similar to those of the Olton, Tipton, and Miles soils.

A representative profile of a soil in the Abilene series (0.1 mile west of the northeast corner sec. 135, Block S5 of the D. and P. RR. Co. survey; and about 50 feet south of State Highway No. 86)—

Ap—0 to 8 inches, brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) when moist; weak, granular structure; slightly hard when dry, friable when moist; noncalcareous; mildly alkaline; abrupt boundary.

B1t—8 to 16 inches, dark-brown (7.5YR 3/2) clay loam, very dark brown (7.5YR 2/2) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; noncalcareous; mildly alkaline; thin, patchy clay films; gradual boundary.

- B21t—16 to 24 inches, brown (7.5YR 4/2) light clay with slightly more clay than layer above; dark brown (7.5YR 3/2) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist; noncalcareous; mildly alkaline; continuous clay films; clear boundary.
- B22t—24 to 30 inches, brown (7.5YR 5/2) light clay, dark brown (7.5YR 4/2) when moist; moderate, medium, subangular blocky structure; very hard when dry, very firm when moist; calcareous; moderately alkaline; few threads and films of calcium carbonate; distinct, continuous clay films; gradual boundary.
- B3—30 to 40 inches, brown (7.5YR 5/2) clay loam with less clay than layer above; dark brown (7.5YR 4/2) when moist; hard when dry, firm when moist; calcareous; moderately alkaline; threads of calcium carbonate common; few fine concretions of calcium carbonate; diffuse boundary.
- Cca—40 to 60 inches, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) when moist; calcareous; strongly alkaline; many threads and films of calcium carbonate; fine, soft concretions of calcium carbonate common; gradual boundary.
- C—60 to 76 inches +, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) when moist; similar to horizon above, but contains less calcium carbonate.

The A horizon ranges from brown to grayish brown in hues of 7.5YR to 10YR. The texture ranges from loam to clay loam. The thickness of the A horizon ranges from 5 to 12 inches and that of the B1t horizon from 4 to 12 inches. A few areas do not have a B1t horizon. The color of the Bt horizon ranges from dark reddish gray to dark grayish brown in hues of 5YR to 10YR, values of 2 to 5, and chromas of 2 to 3. The texture of the Bt horizons ranges from clay loam to clay or silty clay. The depth to the Cca horizon is 32 to 54 inches, but a few areas have no distinct Cca horizon. In a few areas, IIC horizons occur at a depth of 4 to 6 feet.

ALTUS SERIES

The soils of the Altus series are in the Typic Argiustoll subgroup and the fine loamy, mixed, thermic family. They have developed in calcareous, loamy old alluvium. These soils are not extensive and occur in valleys or on terraces along small streams. Slopes are mainly 0 to 1 percent. Altus fine sandy loam is the only soil type mapped in the county.

The Altus soils are darker than the nearby Miles soils, and generally are lower. They are slightly sandier than the Tipton soils and are more mature.

A representative profile of a soil in the Altus series (in a field 0.25 mile west of Lakeview on State Highway No. 256, and 0.1 mile north)—

- Ap—0 to 8 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) when moist; weak, granular structure; soft when dry, very friable when moist; noncalcareous; mildly alkaline; abrupt boundary.
- A1—8 to 16 inches, dark-brown (7.5YR 3/2) fine sandy loam, very dark brown (7.5YR 2/2) when moist; weak, subangular blocky structure; hard when dry, friable when moist; noncalcareous; mildly alkaline; gradual boundary.
- B2t—16 to 36 inches, brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 4/2) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; calcareous; moderately alkaline; few films and threads of calcium carbonate becoming more numerous with depth; few, thin, patchy clay films; clear boundary.
- Cca—36 to 48 inches, light-gray (10YR 6/1) sandy clay loam with less clay than layer above; grayish brown (10YR 5/2) when moist; very strongly calcareous;

moderately alkaline; soft masses of calcium carbonate, about 10 percent by volume; gradual boundary.

C—48 to 72 inches +, materials that are similar in color and texture to the Cca horizon but that contain less calcium carbonate.

The thickness of the A horizon ranges from 8 to 20 inches. The color ranges from brown to grayish brown in hues of 7.5YR to 10 YR, values of 3 to 6, and chromas of 2 to 4. A B1 horizon occurs in some areas. If present, it is dark-brown to dark grayish-brown loam or sandy clay loam. The color of the B2t horizon ranges from dark reddish gray to brown or dark grayish brown in hues of 5YR to 10YR, values of 2 to 4, and chromas of 2 to 4. The depth to the Cca horizon is 30 to 42 inches; a few areas do not have a well-defined Cca horizon. The color of the Cca and C horizons ranges from reddish brown to light gray or grayish brown in hues of 5YR to 10YR. The texture ranges from loam or fine sandy loam to sandy clay loam or clay loam.

ARCH SERIES

The soils of the Arch series are in the Typic Calciorthids subgroup and the fine loamy, mixed, thermic family. They have developed in white or light-colored, highly calcareous, chalky, gypsiferous earth materials. These soils occur extensively in small scattered areas. The slopes range from 0.5 to 3 percent. Arch loams, the only type in the county, was mapped in an undifferentiated group with Cottonwood soils.

The Arch soils are deeper and more developed than the nearby Cottonwood soils that have formed in chalky gypsum materials. They are not so well developed as the St. Paul, Abilene, and Tipton soils.

A representative profile of a soil in the Arch series (in a field 0.05 mile east of the southwest corner sec. 46, Block 18, of the H. & G. N. RR. Co. survey, and 100 feet north)—

- Ap—0 to 6 inches, brown (7.5YR 5/3) loam, brown (7.5YR 4/3) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; abrupt boundary.
- A1—6 to 8 inches, brown (7.5YR 5/3) loam, brown (7.5YR 4/3) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; calcareous; moderately alkaline; gradual boundary.
- B2—8 to 20 inches, brown (7.5YR 5/3) loam with slightly more clay than horizon above; brown (7.5YR 4/3) when moist; weak to moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; moderately alkaline; few fine concretions of calcium carbonate; common films of calcium carbonate; gradual boundary.
- C1—20 to 34 inches, light-gray (10YR 7/2) loam, light brownish gray (10YR 6/2) when moist; calcareous; moderately alkaline; partly weathered gypsum materials; abrupt boundary.
- C2—34 to 48 inches +, white (10YR 8/2), calcareous, chalky, compact gypsum beds.

The thickness of the A horizon ranges from 6 to 12 inches. The color ranges from reddish brown to brown in hues of 5YR to 7.5YR. The color of the B2 horizon is mainly brown or grayish brown in hues of 7.5YR to 10YR, but in a few areas it is reddish brown. The texture of the B2 horizon ranges from loam to clay loam. The depth to the chalky C horizon ranges from 12 to 30 inches but is 16 to 20 inches in most areas. The color of the underlying gypsum beds range from white to light

gray or pale brown. These beds are indurated in some areas.

BROWNFIELD SERIES

The soils of the Brownfield series are in the Typic Haplustalf subgroup and the fine loamy, siliceous, thermic family. They have developed in sandy eolian deposits, probably of Pleistocene age. They are not extensive and occur only in the southwestern corner of the county. Slopes range from 0 to 5 percent. Brownfield fine sand is the only soil type mapped in the county.

The Brownfield soils are similar to the Nobscot soils but have a more clayey subsoil. They have a sandier surface horizon than the Miles soils.

A representative profile of a soil in the Brownfield series (in a pasture 0.65 mile north of the Hall-Motley County line on State Highway No. 70, and 300 feet west)—

- A1—0 to 6 inches, brown (7.5YR 5/3) fine sand, dark brown (7.5YR 4/2) when moist; structureless; loose when dry or moist; noncalcareous; near neutral; clear boundary.
- A2—6 to 26 inches, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; structureless; loose when dry or moist; noncalcareous; slightly acid; clear boundary.
- B2t—26 to 42 inches, reddish-brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; thin, patchy clay films; noncalcareous; near neutral; gradual boundary.
- B3—42 to 52 inches, brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; near neutral; gradual boundary.
- C—52 to 60 inches ±, light-brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) when moist; loose; noncalcareous; near neutral.

The thickness of the A horizon ranges from 12 to 34 inches. The thickness of the A1 horizon ranges from 4 to 8 inches. The A2 horizon is weakly to very weakly developed. The color of the A2 horizon ranges from light brown to light reddish brown. The color of the B2t horizon ranges from red to reddish brown, and the texture ranges from sandy clay loam to clay loam. The thickness of the B2t horizon ranges from 10 to 24 inches. The texture of the C horizon ranges from loamy fine sand to fine sand.

CAREY SERIES

The soils of the Carey series are in the Typic Argiustoll subgroup and the fine silty, mixed, thermic family. They have developed in calcareous, very fine grained, soft sandstone materials of Permian age. They are deep, well-drained soils and are extensive in the eastern part of the county. The larger areas have 1 to 3 percent slopes, but some smaller areas have 3 to 5 percent slopes. In Hall County, Carey loam is the only soil type mapped.

The Carey soils are deeper and more mature than the Woodward soils. They are lighter colored, are more permeable, and have steeper slopes than the St. Paul soils. The Carey soils are in the same catena as Woodward and St. Paul soils and have developed in similar parent materials.

A representative profile of a soil in the Carey series (in a field about 0.3 mile north of the southeast corner

sec. 1, Block S5S, B.S. and F. survey, and 200 feet west of the county road)—

- Ap—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; mildly alkaline; abrupt boundary.
- B1—8 to 16 inches, reddish-brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; weak, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; mildly alkaline; gradual boundary.
- B2t—16 to 28 inches, reddish-brown (5YR 4/4) sandy clay loam with more clay than the layer above; dark reddish brown (5YR 3/4) when moist; weak to moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; mildly alkaline; thin clay films; gradual boundary.
- B3—28 to 44 inches, red (2.5YR 4/6) loam, dark red (2.5YR 3/6) when moist; weak, medium, subangular blocky structure; slightly hard when dry, friable when moist; calcareous; moderately alkaline; gradual boundary.
- Cca—44 to 72 inches, light-red (2.5YR 6/6) very fine sandy loam, red (2.5YR 5/6) when moist; soft when dry, very friable when moist; calcareous; moderately alkaline; few hard concretions of calcium carbonate; diffuse boundary.
- C—72 to 90 inches ±, red (2.5YR 5/6), soft, sandy Permian red beds; calcareous; many, fine, grayish spots throughout.

The thickness of the A horizon ranges from 4 to 12 inches. The pH value of the A horizon ranges from 7.5 to 8.0. The B1 horizon is absent in a few areas. The texture of the B horizon ranges from loam to clay loam, and the color ranges from reddish brown to red. In places the B horizon is calcareous throughout. The depth to free lime ranges from 15 to 60 inches but is dominantly less than 40 inches. A distinct Cca horizon occurs in about 60 percent of the areas.

COTTONWOOD SERIES

The soils of the Cottonwood series are in the Typic Haplorthents subgroup and the loamy, thermic, very thin (less than 10 inches) family. They have developed in highly calcareous, white or grayish-colored, gypsum materials. Slopes are mainly 1 to 3 percent, but in scattered areas, they are as much as 4 percent. In Hall County, Cottonwood soils are mapped only in an undifferentiated group with Arch soils.

The Cottonwood soils are not so well developed and are not so deep as the nearby Arch soils, which have developed in similar parent materials.

A representative profile of a soil in the Cottonwood series (in a field 0.2 mile north of the southeast corner sec. 74, Block 2, T. & P. RR. Co. survey, and 200 feet west of road)—

- Ap—0 to 6 inches, light-brown (7.5YR 6/3) loam, brown (7.5YR 5/3) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; abrupt boundary.
- R—6 to 24 inches ±, white (N 8/0) calcareous, compact gypsum beds; light gray (N 7/0) when moist.

The thickness of the surface layer ranges from 3 to 12 inches, and the color from light brown or brown to reddish brown. The redder colored surface layers are probably the result of accumulations of material from surrounding soils.

ENTERPRISE SERIES

The soils of the Enterprise series are in the Typic Haplustolls subgroup and the coarse silty, mixed, thermic family. The parent materials are calcareous, eolian sandy loams that were blown out of channels of the Prairie Dog Town Fork of the Red River and other major streams and deposited in lands adjacent to the channels. The soils are extensive and are mainly in a band 1 to 3 miles wide bordering the Prairie Dog Town Fork of the Red River. Slopes range from nearly level to steep. The slope of these soils is similar to the slope on which the materials were deposited. Enterprise very fine sandy loam and fine sandy loam soil types were mapped in the county.

The Enterprise soils are near the Tivoli soils but are less sandy. They are deeper than the Woodward soils, which have formed in soft, sandstone materials.

A representative profile of a soil in the Enterprise series (near the southeast corner of Estelline, approximately 0.3 mile south of the northeast corner sec. 796, Block H, W. & NW. RR. Co. survey)—

Ap—0 to 6 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 4/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist, calcareous; moderately alkaline; abrupt boundary.

A1—6 to 24 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; calcareous; moderately alkaline; diffuse boundary.

C—24 to 72 inches +, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) when moist; soft when dry, very friable when moist; calcareous; moderately alkaline.

The thickness of the A horizon ranges from 15 to 34 inches. The color ranges from light reddish brown to reddish brown. The texture of the A horizon ranges from loam or very fine sandy loam to fine sandy loam or loamy fine sand. The color of the C horizon ranges from light reddish brown to reddish brown.

GUADALUPE SERIES

The soils of the Guadalupe series are in the Cumulic Haplorthent subgroup and the coarse loamy, siliceous, calcareous, thermic family. The parent materials are recent alluvial sediments deposited from floodwaters of small streams. Most areas are occasionally flooded. These soils are not extensive. They occur along drainage canals in the northern part of the county in narrow areas parallel to the canals. In Hall County, Guadalupe soils are mapped only in an undifferentiated group with the Tipton soils.

The Guadalupe soils are more sandy than the Spur soils. They are browner than the Yahola soils.

A representative profile of a soil in the Guadalupe series (in a field 1.1 miles west of Plaska on farm road 657, and 0.1 mile north)—

A1—0 to 15 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 4/2) when moist; loose; calcareous; moderately alkaline; stratified with thin lenses of sandy material; abrupt boundary.

C—15 to 60 inches +, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; calcareous; moderately alkaline; stratified alluvial sediments with thin lenses of sandier materials.

The thickness of the A1 horizon ranges from 12 to 18 inches and the texture from fine sandy loam to loamy fine sand. The color ranges from brown to grayish brown in hues of 7.5YR to 10YR.

LATOM SERIES

The soils of the Latom series are in the Lithic Haplorthent subgroup and the loamy, thermic, very thin (less than 10 inches) family. They have developed in sandstone materials. These soils are not extensive in the county and occur mainly on the top of sandstone buttes in the northeastern part. They range from gently sloping to steep, but the gentle slopes are more common. Latom stony loam is the only soil type mapped in Hall County.

The Latom soils are browner than the Quinlan and are underlain by hard sandstone rock, whereas the Quinlan soils are underlain by soft sandstone materials.

A representative profile of a soil in the Latom series (0.5 mile east and 0.4 mile south of the northwest corner sec. 7, Block 19, H. & G.N. RR. Co. survey, and 200 feet north of State Highway No. 256)—

A1—0 to 4 inches, brown (7.5YR 5/3) stony loam, dark brown (7.5YR 4/3) when moist; weak, granular structure; soft when dry, friable when moist; calcareous; moderately alkaline; stone fragments similar to the stone in the horizon below and from 1 to 6 inches across are commonly on the surface and throughout horizon; abrupt boundary.

R—4 to 12 inches +, pinkish, consolidated sandstone, coated on top with calcium carbonate $\frac{1}{8}$ inch thick.

The color of the A horizon ranges from brown to reddish brown. The thickness ranges from 1 to 10 inches but is mainly less than 6 inches.

LINCOLN SERIES

The soils of the Lincoln series are in the Cumulic Normipsamments subgroup and the sandy, siliceous, nonacid, thermic family. The parent materials are sandy alluvial sediments. The soils occur mainly on the level flood plains of Prairie Dog Town Fork of the Red River, but a few areas are along the large streams in the northern part of the county. These soils are not extensive and occur only in small, scattered areas. In Hall County they are mapped only as an undifferentiated group with the Yahola soils.

The texture of the surface layer ranges from fine sandy loam to loamy fine sand, but it is fine sandy loam in about 60 percent of the areas. Most areas are too saline for normal plant growth, and the salt-tolerant species grow best. The surface horizon is slightly saline ($EC_e \times 10^3 = 3.2$) and the substrata is strongly saline ($EC_e \times 10^3 = 15.0$) (10).

The Lincoln soils are similar to Sandy alluvial land but are less variable, are in higher positions, and are less frequently flooded. They are sandier than the Yahola soils.

A representative profile of a soil in the Lincoln series (500 feet northeast of the railroad depot at Estelline)—

A1—0 to 8 inches, reddish-brown (5YR 5/3) fine sandy loam, reddish brown (5YR 4/3) when moist; structureless; soft when dry, very friable when moist; calcareous; moderately alkaline; distinctly stratified with thin lenses of sandier and siltier materials; clear boundary.

C1—8 to 24 inches, light reddish-brown (5YR 6/4) loamy fine sand, reddish brown (5YR 5/4) when moist; structureless; loose when dry or moist; calcareous; moderately alkaline; distinctly stratified; thin lenses of sandier and siltier material common; gradual boundary.

C2—24 to 60 inches +, pink (5YR 7/4) sand, light reddish-brown (5YR 6/4) when moist; structureless; loose when dry or moist; calcareous; moderately alkaline; water table at a depth of 30 inches.

The texture of the surface layer ranges from fine sandy loam to loamy fine sand. The color ranges from light reddish brown to reddish brown or reddish yellow. The depth to the sandy substratum ranges from 15 to 30 inches. The texture of the substratum is mainly sand or a mixture of sand and gravel. The color ranges from reddish yellow to pink or light reddish brown. The depth to the water table ranges from 2 to 4 feet in most places.

MANSKER SERIES

The soils of the Mansker series are in the Typic Calciustolls subgroup and the fine loamy, mixed, thermic family.

They are calcareous and moderately deep. They have formed in calcareous sandy outwash, probably of Pleistocene age. The soils are nearly level to strongly sloping and occur in small, scattered areas in the northwestern and southwestern parts of the county. Slopes range from 0.5 percent to 12 percent. In Hall County, Mansker fine sandy loam is the only soil type of the Mansker series mapped.

The Mansker soils are near the Miles soils but are not so well developed. They are browner and have developed in sandier materials than the Weymouth soils.

A representative profile of a soil in the Mansker series (in field 0.25 mile west of the northeast corner sec. 2, Block 20, H. & G.N. RR. Co. survey, and 200 feet south of a farm road)—

Ap—0 to 7 inches, brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; abrupt boundary.

B2—7 to 18 inches, light-brown (7.5YR 6/3) light sandy clay loam, brown (7.5YR 4/3) when moist; weak, subangular blocky structure; hard when dry, friable when moist; calcareous; moderately alkaline; hard concretions of calcium carbonate; clear boundary.

Cca—18 to 42 inches, pink (5YR 7/4) clay loam, reddish brown (5YR 5/4) when moist; calcareous; moderately alkaline; soft masses and concretions of calcium carbonate, about 30 percent by volume; gradual boundary.

C—42 to 60 inches +, light reddish-brown (5YR 6/4), calcareous, loamy, outwash materials.

The thickness of the A horizon ranges from 4 to 12 inches. The color is mainly light brown to brown in hues of 7.5YR, values of 3 to 6, and chromas of 2 to 4. The color of the B2 horizon ranges from brown to reddish brown, and the texture ranges from sandy loam to sandy clay loam. The depth to the Cca horizon ranges from 10 to 24 inches. This horizon ranges from strongly developed to weakly developed. The texture of the C and Cca horizons ranges from sandy loam or loam to sandy clay loam.

MILES SERIES

The soils of the Miles series are in the Mollic Haplustalf subgroup and the fine loamy, mixed, thermic

family. They have developed in outwash or old alluvial materials of the Pleistocene or Pliocene age. They are extensive in the northern and southwestern parts of the county. They are nearly level to strongly sloping. Slopes range from 0.3 percent to 8 percent. Two types of the Miles soils, fine sandy loam and loamy fine sand, were mapped in the county.

The Miles soils occur near the Olton soils but are more sandy. They are deeper and better developed than the Mansker and Weymouth soils. The Miles soils have a more clayey subsoil than the Springer soils. They are not so dark as the Altus and Tipton soils and are in higher positions. They are not so sandy as the Brownfield and Nobscot soils.

Most areas of the Miles soils are cultivated to cotton, small grain, and grain sorghums.

A representative profile of a soil in the Miles series (in a field 0.35 mile south of the northwest corner sec. 71, Block 18, H. & G.N. RR. Co. survey, and 100 feet east)—

Ap—0 to 7 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/3) when moist; weak, granular structure; soft when dry, very friable when moist; noncalcareous; near neutral; few pebbles on surface; abrupt boundary.

B1—7 to 13 inches, reddish-brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak, subangular blocky structure; hard when dry, friable when moist; noncalcareous; near neutral; few pebbles; gradual boundary.

B2t—13 to 26 inches, reddish-brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; mildly alkaline; thin clay films; gradual boundary.

B3—26 to 40 inches, red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; mildly alkaline; gradual boundary.

C—40 to 60 inches +, light-red (2.5YR 6/6) light sandy clay loam, red (2.5YR 4/6) when moist; few pebbles; weakly calcareous; moderately alkaline.

The texture of the A horizon ranges from fine sandy loam to loamy fine sand. The color ranges from light reddish brown or reddish brown to brown in hues of 5YR to 7.5YR, values of 3 to 6, and chromas of 2 to 4. The thickness of the A horizon ranges from 5 to 14 inches in the fine sandy loam soil type, and from 8 to 20 inches in the loamy fine sand type.

A B1 horizon is in the fine sandy loam type, but not in the loamy fine sand type. It is 4 to 10 inches thick. The texture of the B2t horizon ranges from light sandy clay loam to clay loam. The color ranges from reddish brown to red in hues of 5YR to 2.5YR, values of 3 to 5, and chromas of 2 to 4. The thickness of the B2t horizon ranges from 10 to 26 inches.

The B3 horizon ranges from fine sandy loam to sandy clay loam. The color ranges from red to reddish brown. In a few areas this horizon is calcareous.

A distinct Cca horizon occurs in some areas of Miles fine sandy loam. The C horizon ranges from noncalcareous to weakly calcareous. The color of this horizon ranges from red or reddish brown to yellowish red. A IIC horizon of Permian red-bed material occurs in places at a depth of 3 to 5 feet.

NOBSCOT SERIES

The soils of the Nobscot series are in the Typic Haplustalf subgroup and the coarse loamy, siliceous, thermic family. They have developed in eolian sand of Pleistocene age. These soils are not extensive and occur only in one small area in the southwest corner of the county. They range from gently sloping to rolling, and in most areas they are billowy or hummocky. Slopes range from 1 to 5 percent. Nobscot fine sand is the only soil type mapped in the county.

The Nobscot soils are near the Brownfield soils but have a sandier B horizon. They are sandier throughout than the Miles and Springer soils.

A representative profile of a soil in the Nobscot series (0.4 mile south of the northwest corner sec. 6, Block L, D. and P. RR. Co. survey, and about 300 feet along county line)—

- A1—0 to 7 inches, brown (7.5YR 5/3) fine sand, dark brown (7.5YR 3/3) when moist; structureless; loose when dry or moist; noncalcareous; near neutral; many roots; clear boundary.
- A2—7 to 17 inches, light-brown (7.5YR 6/3) fine sand, brown (7.5YR 5/3) when moist; structureless; loose; noncalcareous; slightly acid; clear boundary.
- B2—17 to 32 inches, yellowish-red (5YR 5/6) sandy loam, yellowish red when moist; few lenses of reddish-brown (5YR 4/4) or dark reddish-brown (5YR 3/4) sandy clay loam 1/8 to 1 inch thick, mostly in the upper part; weak, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; neutral; gradual boundary.
- B3—32 to 44 inches, reddish-yellow (5YR 6/6) fine sandy loam or loamy fine sand, yellowish red (5YR 5/6) when moist; soft when dry, very friable when moist; noncalcareous; near neutral; diffuse boundary.
- C—44 to 60 inches +, reddish-yellow (7.5YR 6/6) fine sand or sand, strong brown (7.5YR 5/6) when moist; structureless; loose; noncalcareous; near neutral.

The thickness of the A1 horizon ranges from 3 to 8 inches. The development of the A2 horizon ranges from weak to very weak; the thickness ranges from 7 to 22 inches. Depth to the B2 horizon ranges from 15 to 30 inches in most places. The texture of the B2 horizon ranges from loamy fine sand to fine sandy loam, and the thickness ranges from 8 to 18 inches. The color ranges from reddish brown or yellowish red to red.

OLTON SERIES

The soils of the Olton series are in the Typic Argiustoll subgroup and the fine, mixed, thermic family. They have developed in calcareous outwash or old alluvial materials of Pleistocene age. They are mainly nearly level to gently sloping. Slopes range from 0.3 percent to 3 percent. These soils are not extensive and are in the southwestern and northern parts of the county. Olton loam is the only soil type mapped in the county.

These soils are near the Miles and Abilene soils. They are more clayey than the Miles soils. They are redder than the Abilene soils and are not so clayey. The Olton soils are deeper and better developed than the Weymouth and Mansker soils.

Most areas of the Olton soils are cultivated and are very productive. Cotton and small grain are grown extensively.

A representative profile of a soil in the Olton series (in a field 0.2 mile east of the southwest corner sec. 144, Block 55, D. and P. RR. Co. survey, and 100 feet north)—

- Ap—0 to 7 inches, reddish-brown (5YR 5/3) loam, reddish brown (5YR 4/3) when moist; weak, granular structure; hard when dry, friable when moist; noncalcareous; mildly alkaline; few pebbles on surface; abrupt boundary.
- B1—7 to 12 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; noncalcareous; mildly alkaline; gradual boundary.
- B2t—12 to 22 inches, reddish-brown (5YR 4/4) clay loam with more clay than the layer above; dark reddish brown (5YR 3/4) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; noncalcareous; mildly alkaline; few fine pebbles; thin clay films; clear boundary.
- B22t—22 to 34 inches, reddish-brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) when moist; moderate, fine and medium, blocky structure; very hard when dry, very firm when moist; few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; few pebbles; diffuse boundary.
- B3—34 to 46 inches, red (2.5YR 4/6) clay loam with less clay than the layer above; dark red (2.5YR 3/6) when moist; hard when dry, firm when moist; calcareous; soft masses and concretions of calcium carbonate common; clear boundary.
- Cca—46 to 76 inches, light-red (2.5YR 6/6) clay loam, red (2.5YR 5/6) when moist; slightly hard when dry, friable when moist; calcareous; moderately alkaline; soft calcium carbonate masses and concretions, about 15 percent by volume; gradual boundary.
- C—76 to 84 inches, red (2.5YR 5/6) light clay loam, red (2.5YR 4/6) when moist; calcareous outwash materials containing much less calcium carbonate than the Cca horizon; few fine pebbles.

The color of the A1 horizon ranges from reddish brown to brown in hues of 5YR to 7.5YR, values of 3 to 5, and chromas of 2 to 4. The thickness ranges from 5 to 14 inches. The texture of this horizon ranges from loam to clay loam. The thickness of the B1 horizon ranges from 4 to 8 inches, and the color from dark reddish gray to reddish brown. The texture ranges from heavy loam to light clay loam. The texture of the B2t horizon ranges from sandy clay loam to clay loam. The color ranges from reddish brown to red in hues of 5YR to 2.5YR, values of 3 to 5, and chromas of 2 to 6. The thickness ranges from 12 to 30 inches. The color of the B3 horizon ranges from red to reddish brown, and the texture from loam to sandy clay loam or clay loam. The depth to the Cca horizon is 32 to 54 inches. This horizon ranges from weakly developed to distinct and well developed. The colors are mainly red or reddish brown. In places a IIC horizon of Permian red-bed material is at a depth of 3 to 6 feet.

QUINLAN SERIES

The soils of the Quinlan series are in the Typic Eutrochrepts subgroup and the fine silty, mixed, thermic, thin family. The parent material of soils in this series is soft Permian sandstone. These soils are extensive in the southern and west-central parts of the county. They are moderately sloping to steep. Slopes range from 4 to 20 percent. The Quinlan soils are mapped only in a complex with the Woodward soils in Hall County.

The Quinlan soils are near the Woodward soils, but are not so well developed and are not so deep as those soils. They are deeper than the Latom soils, which are also underlain by sandstone. The Quinlan soils are not

so dark as the Cottonwood soils, which are underlain by gypsum materials.

A representative profile of a soil in the Quinlan series (in the northwest corner sec. 79, Block H, B.S. and F. RR. Co. survey)—

- A1—0 to 12 inches, red (2.5YR 5/6) loam, dark red (2.5YR 3/6) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; gradual boundary.
- C—12 to 48 inches +, light-red (2.5YR 6/6), calcareous, soft Permian sandstone; red (2.5YR 4/6) when moist; many, fine, grayish flecks scattered throughout the sandstone.

The color of the A horizon ranges from light red to reddish brown in hues of 2.5YR to 5YR, values of 4 to 6, and chromas of 4 to 6. The texture ranges from very fine sandy loam to loam. The thickness of this horizon ranges from 4 to 15 inches. The C horizon consists mainly of soft sandstone, but in a few places it is strongly indurated sandstone.

SPRINGER SERIES

The soils of the Springer series are in the Typic Haplustalf subgroup and the coarse loamy, siliceous, thermic family. They have developed in sandy outwash materials of the Pleistocene age. They are in scattered areas in the northern and southwestern parts of the county. The Springer soils are undulating to hummocky. Slopes are mainly 1 to 6 percent.

The Springer soils are near the Miles soils, but they have a more sandy B horizon. They are not so sandy as the Brownfield and Nobscot soils, which have a weak A2 horizon.

A representative profile of a soil in the Springer series (in a field 0.45 mile west of the southeast corner sec. 13, Block 18, H. & G.N. RR. Co. survey, and 200 feet north)—

- Ap—0 to 12 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; structureless; loose when dry or moist; noncalcareous; near neutral; abrupt boundary.
- B2—12 to 30 inches, reddish-brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; mildly alkaline; gradual boundary.
- B3—30 to 42 inches, reddish-brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) when moist; weak, subangular blocky structure; noncalcareous; mildly alkaline; few fine pebbles; diffuse boundary.
- C—42 to 60 inches +, red (2.5YR 5/6) loamy fine sand, red (2.5YR 4/6) when moist; loose; structureless; noncalcareous; mildly alkaline; few pebbles.

The thickness of the A horizon ranges from 6 to 20 inches. The color ranges from light reddish brown to reddish brown. The texture of the B2 horizon ranges from heavy fine sandy loam to heavy loamy fine sand. The color ranges from red to reddish brown or yellowish red in hues of 2.5YR to 5YR, values of 3 to 5, and chromas of 3 to 6. The thickness of this horizon ranges from 10 to 20 inches. The texture of the B3 horizon ranges from fine sandy loam to loamy fine sand. In a few places, a weak Cca horizon occurs.

SPUR SERIES

The soils of the Spur series are in the Cumulic Haplustoll subgroup and the fine loamy, mixed, thermic family.

They have developed in recent, loamy, alluvial sediments deposited by floodwaters of small streams. They occur in scattered areas over the county on nearly level flood plains. Most areas are occasionally flooded.

The Spur soils are near the Yahola soils, but they have a more clayey subsoil. They are not so well developed as the Tipton soils and occur in lower positions. The Spur soils are not so sandy as the Lincoln soils.

Most areas of the Spur soils are cultivated and are very productive. They have few limitations.

A representative profile of a soil in the Spur series (in a field 0.45 mile west of the northeast corner sec. 49, Block 2, T. & P. RR. Co. survey, and 300 feet south)—

- A1—0 to 10 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) when moist; structureless to weak, granular structure; soft when dry, very friable when moist; distinctly stratified; contains lenses of very fine sandy loam and silt loam; calcareous; moderately alkaline; clear boundary.
- C—10 to 60 inches +, light reddish-brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) when moist; weak, subangular blocky structure; hard when dry, friable when moist; distinctly stratified; alternate layers of clay loam and silty clay loam that become less clayey with depth; calcareous; moderately alkaline.

The thickness of the A1 horizon ranges from 7 to 20 inches. The color ranges from brown to reddish brown in hues of 5YR to 7.5YR, values of 3 to 5, and chromas of 3 to 4. The texture of the C horizon ranges from loam or silt loam to silty clay loam or clay loam. The color ranges from reddish brown or light reddish brown to brown. Thin strata of sandy loam materials occur in many places at a depth of 3 to 6 feet.

ST. PAUL SERIES

The soils of the St. Paul series are in the Typic Argiustoll subgroup and the fine silty, mixed, thermic family. They have developed in old alluvial deposits or in sandstone material of Permian age. These soils are mostly nearly level and are near the soils that have developed in sandy Permian red beds. The St. Paul soils are mainly in the northeastern and southeastern parts of the county. Slopes range from 0 to 2 percent. St. Paul silt loam is the only soil type mapped in the county.

The St. Paul soils are darker, less permeable, and better developed than the Carey soils. They are darker, deeper, and less sloping than the Woodward soils. The St. Paul soils have a less compact subsoil than the Abilene soils.

A representative profile of a soil in the St. Paul series (0.1 mile west and 100 feet north of the southeast corner sec. 9, Block 18, H. & G.N. RR. Co. survey)—

- Ap—0 to 8 inches, brown (7.5YR 5/3) silt loam, dark brown (7.5YR 3/3) when moist; weak, granular structure; soft when dry, very friable when moist; noncalcareous; mildly alkaline; abrupt boundary.
- B1—8 to 15 inches, brown (7.5YR 4/2) silt loam with more clay than the layer above; dark brown (7.5YR 3/2) when moist; weak to moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; mildly alkaline; gradual boundary.
- B21t—15 to 25 inches, dark reddish-gray (5YR 4/2) silty clay loam, dark reddish brown (5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; mildly alkaline; thin, continuous clay films; diffuse boundary.

- B22t—25 to 36 inches, reddish-brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) when moist; moderate to strong, fine and medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; mildly alkaline; thin, continuous clay films; gradual boundary.
- Ccs—36 to 54 inches, brown (7.5YR 5/2) clay loam, brown (7.5YR 4/2) when moist; calcareous; moderately alkaline; many soft masses of calcium carbonate; gradual boundary.
- C—54 to 60 inches +, reddish-yellow (5YR 6/6) loam or clay loam, yellowish red (5YR 4/6) when moist; calcareous; old alluvial materials.

The thickness of the A horizon ranges from 6 to 15 inches. The color ranges from brown to reddish gray in hues of 5YR to 7.5YR, values of 2 to 5 and chromas of 2 to 4. In a few areas, there is no B1 horizon. The color of the B horizons ranges from brown or dark brown to reddish gray or reddish brown in hues of 5YR to 7.5YR, values of 2 to 5, and chromas of 2 to 4. The texture of the B horizons ranges from heavy loam to clay loam or silty clay loam. The depth to the Cca horizon ranges from 32 to 60 inches. In some areas the Cca horizon is weakly developed. The color of this horizon ranges from brown to reddish brown. The C horizon is variable. In some areas it consists of loamy outwash or old alluvial materials; in other areas it consists of Permian sandstone materials. In some areas a large amount of soft gypsum material is in the C horizon.

TIPTON SERIES

The soils of the Tipton series are in the Typic Argiustoll subgroup and the fine silty, mixed, thermic family. They have developed in old alluvial deposits. They are extensive in the northwestern part of the county. These soils are mostly in valleys, but in a few places they are on terraces along streams. Tipton soils are nearly level, but a few areas have gentle slopes. The slopes range from 0 to 2 percent. Tipton loam is the only soil type mapped in Hall County.

The Tipton soils are darker, more silty, and not so well developed as the Miles soils. They are also in lower positions. The Tipton soils are more developed than the Spur soils and are in higher positions. They are similar to the Altus soils but are less sandy throughout.

A representative profile of a soil in the Tipton series (in a field 0.25 mile east of the southwest corner sec. 111, Block 1, S.P. RR. Co. survey, and 100 feet north)—

- Ap—0 to 7 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/2) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; abrupt boundary.
- A1—7 to 12 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; calcareous; moderately alkaline; gradual boundary.
- B21—12 to 25 inches, reddish-brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; calcareous; moderately alkaline; gradual boundary.
- B22—25 to 42 inches, light reddish-brown (5YR 6/3) clay loam, reddish brown (5YR 4/3) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, firm when moist; threads and films of calcium carbonate common on peds; calcareous; moderately alkaline; gradual boundary.
- C—42 to 60 inches +, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 4/6) when moist; many films of calcium carbonate; calcareous; moderately alkaline.

The thickness of the A horizon ranges from 6 to 16 inches. The color ranges from brown to reddish brown in hues of 5YR to 7.5YR, values of 2 to 5, and chromas of 2 to 4. The texture of the A horizon ranges from loam to fine sandy loam. The texture of the B2 horizon ranges from loam to clay loam or silty clay loam. The color ranges from reddish brown to reddish gray. The thickness of the B2 horizons ranges from 15 to 36 inches.

TIVOLI SERIES

The soils of the Tivoli series are in the Typic Normipsamment subgroup and the sandy, siliceous, nonacid, thermic family. They have formed in recent eolian sands that have been blown out of the major stream channels and deposited near the streams. These soils are extensive along the Prairie Dog Town Fork of the Red River. A band $\frac{1}{2}$ mile to 2 miles wide is along the south side of the Prairie Dog Town Fork of the Red River, and smaller areas are on the north side. Other areas are along the east side of the smaller streams in the northern part of the county. These soils have many dunes. Tivoli fine sand is the only soil type mapped in Hall County.

The Tivoli soils are more sandy than the nearby Enterprise soils, which do not have dunes. The Tivoli soils are similar to Active dunes, but they have a weakly developed A horizon and a cover of vegetation.

A representative profile of a soil in the Tivoli series (in a pasture about 0.3 mile south of a bridge across the Prairie Dog Town Fork of the Red River on U.S. Highway No. 287 near Estelline, and 300 feet west)—

- A1—0 to 6 inches, reddish-brown (5YR 5/4) fine sand, reddish brown (5YR 4/4) when moist; structureless; loose; calcareous; mildly alkaline; clear boundary.
- C—6 to 60 inches +, light reddish-brown (5YR 6/4) fine sand, reddish brown (5YR 5/4) when moist; structureless; loose; calcareous; mildly alkaline.

The thickness of the A1 horizon ranges from 4 to 12 inches, but is mostly less than 8 inches. The texture of the surface layer ranges from loamy fine sand to fine sand. These soils range from calcareous to noncalcareous but are mostly calcareous.

WEYMOUTH SERIES

The soils of the Weymouth series are in the Typic Calcicustoll subgroup and the fine loamy, mixed, thermic family. They have developed in silty or light clayey Permian red-bed materials or outwash materials. These soils are mostly in the western and northern parts of the county. They are mostly on ridges and have convex slopes ranging from 2 to 5 percent. Weymouth loam is the only soil type of this series mapped in the county.

The Weymouth soils have a more clayey subsoil than the Woodward soils. They are less sandy and redder than the Mansker soils. They have a less developed profile than the Olton and Miles soils.

A representative profile of a soil in the Weymouth series (0.1 mile north of the southeast corner sec. 11, Block 19, H. & G.N. RR. Co. survey, and 100 feet west of a road)—

- Ap—0 to 7 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; few concretions of calcium carbonate on surface; abrupt boundary.

- B2—7 to 18 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) when moist; moderate, fine, subangular blocky structure; hard when dry, friable when moist; many pores and worm casts; few soft masses of calcium carbonate; calcareous; moderately alkaline; clear boundary.
- Cca—18 to 30 inches, pink (5YR 8/4) clay loam, light reddish brown (5YR 6/4) when moist; hard when dry, friable when moist; masses and concretions of calcium carbonate about 20 percent by volume; gradual boundary.
- C—30 to 60 inches +, reddish-yellow (5YR 6/6) loam; calcareous outwash materials.

The thickness of the A horizon ranges from 5 to 10 inches. The color ranges from reddish brown to brown in hues of 5YR to 7.5YR. The texture of the B2 horizon ranges from loam to clay loam. The color ranges from red to reddish brown in hues of 2.5YR to 5YR. The depth to the Cca horizon ranges from 10 to 24 inches, but dominantly it is 15 to 20 inches. This horizon is very distinctly developed to weakly developed. The C horizon ranges from silty or clayey Permian red-bed materials to silty or clayey outwash materials. In places strata of sandy and clayey red-bed materials occur in the C horizon.

WOODWARD SERIES

The soils of the Woodward series are in the Typic Haplustoll subgroup and the fine silty, mixed, thermic family. They have developed in calcareous, soft, Permian sandstone materials. They are very extensive in the eastern and southern parts of the county. The Woodward soils occur on ridges and in convex positions. Slopes range from 2 to 10 percent. Woodward loam is the only soil type mapped in the county.

The Woodward soils are not so well developed as the nearby Carey soils. Also, they are calcareous. They are deeper and better developed than the Quinlan soils and are less clayey than the Weymouth soils, which have developed in silty red-bed materials. The Woodward soils are not so deep as the Enterprise soils, which have developed in eolian materials.

A representative profile of a soil in the Woodward series (0.25 mile south and 0.1 mile west of the northeast corner sec. 55, Block H, A. B. & M. RR. Co. survey)—

- Ap—0 to 5 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 4/4) when moist; weak, granular structure; soft when dry, very friable when moist; calcareous; moderately alkaline; few concretions of calcium carbonate on the surface; abrupt boundary.
- A1—5 to 10 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; calcareous; moderately alkaline; gradual boundary.
- B2—10 to 22 inches, red (2.5YR 5/6) loam, red (2.5YR 4/6) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; few threads of calcium carbonate; calcareous; moderately alkaline; gradual boundary.
- Cca—22 to 30 inches, light-red (2.5YR 6/6) very fine sandy loam, red (2.5YR 5/6) when moist; calcareous; strongly alkaline; concretions of calcium carbonate; common; gradual boundary.
- C—30 to 60 inches +, light-red (2.5YR 6/6), soft, calcareous, Permian sandstone; red (2.5YR 4/6) when moist; many, fine, grayish flecks.

The thickness of the A horizon ranges from 6 to 14 inches. The color ranges from light reddish brown to reddish brown in hues of 2.5YR to 5YR, values of 4 to 6, and chromas of 4 to 6. The texture of the B2 horizon

is dominantly loam or very fine sandy loam, but in some areas it is sandy clay loam. The color of the B2 horizon ranges from reddish brown to red in hues of 2.5YR to 5YR, values of 4 to 5, and chromas of 4 to 6. The depth to the Cca horizon ranges from 15 to 40 inches but is dominantly 18 to 28 inches. In a few areas no defined Cca horizon is present. In a few areas, the C horizon is stratified with layers that are more clayey.

YAHOLA SERIES

The soils of the Yahola series are in the Cumulic Haplorthent subgroup and coarse loamy, siliceous, calcareous, thermic family. They have developed in the recent alluvial sediments deposited along the flood plains of streams. Most areas are occasionally flooded and receive new sediments. These soils occur in small scattered areas throughout the county. Two soil types, fine sandy loam and very fine sandy loam, were mapped in the county. The Yahola soils are not so sandy as the Lincoln soils. They are in higher positions than Sandy alluvial land and are less sandy. The Yahola soils are sandier and more permeable than the Spur soils.

A representative profile of a soil in the Yahola series (in a field 0.3 mile south of the northwest corner sec. 81, Block 2, T. & P. RR. Co. survey, and 100 feet east)—

- A1—0 to 16 inches, reddish-brown (5YR 5/4) very fine sandy loam, dark reddish brown (5YR 3/4) when moist; weak, subangular blocky structure; soft when dry, very friable when moist; weakly stratified; calcareous; moderately alkaline; gradual boundary.
- C—16 to 48 inches +, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 4/4) when moist; distinctly stratified alluvial materials with lenses of silt loam and fine sandy loam; calcareous; moderately alkaline.

The thickness of the A horizon ranges from 10 to 24 inches. The color ranges from light reddish brown to reddish brown in hues of 2.5YR to 5YR, values of 3 to 6, and chromas of 4 to 6. The texture of the A horizon ranges from loam or very fine sandy loam to fine sandy loam. The C horizon is usually one value lighter in color than the A horizon. The texture of the C horizon ranges from loam or very fine sandy loam to fine sandy loam. Thin strata of silt loam to clay loam materials are common at a depth of 3 to 6 feet. In places buried darker, organic layers are also at a depth of 3 to 6 feet.

General Nature of the Area

This section was prepared mainly for those who want general information about Hall County. Physiography, relief, and drainage; climate; agriculture; and other subjects of general interest are briefly discussed.

Physiography, Relief, and Drainage

The relief of Hall County ranges from nearly level to steep but is predominantly rolling to hilly. The general slope of the county is from the northwest to the southeast. The elevation ranges from 1,900 feet in the southeastern corner to 2,400 in the western part.

Most of the county is drained by the Prairie Dog Town Fork of the Red River and its tributaries. The southern part is drained by tributaries of the South Pease River.

Because of an unusual drainage pattern, Hall County has extensive alluvial soils in the northwestern part. In this part there are several streams that flow southward toward the Prairie Dog Town Fork of the Red River. The relief is very steep at the upper ends of these streams, which are in Donley County. There is a large amount of runoff during rains of high intensity. The stream channels are wide and deep, but as the streams flow southward toward the Prairie Dog Town Fork of the Red River, the landscape is less sloping and the stream channels become shallow. Some stream channels end in large flat areas or valleys. Some of these valleys are several miles wide. The Spur, Yahola, Tipton, and Altus soils formed in these areas. Excess water is a problem on these soils during heavy rains. Drainage ditches and dikes are commonly used to remove the excess water and direct its flow. Flood damage is great in some of these areas after heavy rains.

The Prairie Dog Town Fork of the Red River, Indian and Mulberry Creeks, and other large streams have very wide channels. During heavy rains, they are capable of carrying most of the floodwaters within the channels. Consequently, there is very little alluvial land along these streams.

The flow of most of the streams in the county does not continue in all months of the year. Except during the summer, the larger streams flow most of the year. A few streams are spring fed and have a permanent flow.

Most soils in the county are well drained. A few of the deep sandy soils are excessively drained.

Climate ⁵

The climate of Hall County is of the semiarid, continental type. The county receives more rainfall than counties in the High Plains to the west but less than those to the east. As is characteristic of the continental type, the climate is marked by rapid changes and wide ranges in both daily and annual temperature. The temperature and precipitation of Hall County, as recorded by the U.S. Weather Bureau, are shown in table 7.

From 1905 to 1930 the average annual rainfall was 22.91 inches; from 1931 to 1952 the average was 18.67 inches; and from 1933 to 1962 it was 19.91 inches. Departures from these averages have ranged from 11.92 inches in 1917, the driest year of record in Texas, to 36.69 inches in 1960. The rains occur most frequently as the result of thunderstorms. The maximum amount usually falls late in spring and early in summer. Three-fourths of the total annual precipitation falls in the warmer 6 months of the year, April through September. Rainfall caused by thunderstorms is generally extremely variable, both in intensity and in the area covered. The period of the most frequent, heavy, washing thunder-showers, often accompanied by hail and strong winds, comes during the harvest season for wheat, and the period of early growth of cotton. The intensive downpours usually do more damage than good to crops. Prolonged droughts do not occur often, although a whole

⁵This subsection was prepared by ROBERT B. ORTON, State climatologist.

TABLE 7.—Summary of climatological

[Elevation

Month	Temperature								Average number of days		
	Monthly			Extremes				Maximum temperature of—		Minimum temperature of—	
	Average maximum	Average minimum	Average	Highest		Lowest		90° or above	32° or below	32° or below ²	
				°F.	Year	°F.	Year				
January.....	52.8	25.3	39.1	83	1956 ³	-7	1947	0	3	26	
February.....	56.8	28.8	42.8	92	1962	-3	1933	(⁴)	2	17	
March.....	65.3	35.0	50.2	95	1946	4	1960	1	1	11	
April.....	75.2	45.1	60.2	103	1959	21	1940	5	0	1	
May.....	83.1	55.1	69.1	108	1953	32	1954	10	0	0	
June.....	92.9	64.9	78.9	115	1953	47	1947	19	0	0	
July.....	97.7	68.9	83.3	115	1936	54	1952	27	0	0	
August.....	98.0	68.1	83.1	117	1944 ³	49	1950	28	0	0	
September.....	88.8	60.0	74.4	110	1952 ³	38	1942	18	0	0	
October.....	78.0	48.0	63.0	100	1954 ³	26	1957	4	0	1	
November.....	63.8	34.2	49.0	92	1945	11	1940	0	(⁴)	11	
December.....	55.8	28.0	41.9	88	1955 ³	7	1961	0	1	23	
Year.....	75.7	46.8	61.3	117	1944 ³	-7	1947	112	7	90	

¹ Average length of record is 30 years, 1933-62, except for degree days, which is 10 years.

² Temperature was 0° or less for less than one-half day in January.

month's rainfall may come from only one or two widely spaced showers.

The average annual snowfall of 6.7 inches is considerably less than that on the High Plains to the north. An even cover of snow is very unusual because of the high velocity of winds accompanying the cold winter air masses. Usually, snow melts as it falls.

As shown in table 7, temperature, like rainfall, is extremely variable, especially during the colder 6 months of the year. During the winter and early in spring, cold fronts from the northern plains sweep southward rapidly and cause a sharp drop in temperature in a few hours. Cold spells are of short duration, however, and seldom last more than 2 or 3 days before a warm west or southwest wind brings rapid relief. Because it is located just below the Caprock escarpment, Hall County has slightly milder winters than counties on the High Plains, but it also has hotter summers. A maximum daily temperature of 100° F. or above is not unusual in July and August.

Northerly winds prevail from November through March, and southerly winds from May through September. April and October are transitional months. The Caprock escarpment, the canyon breaks along the Prairie Dog Town Fork of the Red River, and the generally rolling to hilly terrain in most of the county help to reduce the velocity of the wind.

The relative humidity averages about 76 percent at 6:00 a.m. and about 49 percent both at noon and at 6:00 p.m. Sunshine is abundant the year round; it averages

about 70 percent of the total time possible annually. The average annual sky cover is less than 50 percent, and most cloudiness occurs from January through May.

The average length of the freeze-free season is 213 days, but this length varies considerably from year to year. The average number of days between the last occurrence of 28° F. in spring and the first in fall is 231 days. The average date of the last occurrence of 32° in spring is April 4, with one chance in 20 that a freeze will occur after April 25. The average date of the first occurrence of 32° in fall is November 4, with one chance in 20 that a freeze will occur before October 19. Because of the differences in elevation and the roughness of the terrain, these average dates vary locally within the county and often on the same farm.

Because the climate is semiarid, evaporation is comparatively high. The average annual evaporation from 48-inch Weather Bureau pans is approximately 97 inches. Of this amount, approximately 69 percent or 67 inches evaporates during the period of May through October. The average annual evaporation from lakes is approximately 67 inches.

In table 7, temperatures are also given in terms of degree days. The number of degree days is the difference between the average temperature for a given day and 65° F. It is a measure of the amount of heat needed to keep the temperature that day at 65°. For example, a day that has an average temperature of 50° would be counted as 15 degree days. A knowledge of accumulated degree days for a stated time is helpful in calculating

data at Memphis, Hall County, Tex.¹

2,067 feet]

Heating degree days		Precipitation												
		Average monthly		Greatest daily		Driest year (1952)	Wettest year (1960)	1 year in 10 will have—		Average number of days having precipitation of—			Snowfall	
								Less than—	More than—	0.10 inch	0.50 inch	1.00 inch	Average	Maximum monthly
Number	Inches	Inches	Year	Inches	Inches	Inches	Inches				Inches	Inches	Year	
819	0.76	1.55	1939	1.24	2.13	0.1	1.7	2	(⁴)	0	2.0	11.0	1960	
611	.77	1.50	1950	.12	1.19	0	1.8	2	1	(⁴)	2.0	10.0	1956	
487	.89	2.10	1961	-----	1.00	0	1.9	2	1	(⁴)	.9	9.0	1942	
193	1.76	2.60	1957	4.65	0	0	4.2	3	1	(⁴)	.2	4.0	1938	
30	4.28	3.05	1935	1.25	5.49	1.1	7.0	7	4	2	0	0	-----	
3	2.78	8.80	1960	1.10	13.26	.5	4.9	5	3	1	0	0	-----	
0	1.84	2.10	1944	1.06	1.35	.2	3.7	5	2	1	0	0	-----	
0	1.62	2.80	1944	.26	1.20	0	3.6	3	1	(⁴)	0	0	-----	
7	2.07	2.25	1936	.20	2.11	.2	4.0	3	1	1	0	0	-----	
123	2.01	2.42	1957	-----	6.77	0	5.2	4	2	1	.1	2.0	1936	
480	.50	1.35	1940	1.18	0	0	1.2	1	(⁴)	(⁴)	(⁵)	(⁵)	³ 1959	
674	.63	1.30	1941	1.42	2.19	0	1.4	1	(⁴)	0	1.5	17.0	1960	
3,427	19.91	8.80	1960	12.48	36.69	12.5	26.6	38	16	6	6.7	17.0	1960	

³ Also occurred on dates earlier than those shown.

⁴ Less than one-half day.

⁵ Trace.

the amount of fuel needed for heating buildings and for determining the rate of growth and the maturity date of crops.

Early History and Agriculture

After the great slaughter of buffalo about 1800, settlement began in the county. At first the county was made up mostly of large cattle ranches. In the 1890's and early 1900's, many of the ranches were divided into smaller tracts, and the suitable land was cultivated. The early agriculture development was retarded by droughts, lack of markets, and low prices, and many early settlers were forced to leave the county.

The first crops were mainly wheat and sorghum. The first cotton was grown in Hall County in 1892, and the first cotton gin was built in 1893. As the demand increased, cotton was planted in more acreage and soon became the major crop. At one time Hall County produced more cotton than any other county in the State and had 25 operating cotton gins. Hall County was organized in 1890, and Salisbury was the first town established. Memphis, the county seat, was established in 1890. The Fort Worth and Denver Railroad was built in 1887. A branch line of this railroad was built from Estelline to Turkey in 1928.

Although dryland farming is dominant in Hall County, about 12,000 acres were being irrigated at the time of the survey. The irrigated areas are mostly in the northwestern and southwestern parts of the county, in the Lakeview, Plaska, Lesley, Brice, and Turkey communities. In these areas suitable water is available.

All the irrigation water comes from wells, which numbered about 200 in the county at the time of the survey. Most of the wells range from 75 to 150 feet in depth. The water in most areas is of poor quality because it contains a large amount of salts. The salts in the water most harmful to crops are sodium chloride (table salt) and magnesium sulfate (Epsom salts). Other salts that occur in large amounts but are not harmful are calcium sulfate (gypsum) and calcium carbonate (lime).

In most areas irrigated, the sprinkler method is used. The soils of Hall County are best suited to sprinkler irrigation because they are sloping and have high water-intake rates. Irrigation is restricted mainly to the nearly level or gently sloping soils.

In the following pages some statistics significant to the agriculture of the county are discussed. The statistics are from the U.S. Census of Agriculture.

Crops

The acreage of the principal crops in Hall County for 1949, 1954, and 1959 are listed in table 8. Because of the small number of crops suited to the county, farming is not well diversified. The main crops are cotton, sorghum, and wheat.

Cotton.—Cotton is the crop most extensively grown in the county. It is grown on all the soils suitable for cultivation. The acreage of cotton has decreased rapidly in the past few years because of control programs. Yields vary widely from year to year, but they are gradually increasing, mainly because more fertilizer, better management practices, and more irrigation are used. Much of the cotton is harvested mechanically. Insects are a

great hazard, and the cotton must be sprayed several times during the growing season to control them. Cotton is best suited to the deep soils.

Sorghum.—Sorghum is the next most important crop in the county. Most of the sorghum is the dwarf hybrid type that is harvested for grain, but small acreage are still harvested as bundle feed. Sorghum is well suited to the climate of the county. It withstands periods of drought better than most crops and yields well, even in years of low rainfall. Sorghum is grown on all the soils suitable for cultivation, but it is grown most extensively on the shallower, steeper, and sandier soils. Sorghum is beneficial to the soils because it leaves a large amount of residue.

Wheat.—The acreage of wheat has declined considerably in the county in the past few years. The wheat grown is of the winter variety. The soils in the county are not so well suited to wheat, as they are all medium to coarse textured. Most of the wheat in the county is grown on moderately fine and medium textured soils that have a heavy subsoil, such as the Abilene, Olton, and St. Paul. Most of the wheat is grazed during the winter months, if it has made sufficient growth.

Minor crops.—Among the crops grown in small acreages are oats, barley, rye, alfalfa, guar, winter peas, and perennial grasses. The oats, barley, and rye are planted mainly for winter grazing. Alfalfa is used for hay and as a soil-improving crop, and most areas are irrigated. Small acreages of guar and winter peas are planted each year for soil improvement. A large acreage of perennial grasses has been established in the past few years on shallow, steep, and sandy soils that formerly were cultivated.

TABLE 8.—Acreage of principal crops in stated years

Crop	1949	1954	1959
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Cotton.....	156, 271	96, 370	79, 022
Sorghum for all purposes.....	24, 931	61, 992	52, 279
Wheat.....	45, 173	8, 468	6, 645
Oats.....	686	164	108
Barley.....	475	466	858
Alfalfa.....	2, 252	1, 986	891

Livestock

The number of livestock on the farms in Hall County, as shown in the 1949, 1954, and 1959 census of agriculture, is given in table 9.

Cattle.—Beef cattle are the principal kind of livestock raised in the county. Hereford is the dominant breed. There are several large ranches in the county that are used entirely for cattle ranching, and most farms have a few beef cattle. Most of the cattle are of high quality, and in many herds all the animals are registered. Most of the cattle are wintered on native ranges; cottonseed cake is used as a supplemental feed. Temporary forage crops are grazed on the smaller farms during the summer months, in addition to the native pastures. There are few dairy cattle in the county.

Horses.—The number of horses declined rapidly when tractors became available on farms. Horses are now used

mostly for managing cattle. The number will remain fairly constant for this use.

Hogs.—Hogs are not raised in large numbers in Hall County. Most farms have only a few, and many farms have none.

Chickens.—Most farms in the county have only a small flock of chickens, mainly for home use. The number has decreased rapidly as the number of farms in the county has decreased.

TABLE 9.—*Livestock on farms in stated years*

Livestock	1949	1954	1959
Cattle-----	25, 801	14, 834	27, 636
Horses and mules-----	835	525	318
Hogs and pigs-----	3, 307	1, 596	2, 296
Chickens ¹ -----	62, 334	27, 506	14, 947

¹ 4 months old and over.

Land Use

Since 1950 the number of farms has rapidly decreased, but the size has increased. This increase in size is mainly because large acreages were taken out of cultivation, reseeded to native grasses, and added to other holdings. Also, farming has become more mechanized and therefore larger farms are more economically managed.

In 1950 there were 951 farms that averaged 663 acres. In 1959 the 601 farms in the county ranged from less than 10 acres to more than 1,000 acres. Of this number, 8 had less than 10 acres to more than 1,000 acres; 4 had 10 to 49 acres; 16 had 50 to 99 acres; 83 had 100 to 179 acres; 60 had 180 to 259 acres; 203 had 260 to 499 acres; 146 had 500 to 999 acres; and 81 had more than 1,000 acres.

Water Supply

Most of Hall County is well supplied with water, but much of it is of poor quality because it contains gypsum and other salts.

A large number of rural people must haul water for domestic use, especially in the northern one-half of the county. Cisterns are used extensively in these areas for water storage.

Water for livestock comes mainly from wells and ponds. In some areas the soils are too sandy or contain too much gypsum for the construction of ponds that will hold water, and water in these areas must be obtained from wells. A few spring-fed streams in the county furnish permanent water for livestock.

The towns of Memphis, Lakeview, Estelline, and Turkey get water from deep wells.

Transportation and Markets

There are two railroads in the county. The main line of the Fort Worth and Denver Railroad passes through Memphis and Estelline, and a branch line runs from Estelline westward through Turkey.

Several hard-surfaced highways cross the county, and most county roads are improved. But in the areas of large ranches, there are few roads.

Most crops, such as cotton, small grain, and grain sorghum, are marketed locally. Most beef cattle are shipped to markets outside the county.

Industries

Agriculture is the dominant enterprise of the county, and most industries are related to agriculture. There are 14 cotton gins operating in the county, a cotton seed delinting plant, and several grain elevators.

The district office of a telephone company is located in Memphis. Also, there are several small manufacturing plants producing cloth products, plastic products, and playground equipment. These industries employ several hundred persons.

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Glossary

- Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.
- Blowout.** An excavation produced by wind action in loose soil, usually sand.
- Caliche.** A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Concave slope.** A slope that is shaped like a bowl.

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

Loose. Noncoherent; will not hold together in a mass.

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

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

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

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

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

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

Cemented. Hard and brittle; little affected by moistening.

Convex slope. A slope that is curved like the exterior of an arch.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

Land leveling. The reshaping of the ground surface to make for a more uniform application of irrigation water.

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

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

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

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

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

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

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

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

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy*, (laminated), *prismatic*, (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

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

Substratum. Any layer lying beneath the solum, or true soil; the C or R horizon.

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

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

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also clay, sand, and silt.) The basic textural classes, in order of increasing proportions of fine particles are as follows; Sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

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

Winnowing. The removal of clay and fine silt particles from the soil by strong winds; coarser textured particles are left, and the soil becomes sandier.

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